

Superstition in the Housing Market¹

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Abstract

In this paper, we provide the first solid evidence that superstitious beliefs can have significant and sizeable effects on house prices in a North American market with a large immigrant population. Using detailed real estate data on close to 117,000 house sales over a five-year period, we find that, in neighborhoods with a percentage of Chinese residents higher than the metropolitan average of 18%, houses with street numbers ending in four are sold at a 2.2% discount and houses with street numbers ending in eight are sold at a 2.5% premium in comparison to houses with street numbers ending with any other digits. The size of the effects found are consistent with real estate agents acting as informed participants in this market and fuel the contention that transaction costs limit the efficiency of housing markets.

Keywords: superstition, housing markets, immigration, lucky Chinese numbers

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I. Introduction

When the Beijing Summer Olympics opened at 08:08:08 pm on the 8th day of the 8th month of 2008, it was shown to the world that the Chinese take the auspiciousness of the number “8” seriously. In Las Vegas, where superstitious beliefs are rampant, many large casino-hotels (such as MGM, Wynn and Palms Place) omit floor numbers 4, 14, 24, 34 and 40 to 49 because the number “4” is considered unlucky in the Chinese tradition.² This *tetraphobia* comes from the fact that the pronunciation of the word for four (四: sì) is very similar to the word for death (死: sǐ) in Mandarin, Cantonese, and several Chinese dialects. On the other hand, the word for eight (八: bā) is phonetically similar to the word for prosperity or wealth (发: fā). In this paper, we seek to price the value of auspicious and inauspicious Chinese numbers in street addresses in the Greater Vancouver residential market. We thus contribute to an emerging literature on the economic impact of superstitious beliefs, as well as to the literature on the impact of immigration in housing markets. We also contribute to the housing literature by highlighting the role of transaction costs in limiting the efficiency of housing markets. Further, our results are consistent the findings of Levitt and Syverson (2009) that real estate agents may be exploiting their informational advantage in the housing market.

Although Vancouver, B.C., has a long history of Chinese immigration dating back to the construction of the Canadian Pacific Railway in the 19th century, the impending return of Hong Kong to the People's Republic of China in 1997 sent a new wave of immigrants from Hong Kong

² Some hotels also omit the 13th floor considered unlucky in the Western tradition. In Vancouver, many new residential towers also skip the floors numbers that include a four.

in the 1980s and 1990s.³ Since then, Vancouver has continued to see a large number of immigrants from mainland China, many of them admitted as Business Class Applicants. This large influx of immigrants resulted in the development of several Chinese ethnic enclaves in Greater Vancouver.⁴ This allows us to exploit differences in the concentration of ethnic Chinese residents across neighborhoods to identify the effect of the lucky and unlucky numbers and claim that they are driven by Chinese superstitious beliefs or “cultural cues”. We do not aim to study whether the numbers actually bring “fortune” or “doom” to the homebuyers; rather we simply seek the price impacts of these cultural preferences. Our immigrant shock is not as punctual as the Mariel Boatlift, studied by Card (1990) and Saiz (2003), but rather a prolonged affair. Yet because the effects sought are directly linkable to Chinese culture and are found only in Chinese neighborhoods, we can still accurately pinpoint the effects of the Chinese immigration inflows on housing.

We combine a large and detailed real estate data set containing information on all single-family house sales (close to 117,000 transactions) in the Greater Vancouver area over the five-year period from January 2000 to May 2005 with census tract (CT) information from the 2001 Canadian Census. Our empirical specification begins with a classic hedonic analysis (Rosen, 1974) of the log transaction price where the structural, locational and neighborhood attributes of a house are thought to affect price. In addition to a host of structural house attributes, we control for detailed location characteristics by including street and CT fixed effects, and we control for seasonal and yearly price effects with month-year fixed effects.

³ Chinese immigration flows were curtailed with the imposition of a head tax in 1885, and banned formally in 1923. While there was a continuous trickle of Chinese refugees thereafter, the relaxation of ethnic restrictions in Canadian immigration regulations in the 1970s saw a dramatic increase in the number of immigrants from China.

⁴ See Hou and Picot (2004) for details.

We focus our search for the effects of superstitious beliefs on house street numbers ending with the digits four and eight as these beliefs are thought to be greatest and the last digit of a house number is thought to leave a final impression in the pronunciation of one's address.⁵ There may be other digits or combinations of digits in the house number also associated with superstitious beliefs for which we perform some limited tests.

We employ a difference-in-difference estimation strategy. Once we control for CT fixed effects and the Chinese concentration in the CT, the coefficient of the interaction between the fateful house street numbers and the Chinese concentration in the CT gives us the relative price effect of fateful house numbers in Chinese neighborhoods in comparison to other neighborhoods. We find that in neighborhoods where the percentage of Chinese residents exceeds the Greater Vancouver average of 18%, houses with street numbers ending in "4" are sold at a 2.2% discount and those ending in "8" are sold with a 2.5% premium in comparison to houses with street numbers ending in any other digits. We argue below that the magnitude of these effects is consistent with transaction costs limiting arbitrage opportunities. These results add weight to the argument that transaction costs and heterogeneous preferences limit the efficiency of the market for single-family homes (Case and Shiller, 1989; Meese and Wallace, 1994; Rosenthal, 1999.)⁶

The structure of the paper is as follows. Section II provides some background on the literature on Chinese superstitious numbers. Section III introduces the data used. Section IV presents the basic empirical specification and the empirical results. Section IV discusses the interpretation of the results. Section V concludes.

⁵ Many papers investigating the role of Chinese superstitious beliefs also focus on the last digit effect. For example, Simmons and Schindler (2002) in marketing, and Brown, Chua and Mitchell (2002) in finance focus attention on the last digit of the price.

⁶ Case and Shiller (1989) first suggested that profit opportunities in the single-family home market are difficult to exploit due to transactions costs, carrying costs and tax considerations.

II. Background

There is little theoretical work in economics, except for Fudenberg and Levine (2006), regarding superstitious beliefs, especially on whether we should expect these false beliefs to persist over time. In a game-theoretic model with rational learning, Fudenberg and Levine characterize the conditions under which false beliefs can persist. They argue that superstitious beliefs are more likely to persist for events off the equilibrium path. In this context, agents are never presented with counterfactual evidence to dispel the superstitious beliefs. In the housing market, fateful outcomes are not easily measured or evaluated, making counterfactuals difficult to construct and leaving room for these beliefs to persist.⁷

But the housing market is a competitive market. For superstitious beliefs to have a quantifiable impact in competitive markets, a sufficient number of buyers need to hold these beliefs. Homebuyers typically choose a neighborhood or set of neighborhoods in which they would like to live, and then search within those neighborhoods for specific houses. In addition, it is well-known that individuals exhibit a preference for living in neighborhoods in which their ethnicity has a notable presence. This is particularly true for immigrants (Bartel, 1989). Notwithstanding arbitrage opportunities, which we discuss below, we thus expect to find a premium on houses associated with good luck in neighborhoods where there are more buyers who hold these beliefs than they are such houses available. Conversely, there may be a penalty on a house associated with bad luck in neighborhoods where most potential buyers would hold these beliefs. In addition, the perceived benefit or cost of living in a Chinese neighborhood may affect the impact of superstitious beliefs on market prices. We would observe reduced (or the

⁷ Conversely, Brown and Mitchell (2008) who study price clustering on the Shanghai and Shenzhen stock exchanges, find that preferences for prices ending with “8” relative to “4” have declined over time.

absence of) discounts on houses associated with bad luck if non-Chinese buyers perceive little or no cost to living in Chinese neighborhoods.

We are aware of two other publications that study the effects of lucky and unlucky Chinese numbers in residential markets. Bourassa and Peng (1999) consider the effect of unlucky and lucky house numbers on 2,164 house sales in a few neighborhoods of Auckland, New Zealand and find a significant positive premium for lucky numbers. Bourassa and Peng argue that the Chinese homophonic principles of number interpretation are linked to the practice of *Feng Sui*, a system which is intrinsically linked to the Taoist philosophy and is more substantial than simple superstitions. Chau, Ma and Ho (2001) investigate the effects of lucky floor numbers 8, 18 and 28 on 1,019 apartment sale prices in Hong Kong and find that apartment on lucky floors sell for higher prices during property booms.⁸ Although both studies present some evidence of a potential effect of Chinese superstitious beliefs on house prices, they are limited by small sample sizes and by the lack of clear control groups. We thus claim to provide the first solid empirical evidence that superstitious beliefs have statistically and quantitatively significant effects on transaction prices in North American residential markets.

Other papers that investigate the impact of Chinese superstitious beliefs have focused on the willingness to pay (WTP) for special license plates in Hong Kong (e.g. Woo, Horowitz, Luk, and Lai, 2008; Ng, Chonga and Du, 2010). Woo et al (2008) study the impact of lucky numbers on the WTP of consumers at 348 auctions between 1990 and 2005. Because there is a large choice of available digit combinations, the authors are able to study a wide range of 3-digits and

⁸ Chau et al. (2001) use the transaction records of apartment sales from only one private sector real estate company in Hong Kong's apartment market, which is not necessarily representative of the entire market.

4-digits combinations, each with different meaning.⁹ They find significantly higher WTP for auspicious license plates numbers that cater to the motorists' superstitions, and they also find that the WTP for these license plates is influenced by economic conditions, like other conspicuous consumption. Ng, Chonga and Du (2010) consider the effects of single digits on the WTP for license plates in a larger set of auctions and find that number "8" is associated with plates with significantly higher winning bids, while number "4" is associated with plates with significantly lower winning bids. While these results are interesting, the license plate market is arguably a thin market where the absence of a resale market (for special plates) prevents prices to be observed on the equilibrium path.

III. Data Used

We use high quality housing data compiled by the property assessment firm, Landcor Data Corporation. This firm works closely with the British Columbia Assessment Authority (BCAA), a public corporation responsible for property assessments used to establish property taxes. From the complete universe of transaction records from January 2000 to May 2005, we select sales transactions for single-family dwellings for 13 major cities in the Greater Vancouver area.¹⁰ We omit records from rural areas, estates of more than 10,000 square feet, and other observations with missing values, this brings our sample down to 116,939 observations from a potential of 123,542 observations. Figure 1 displays the average nominal price for the entire Greater Vancouver area and for our sample. It shows that by contrast with other North-American metropolitan areas, our data largely precede what some see as a large and continuing bubble in

⁹ For example, they consider "228 (double easy prosperity)", "338 (double longevity and prosperity)", "988 (long-lasting double prosperity)" among many others.

¹⁰ These include Burnaby, Coquitlam, Delta, Langley, Maple Ridge, New Westminister, North Vancouver, Pitt Meadows, Port Coquitlam, Richmond, Surrey, Vancouver, and West Vancouver.

housing prices, which barely burst in the 2008 housing crisis. Year to year variations in the seasonality of prices suggest that month-year fixed effects will best capture the housing price inflation.

The housing information includes the street address, the date of the transaction and the transaction price, as well as a host of structural house characteristics: lot size, finished floor area, finished basement area and total basement area, house age, number of bedrooms, full bathrooms, half bathrooms, single-car garages, multi-car garages and stories, and the presence of a basement suite and a swimming pool.¹¹ But we do not know the identity or ethnicity of the buyers and sellers or of the real estate agents, neither do we know the details of the transaction (asking price, time of the market, and so on). We appeal to census data to supplement the ethnicity information at the neighborhood (CT) level.

The census asks many questions about immigrant status: country of origin, languages spoken, single and multiple ethnicities, and visible minority status. We use the Chinese category of the visible minority status question to compute the proportion of ethnic Chinese residents in a CT to avoid the problem of double counting people with multiple ethnicities. The census provides information on the average characteristics of the CT based on interviews of one in five residents in the CT.¹² While ethnic Chinese residents made up about 18% of the total population of Greater Vancouver in 2001, there are 22 census tracts in Vancouver and its suburb of Richmond where the percentage of ethnic Chinese exceeded 50% of the population.¹³ Figure 2 illustrates the percentage of single ethnic Chinese origin by CT in 2001 and shows great diversity

¹¹ We exclude observations below \$100,000 as these are likely to include “other considerations” as part of the transaction. Descriptive statistics on the housing and CT data are available in the online Appendix.

¹² Census tract populations range from 280 to 11,915 residents in our area of interest.

¹³ We note that in Chinese, Richmond translates as the “City of Rich Gate” since “mond” has the same pronunciation as “gate” in Chinese.

across the metropolitan area with concentrations of Chinese residents in the core city as well as in some suburbs. The sales transactions data are merged with Census data for 363 CTs using postal codes.¹⁴

Appendix Table A1 reports the means of the transaction prices and house characteristics for the entire sample, as well as for CTs with a proportion of ethnic Chinese residents below and above the city’s average, separately. The numbers show that on average homes in the more Chinese neighborhoods are larger and almost twice as likely to include a basement suite – possibly to house multi-generational households – and are sold on average at a transaction price higher \$100,000 greater than homes in other neighborhoods. Transactions of homes with address ending with a “4” are almost half as likely to be observed in neighborhoods with a higher than average proportion of ethnic Chinese residents. On the other hand, the percentage of transactions (11%) with an address ending with an “8” is about the same across all neighborhoods.¹⁵

II. Empirical Analysis

Our more complete empirical specification subsumes the classic hedonic price regression on the logarithm of transaction price of observation i on street s in CT c at time t ,

$$\begin{aligned} \ln(P_{isct}) = & \beta_0 + \beta_4 L4_{isct} + \beta_8 L8_{isct} + \mathbf{H}'_{isct} \boldsymbol{\alpha}_H + \mathbf{D}'_t \boldsymbol{\alpha}_t + \mathbf{D}'_s \boldsymbol{\alpha}_s + \mathbf{D}'_c \boldsymbol{\alpha}_c \\ & + \delta_e E_c + \delta_{4e} E_c * L4_{isct} + \delta_{8e} E_c * L8_{isct} + \varepsilon_{isct}, \end{aligned} \quad (1)$$

¹⁴ Each street address in the sales transactions data is matched to a postal code, and this postal code is matched to a CT through the postal code conversion files provided by the Canadian Census Analyzer at the University of Toronto.

¹⁵ We note that the distribution of addresses is not uniform across all ending digits. Addresses increase by units of 100 for each street block. So if there are less than 100 homes on a block, there is room for address changes where allowed.

where $L4_{isct}$ and $L8_{isct}$ denote a house street number ending with a four or an eight, respectively, H'_{isct} is a vector of house characteristics, and D'_t , D'_s and D'_c are vectors of month-year, street, and CT dummies to control for time and location effects. The *Chineseness* of the census tract is identified with the variable E_c . The parameters β_4 and β_8 thus capture the base effect (in the non-Chinese neighborhoods) on log transaction price of a house street address ending with the fateful numbers, and the parameters δ_4 and δ_8 capture the added effect of the fateful numbers in Chinese neighborhoods.

We begin in Table 1 by establishing the distinctiveness of the numbers “4” and “8” by regressing the last digit of the house address on log transaction price, controlling for house characteristics and including 52 month-year dummies. Columns (1) and (2), respectively omitting the numbers “4” and “8”, show that the effect of the other digits are all statistically different from the omitted category (F-statistic= 29.83), positive in the first case and negative in the second case. We note that none of the other digits have this property.¹⁶ Column (3) shows that without location controls, the negative price effect of a house number ending in four $\hat{\beta}_4$ is about 3.1%, and the positive price effect of a house number ending in eight $\hat{\beta}_8$ is about 3.4% in comparison to house numbers ending in any other digit.¹⁷

In Table 2, we add our extensive set of locational controls, the street (6100 dummies) and CT fixed effects (363 dummies), respectively thought to capture location attributes, such as views or commercial streets, and neighborhoods amenities, such as school quality, proximity to rapid transit, or ethnic mix.¹⁸ In accordance to the “location, location, location” precept of real

¹⁶ For each other last digit, the effect of at least one other last digit is not statistically distinguishable. For example, the effects of “0” and “5”, “2” and “7” and all of “1”, “3”, “6” and “9” are not statistically different.

¹⁷ The parameter estimates of the housing characteristics are reported in Appendix Table A2.

¹⁸ For street fixed effects, we actually use the STATA command “areg” which absorbs the effects of 6,100 streets.

estate the introduction of these controls increases the adjusted R^2 from 0.44 to 0.76. Column (1) shows that the effects of fateful numbers are almost entirely absorbed by our location controls. As anticipated, there are some locations where the fateful numbers have an impact and others where they do not. In Columns (2) and (3), we unbundle the effects of location controls by singling out the effect of Chinese ethnicity. In Column (2), Chinese ethnicity, $E_c = \mathbb{I}[A_c > 0.18]$, is measured using a dummy indicating an above average percentage (greater than 18%) of Chinese residents in the CT. The values of $\hat{\delta}_4$ and $\hat{\delta}_8$ indicate a 2.1% discount and a 2.5% premium arising from the fateful numbers in CTs with above average Chinese ethnicity. In Column (3), we exclude within-sample repeated sales and see the magnitude of premium and discount increases somewhat but significantly, reflecting that some repeated sales may be used as arbitrage opportunities.¹⁹ Importantly in both Columns (2) and (3), the effects of the fateful numbers in non-Chinese neighborhoods, $\hat{\beta}_4$ and $\hat{\beta}_8$, go to zero, showing the effects of the fateful numbers originate from CTs with substantial proportions of residents potentially holding Chinese superstitious beliefs.

Figure 3 displays the values of $\hat{\delta}_4$ and $\hat{\delta}_8$ as we gradually increased the proportion of ethnic Chinese residents a that turns the dummy, $E_c = \mathbb{I}[A_c > a]$, to one. For the last “8”, it shows that starting from zero in non-Chinese neighborhoods, $\hat{\delta}_8$ becomes positive and significant as the proportion of ethnic Chinese residents exceeds the availability of these addresses (about 11%), reaching 2% when the proportion attains 0.12. Even as the proportion of ethnic Chinese residents grows, the point estimates continue to hover between 2% and 3% showing, as we argue below, that arbitrage opportunities, albeit limited by transaction costs, are

¹⁹ More precisely, column (3) excludes the second, third, and higher transactions on the same property roll-number. When we also exclude the first transaction on these properties, the values of $\hat{\delta}_4$ and $\hat{\delta}_8$ are -0.025 (0.007) and 0.024 (0.005), respectively.

being exercised. For the last “4”, the point estimates for the penalty hover around 2%, but become non-significant as the proportion of ethnic Chinese residents increases and very few transactions of houses with addresses ending with the “death”-ridden number “4” are actually observed.

We conducted additional tests of alternative placement of the fateful digits and found these effects to be dominated by the last digit effects. We report in Table 3 the results of tests for two other salient combinations of digits. The effects of house street numbers ending with the two-digit combination “88”, which resembles “double joy” or “happiness”, and is sought after by real estate agents who cater to buyers from mainland China, and the two-digit combination “13”, thought to be unlucky in the Western tradition. The results from specifications corresponding to Column (3) of Table 1, first show that including these additional fateful combinations yield a statistically significant positive effect of 6.1% for the numbers ending in “88”, and a negative effect of 2.8% for the numbers ending in “13” in columns (1) and (3) of Table 3. Second, these additions does not change the effects of the last “4” or the last “8” found Column (3) of Table 1 and Column (2) of Table 2, the latter remaining at 2.1-2.2% for the discount and 2.4-2.5% for the premium. Third, we were unable to trace these added effects to the Chinese ethnicity, meaning that the corresponding parameters $\hat{\delta}_{88}$ and $\hat{\delta}_{13}$ were not statistically significant from zero. In the first case, we speculate that for Chinese buyers the desirability of the number “88” may exceed the desirability of living in a neighborhood with an above average proportion of ethnic Chinese residents. In the second case, the fact that the unluckiness of the numbers ending in “13” did not get any traction in Chinese neighborhoods is consistent with the view that this number is not considered unlucky in the Chinese tradition.

III. Interpretation

In a market where opportunistic real estate agents interact with both superstitious and non-superstitious buyers, these results raise the basic question: why have arbitrage opportunities not driven the discount/premium to zero?²⁰ First, there is anecdotal evidence that arbitrage opportunities are being exercised in other ways. Some homebuyers purchase houses with street numbers ending in “4” and then petition the cities for a change in house number. This should reduce the number of inauspicious houses for sale. We do indeed observe that transactions with street addresses ending in “4” represent only 3.9% of sales in CTs with an above average proportion of ethnic Chinese versus 7.4% of sales in other CTs.²¹ Second, transaction costs, which importantly include the real estate agents’ margins of between five and six percent equally split between the home sellers and home buyers’ agents, limit profitable arbitrage opportunities to the two to three percent range that we identify. Even when real estate agents themselves are involved in the transaction, they still have to pay the other agent’s fee.²²

Let $\bar{P}_{sct}(H)$ be the average price of a house with a neutral street address and housing characteristics H and consider extreme cases of intra-day house flipping, which abstracts from mortgage bridging costs.²³ In such cases, an informed house flipper (or rehabber) could make a profit buying a house with a street address with ending with a number “8” from an uninformed seller at $\bar{P}_{sct}(H)$ and selling it at $(1 + \delta_8)\bar{P}_{sct}(H)$ to a superstitious buyer, where $\delta_8 > 0$ is the

²⁰ There is ample anecdotal evidence that real estate agents, especially those who cater to a clientele from Mainland China, are fully informed of the superstitious beliefs. Not only do they seek to offer to properties with lucky addresses, but asking prices also frequently end with an “8”.

²¹ Fearing the disappearance of the number “4”, the city of Richmond adopted the following policy in 2008: “Address changes as a result of a personal preference on the part of the property owner are discouraged for any other reason, i.e. superstition and religious beliefs, numerology, etc.” (City of Richmond, 2008).

²² Some also have to pay a portion to their firms, but some agents are independent. There are also a few discount (1%) real estate agents.

²³ Levitt and Syverson (2002) also ignore these considerations. But in truth, there are very few intra-day transactions. In our sample of 22,710 repeated sales, we observe only 128 intra-day transactions, but 20% (4480) of repeated sales occur within 240 days.

premium for the lucky home. We note that the likelihood of finding such a seller/buyer combination is greater in neighbourhoods that experienced a recent influx of Chinese immigrants. Assuming a linear transaction cost of c , this house flipper will make a profit only if $(1 - c)(1 + \delta_8)\bar{P}_{sct}(H) - \bar{P}_{sct}(H) \geq 0$ that is, whenever $\delta_8 \geq c/(1 - c)$. Thus $\delta_8^* = c/(1 - c)$ represents the premium after all arbitrage opportunities has been exhausted. In a market where arbitrage opportunities are exercised only by regular homebuyers paying a commission in the 5% to 6% range, we would expect a premium of 6.4%. But, as argued by Levitt and Syverson (2008), real estate agents are more likely to be “rehabbers” than other sellers, given that they are more informed than regular homebuyers about client preferences and neighbourhoods dynamics. In this case, because real estate agents incur a transaction cost of half the total commission, the premium for house address ending with an “8” would be in the 2.7%- 3.1% range, not accounting for additional fixed closing costs, consistent with our findings.

Conversely, an informed house flipper could make a profit buying a house with a street address with ending with a number “4” from an informed seller (or in a market where there are fewer buyers of the unlucky property) at a discounted price $(1 - \delta_4)\bar{P}_{sct}(H)$ and selling it at $\bar{P}_{sct}(H)$ to an uninformed buyer, where $\delta_4 > 0$ is the discount for the unlucky address. A thinner market for these homes is likely found in Chinese neighbourhoods with a high proportion of residents who have distaste for home address ending with a “4” and where less non-Chinese residents prefer to live. This house flipper will make a profit only if $(1 - c)\bar{P}_{sct}(H) - (1 - \delta_4)\bar{P}_{sct}(H) \geq 0$ that is, whenever $\delta_4 \geq c$. In this case, $\delta_4^* = c$ represents the discount after arbitrage opportunities have been exercised. As before, if real estate agents engage in house flipping and incur transaction costs of half the usual (5%-6%) commission, we should see a discount in the 2.5%-3% for houses with street addresses ending with a “4”, not accounting for

closing costs.²⁴ Because further arbitrage opportunities are curtailed by transaction costs, we conclude that it is likely we have identified equilibrium outcomes.²⁵

Finally, although we have traced the price effects of the numbers thought to be fateful in the Chinese tradition to a substantial presence of ethnic Chinese residents in the CT, we are unable to distinguish true superstitious beliefs from Veblen effects or from other psychological effects. Some buyers of auspicious house numbers may believe in the “magic” of the numbers. Others may simply enjoy the associated Veblen or status effects, gaining bragging rights or favorable treatment from family, friends, and clients. For others, the fateful numbers may act as a placebo pill and yield tangible benefits or costs. In medicine, Phillips *et al.* (2001) found that for Chinese Americans and Japanese Americans, the peak of mortality among chronic cardiac patients occurs on the 4th of the month, a striking pattern not found among White Americans. In the license plate market, auspicious and inauspicious outcomes might be measured by the frequency of car crashes.²⁶ In the housing market, it is not clear that there are such fateful outcomes; fires or burglaries would be not frequent enough to serve as such a measure.

IV. Conclusion

In this paper, we have shown that in the presence of sizeable transaction costs, superstitious beliefs associated with fateful Chinese numbers can sustain statistically and quantitatively significant effects on house prices, even in North American residential markets.

²⁴ As these simple computations predict, we do find that magnitude of the discount to be a bit smaller than the premium.

²⁵ A more complete analysis of the dynamics towards that price equilibrium would have required data from earlier decades when the proportion of Chinese residents was lower than the availability of fateful addresses.

²⁶ The China Global Times reported on October 20, 2010, that the Beijing Traffic Management Bureau had stopped issuing license plates that contain the number four. It is not known whether this was the result of simple superstitions or of an impact analysis of the license plate numbers on car accidents, but the latter might have been feasible.

With a mean nominal house price of about CAD\$400,000 over the sample period, we have found that in neighborhoods where the percentage of ethnic Chinese residents is above 18%, houses with street numbers ending with the “death”-ridden “4” are sold at a \$8,000 discount and those ending with the “wealth”-laden “8” are sold with a \$10,000 premium in comparison to houses with street numbers ending in any other digit. These results highlight the role of high transaction costs in limiting the efficiency of the real estate market.

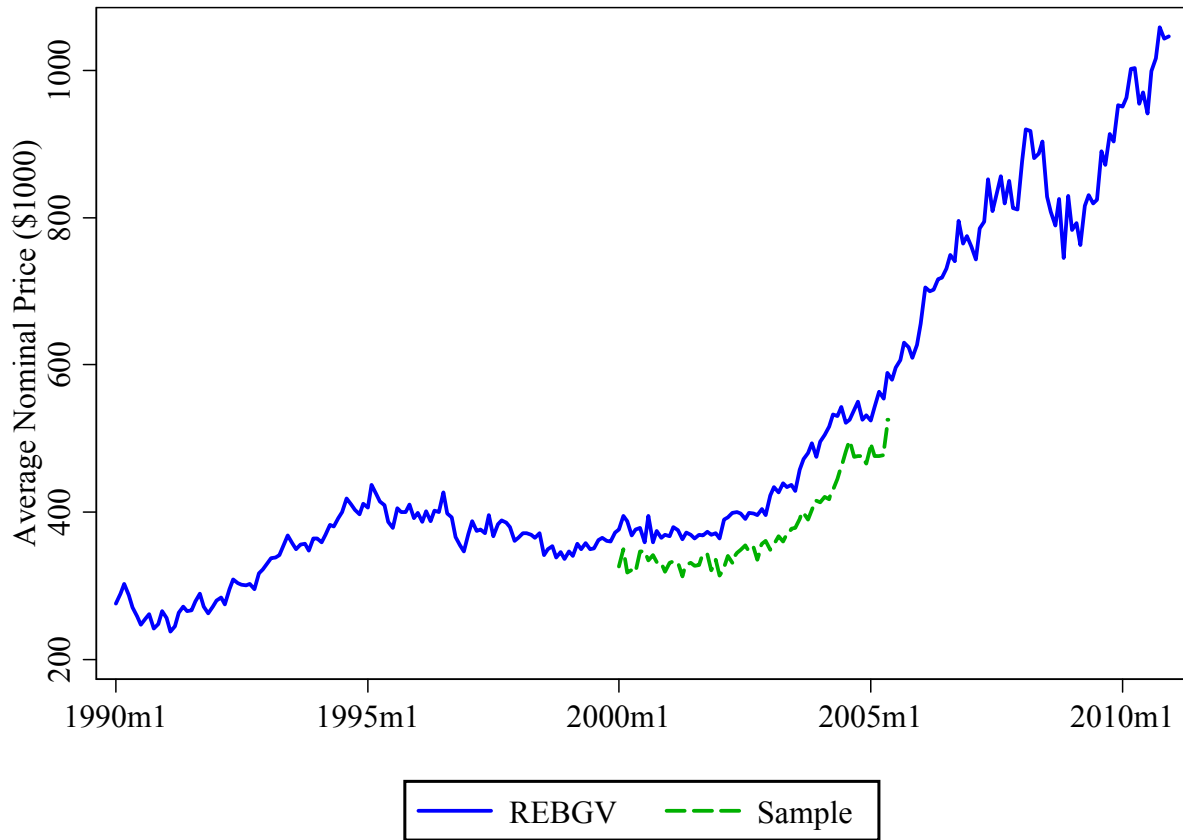
Our results also speak to the impact of immigrants’ cultural beliefs on housing markets in North America. Popular anti-immigrant sentiments often emerge not only when natives feel threatened in their economic position (Mayda, 2006), but perhaps as importantly when their cultural values are threatened by newcomers (Dustmann and Preston, 2007). Our analysis goes beyond the anecdotal evidence documenting the relatively benign elimination of the number “4” in the elevators of many new residential towers in Vancouver and investigates the price effects of culturally driven superstitious beliefs. Clearly, for many long time residents of Greater Vancouver living at an address ending with a “4”, it is unwelcome news that because of the recent influx of Chinese immigrants their homes are now likely to be sold for 2% less than homes with neutral addresses. For them, the price of welcoming other cultures and their superstitious beliefs is steep. At the same time, of course, a longtime resident living at an address ending in an “8” is likely to be much more welcoming.

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Figure 1 – Average Nominal Price of Detached Homes in the Greater Vancouver Area



Source: REBGV average price data are from the Real Estate Board of Greater Vancouver.

Figure 2 – Percentage of Ethnic Chinese (Single Ethnic Origin) by Census Tract (2001)

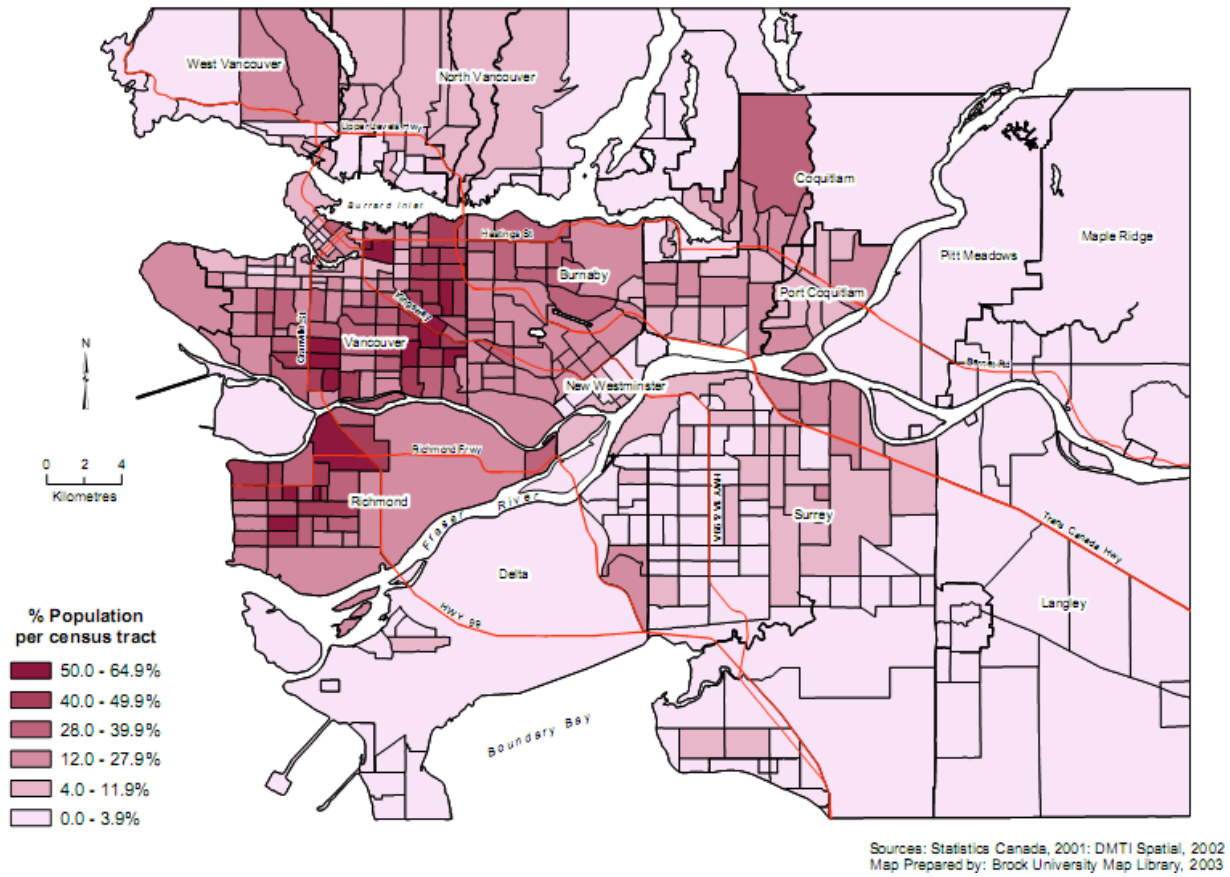


Figure 3. Price Effects of Last Digit “4” and Last Digit “8”
by the Proportion of Ethnic Chinese Residents in the Census Tract

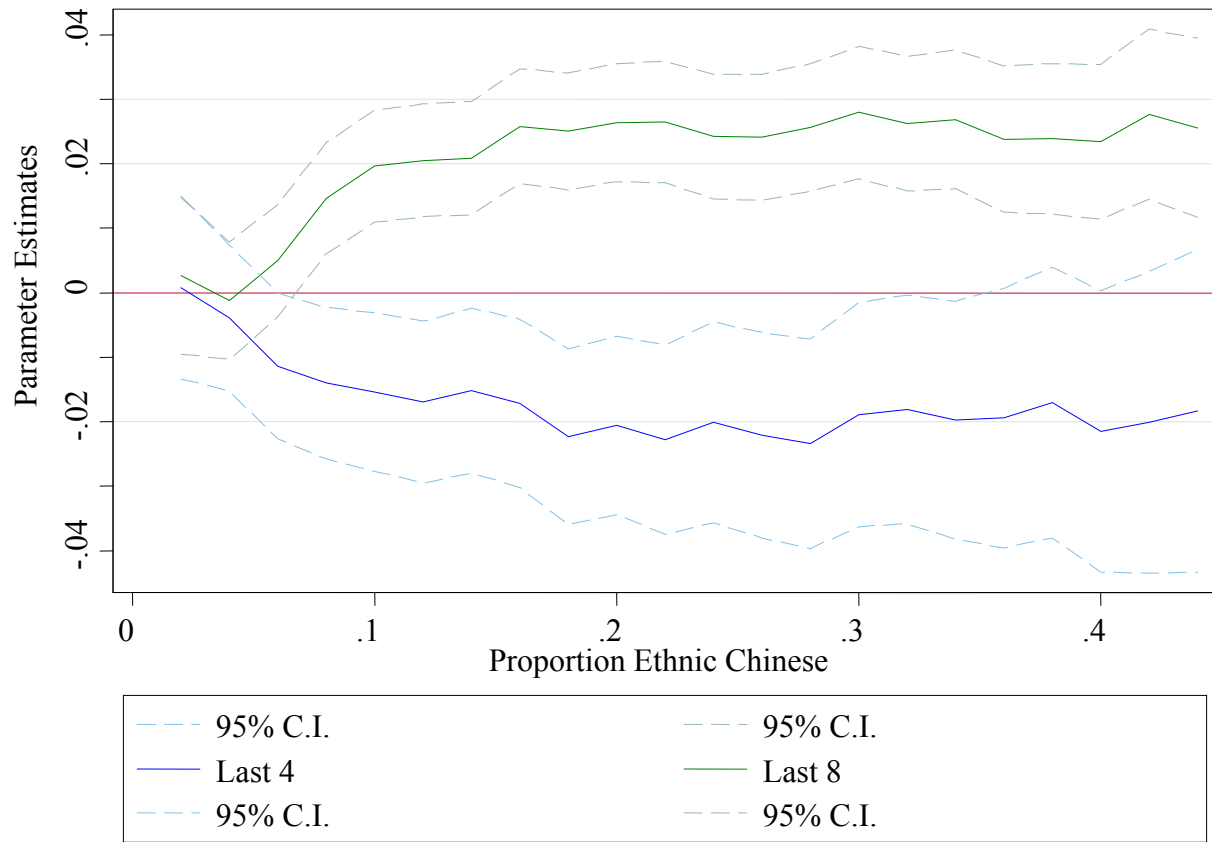


Table 1. Distinctiveness of "8" and "4" in the Effect of House Street Number on Log Transaction Price

	(1)	(2)	(3)
Last digit = 0	0.045*** (0.005)	-0.020*** (0.004)	
Last digit = 1	0.027*** (0.005)	-0.037*** (0.004)	
Last digit = 2	0.019*** (0.005)	-0.046*** (0.004)	
Last digit = 3	0.026*** (0.005)	-0.038*** (0.005)	
Last digit = 4		-0.065*** (0.005)	-0.031*** (0.004)
Last digit = 5	0.043*** (0.005)	-0.022*** (0.004)	
Last digit = 6	0.024*** (0.005)	-0.040*** (0.004)	
Last digit = 7	0.017*** (0.005)	-0.048*** (0.005)	
Last digit = 8	0.065*** (0.005)		0.034*** (0.003)
Last digit = 9	0.030*** (0.005)	-0.035*** (0.004)	
Adj. R-squared	0.444	0.444	0.443

Note: The dependent variable is the natural logarithm of house transaction price. Standard errors are in parentheses. Asterisks indicate the level of statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. All regressions include year-month dummies and the following house characteristics: lot size, finished floor area, finished basement area and total basement area (all in 1000 sq ft), house age (10 years), house age squared (100 years), number of full bathrooms, of half bathrooms, of single car garages, of multi-car garages, of stories, dummies for basement suite and pool. There are 116,939 observations.

Table 2. Impact of Chinese Ethnicity on the Effect of a House Street Number Ending with a "4" or a "8" on Log Transaction Price

	(1)	(2)	(3)
Sample		Full	Excluding Repeated Sales
Ethnicity Control	None	Dummy above average in CT	Dummy above average in CT
Chinese		0.616 (0.386)	0.631 (0.390)
Interaction with Last digit = 4		-0.022*** (0.007)	-0.028*** (0.007)
Interaction with Last digit = 8		0.025*** (0.005)	0.031*** (0.005)
Last digit = 4 ^a	-0.002 (0.003)	0.002 (0.003)	0.006 (0.003)
Last digit = 8 ^b	0.008*** (0.002)	-0.001 (0.003)	-0.002 (0.003)
Census Tract Dummies	Yes	Yes	Yes
Street Fixed Effects	Yes	Yes	Yes
Adj. R-squared	0.756	0.756	0.77
No. of observations	116,939	116,939	94,769

Note: The dependent variable is the natural logarithm of house transaction price. Standard errors are in parentheses. Asterisks indicate the level of statistical significance: *** p<0.01, ** p<0.05, * p<0.10. All regressions include year-month dummies and the same house characteristics as Table 1.

^a There are 7,262 (6,035) sales of houses ending with "4" in the full (non-repeat) sample.

^b There are 13,093 (10,466) sales of houses ending with "8" in the full (non-repeat) sample.

Table 3. Impact of Chinese Ethnicity on the Effect of Other Digit Combinations in Street Number on Log Transaction Price

	(1)	(2)	(3)	(4)
Ethnicity Control	None	Dummy above average in CT	None	Dummy above average in CT
Chinese		0.210 (0.340)		0.210 (0.340)
Interaction with Last digit = 4		-0.022*** (0.007)		-0.021*** (0.007)
Interaction with Last digit = 8		0.024*** (0.005)		0.025*** (0.005)
Interaction with Last two digits=88 ^a		0.008 (0.013)		
Interaction with Last two digits=13 ^b				0.026 (0.021)
Last digit = 4	-0.031*** (0.004)	0.002 (0.003)	-0.031*** (0.004)	0.002 (0.003)
Last digit = 8	0.026*** (0.003)	-0.002 (0.003)	0.033*** (0.003)	-0.001 (0.003)
Last two digits=88	0.061*** (0.009)	0.006 (0.008)		
Last two digits=13			-0.028** (0.013)	-0.001 (0.010)
Census Tract Dummies	No	Yes	No	Yes
Street Fixed Effects	No	Yes	No	Yes
Adj. R-squared	0.444	0.756	0.443	0.756

Note: The dependent variable is the natural logarithm of house transaction price. Standard errors are in parentheses. Asterisks indicate the level of statistical significance: *** p<0.01, ** p<0.05, * p<0.10. All regressions include year-month dummies and the same house characteristics as Table 1. There are 116,939 observations.

^a There 1670 sales of houses ending with "88" .

^b There 658 sales of houses ending with "13".

Appendix Table A1. Descriptive Statistics

Chinese Ethnicity	All CTs		CT with less or average		CT with above average	
	Means	Standard Errors	Means	Standard Errors	Means	Standard Errors
Housing variables						
Transaction price	376,999.40	722.496	340,366.50	787.911	447,392.20	1405.388
Finished floor area (sq ft)	2,407.71	2.980	2,342.41	3.420	2,533.20	5.656
Lot size (1000 sq ft)	809.50	6.277	1,226.55	9.189	810.29	3.828
Finished basement area (sq ft)	584.28	1.615	555.45	0.002	639.68	2.681
Basement area (sq ft)	886.35	1.850	876.86	2.328	904.58	3.033
House age	25.29	0.066	23.21	0.007	29.30	0.013
Number of bedrooms	3.987	0.004	3.845	0.004	4.262	0.007
Number of full bathrooms	2.213	0.003	2.119	0.004	2.392	0.007
Number of half bathrooms	0.598	0.002	0.622	0.002	0.551	0.003
Number of single car garages	0.182	0.001	0.166	0.001	0.198	0.002
Number of multi car garages	0.569	0.001	0.573	0.002	0.587	0.003
Number of stories	1.434	0.001	1.416	0.002	1.455	0.002
Basement suite (dummy)	0.175	0.001	0.134	0.001	0.253	0.002
Swimming Pool (dummy)	0.033	0.001	0.034	0.001	0.033	0.001
Last "4"	0.062	0.241	0.074	0.001	0.039	0.001
Last "8"	0.112	0.315	0.111	0.001	0.115	0.002
No. of observations	116939		76913		40026	

Appendix Table A2. Effects of Housing Characteristics
on Log Transaction Price

Specification	Table 1, Col. (3)	Table 2, Col. (1)	Table 2, Col. (2)
Finished floor area (1000 sq ft)	0.2383 (0.0022)	0.1625 (0.0018)	0.1626 (0.0018)
Lot size (1000 sq ft)	-0.0266 (0.0005)	-0.0028 (0.0015)	-0.0029 (0.0015)
Number of full bathrooms	0.0532 (0.0015)	0.0051 (0.0011)	0.0051 (0.0011)
Number of half bathrooms	0.0562 (0.0021)	0.0194 (0.0015)	0.0194 (0.0015)
Number of multi car garages	0.1221 (0.0029)	0.0846 (0.0022)	0.0846 (0.0022)
Number of single car garages	0.0156 (0.0029)	0.0078 (0.0021)	0.0079 (0.0021)
Number of stories	0.0323 (0.0036)	-0.0162 (0.0028)	-0.0163 (0.0028)
House age (10 years)	0.1458 (0.0018)	0.0587 (0.0015)	0.0587 (0.0015)
House age squared (100 years)	-0.0093 (0.0002)	-0.0072 (0.0002)	-0.0072 (0.0002)
Basement suite (dummy)	0.0242 (0.003)	0.0333 (0.0023)	0.0334 (0.0023)
Basement area (sq ft)	0.0675 (0.0026)	0.0482 (0.002)	0.0483 (0.002)
Finished basement area (sq ft)	-0.1979 (0.0037)	-0.1438 (0.0028)	-0.1440 (0.0028)
Swimming Pool (dummy)	0.1407 (0.0058)	0.0779 (0.0042)	0.0779 (0.0041)
Constant	11.9764 (0.0193)	12.4876 (0.2589)	12.1256 (0.2978)
Year-Month Dummies	Yes	Yes	Yes
Census Tract Fixed Effects	No	Yes	Yes
Street Fixed Effects	No	Yes	Yes
Observations	116939	116939	116939
Adj. R-squared	0.443	0.757	0.757