The Value of Superstitions

Ng, Travis and Chong, Terence and Xin, Du

The Chinese University of Hong Kong

February 2009

The Value of Superstitions

Travis Ng[*], Terence Chong[†], and Xin Du [‡]

February 2009

Abstract

This paper estimates the value of superstitions by studying the auctions of vehicle license plates. We show that the value of superstitions is economically significant, which in turn justifies their persistence in human civilization. We also show that such a value, though based inherently on irrational beliefs, would respond to changes in a manner consistent with economic intuition. In addition, the paper contributes to the recently-heated debate on whether recessions draw people to churches; our results are consistent with people being more superstitious in bad times.

Keywords: superstitions, auction

JEL classification: D44, D46

[*]Corresponding author. Address: Department of Economics, 9th Floor, Esther Lee Building, Ching Chi Campus, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong. Email: TravisNg@cuhk.edu.hk. Phone (852) 2609-8184. Fax (852) 2603-5805.

[†]Department of Economics, The Chinese University of Hong Kong, Hong Kong

[‡]The authors would like to thank the Transport Department of Hong Kong SAR Government for providing data. We also like to thank Victor Kong for able research assistance. We thank Jiahua Che, and Tat-Kei Lai for many helpful comments.

1 Introduction

"When you believe in things that you don't understand,

Then you suffer,

Superstition ain't the way."

Stevie Wonder, *Superstition (1972)*

By how much does one have to pay (or suffer, according to Stevie Wonder) for a superstition? Superstitions, rightly or wrongly, change a variety of human behaviors. Superstitions, therefore, would also change the allocation of economic resources. It is therefore both interesting and economically relevant to document the significance of superstitions.

Superstitions, beliefs not based on reason or knowledge, exist as early as human history.[1] While some old ones eventually vanish, new ones keep developing and many others persist. Friday the Thirteenth, black cat, evil eye, etc, are factors that many take into account in their everyday decisions. A habitual "God bless you" after someone sneezes, rather than showing politeness, came from a superstition.[2]

If people are rational, it is puzzling why superstitions would persist. Many researchers in other disciplines have touched on this issue. Economists, however, have not addressed much. One exception is Fudenberg and Levine (2006). The authors ask how superstitions can persist if we are ever rational, and if so, which types of superstitions would be more likely to persist. They construct a game-theoretic model with rational learning, taking superstitions as beliefs concerning events off the equilibrium path. They characterize conditions under which a false belief can persist. Two important implications follow. First, under rationality assumption, some superstitions *can* persist. Second, in equilibrium, persistent superstitions

[1] According to the Merriam-Webster Online Dictionary, "Superstition" is "a term used by critics for a belief that is not based on reason. http://www.m-w.com/dictionary/superstition" In fact, superstition is not exclusive to human beings. Skinner (1948) shows that trapped pigeons develop behaviors as if they believe that there were a causal relation between their behavior and the presentation of food, although such a relation was lacking. The study concludes that animals also tend to develop behavior to support false belief, an act of superstition.

[2] Pope Saint Gregory I the Great ordered that people do so, believing that it would help prevent the spread of the plague around AD 590.

in turn *do* affect the behavior of people. The second implication is important, and it forms the theoretical basis of this paper. Since superstitions do change behaviors, the allocation of economic resources would depend on superstitions. As a result, they must carry economic value. We estimate such value for a particular type of superstitions. In addition, we examine whether superstitions, while inherently irrational, would have their value respond to changes in ways consistent with economic intuition.

Numerous interesting studies lend support to the second implication. Foster and Kokko (2008) present experiments in which interviewees were requested to make risky decisions. They found that facing the same set of risky decisions, interviewees tended to behave more risk-averse on Friday the Thirteenth than they did on other neutral dates. Consistent with their finding, casual estimates suggest that U.S. businesses lose between $800 - $900 million on every Friday the Thirteenth. Peltzer and Renner (2003) conduct survey interviews with taxi drivers in South Africa and conclude that those who are more superstitious tend to drive less carefully, and have incurred in more car accidents.

To perform our estimations, we identify a type of assets that satisfies a few criteria. First, superstitions would potentially determine their prices. Second, their prices are observable over a long period of time. Third, other factors that determine their prices can be controlled for. Fourth, their prices closely proxy underlying social value. We pick the auction data of vehicle license plates in Hong Kong. Section 2 explains why the data fits these criteria. The data allows us to link one particular type of superstitions to social value - bearing a license plate with a lucky number brings luck, and vice versa.

Our main result is that superstitions do carry significant economic value. This finding lends further support to the fact that many business practices take superstitions seriously.[3] We also found that the value of superstitions would change in response to exogenous changes.

[3]For instance, Mr. Dilip Rangnekar and Miss Elizabeth Young from the Communications Department of Otis Elevator Company, the world's largest elevator manufacturer, confirmed to us that roughly 80 percent of their elevators around the world omit the 13th-floor button. One can easily find many accessories selling in Europe containing an evil eye. Kramer and Block (2008) give many more examples on superstition and marketing practices.

In particular, the ways how the value changes, though based inherently on false beliefs, are rather consistent with economic intuition. In addition, we find some evidence in support of the view that people are more superstitious in bad times.

A number of interesting studies have also documented people "pay" for superstitions. Wong and Yung (2005) show that many Chinese carefully time their babies' birth year; they believe that the "year of dragon" would bring their babies good fate. Bourassa and Peng (1999) show that beliefs in numerology affect real estate prices in regions of New Zealand with a large Chinese population. They find that houses ending with a "lucky" number are more expensive. Chau, Ma, and Ho (2001) investigate lucky number "8" in determining real estate prices. They find that houses with an "8" in their floor numbers sell for higher prices during property booms. Doucouliagos (2004) shows that the Australian stock prices reflect significant number preferences attributable to superstitions.

This paper relates closely to the work of Woo and Kwok (1994), and Woo et al. (2008). Both papers study auctions of vehicle license plates in Hong Kong as well. Our larger dataset, in contrast, allow us to do estimations on different types of plates separately. Estimating different types of plates separately is important in disentangling the effect of superstitions from the effect of conspicuous consumption; section 3.1 will elaborate on this point. This paper is also the first study, even beyond research in economics, asking how the value of superstitions respond to exogenous changes. Our dataset covers periods before and after a major policy change in 2006 - the introduction of an additional type of license plates. It provides a unique opportunity for us to study the change in the value of superstitions in response to the policy change. We also link the data with the stock market index and examine whether the value of superstitions changes as macroeconomic environment changes. Beckwoth (2009) shows an interesting phenomenon - church attendance peaks during recessions. Parallel to the study, we are interesting in asking whether people are more superstitious in bad times.

2 Data and Variables

This study takes advantages of one of the few data sets that make it possible to link superstitions with social value: the auction data of vehicle license plates in Hong Kong. Over 95% of Hong Kong population is of Chinese descent. The largest ethnic group in the world, Chinese would have to be rather superstitious in order to justify the following observations: the $888 round-trip deal - from New York to Beijing by Continental Airlines in 2005; 2008/08/08 at 8pm - the Beijing Olympics opening moment; the missing 4th, 14th and 24th floors in many apartments in Hong Kong; and the peak of cardiac mortality of Chinese Americans and Japanese Americans (for whom "4" is unlucky) on the 4th of the month, a striking pattern absent in White Americans.[4]

2.1 Institutional Background

The Hong Kong government started auctioning license plates since 1973.[5] The government is the only one selling plates through an open auction. Table 1 summarizes the main features of different types of plates available for auctions.[6]

There were only traditional plates before September 2006. They consist of either no letter prefix, or 2-letter prefix, followed by a number between 1 and 9999 (e.g., AB 1234, LB 453, and 18).[7]

The law further groups traditional plates into two mutually-exclusive types: ordinary and special.[8] Their key distinctions, namely, assignment and transferability, deserve a brief

[4]Phillips et al. (2001) examine mortality data in the United States and found such a striking pattern.

[5]In 1973, legislation was introduced whereby vehicle plates could be purchased by auction. The proceeds of auctions go to a charity fund called Lotteries Fund.

[6]To be precise, it is the right of putting a specific number on a license plate that is sold, not the plate per se. The buyer can put the specific number in whatever plates he sees fit.

[7]The earliest plates contain numbers only. When the number of vehicles exhausted plates containing only numbers, the government added Roman alphabet letters such as "HK" and "XX" as prefixes. After "HK" and "XX" are exhausted, license plates starting from "AA", "AB", "AC", and so on are used.

[8]As stated in Schedule 5 of the Road Traffic (Registration and Licensing of Vehicles) regulations (Cap. 374 sub.leg. E), a plate is special if it satisfies one or more of the following criteria: (1) no letter prefix; (2) number below 100; (3) number in hundreds or thousands; (4) symmetric mark; (5) sequential mark; (6) two pairs; (7) alternate pairs; (8) mark with identical numbers.

explanation.

The government automatically assign to Mary, for example, an ordinary plate upon registration of her vehicle (usually by sequence). If Mary does not like the plate, she can return it to the government, and bids a plate she likes in an auction. Mary can either go to an auction; but there is no guarantee that the auction has one plate she likes. Alternatively, she can reserve one unassigned plate (including ordinary and special) in advance, and go to the particular auction to bid for the plate she has reserved. Of course, there is no guarantee that she will win that plate. Mary can also buy a plate from someone else.

The government does not assign special plates. They are generally more appealing numbers. If Mary wants a special plate from the government, she can only get it through auction.

Ordinary plates can be legally transferred. If Mary likes Peter's ordinary plate, they can trade with each other. In contrast, if Mary likes John's special plate, even if John would like to sell to her, they cannot legally make a deal.

This non-transferability restriction is intended to curb speculation. However, some "clever" practices can get around this restriction.[9] This would have implications on our estimation strategy.

In March 2004, the Hong Kong government first proposed to introduce personalized plates. The motivation was fiscal budget deficit, a result of SARS in 2003 and the economic downturn from 2002 to 2004.[10] Since the sales of traditional plates went to a charity fund instead, the government proposed selling personalized plates to raise government revenue.[11] Personalized plates allows vehicle owners to, subject to certain restrictions, personalize their plate numbers up to eight digits (e.g., 1 LOVE U, WWW, RELAX, etc.). The first auction of personalized plates was in September 2006.

[9] As vehicles may be registered under the name of a company, some have circumvented the restriction by assigning a special plate to a vehicle registered under the name of a company. Selling all the shares of the company to another party thus effectively means transferring the special plate. These "clever" practices blur the non-transferability feature, the supposedly key distinction between ordinary and special plates.

[10] SARS stands for Severe Acute Respiratory Syndrome, a highly contagious disease that killed 304 people in Hong Kong in 2003.

[11] This motive was clearly documented in many Legislative Council documents. For instance, on a review of personalized plates dated on January 2008 (document number CB(1)590/07-08(01).

2.2 The Auction

The Hong Kong government sells plates by English oral ascending auctions. Ordinary plates have a reserve price of HKD$1,000 (HKD$7.8 = USD$1). Reserve prices vary for special plates and are set by the government. The auctioneer can raise the minimum bid increment during the auction. Auctions are usually held in weekends and in Chinese Lunar New Year holidays. There is no fixed schedule and therefore the number of auctions in a given month can vary. Each auction sells, on average, more than a hundred different plates sequentially.

Auction theory suggests that in an English oral ascending auction, if there is no binding minimum bid increment and binding reserve price, and the valuations of bidders are independent, then in equilibrium the winner pays an amount equal to the valuation of the second highest bidder. The winning bid is thus the social opportunity cost. Controlling for other factors, if superstitions determine prices, the auction data would allow us to link superstitions with social value.

Ideally, if plates are all non-transferable, as are supposedly the case for special plates, then the assumption of independent bidders' valuations seem plausible. As mentioned, however, there are ways to "cleverly" transfer special plates that are supposed to be non-transferable. Ordinary plates are not subject to any transferability restriction. There are companies bidding plates in auctions, aiming at trading them for a profit.[12] Their valuations of a plate, therefore, depend on their estimates of its future price. These bidders' valuations, therefore, have a common value component. This leads to the possibility of the winner's curse: the winning bidder is the most optimistic one who over-estimates the future price.[13] The common value component makes it non-trivial to map winning bids to social cost. These

[12]This issue should be a legitimate concern. Two pieces of evidence support this claims. First, according to the Official Record of Proceedings on 2006 October 18 by the Hong Kong Legislative council, the first auction of personalized plate numbers sold 210 plates to 159 buyers. Among whom 143 buyers (68% of plates) have only acquired one for their own use, while 16 buyers have acquired more than one plates (32% of plates). One buyer acquired 22 plates and was believed they will be used for trading purposes. Second, one can easily find many companies advertising their inventory of plates for sales.

[13]Garratt and Troger (2006) gives a theoretical foundation on auction equilibrium in the presence of speculators in auctions.

concerns would constrain our empirical strategies.

2.3 Data

Our data is from Hong Kong Transport Department. It contains 292 auctions of traditional plates from January 1997 to January 2009. The data span two very different periods. Up to August 2006, only traditional plates were available. The introduction of personalized plates in September 2006 marked a transition in this market. There were 46,678 traditional plates available for auction; of which 41,069 were sold. Our dataset does not include the results of the 16 auctions of personalized plates since September 2006. Table 2 gives the breakdown of the number of observations by year.

We observe the plate number, the auction date, whether or not the plate was successfully sold in the auction, and if so, the winning bids. We do not, however, observe the reserve prices of special plates (which are made known at the auction house right before the auction begins), the number of bids, the bidders' identities, the bid increments, and the sequence of the auction.[14] In addition, we do not observe whether the plates sold in auctions are for personal use or for trade.

Table 3 presents the real prices of plates by types and by year. We denominate the nominal prices by the CPI of the auction month to adjust for inflation.

3 Empirical Analysis

3.1 Estimation method

While structural estimations of auctions are the usual strategies for empirical auction studies, in addition to data limitation, the presence of (i) common value component, (ii) potentially binding reserve price, (iii) potentially binding minimum bid increment, and (iv) sequential

[14]The data on reserve prices of special plates are not publicly available. For other data, the Transport Department claimed that they did not keep historical records.

auctions of many plates, substantially complicate the use of a structural estimation approach. The theory has yet to draw a mapping between winning bids and the bidders' valuations under all these constraints. We therefore abstract away from the use of structural estimations and instead, use the hedonic pricing estimation.

The hedonic pricing method studies how the price of a commodity relates to its attributes. Court (1939) first introduces the methodology. Lancaster (1966) and Rosen (1974) further develop it. Woo and Kwok (1994), and Woo et al. (2008) employ hedonic estimations as well. McDonald and Slawson (2002) use hedonic estimations to study the effect of seller's reputation in internet auction. As noted in Bajari and Hortacsu (2004), however, using hedonic estimations requires somewhat stringent assumptions to interpret the "implicit prices" as buyer valuations.[15] Interpreting results of hedonic estimations, therefore, calls for special caution.

A license plate serves no other purpose, literally, other than to legalize a car to use the road. The plate number does not change its legal function. Huge variations in the winning bids of plates, therefore, must have reflected some preferences on the plate numbers per se. We hypothesize that superstitions play a role in explaining price variation, i.e., controlling for other factors, superstitions do explain the price variation.

A particular type of superstitions we focus on is the belief that a number (or a series of numbers) that rhymes something good(bad) would bring good(bad) luck to the owner. It is a false belief because obviously how likely one gets involved in a car accident has to do with his driving habit but not his plate number. Such superstitions would change the allocation of economic resources. For instance, whoever has an "unlucky" plate drives his car unnecessarily slower is an economic cost. If such superstitions carry significant economic value, their prices must reflect that.

Testing this hypothesis involves two inherent difficulties. First, license plates are publicly

[15] On page 474 of the article, the conditions are: (i) no common value component, (ii) no asymmetric information among bidders about the marginal values of the observed product characteristics, (iii) no minimum bids or reserve prices, (iv) all bidders are ex ante symmetric, (v) all product characteristics are observable, (vi) entry is exogenous and a dummy variable for the number of bidders is included in the regression.

visible; they are conspicuous goods (also known as Veblen good). People buy a conspicuous good in order to signal high income and achieve greater social status. Those plates that most believe are expensive would serve such a purpose.[16] They are sold at a higher price because everyone expects so, a self-fulfilling equilibrium. This effect, however, has nothing to do with superstitions.

Second, plates with different plate numbers are visually differentiated. Some number patterns are generally regarded as visually more appealing than others. Differences in visual appeal, therefore, has to be controlled for.

To disentangle the conspicuous effect from the effect of superstitions, we use two strategies. First, we do estimations on different types of plates separately. The idea is to exploit the fact that most expect plates with fewer digits command higher prices. Table 3 reflects this expectation. Not many, however, can tell the price difference among plates with the same number of digits. For instance, most expect "LB 36" is more expensive than "LB 4566", and "DR 388" is more expensive than "DR 4598". Not many can tell whether "LB 4566" or "LB 3587" is more expensive. Second, in each estimation, we control for plate numbers that most expect are expensive, in particular, those with no prefix, prefix of "HK", and "XX".[17] Most would not tell the price difference between "DR 3982" and an "AG 1793" but most would expect "HK 3982" and "XX 1793" are more expensive than "DR 3982" and "AG 1793" respectively.

To disentangle differences in visual appeal from the effect of superstitions, we control for a variety of different combination patterns. Table 4 summarizes the variables we control for. In particular, we assume that people does not systematically prefer any particular letter or number in terms of their visual appeal. For example, people should not value "AB" systematically higher than "JB", or "KK" higher than "JJ". However, people may value "KK" systematically higher than "JB"; same-letter prefix is visually more appealing. In

[16] See Biddle (1991), for instance, for the study of conspicous effects of license plates in the United States.

[17] Those earliest plates containing numbers only, and those with "HK" and "XX" as prefixes are, perhaps because of their long history, substantially more expensive than others.

addition, people should not systematically value "132" higher than "379", but they would value "1234" higher than "4591" because of sequential numbers.

The regression model takes the following form, estimated by plate types:

$$\begin{aligned} \ln(\text{Real price}) &= \alpha + \beta(\text{letter prefix characteristics}) + \gamma(\text{number patterns}) \\ &\quad + \delta(\text{number counts of "0" to "9"}) \\ &\quad + \lambda(\text{year-month dummies}) + \text{error}. \end{aligned} \tag{1}$$

The notations β, γ, δ, and λ are vectors. The year-month dummies capture the macro-economic environment that systematically affect winning bids within the month.[18]

Although we do not observe the number and identities of bidders, we believe that their composition in any particular auction would influence winning bids in that auction in certain ways. To take this into account, the model assumes that the error terms within an auction date are correlated in some unknown way, but that plates auctioned on different dates do not have correlated errors. We therefore calculate the standard errors clustered by auction date. In addition, to account for heteroscedasticity, white-corrected standard errors are calculated.

3.2 Main results

3.2.1 Superstitions carry significant economic value

Our hypothesis is that superstitions play a role in determining winning bids.

Different numbers rhyme differently in Cantonese; but there is a universal consensus in Hong Kong that "8" is good and "4" is bad. The number "8" rhymes similarly to the word "prosper" or "prosperity"; the associated superstition is that an "8" brings prosperity. The number "4" rhymes similarly to the word "die" or "death"; the associated superstition is that a "4" increases the odds of dying. Given that these superstitions persist for a long

[18] In another specification (for which we do not report), we can use year dummies only but we include month-end stock market index (i.e., the Hang Seng index) to proxy for the macro-economic variations. The results are very similar.

time, they must carry significant economic value. Consistent with this logic, the number "8" would carry a significant premium on a license plate, while the number "4" would carry a significant discount.

Table 5 shows the main results for hedonic regressions of different types of plate. In particular, we found that the number "8" is associated with plates with significantly higher winning bids, and the number "4" is associated with plates with significantly lower winning bids. Controlling for other factors, an ordinary 4-digit plate with one extra "8" on average was sold at 63.5% higher, while an ordinary 4-digit plate with one extra "4" on average was sold at 11% lower (both relative to the number "7"). The corresponding estimates for ordinary 3-digit plates are 94.8% and 27.3% respectively. We obtain similar results on special plates of all digits.

In short, consistent with our hypothesis, an "8" does carry a significant premium while a "4" does carry a significant discount. Our results are largely consistent with those in Woo and Kwok (1994), and Woo et al. (2008), despite the fact that we are using a substantially bigger dataset that covers a different period of time.

One may argue that the significance of our results may well be attributed to number preferences per se rather than to superstitions, i.e., people in Hong Kong simply systematically prefer "8" and dislike "4". Such preferences have nothing to do with superstitions. To address this issue, we control for the number preferences by controlling for the numbers that appear on a plate per se. We estimate the following equation on 3-digit ordinary plates:

$$\begin{aligned} \ln(\text{Real price}) &= \alpha + \beta(\text{letter prefix characteristics}) + \delta(\text{ordered combinations}) \\ &\quad + \lambda(\text{year-month dummies}) + \text{error}. \end{aligned} \tag{2}$$

The bottom panel of Table 4 gives the definition of the variables we use. The idea is to exploit the fact that even for the same set of numbers, what they rhymes similarly to depends on how they are ordered. Numbers ordered in such a way that rhymes similarly to

some good(bad) phrases should carry a significant premium(discount), which has nothing to do with number preferences anymore. We estimate this equation on 3-digit ordinary plates separately for four sets of number combinations, (1) "1", "6", and "8", (2) "1", "3", and "8", (3) "1", "4", and "8", and (4) "2", "3", and "8".

The most preferred plate number is "168", which rhymes similarly to "proper all the way".[19] Controlling for numbers, if superstitions have value, "168" should be associated with higher winning bids. The first column of Table 6 shows consistent results. A "168" plate is significantly more expensive than a "861" plate; it was sold for, on average, close to three times more expensive than a "861" plate, for "861" does not rhyme similarly to any phrase that makes sense in Cantonese.[20]

The numbers "138", "813", "148" and "814" rhymes similarly to "I will be wealthy my entire life." The second and the third column of Table 6 show that they are all associated with plates with higher winning bids.[21]

The number "238" rhymes similarly to "this life is prosperous", and "328" to "business is profitable". Column four of Table 6 show that they are again associated with plates with higher winning bids.

The results suggest that number preferences alone cannot explain the price variations. It is how a plate number rhymes that determine its price. And plate numbers that rhymes similarly to good phrases are associated with higher winning bids.

3.2.2 The economics of superstitions

Our results also allow us to address one interesting question: to what extent would the value of superstitions, based fundamentally on beliefs that are inherently irrational, be explained by economic intuition? We present three pieces of evidence that suggest that responses of

[19]The number "16" rhymes similarly to "all the way" (as an adverb), "168" therefore rhymes similarly to "(I) prosper all the way".

[20]Both "861" and "681" do not rhyme similarly to any phrase that makes sense in Cantonese. However, "186", "618", and "816" are all variations, in terms of how they rhyme, of "road to propersity".

[21]Again, "283", "382", "823", and "832" do not rhyme similarly to any phrase that makes sense in Cantonese.

the value of superstitions to changes square with economic intuition well.

We first look at the change of the premium and the discount of an "8" and a "4" across different types of plates. An analogy would explain the relevant economic intuition. Suppose, rather than leaving the next year's health to randomness, one can buy a healthy year from God. How much in terms of his share of wealth would he be willing to pay for? The sooner he expects to die, the larger the share he is willing to give up. A year of good health weights more in a shorter life. Analogously, one's willingness to pay to acquire an "8" (or to get rid of a "4") would on average increase with a plate with fewer digits. The increase is because of a bigger share of a number in plates with fewer digit.

The results in Table 5 allow us to examine whether the estimates are consistent with this logic. The discount of a "4" are all statistically significant across all types of plates. More interestingly, the size increases as we move from ordinary 4-digit plates to ordinary 3-digit plates, with the increase from 11% to 27.3%. Estimates of special plates exhibit a similar pattern: larger discount when moving from 4-digit, to 3-digit, to 2-digit, and to 1-digit, with figures 15.6%, 20.9%, 34.5% and 83.2% respectively. We find the exact same pattern on the premium of an "8". An unlucky "4" is bad but it is the worst if it is on a 1-digit plate, than it is on a 2-digit plate. On the other hand, a lucky "8" is good but it is the best if it is on a 1-digit plate. Such a pattern is not in general true for other numbers.

We also make use of the introduction of personalized plates as a natural experiment. We ask whether, after the introduction of personalized plates in 2006, the sizes of the premium on an "8", and the discount on a "4", change, and if so, in which direction.

Though based on irrational beliefs, there must be a demand for any particular superstition. Economic intuition suggests that a demand would change under exogenous change: the demand for a superstition would shift down as more substitutes are available. Expressing oneself by means of a personalized plate, rather than having a "lucky" plate, was not an option until 2006.

Formally, in the regressions, we hypothesize that the coefficients of an "8" and a "4"

differ before and after 2006. Precisely when the effect of personalized plates started is hard to say. We believe it is more reasonable to think that it started at the beginning of 2006 when the bill was finally passed and people started reserving for their personalized plates for auctions, rather than when the personalized plates first auction was held.

Table 7 shows the results. The sizes of the premium on an "8" and the discount on a "4" universally reduced after 2006 for all the 4-digit (including ordinary and special) and 3-digit ordinary plates. The results of Wald tests on these three types of plates indicate that the estimated coefficients of a "4" and an "8" differ significantly before and after 2006, suggesting that the introduction of personalized plates did affect people's attitude towards superstitions. For instance, for an ordinary 4-digit plate, on average, an "8" carries a 64.8% premium before 2006 but only 61.4% after 2006. Corresponding figures for an ordinary 3-digit plate are 98.9% before 2006 and 87% after 2006.

The significance of the differences of the estimated coefficients is marginal for special plates fewer than 4 digits. We do not see a universal pattern of the changes in premium and discount before and after 2006.

Of which types of plates should the value of superstitions be most responsive to the introduction of personalized plates? Consumer theory suggests that the degree of substitutability is larger among a pair of substitutes that sells at similar price ranges relative to a pair that sell at very different price ranges. For instance, introducing a new Cadillac model should impact the demand of Mercedez E-class more relative to that of Honda Civic.

Though we do not have data on the price of personalized plates, we can infer its price range because the government set their reserve price uniformly at $5,000. This is the minimum that anyone who bids for any personalized plate would have to pay. The average price therefore should be at least higher than $5,000 (denominated by CPI, the amount is roughly $4,950 in real price.).[22] Table 3 shows that the average real prices for ordinary 3-digit plates was around $9,562 before 2006, and that for ordinary 4-digit plates was roughly $4,532. It

[22]One price example of a personalized plate was "HAHAHAHA" sold at $65,000 on Sep 16, 2006.

is therefore reasonable to expect that the personalized plates should be more appealing to those people that would be more inclined to buying an ordinary 3-digit plates, rather than an ordinary 4-digit plates. The degree of substitutability between ordinary 3-digit plates and personalized plates should be higher. We therefore expect that the impact of the introduction of personalized plates on the value of superstitions is larger on ordinary 3-digit plates than on 4-digit ordinary plates.

The result in Table 7 shows consistent results. The reduction in size after 2006, in terms of the premimum on replacing a "4" with an "8" in an ordinary plate, is larger for 4-digit plates than 3-digit plates; it adds, on average, 134.8% to the price of an ordinary 3-digit plates before 2006, but only 97.4% after 2006. The percentage drop was 27.75%. Corresponding figures are 77.8% to the price of an ordinary 4-digit plates before 2006, and 61.4% after 2006. The percentage drop was 22.88%. Ordinary 3-digit plates, priced at similar price range as personalized plates, respond to its introduction in a bigger magnitude relative to ordinary 4-digit plates.

3.2.3 Are people more superstitious in bad times?

Beckworth (2009) shows that more people attend churches during recessions. One of the possible explanations is that people tend to be more religious in bad times. A recent New York Times article has elevated this controversial explanation to a nation-wide heated debate.[23] Parallel to the interesting study, we examine whether people become more superstition in bad times. We run the following regression on different types of plates.

$$\begin{aligned} \ln(\text{Real price}) \;=\; & \alpha + \beta(\text{letter prefix characteristics}) + \gamma(\text{number patterns}) \\ & + \delta(\text{number counts of "0" to "9"}) \\ & + \theta((\text{number counts of "0" to "9"})(\text{market condition})) \\ & + \lambda(\text{year-month dummies}) + \text{error}. \end{aligned} \tag{3}$$

[23] Vitello, Paul. 2008. "Bad Times Draw Bigger Crowds to Churches." The New York Times Magazine. December 13. http://www.nytimes.com/2008/12/14/nyregion/14churches.html

The notations β, γ, θ, δ, and λ are vectors. We use the natural log of the Hong Kong Hang Seng Index at the end of the month the plate was auctioned to proxy for the market condition. The premium for each number "j" now is

$$\partial[\ln(\text{Real Price})]/\partial[\text{num "}j\text{"}] = \delta_j + \theta_j \ln(\text{Stock market index}). \tag{4}$$

This specification allows different premium or discount of superstitions, if any, under different market condition.

If we expect people are more superstitious in bad times, the premium on an "8" should be larger in bad times relative to that in good times. In turn, we expect θ_8 is significantly negative. Similary, the discount on a "4" should be larger in bad times, i.e., θ_4 is significantly positive.

Column 1 to 4 of Table 8 shows the results for both special and ordinary 4-digit and 3-digit plates, which comprise of 90.3% of our total observations. The results suggest that the size of the discount on a "4" is negatively associated with the market index. People tend to discount a "4" even more in bad times. For instance, the discount on a "4" in a 4-digit ordinary plate is on average equal to -201.1% + 19.9%ln(stock market index). A one percent drop in the stock index adds an extra 19.9% in the size of the discount. A "4" is bad, but it is even worse in a bad time.

The results suggest that an "8" is associated with a significant premium. For ordinary 4-digit and 3-digit plates, the premium does not change under different market conditions. For special 4-digit and 3-digit plates, however, the premium tends to be even larger during bad times. For instance, the premium on a "8" in a 4-digit special plate is on average equal to +200.8% - 11.1%ln(stock market index). A one percent drop in the stock market index adds an extra 11.1% in the size of the premium.

It is interesting that the premium on an "8" tend to be more stable than the discount on a "4"; for ordinary plates, the premium on an "8" does not vary with the market condition,

while the discount on a "4" does. For special 3-digit and 4-digit plates, the discount on a "4" varies with market condition in a greater proportion relative to that of the premium on an "8".

We do not, however, find a similar pattern for 2-digit and 1-digit plates, which comprise of a little less than 10% of our data.

4 Conclusion

This paper estimates the value of a particular type of superstitions - a "lucky"("unlucky") number brings good(bad) luck. We have shown that the value of superstitions can be economically significant. We believe that the results are consistent with the fact that superstitions persist over time.

Though we may not be the first to document the value of superstitions, we are the first to address the question of how such value changes over time, and in response to other policy changes. We find that, interestingly, the value of superstitions changes in ways that are consistent with economic intuition. The dataset we have and the exogenous policy change provides us a unique opportunity to address this issue.

We have also shown some results consistent with the view that people tend to be more superstitious in bad times. Our results suggest that people tend to discount a bad number even more in bad times. However, people place a higher premium on a good number in bad times only for a small subset of plates. We conjecture that people's attitude towards superstitions does change with macroeconomic environment, but the changes are different among positive and negative superstitions. By positive superstitions, we mean the false belief that some logically unrelated items or actions bring good luck. Negative superstitions would be the opposite case. We are not aware of any theory that distinguishes positive superstitions from negative superstitions.

To conclude, while our empirical analysis documents the value of superstitions and how

they change over time and in response to exogenous changes, it also calls for modeling different types of superstitions explicitly in order to understand the empirical findings. We hope our research would motivate theoretical research on this particular issue.

References

[1] **Bajari, Patrick, and Ali Hortacsu**. 2004. "Economic Insights from Internet Auctions." *Journal of Economic Literature*, 42(2): 457-486.

[2] **Beckworth, David**. 2009. "Praying for a Recession: The Business Cycle and Protestant Religiosity in the United States." *SSRN Working Paper Series*.
Available at SSRN: http://ssrn.com/abstract=1103142

[3] **Bourassa, Steven C., and Vincent S. Peng**. 1999. "Hedonic Prices and House Numbers: the Influence of Feng Shui." *International Real Estate Review*, 2(1): 79-93.

[4] **Biddle, Jeff**. 1991. "A Bandwagon Effect in Personalized License Plates?" *Economic Inquiry*, 29(2): 375-388.

[5] **Chau, K.W., Vincent S. M. Ma, and Daniel C. W. Ho**. 2000. "The Pricing of Luckiness in the Apartment Market." *Journal of Real Estate Literature*, 9(1): 31-40.

[6] **Court, Andrew T**. 1939. "Hedonic Price Indexes with Automotive Examples." In *The Dynamics of Automotive Demand*, New York, NY: General Motors.

[7] **Doucouliagos, Hristos C**. 2004. "Number Preference in Australian Stocks." *Applied Financial Economics*, 14(1): 43-54.

[8] **Foster, Kevin R., and Hannah Kokko**. 2008. "The Evolution of Superstitious and Superstition-like Behaviour." *Proceedings of the Royal Society of London, Series B*.

[9] **Fudenberg, Drew, and David K Levine**. 2006. "Superstition and Rational Learning." *American Economic Review*, 96(3): 630-651.

[10] **Garratt, Rod, and Thomas Troger**. 2006. "Speculation in Standard Auctions with Resale." *Econometrica*, 74(3): 753-769.

[11] **Kramer, Thomas, and Lauren Block**. 2008. "Conscious and Nonconscious Components of Superstitious Beliefs in Judgment and Decision Making." *Journal of Consumer Research*, 34(6): 783-793.

[12] **Lancaster, Kelvin J**. 1966. "A New Approach to Consumer Theory." *Journal of Political Economy*, 74(2): 132-157.

[13] **McDonald, Cynthia G., and V. Carlos Slawson**. 2002. "Reputation in an Internet Auction." *Economic Inquiry*, 40(4): 633-650.

[14] **Phillips, David P., George C. Liu, Kennon Kwok, Jason R Jarvinen, Wei Zhang, and Ian S Abramson**. 2001. "The Hound of the Baskervilles Effect: Natural Experiment on the Influence of Psychological Stress on Timing of Death." *British Medical Journal*, 323(22-29 December): 1443-1446.

[15] **Peltzer, Karl, and Walter Renner**. 2003. "Superstition, Risk-taking and Risk Perception of Accidents Among South African Taxi Drivers." *Accident Analysis and Prevention*, 35(4): 619-623.

[16] **Skinner, Burrhus F**. 1948. "Superstition in the Pigeon." *Journal of Experimental Psychology*, 38(2): 168-172.

[17] **Rosen, Sherin**. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy*, 82(1): 34-35.

[18] **Wong, Ka-Fu, and Linda Yung**. 2005. "Do Dragon Have Better Fate?" *Economic Inquiry*, 43(3): 689-697.

[19] **Woo, Chi-Keung, and Raymond H.F. Kwok**. 1994. "Vanity, Superstition and Auction Price." *Economics Letters*, 44(4): 389-395.

[20] **Woo, Chi-Keung, Ira Horowitz, Stephen Luk, and Aaron Lai**. 2008. "Willingness to Pay and Nuanced Cultural Cues: Evidence from Hong Kong's License-plate Auction Market." *Journal of Economic Psychology*, 29(1): 35-53.

Table 1: Features of license plates by type

		Traditional		Personalized
		Ordinary	Special	–
Features	Structure	no, or 2-Letter prefix, followed by a number between 1-9999		8-digit, combinations of numbers, letters and space
	Examples	AA 347 DR 5689	AA 1 DR 3883	1 LOVE U RELAX
	Expire?	No expiry date	Until the holder dies or the company dissolves	15 years
Allocation	Legally transferable?	Yes	No	No
	Assigned?	Yes	No	No
	Auctioned?	Yes	Yes	Yes
Availability	Before Sep 2006	Yes	Yes	No
	After Sep 2006	Yes	Yes	Yes
Auction	Reserve price	$1,000	Varies	$5,000
	Min. Bid increment	Varies	Varies	Varies

Table 2: Summary of data by year and types of plate

					Total	Breakdown of plate types (sold and unsold)					
		Number of			Nominal	1-digit	2-digit	3-digit		4-digit	
Year	Auctions	Plates	Sold	Unsold	Sales (HKD$)	special	special	special	ordinary	special	ordinary
1997	23	2388	2258	130	$72,000,000	3.02%	6.20%	4.98%	37.44%	7.24%	37.44%
1998	27	2605	2358	247	$54,500,000	2.42%	7.37%	5.68%	37.85%	7.18%	37.85%
1999	28	2487	2158	329	$47,500,000	3.10%	6.88%	5.75%	39.20%	6.84%	39.20%
2000	31	3518	3152	366	$68,100,000	2.42%	4.55%	4.78%	40.62%	6.05%	40.62%
2001	32	3795	3275	520	$62,800,000	3.03%	6.64%	6.56%	38.55%	5.96%	38.55%
2002	27	3100	2679	421	$51,600,000	3.03%	8.26%	6.39%	36.81%	5.84%	36.81%
2003	31	6885	5893	992	$89,500,000	2.88%	7.61%	6.51%	36.85%	6.30%	36.85%
2004	17	3517	3026	491	$47,900,000	1.93%	12.68%	6.48%	37.56%	6.28%	37.56%
2005	19	4355	3846	509	$64,300,000	1.79%	12.01%	6.41%	35.94%	5.26%	35.94%
2006	20	4615	4088	527	$53,800,000	1.73%	9.71%	6.59%	38.70%	5.66%	38.70%
2007	15	3705	3345	360	$50,500,000	1.67%	8.77%	5.34%	39.30%	4.83%	39.30%
2008	21	5428	4776	652	$94,500,000	1.68%	10.17%	6.74%	36.57%	6.06%	36.57%
2009*	1	280	215	65	$2,649,000	1.79%	13.57%	8.93%	30.36%	7.86%	30.36%
Total	292	46678	41069	5609	$759,649,000	2.33%	8.64%	6.15%	37.75%	6.05%	37.75%

* 2009 is up to January only.

Table 3: Average real prices by year and types of plate, in $HKD (base year is Oct 2004 - Sep 2005)

		Breakdown by plate types							
		All types		1-digit	2-digit	3-digit		4-digit	
YEAR	All	Special	Ordinary	Special	Special	Special	Ordinary	Special	Ordinary
1997	$28,220	$90,339	$12,197	$172,220	$114,172	$60,585	$17,241	$48,535	$7,270
1998	$19,876	$63,860	$9,159	$168,733	$49,739	$54,048	$12,311	$48,794	$5,857
1999	$19,697	$69,121	$9,133	$161,301	$49,284	$58,776	$13,271	$48,141	$4,418
2000	$20,119	$87,962	$8,879	$157,339	$113,109	$62,634	$11,634	$48,379	$5,965
2001	$18,145	$74,226	$7,849	$153,095	$54,906	$77,518	$10,868	$39,454	$4,634
2002	$18,800	$61,134	$10,001	$130,508	$60,569	$45,152	$14,321	$34,654	$5,555
2003	$15,220	$53,922	$6,644	$108,158	$40,429	$51,562	$8,787	$35,549	$4,437
2004	$15,925	$47,903	$6,883	$117,762	$43,595	$39,339	$9,032	$38,787	$4,348
2005	$16,685	$50,180	$7,110	$117,305	$44,029	$45,133	$9,562	$43,930	$4,532
2006	$12,860	$37,670	$6,415	$100,443	$28,645	$29,918	$8,512	$41,481	$3,945
2007	$14,433	$47,654	$6,860	$114,604	$41,339	$37,448	$8,393	$42,943	$5,156
2008	$18,210	$69,139	$5,812	$96,600	$80,600	$52,702	$7,127	$54,729	$4,448
All years	$17,530	$59,827	$7,688	$130,135	$54,591	$49,492	$10,275	$43,785	$4,914

Table 4: Definitions of independent variables

Variables	Descriptions	Dummy?	Examples
Letter prefix characteristics			
sameletter	same letter prefix	Y	AA 345, JJ 7
noletter	no letter prefix	Y	18, 3445
hk	the letter prefix is "HK"	Y	HK 80, HK 71
xx	the letter prefix is "XX"	Y	XX 73, XX 167
Number patterns			
n911	"the" classic Porsche model	Y	LB 911, DR 911
n100x	multiple of 100	Y	XX 700, JB 300
n1000x	multiple of 1000	Y	JK 2000, ME 4000
symmetric	symmetric sequence	Y	MB 373, AK 1441
aabb	2 pairs in parallel	Y	MB 3344, LL 4466
abab	2 pairs in mix	Y	MB 3534, LL 4646
aaab	3 of a kind at the front	Y	AJ 1113, LA 7779
abbb	3 of a kind at the end	Y	AJ 1333, LA 7999
aaba	3 of a kind on the side I	Y	AG 1131, LE 7797
abaa	3 of a kind on the side II	Y	AG 1311, LE 7977
aab	1 pair at the front	Y	NN 660, EL 773
abb	1 pair at the end	Y	NN 677, EL 144
abcd	sequential sequence	Y	AA 1234, HB 567
dcba	reverse sequential	Y	AA 4321, HB 765
aa	2 of a kind	Y	BB 22, AL 66
aaa	3 of a kind	Y	BB 222, AL 666
aaaa	4 of a kind	Y	BB 2222, AL 6666
n13	"13", "131", "113" and "1313"	Y	HK 13, AL 113
Number counts			
num1	the count of number "1"	N	
num2	the count of number "2"	N	
num3	the count of number "3"	N	
num4	the count of number "4"	N	
num5	the count of number "5"	N	
num6	the count of number "6"	N	
num7	the count of number "7"	N	
num8	the count of number "8"	N	
num9	the count of number "9"	N	
num0	the count of number "0"	N	
Ordered combinations			
numxyz	whether the 3 numbers are ordered in "x", "y", "z" pattern	Y	

Table 5: Regressions of superstitions on winning bids by types of plate. Dependent variable: natural log of Winning bids, 1997-2008.

	4 ordinary	3 ordinary	4 special	3 special	2 special	1 special
sameletter	0.635***	0.749***	0.795***	0.869***	0.884***	0.955***
	[0.0258]	[0.0286]	[0.0445]	[0.0401]	[0.0463]	[0.0876]
noletter	–	–	3.475***	3.803***	4.569***	no obs
			[0.0717]	[0.125]	[0.449]	
hk	2.563***	2.405***	1.895***	2.209***	2.157***	no obs
	[0.108]	[0.0736]	[0.159]	[0.213]	[0.153]	
xx	1.900***	1.575***	1.077***	1.192***	1.023***	0.619*
	[0.0709]	[0.0671]	[0.142]	[0.138]	[0.153]	[0.325]
n911	–	0.894***	–	–	–	–
		[0.0520]				
n100x	–	–	-0.231***	0.674***	–	–
			[0.0817]	[0.198]		
n1000x	–	–	0.665**	–	–	–
			[0.274]			
symmetric	–	–	1.004***	0.530***	–	–
			[0.0804]	[0.131]		
aabb	–	–	1.319***	–	–	–
			[0.0737]			
abab	–	–	1.085***	–	–	–
			[0.0780]			
aaab	0.749***	–	0.719***	–	–	–
	[0.0225]		[0.218]			
abbb	0.801***	–	0.485**	–	–	–
	[0.0222]		[0.233]			
aaba	0.289***	–	0.245	–	–	–
	[0.0247]		[0.172]			
abaa	0.330***	–	0.506***	–	–	–
	[0.0271]		[0.158]			
aab	–	0.530***	–	0.505***	–	–
		[0.0164]		[0.117]		
abb	–	0.424***	–	0.324**	–	–
		[0.0162]		[0.137]		
abcd	–	–	1.014***	1.120***	–	–
			[0.140]	[0.136]		
dcba	0.0859	0.207***	–	–	–	–
	[0.145]	[0.0494]				
aa	–	–	–	–	0.731***	
					[0.0265]	
aaa	–	–	–	1.942***	–	–
				[0.136]		
aaaa	–	–	2.416***	–	–	–
			[0.0862]			
n13	–	0.221***	0.706***	-0.337***	0.0192	–
		[0.0558]	[0.240]	[0.0956]	[0.0678]	
num1	0.332***	0.469***	0.0580**	0.0935***	0.317***	1.481***
	[0.0131]	[0.0131]	[0.0259]	[0.0221]	[0.0279]	[0.0697]
num2	0.321***	0.427***	0.128***	0.101***	0.244***	0.293***
	[0.0131]	[0.0136]	[0.0302]	[0.0217]	[0.0295]	[0.0610]
num3	0.325***	0.554***	0.206***	0.189***	0.300***	0.453***
	[0.0136]	[0.0144]	[0.0278]	[0.0212]	[0.0293]	[0.0625]
num4	-0.110***	-0.273***	-0.156***	-0.209***	-0.345***	-0.832***
	[0.0191]	[0.0220]	[0.0592]	[0.0484]	[0.0510]	[0.0740]
num5	-0.125***	-0.195***	-0.0312	-0.149***	-0.149***	-0.157**
	[0.0195]	[0.0181]	[0.0386]	[0.0251]	[0.0337]	[0.0633]
num6	0.292***	0.365***	0.0685**	-0.0163	0.127***	0.0762
	[0.0147]	[0.0147]	[0.0312]	[0.0254]	[0.0280]	[0.0574]
num8	0.635***	0.948***	0.365***	0.382***	0.655***	0.809***
	[0.0126]	[0.0164]	[0.0288]	[0.0218]	[0.0315]	[0.0584]
num9	0.215***	0.294***	0.0351	0.0733***	0.105***	0.278***
	[0.0140]	[0.0136]	[0.0298]	[0.0233]	[0.0278]	[0.0614]
num0	0.124***	0.300***	0.181***	0.232***	0.205***	
	[0.0152]	[0.0161]	[0.0347]	[0.0471]	[0.0412]	
Constant	6.462***	7.234***	7.532***	8.151***	9.417***	11.09***
	[0.0429]	[0.0321]	[0.119]	[0.137]	[0.0463]	[0.0426]
Year-month fixed effect	Y	Y	Y	Y	Y	Y
Observations	15993	17149	1809	1937	3042	924
R-squared	0.461	0.559	0.843	0.858	0.681	0.78

Note: Robust standard errors in brackets (clustered by auction date).
Key: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, – not applicable, no obs no observation.

Table 6: Regressions of superstitions on winning bids, holding constant the number combinations. Dependent variable: natural log of Winning bids, 1997-2008.

	168-Model		138-Model		148-Model		238-Model
sameletter	0.890***	sameletter	0.622***	sameletter	0.592***	sameletter	0.857***
	[0.174]		[0.106]		[0.150]		[0.124]
hk	2.330***	hk	2.478***	hk	no obs	hk	1.940***
	[0.528]		[0.0558]				[0.0664]
xx	0.816***	xx	1.740***	xx	no obs	xx	0.940***
	[0.177]		[0.132]				[0.164]
num168	2.730***	num138	1.991***	num148	2.702***	num238	0.630***
	[0.164]		[0.140]		[0.292]		[0.146]
num186	0.367*	num183	0.745***	num184	0.880***	num283	(dropped)
	[0.218]		[0.186]		[0.312]		
num618	0.921***	num318	0.924***	num418	1.397***	num328	1.303***
	[0.166]		[0.131]		[0.305]		[0.154]
num681	-0.193	num381	(dropped)	num481	0.663	num382	0.29
	[0.323]				[0.647]		[0.367]
num816	0.379**	num813	0.728***	num814	1.798***	num823	0.075
	[0.184]		[0.134]		[0.271]		[0.154]
num861	(dropped)	num831	0.106	num841	(dropped)	num832	-0.0371
			[0.153]				[0.165]
Constant	8.296***	Constant	8.384***	Constant	6.662***	Constant	9.117***
	[0.144]		[0.124]		[0.266]		[0.136]
Year-month	Y	Year-month	Y	Year-month	Y	Year-month	Y
fixed effect		fixed effect		fixed effect		fixed effect	
Observations	339	Observations	350	Observations	185	Observations	312
R-squared	0.927	R-squared	0.873	R-squared	0.868	R-squared	0.893

Note: Robust standard errors in brackets (clustered by auction date).
Key: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, – not applicable, no obs no observation.

Table 7: Regressions of superstitions on winning bids by types of plate, pre- and post- 2006. Dependent variable: natural log of Winning bids, 1997-2008.

	non 4 pre	non 4 pre	spe 4 pre	spe 4 pre	non 3 pre	non 3 pre	spe 3 pre	spe 3 pre	spe 2 pre	spe 2 pre	spe 1 pre	spe 1 pre
sameletter	0.632***	0.631***	0.814***	0.629***	0.728***	0.928***	0.802***	1.022***	0.786***	1.054***	0.936***	0.948***
	[0.0315]	[0.0459]	[0.0365]	[0.0385]	[0.0527]	[0.0762]	[0.0531]	[0.0565]	[0.0529]	[0.0798]	[0.0929]	[0.240]
noletter	–	–	–	–	3.358***	3.831***	3.607***	4.451***	4.102***	5.930***	no obs	no obs
					[0.0724]	[0.113]	[0.122]	[0.205]	[0.422]	[0.386]		
hk	2.452***	3.055***	2.294***	3.031***	1.708***	2.356***	2.004***	2.564***	1.877***	2.632***	no obs	no obs
	[0.114]	[0.233]	[0.0718]	[0.175]	[0.194]	[0.165]	[0.282]	[0.230]	[0.152]	[0.262]		
xx	1.922***	1.870***	1.469***	1.900***	0.927***	1.451***	1.090***	1.373***	0.733***	1.283***	0.822**	0.460**
	[0.0960]	[0.0826]	[0.0796]	[0.100]	[0.196]	[0.185]	[0.166]	[0.126]	[0.167]	[0.200]	[0.368]	[0.230]
n911	–	–	0.869***	0.961***	–	–	–	–	–	–	–	–
			[0.0601]	[0.105]								
n100x	–	–	–	–	-0.239***	-0.0736	0.550**	1.059***	–	–	–	–
					[0.0905]	[0.129]	[0.212]	[0.342]				
n1000x	–	–	–	–	1.082***	0.411*	–	–	–	–	–	–
					[0.259]	[0.236]						
symmetric	–	–	–	–	1.064***	0.979***	0.541***	0.689***	–	–	–	–
					[0.0845]	[0.136]	[0.132]	[0.215]				
aabb	–	–	–	–	1.389***	1.209***	–	–	–	–	–	–
					[0.0823]	[0.115]						
abab	–	–	–	–	1.173***	0.962***	–	–	–	–	–	–
					[0.0826]	[0.131]						
aaab	0.767***	0.712***	–	–	0.669***	0.639	–	–	–	–	–	–
	[0.0283]	[0.0368]			[0.239]	[0.401]						
abbb	0.868***	0.708***	–	–	0.184	0.532**	–	–	–	–	–	–
	[0.0286]	[0.0291]			[0.209]	[0.211]						
aaba	0.321***	0.226***	–	–	0.353*	-0.0567	–	–	–	–	–	–
	[0.0326]	[0.0368]			[0.186]	[0.333]						
abaa	0.386***	0.228***	–	–	0.583***	0.835***	–	–	–	–	–	–
	[0.0357]	[0.0359]			[0.147]	[0.158]						
aab	–	–	0.574***	0.441***	–	–	0.402***	0.329**	–	–	–	–
			[0.0201]	[0.0249]			[0.139]	[0.143]				
abb	–	–	0.431***	0.399***	–	–	0.321**	0.241	–	–	–	–
			[0.0199]	[0.0293]			[0.147]	[0.220]				
abcd	–	–	–	–	1.018***	0.985***	1.039***	1.439***	–	–	–	–
					[0.154]	[0.212]	[0.146]	[0.221]				
dcba	0.0492	0.0952	0.246***	0.127	–	–	–	–	–	–	–	–
	[0.158]	[0.227]	[0.0606]	[0.0809]								
aa	–	–	–	–	–	–	–	–	0.665***	0.862***	–	–
									[0.0277]	[0.0490]		
aaa	–	–	–	–	–	–	1.864***	2.315***	–	–	–	–
							[0.139]	[0.222]				
aaaa	–	–	–	–	2.469***	2.318***	–	–	–	–	–	–
					[0.0916]	[0.133]						
n13	–	–	0.142**	0.411***	0.798***	-0.313*	-0.457***	-0.151	-0.0577	0.109	–	–
			[0.0671]	[0.0974]	[0.149]	[0.171]	[0.122]	[0.148]	[0.0888]	[0.0972]		
num1	0.340***	0.314***	0.481***	0.446***	0.0748**	-0.00889	0.0886***	0.130***	0.297***	0.349***	1.541***	1.326***
	[0.0163]	[0.0185]	[0.0165]	[0.0209]	[0.0316]	[0.0426]	[0.0274]	[0.0346]	[0.0338]	[0.0484]	[0.0770]	[0.147]
num2	0.333***	0.297***	0.439***	0.406***	0.156***	0.00313	0.131***	0.0399	0.197***	0.310***	0.340***	0.185
	[0.0162]	[0.0185]	[0.0168]	[0.0216]	[0.0353]	[0.0510]	[0.0248]	[0.0423]	[0.0374]	[0.0447]	[0.0673]	[0.165]
num3	0.337***	0.310***	0.565***	0.525***	0.236***	0.114***	0.205***	0.133***	0.265***	0.375***	0.590***	-0.0146
	[0.0167]	[0.0214]	[0.0183]	[0.0209]	[0.0326]	[0.0405]	[0.0262]	[0.0362]	[0.0360]	[0.0485]	[0.0661]	[0.125]
num4	-0.130***	-0.0468	-0.359***	-0.104***	-0.221***	-0.00554	-0.250***	-0.124	-0.384***	-0.252***	-0.708***	-1.169***
	[0.0221]	[0.0363]	[0.0241]	[0.0350]	[0.0708]	[0.0959]	[0.0573]	[0.0850]	[0.0828]	[0.0539]	[0.0821]	[0.133]
num5	-0.123***	-0.126***	-0.221***	-0.129***	-0.0172	-0.0952*	-0.185***	-0.0961**	-0.131***	-0.216***	-0.0994	-0.365**
	[0.0234]	[0.0322]	[0.0223]	[0.0266]	[0.0484]	[0.0560]	[0.0301]	[0.0451]	[0.0407]	[0.0621]	[0.0695]	[0.145]
num6	0.287***	0.307***	0.381***	0.336***	0.0686*	0.035	-0.0233	-0.0175	0.0803**	0.204***	0.201***	-0.351***
	[0.0182]	[0.0220]	[0.0178]	[0.0245]	[0.0393]	[0.0495]	[0.0290]	[0.0493]	[0.0327]	[0.0488]	[0.0622]	[0.121]
num8	0.648***	0.614***	0.989***	0.870***	0.388***	0.292***	0.394***	0.342***	0.598***	0.737***	0.884***	0.571***
	[0.0159]	[0.0174]	[0.0197]	[0.0254]	[0.0330]	[0.0525]	[0.0260]	[0.0390]	[0.0385]	[0.0533]	[0.0663]	[0.120]
num9	0.209***	0.235***	0.280***	0.325***	0.0285	0.0407	0.0696**	0.0699*	0.0516	0.177***	0.317***	0.173
	[0.0166]	[0.0252]	[0.0167]	[0.0213]	[0.0346]	[0.0556]	[0.0314]	[0.0355]	[0.0354]	[0.0395]	[0.0680]	[0.139]
num0	0.108***	0.172***	0.319***	0.266***	0.204***	0.0747	0.265***	0.214***	0.104**	0.362***	–	–
	[0.0183]	[0.0252]	[0.0198]	[0.0254]	[0.0417]	[0.0517]	[0.0611]	[0.0720]	[0.0475]	[0.0623]		
Constant	6.484***	6.389***	7.262***	7.151***	7.537***	7.549***	8.338***	7.603***	9.670***	8.984***	11.05***	11.20***
	[0.0525]	[0.0630]	[0.0400]	[0.0504]	[0.140]	[0.175]	[0.137]	[0.225]	[0.0576]	[0.0684]	[0.0469]	[0.0850]
Year-month fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	11328	4665	12004	5145	1312	497	1304	633	1974	1068	723	201
R-squared	0.449	0.506	0.564	0.551	0.848	0.866	0.859	0.866	0.668	0.673	0.786	0.774
Wald test ∨	$F(2, 281) = 6.54$		$F(2, 280) = 34.40$		$F(2, 284) = 2.87$		$F(2, 280) = 1.00$		$F(2, 284) = 0.78$		$F(2, 266) = 2.25$	
	Prob > $F = 0.0017$		Prob > $F = 0.0000$		Prob > $F = 0.0585$		Prob > $F = 0.3701$		Prob > $F = 0.4591$		Prob > $F = 0.1069$	

Note: Robust standard errors in brackets (clustered by auction date). Key: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, – not applicable, no obs no observation.
∨ Hypothesis: whether coefficients of num4 and num8 differ signficantly between pre- and post-2006 estimations

Table 8: Regressions of superstitions on winning bids by types of plate, with Hong Kong Hang Seng Index. Dependent variable: natural log of Winning bids, 1997-2008.

	4 ordinary	3 ordinary	4 special	3 special	2 special	1 special
sameletter	0.634***	0.750***	0.794***	0.877***	0.878***	0.943***
	[0.0259]	[0.0282]	[0.0446]	[0.0404]	[0.0458]	[0.0869]
noletter	–	–	3.465***	3.810***	4.561***	no obs
			[0.0668]	[0.119]	[0.446]	
hk	2.559***	2.402***	1.884***	2.221***	2.150***	no obs
	[0.107]	[0.0737]	[0.151]	[0.203]	[0.152]	
xx	1.908***	1.580***	1.072***	1.152***	1.022***	0.668**
	[0.0717]	[0.0683]	[0.152]	[0.139]	[0.153]	[0.311]
n911	–	0.898***	–	–	–	–
		[0.0522]				
n100x	–	–	-0.244***	0.691***	–	–
			[0.0802]	[0.189]		
n1000x	–	–	0.681**	–	–	–
			[0.275]			
symmetric	–	–	0.995***	0.534***	–	–
			[0.0764]	[0.125]		
aabb	–	–	1.293***	–	–	–
			[0.0719]			
abab	–	–	1.072***	–	–	–
			[0.0745]			
aaab	0.750***	–	0.706***	–	–	–
	[0.0226]		[0.228]			
abbb	0.803***	–	0.461**	–	–	–
	[0.0220]		[0.230]			
aaba	0.289***	–	0.225	–	–	–
	[0.0247]		[0.169]			
abaa	0.330***	–	0.513***	–	–	–
	[0.0271]		[0.120]			
aab	–	0.531***	–	0.461***	–	–
		[0.0163]		[0.111]		
abb	–	0.421***	–	0.305**	–	–
		[0.0162]		[0.130]		
abcd	–	–	1.040***	1.117***	–	–
			[0.141]	[0.131]		
dcba	0.0831	0.204***	–	–	–	–
	[0.137]	[0.0497]				
aa	–	–	–	–	0.727***	–
					[0.0263]	
aaa	–	–	–	1.947***	–	–
				[0.130]		
aaaa	–	–	2.357***	–	–	–
			[0.0812]			
n13	–	0.220***	0.684***	-0.343***	0.0175	–
		[0.0559]	[0.232]	[0.0958]	[0.0688]	
num1	0.398	0.628*	1.371*	0.803	0.143	5.657**
	[0.347]	[0.362]	[0.810]	[0.606]	[1.070]	[2.193]
num2	0.421	0.849**	1.886*	1.510**	-0.869	3.262*
	[0.354]	[0.384]	[0.961]	[0.676]	[0.997]	[1.895]
num3	0.246	0.473	1.091	0.977	-1.075	5.783***
	[0.358]	[0.403]	[0.890]	[0.624]	[1.004]	[1.736]
num4	-1.977***	-3.826***	-3.728**	-2.720**	-1.581	5.072**
	[0.495]	[0.510]	[1.655]	[1.377]	[1.536]	[2.187]
num5	0.0537	-1.643***	-0.97	-1.801**	0.648	1.701
	[0.612]	[0.495]	[1.263]	[0.761]	[1.311]	[2.078]
num6	-0.257	0.0745	-0.0555	-0.465	-1.168	5.842***
	[0.383]	[0.381]	[0.990]	[0.885]	[1.030]	[1.763]
num8	0.756**	2.008***	1.813*	1.548**	-0.453	3.374*
	[0.334]	[0.454]	[0.994]	[0.687]	[1.063]	[1.849]
num9	-0.474	-0.679*	-0.444	0.23	-1.740**	1.644
	[0.370]	[0.403]	[0.897]	[0.718]	[0.847]	[2.098]
num0	-1.026**	0.643	1.519*	0.666	-1.984	–
	[0.412]	[0.451]	[0.864]	[0.805]	[1.323]	
num1 * ln(hsi)	-0.00694	-0.0166	-0.138	-0.0739	0.0178	-0.440*
	[0.0361]	[0.0378]	[0.0844]	[0.0629]	[0.112]	[0.231]
num2 * ln(hsi)	-0.0105	-0.0441	-0.185*	-0.147**	0.116	-0.313
	[0.0370]	[0.0401]	[0.100]	[0.0710]	[0.104]	[0.201]
num3 * ln(hsi)	0.00841	0.00842	-0.0932	-0.0825	0.143	-0.561***
	[0.0373]	[0.0420]	[0.0929]	[0.0654]	[0.105]	[0.184]
num4 * ln(hsi)	0.196***	0.371***	0.371**	0.264*	0.128	-0.619***
	[0.0521]	[0.0532]	[0.172]	[0.143]	[0.158]	[0.231]
num5 * ln(hsi)	-0.0188	0.152***	0.0985	0.174**	-0.0838	-0.197
	[0.0641]	[0.0515]	[0.131]	[0.0794]	[0.137]	[0.220]
num6 * ln(hsi)	0.0576	0.0306	0.0127	0.0468	0.135	-0.607***
	[0.0399]	[0.0396]	[0.103]	[0.0929]	[0.108]	[0.185]
num8 * ln(hsi)	-0.0125	-0.111**	-0.152	-0.122*	0.115	-0.27
	[0.0347]	[0.0474]	[0.104]	[0.0717]	[0.112]	[0.194]
num9 * ln(hsi)	0.0722*	0.102**	0.0501	-0.0163	0.192**	-0.143
	[0.0389]	[0.0422]	[0.0938]	[0.0745]	[0.0885]	[0.222]
num0 * ln(hsi)	0.121***	-0.0356	-0.141	-0.0454	0.228	–
	[0.0432]	[0.0472]	[0.0900]	[0.0826]	[0.138]	
Constant	6.459***	7.232***	7.567***	8.142***	9.426***	11.09***
	[0.0422]	[0.0321]	[0.118]	[0.131]	[0.0454]	[0.0420]
Year-month fixed effect	Y	Y	Y	Y	Y	Y
Observations	15993	17149	1809	1937	3042	924
R-squared	0.463	0.562	0.847	0.861	0.683	0.786

Note: Robust standard errors in brackets (clustered by auction date).
Key: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, – not applicable, no obs no observation.