Superstition Everywhere*

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Abstract

In Chinese culture, digit 8 (4) is taken as lucky (unlucky). We find that the numerological superstition has a profound impact across China's stock, bond, foreign exchange and commodities markets, affecting asset prices in both the primary and secondary markets. The superstition effect, i.e., the probability of asset price ending with a lucky (unlucky) digit far exceeds (falls short of) what would be expected by chance, is prevalent. The effect is driven by investors' reliance on superstition as an anchor to face uncertainty in asset pricing and the overoptimism of unsophisticated investors. While the superstition effect does not lead to systemic mispricing for assets traded by sophisticated investors, it implies overpricing for assets involving more unsophisticated investors.

Keywords: superstition, anchoring, uncertainty, overoptimism, overpricing, stock, bond, exchange rate, commodity, China

JEL: G12, G40, G41, Z12, Z13

1. Introduction

Superstition has existed since the dawn of human civilization. Divination and sacrificial offering were widely practiced before important events across ancient civilizations. Even today, superstition, as a cultural heritage, remains prevalent in many countries. For instance, in Western culture, since the number 13 is considered unlucky, Formula 1 auto racing bans the number 13 in its entry list for cars (Saward 2009). Kolb and Rodriguez (1987) discuss the stock return on unlucky days, such as Friday the 13th. In Chinese culture, the number 8 is widely considered lucky because it represents "good fortune" and "longevity," while the number 4 is unlucky because in Chinese it sounds similar to the word "death." For this reason, the opening ceremony of the Beijing 2008 Summer Olympic Games officially started at 8:08 p.m. on August 8, 2008, while many apartment buildings avoid floors 4, 14, etc. (Kramer and Block 2008). Even in other Asian countries, which have been significantly influenced by the Chinese culture, there are similar numerological superstition. For instance, Agarwal et al. (2014) find that lucky-numbered housing units and floors enjoy a price premium in Singapore. Given the importance of superstition as a global cultural phenomenon, its existence and impact in financial markets deserve careful examination.

Taking advantage of China's unique numerological superstition culture, we have examined stock and bond prices in both primary and secondary markets. According to the Chinese customer, the last nonzero digit in a price would be taken as the last digit. For instance, although the stock and bond prices are quoted at the hundredths place, the hundredths digit would be taken as the last digit only if it is nonzero. Otherwise, the tenths digit would be taken as the last digit. In this study, we primarily focus on the probability of 8 and 4 at the hundredths digit conditional on the hundredths digit being the last digit for stock and bond prices[1]. We focus on the If an asset price with the last digit being 8 (4), it would be referred to as lucky (unlucky) price. We find that for stocks and bonds in both the primary and secondary market, the probability of lucky (unlucky) asset price far exceeds (falls short of) what would be expected by chance. Similar results also hold for foreign exchange rates and commodity prices. We refer to this phenomenon as the superstition effect.

To understand the prevalence of the superstition effect, we propose the uncertainty hypothesis, i.e., the numerological superstition is used by investors to alleviate the uncertainty concern. No matter how sophisticated an investor is, she will always face uncertainty due to the imperfection of information and pricing models. Uncertainty is fundamentally different from risk. Risk could be measured by probability distribution and be treated by statistical methodologies effectively. Uncertainty, however, refers to the ambiguity of the state probability distribution as illustrated by Knight (1921), Keynes

[1] Since the ten thousandths digit is the last digit of quoted foreign exchange rate, we focus on the probabilities of 8 and 4 at the ten thousandths digit conditional on the ten thousandths digit being nonzero for foreign exchange rate. Similarly, we focus on the last digit of quoted commodity prices, and calculate the probability of 8 and 4 at the last digit of the quoted price conditional on that the last digit of the quoted price is nonzero.

(1936) and LeRoy and Singell (1987). Since uncertainty cannot be perfectly resolved by any rational methods, superstition provides an instrument for investors to alleviate the concern of uncertainty. According to the seminal work of Tversky and Kahneman (1974) that people rely on reference points when making decisions under uncertainty, the numerological superstition provides a natural "anchor" for investors when facing uncertainty about asset value. For instance, if rational methods are only capable of suggesting the range of a bond's yield between 5.52% and 5.62%, the numerological superstition makes it easier for buyers and sellers to agree on 5.58%, as digit 8 is taken as a lucky number. There are two natural implications of the hypothesis: First, the superstition effect would be stronger for assets with more uncertain value; second, the superstition effect would be stronger for assets traded more by unsophisticated investors, who are more likely to resort to superstition due to the lack of information and capability.

In addition to the uncertainty hypothesis, we also propose the overoptimism hypothesis to explain the superstition effect. Namely, the superstition effect is associated with the overoptimism of investors. When investors are overoptimistic about certain asset, they are more likely to resort to the numerological superstition for better chance to realize their wishful thinking of the asset. Since the unsophisticated investors are much more likely to subject to overoptimism, the overoptimism hypothesis mainly applies to the superstition effect in assets involving more unsophisticated investors. The two hypothesis are not mutually exclusive. For assets involving unsophisticated investors both the uncertainty and overoptimism hypothesis could drive the superstition effect.

Does the superstition effect imply mispricing? We propose two hypothesis. The first is the anchoring hypothesis, which is a natural implication of the uncertainty hypothesis. Namely, for assets only involving sophisticated investors, the superstition effect would not imply any systemic mispricing. The superstition effect in these assets is driven by the uncertainty hypothesis, where the superstition belief only provides a natural "anchor" for sophisticated investors, but is irrelevant to their pricing prowess. Therefore, the superstition belief would not systemically distort the asset prices.

The second is the overvaluation hypothesis, which is closely linked to the overoptimism hypothesis. We speculate that the superstition effect implies overpricing for assets involving unsophisticated investors. According to the overoptimism hypothesis, the overoptimistic investors are more likely to turn to the numerological superstition. Therefore, it is straightforward that the superstition effect has a close link to overvaluation.

In the following, we will summarize our findings in stock, bond, FX and commodity markets respectively. For each market, we will first introduce the existence of superstition effect. Then we will show evidence in support of the uncertainty and overoptimism hypothesis. Finally, we will discuss the asset pricing implications. Any evidence of the anchoring (overvaluation) hypothesis would also lend support to the uncertainty (overoptimism).

For the stock primary market, we find strong superstition effect in IPO pricing when the IPO price was more flexibly determined by market from January 1, 1995 to July 1, 2014. During this period, the conditional probabilities[2] of the lucky and unlucky price reached 33.20% and 4.63%, which deviate substantially from 1/9, the probability determined by chance. In fact, we even find evidence of superstition effect on the tenths digit in the subsample with the tenths place being the last digit. The probabilities of the tenths place being 8 and 4, conditional on that the tenths place is the last digit, are 23.04% and 6.21%, significantly different than 1/9. The magnitude of the superstition effect in both the hundredths and tenths digit increase with P/E ratio, lending support to the overoptimism hypothesis. The superstition effect disappeared immediately after July 1, 2014, when strict IPO price control was established and the market no longer determined IPO price.

The superstition effect exists in the seasoned equity offering (SEO) pricing as well. Given the fact that private equity placement (PEP) is the dominant form of SEO in China[3], we focus on PEP in this paper and find that the conditional probabilities of lucky and unlucky price reach 13.71% and 8.26%, both significantly different from 1/9. The superstition effect in SEO is weaker than that in IPO, which is consistent with the uncertainty hypothesis in that the SEO firms are less uncertain and the participants of SEO are more sophisticated. In contrast to the IPO, there is no significant variation of the superstition effect across different P/E group, indicating that the overoptimism hypothesis cannot explain the superstition effect in SEO, which is consistent with the fact that the participants of SEO are mainly sophisticated investors.

Furthermore, we find evidence supporting overvaluation hypothesis for IPO pricing and anchoring hypothesis for SEO pricing. More specifically, we find that firms with lucky IPO prices generate an abnormal return of -15% during the three years post IPO after controlling for other risk factors in a Fama-MacBeth framework. In contrast, there is no similar cross-sectional return predictability of lucky price in SEO. We do not find any evidence of mispricing for SEO with lucky price.

In addition to the primary market, we have also explored the stock secondary market. In particular, we have examined the stock open and close prices as they are the two most important benchmark secondary market prices. In China, while the stock open prices have always been determined by batched call auction in our sample period, the mechanism of the close price formation has changed over time[4]. When open and close prices are determined by batched auction, if investors are more (less) likely to bid for lucky (unlucky) prices, the probability of lucky open and close prices should be higher than otherwise

[2] In this paper, the conditional probability of a certain number refers to the probability of the number at the hundredths place conditional on the hundredths place as the last digit.

[3] There are only 230 public SEO from January 1st, 1998 to March 31st, 2021, as compared to 4,752 PEP in the same period.

[4] The call auction has been adopted for determining the close price since July 1st, 2006 for stocks traded in the SZSE and August 20th, 2018 for stocks traded in the SSE. The close price call auction starts at 14:57 pm and ends at 15:00 pm with the mechanism exactly the same as the open price call auction. Prior to the introduction of call auction, the closing price is determined as the volume weighted average of transaction stock prices within the last one-minute time interval before market is closed for the day for both exchanges.

purely determined by chance. We indeed find robust superstition effect for both the open and close prices, when determined by batched call auction. More specifically, the conditional probability of lucky (unlucky) open price is 13.59% (8.56%) and the conditional probability of lucky (unlucky) close price reaches 12.42% (9.93%), all significantly larger (smaller) than 1/9. As a placebo test, we find no similar superstition effect for close prices, which are determined by the value weighted average transaction prices during the last minute before the final transaction.

To explore the mechanism of the superstition effect in the secondary market, we directly examine the uncertainty and overoptimism hypothesis in a panel data regression framework. The dependent variables are the probabilities of lucky and unlucky open (close) price for each firm-year observation. The independent variables of our primary interest are the stock uncertainty measure constructed by Brenner and Izhakian (2018), and the book-to-market ratio, which proxies for investor overoptimism. We find that there is significant positive (negative) correlation between the probability of lucky (unlucky) price and the stock uncertainty after controlling for stock risk measures and other characteristics. These results are consistent with the uncertainty hypothesis. Meanwhile, we also find strong negative (positive) correlation between the probability of lucky (unlucky) price and the book-to-market ratio, which supports the overoptimism hypothesis. All these results hold for both open price and close price determined by call auction. As a placebo test, we do not find similar significant results for close prices determined by weighted average.

We examine the asset pricing implications of superstition in the secondary market by constructing long-short portfolios. More specifically, we calculate the frequency difference between the lucky and unlucky close price during the past month for each stock[5]. We then sort stocks into quintiles based on the frequency difference and goes long stocks in the quintile with the smallest frequency difference and sells short stocks in the quintile with the largest frequency difference. The long-short portfolio is held for a month before a new portfolio is constructed. The strategy can generate an abnormal return of 0.5% per month among small stocks, when the close prices are determined by batched auction. According to our overoptimism hypothesis, the frequency difference between the lucky and unlucky close price indicates the extent of overoptimism for small stocks, which involve more individual investors. The higher frequency difference implies larger overvaluation for the underlying stock in the past month, and therefore stronger price reversal in the following month. The cross-sectional return predictability of the frequency difference lends strong support on the overvaluation hypothesis for small stocks. In comparison, the long-short strategy does not generate any significant result for large stocks, which are traded more by sophisticated institutional investors. The insignificant result is consistent with the anchoring hypothesis for large stocks. As a placebo test, we repeat the same long-short strategy for stocks with close prices determined by the weighted average transaction prices and find no significant results at all.

[5] For robustness, we have tried different forming period ranges from one day to one month.

In addition to stock market, we also examine China's bond market, which is the second largest in the world and only after the USA. Based on the issuer type, we divide the bonds into the following six categories: Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Bonds, public Non-Financial Corporate (public NFC) Bonds and private placement Non-Financial Corporate (private NFC) Bonds[6]. Among these bonds, the Treasury and National Policy Bank Bonds are sovereign bonds without any default risk. The Local Government Bonds are generally taken as risk-free as they are widely believed to have the implicit guarantee from the central government and have never defaulted. In contrast, the Financial Bonds, public and private NFC Bonds all bear credit risk. Among them, the Financial Bonds have the lowest default risk, since they are issued by banks and large financial institutions, which are under rigorous regulation of the People's Bank of China and China Banking and Insurance Regulatory Commission. The lucky and unlucky prices in bond market are defined the same as in stock market, except that the price quotation is on coupon rate in primary market, but on clean price in the secondary market.

In the bond primary market, the issuance coupon rates are determined by auctions except for private NFC bonds, which are determined through negotiation between issuer and targeted investors. In the single price auction[7], if the investors are subject to the numerological superstition, they would be more (less) willing to bid for lucky (unlucky) rates, which would lead to higher (lower) probability of lucky (unlucky) coupon rate than what would be determined by chance.

We find no significant price superstition effect for risk free bonds, including Treasury Bonds, National Policy Bank Bonds and Local Government Bonds, but significant superstition effect for bonds with credit risk, such as Financial Bonds, public and private NFC Bonds. The conditional probabilities of bonds with lucky (unlucky) coupon rates for Treasury, National Policy Bank, Local Government, Financial Institution, public NFC and private NFC Bonds are 9.94% (10.80%), 10.89% (10.89%), 11.86% (10.44%), 17.56% (7.14%), 20.34% (7.41%) and 24.18% (5.23%), respectively. These findings are consistent with the uncertainty hypothesis in the sense that due to the lack of credit default risk, the risk free bonds bear minimal uncertainty as compared to those bonds with default risk.[8] Similarly, we also discover that bonds with lower credit rating have stronger superstition effect in each bond category.

In addition, among all these credit bonds, the superstition effect exists in both the interbank and exchange markets with the effect stronger for bonds issued in the exchange market. For instance, the probabilities of lucky (unlucky) coupon rate in the exchange and

[6] The issuance of private NFC Bonds is subject to much less regulation and looser information disclosure requirement than that of public NFC Bonds. They are issued targeting a small group of sophisticated investors, who cannot trade these bonds in the bond markets publically, but only among themselves.
[7] In Chinese market, bond auctions take single price auction, except for Treasury Bonds with maturities less or equal to 10 years, which take hybrid auction.
[8] The investors of these risk free bonds in primary market are predominantly banks, which will hold the bonds to maturity.

interbank market are 22.25% (6.83%) and 16.52% (9.42%) for Financial Bonds. This result is consistent with the uncertainty hypothesis as the interbank market is composed of more sophisticate investors than the exchange market.

In order to examine the asset pricing implications of the superstition effect in bond primary market, we regress the issuance yield spread[9] on the lucky coupon dummy, which is equal to one if the coupon rate is lucky, and zero otherwise, after controlling for major bond characteristics and commonly used firm accounting variables. For the public NFC Bonds issued in exchange, we find that bonds with lucky coupon rates have a yield spread of 5.36 bps lower than those without. In comparison, there is no similar significant pricing impact of the lucky number on public NFC Bonds issued in the interbank market. Similarly, for Financial Bonds, while the lucky number is associate with lower issuance yield spread in the exchange market, it is not the case for bonds in the interbank market. All these findings suggest that while the overvaluation hypothesis holds in the exchange market, the anchoring hypothesis applies to the interbank market, where the investors are more sophisticated. It is also worth noting that there is no significant result for private NFC Bonds in either the exchange or interbank market as only the most sophisticated investors participate in the private NFC issuance in both market. The existence of overvaluation in exchange market for public NFC and Financial Bonds also lend support to the overoptimism hypothesis in explaining the strong superstition effect in exchange market.

We then turn our attention to the superstition effect in the secondary bond markets. Our results show significant superstition effect in bond close price for all types of bonds in the exchange market. More specifically, the conditional probabilities of bonds with lucky (unlucky) close price for Treasury, National Policy Bank, Local Government, Financial, public NFC and private NFC Bonds are 13.08% (8.48%), 12.28% (9.58%), 10.76% (8.03%), 12.23% (7.55%), 13.95% (7.46%) and 11.58% (10.75%), respectively. We do not observe similar effect in the interbank market due to the trading mechanism, which does not allow the existence of the superstition effect in close price.

We also examine the superstition effect in the interbank foreign exchange market. We focus on the daily close foreign exchange rate of four major global currencies, including US Dollar, Euro, Japanese Yen and Hong Kong Dollar, against the Chinese Renminbi[10]. These four currencies account for more than 99% of the trading volumes in China's interbank foreign exchange market. Our results show significant superstition effect for all four currencies. More specifically, the probabilities of lucky (unlucky) close exchange rate of the US Dollar, Euro, Japanese Yen and Hong Kong Dollar are 12.52% (9.65%), 12.21% (10.90%), 12.35% (9.41%), and 12.75% (9.58%), respectively.

Finally, we explore the superstition effect in the commodities futures markets by focusing on the daily open and close price of the main contracts. We pool the 29

[9] The issuance yield spread is the difference between the issuance coupon rate and the benchmark bank loan rate of similar maturity.
[10] The open price is guided by the regulator and does not demonstrate any superstition effect.

commodities futures[11] together and find strong superstition effect in the open price and marginal superstition effect in the close price. More specifically, the probabilities of lucky (unlucky) open and close price are 13.72% (8.72%) and 12.09% (11.56%), respectively.

Literature

There has been a couple of studies on superstition in capital markets. Among which, the two most relevant to our work are Hirshleifer, Jian and Zhang (2018) and Bhattacharya et al. (2018). Hirshleifer, Jian and Zhang (2018) find that IPO firms are more likely to have lucky numbers in their listing codes. The Chinese IPO firms with lucky listing codes are traded at a premium and experience inferior post-IPO abnormal returns. Bhattacharya et al. (2018) examine the limit orders of stock index future in Taiwan and find that individual investors submit disproportionately more limit orders ending with digit 8 than at 4. There is no similar effect for institutional investors. Those individual investors subject to numerological superstition tend to lose money because they are not qualified traders as demonstrated by their bad market timing and stale orders.

Our paper differs from the two papers in threefold. First, our work demonstrates the prevalence and significance of numerological superstition effect in asset prices across capital markets. Our paper demonstrates that the effect goes far beyond stock market, and is significant even in markets dominated by sophisticated institutional investors.

Second, we have proposed a unified framework in understanding the superstition effect across asset classes based on the uncertainty and overoptimism hypothesis. While the uncertainty hypothesis holds in all asset markets, the overoptimism hypothesis main applies to markets with significant presence of unsophisticated investors. These two hypothesis are not mutually exclusive and can exist simultaneously in the same market, e.g. the secondary stock market.

Third, we find that the superstition effect has disparate pricing implications across assets. The superstition effect does not lead to any systemic mispricing for assets traded by sophisticated investors, where only the uncertainty hypothesis holds. In contrast, the superstition effect implies overvaluation for assets actively traded by unsophisticated investors due to the overoptimism hypothesis.

This paper also contributes to the literature on ambiguity/uncertainty in financial markets, including Augustin and Izhakian (2020), Brenner and Izhakian (2018), Ju and Miao (2012), Abdellaoui et al. (2011), Bossaerts et al. (2010), Easley and O'Hara (2009), et al. Our findings contribute to the literature by showing how uncertainty would affect investors' trading behavior, i.e., investors use superstition belief as an "anchor" when facing uncertainty.

Finally, our paper contributes to the behavioral finance literature in general. Previous work has provided evidence suggesting that investor's emotion, cultural trait, trust,

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[11] We exclude some commodities because their minimal price quotation unites are not 1, and therefore do not allow certain digits to be the last digit in reported price.

and familiarity all affect investor's judgement and asset pricing (Hirshleifer and Shumway 2003, Edmans et al. 2007, Guiso et al. 2008, Goetzmann et al. 2015, Solnik and Zuo 2017, Baker and Wulger 2006). While our paper is generally consistent with the idea that culture plays a role in financial market, our focus is on numerological superstition. In particular, our paper has shed light on the close connection between superstition and investor overoptimism.

The remainder of the paper is organized as follows. Section 2 introduces the institutional background of China's capital markets. Section 3 describes our data and variable construction. Section 4 and 5 present our main findings in the stock primary and secondary market. Section 6 and 7 analyze the results in bond primary and secondary markets. Section 8 and 9 discuss the foreign exchange and the commodities futures markets. We conclude the paper in Section 10.

2. Institutional Background

2.1. Chinese Stock Market

2.1.1. IPO Pricing

China's domestic stock market, including Shanghai and Shenzhen exchange, is the world's second largest, which recorded 383 new listings for a combined 461 billion yuan ($70.4 billion) in 2020 as compared to New York Stock Exchange's $81.8 billion IPO proceeds in the same period. By the end of 2020, there are 4140 firms listed in China's stock market, with a total market capitalization of 79.72 trillion yuan ($12.2 trillion).

In China, all IPOs are subject to the approval of the Chinese Security Regulatory Committee (CSRC), which also draw rules in regarding to IPO pricing. Before July 1999, IPO pricing followed an online fixed-price method. Under this mechanism, the issue price is set as the product of after-tax earnings per share (EPS) and a Price/Earnings (P/E) ratio. The regulated P/E ratio has a ceiling, which is usually set in reference to the secondary market PE ratio of stocks in the same industry. Starting from July 1999, the CSRC adopted a regulated auction system to replace the old online fixed price method. This system allows underwriters to first set an initial tentative price range in negotiation with the issuer and then submit this price range to the CSRC. After approval, the underwriters can then begin road shows to collect information from investors and determine the final issue price with the issuer.

In Dec. 2004, the CSRC abolished the regulated auction mechanism and switched to a hybrid auction/fixed price mechanism. This new system has two phases—an offline phase and an online phase. In the first (offline) phase, the lead underwriter organizes road shows and conducts book building to set the offer price and allocate the offer shares. During the road show, the underwriter proposes a price range and asks participating institutional investors to submit their bids (price-quantity pairs) for a maximum of 50% of the IPO shares. The institutional investors usually include brokerage firms, mutual funds, qualified foreign institutional investors (QFIIs), insurance companies, trust firms, etc..[12] The underwriter and the firm then set the issue price based on the bidding information and the regulator decreed IPO price ceiling. When there is oversubscription, before November of 2010, both Shanghai and Shenzhen stock exchange allocate shares on a pro-rata basis proportional to bidding volume. Since then, Shenzhen Stock Exchange switched to a lottery system, in which all bids with price above the final offer price enter a lottery and shares are allocated through random drawings. In the second (online) phase, individual investors submit their desired subscription quantities through an online system, based on the issue price determined in the first phase. Retail investors are price taker, who can only accept the price set in the first phase. For more detailed information, please refer to Jagannathan et al. (2015), Gao et al. (2020), and Zhang, Li and Du (2020).

One outstanding characteristic of China's IPO is the existence of IPO price ceiling decreed by CSRC through window guidance. Our sample could be broadly divided into two periods based on the stringency of the price ceiling policy. The first period is from 1996-2013. Although the tightness of the ceiling varied over time, the price ceiling was relatively loose in general. The price ceiling is determined by the product of *Earnings per Share* (EPS) and *Price/Earnings* (P/E) ratio. Before 2005, the P/E ceiling policy was changed constantly varying from nonexistence to 15. After 2005, the policy became relatively stable. From January 2005 to September 2008, the ceiling was kept at 30[13]. Then the P/E ceiling had been completely abandoned until April 2012. The P/E ceiling had been reinstalled to be the 125% of the IPO firm's industry average P/E ratio in the secondary market from April 2012 to January 2014. As for EPS, firms are allowed to use the forecasted EPS to calculate price ceiling for most of the time. Overall, the CSRC did not impose very tight price control and firms have considerable flexibility to determine their IPO price during this period.

Starting from 2014, CSRC has overhauled its policy by imposing a stringent P/E ratio ceiling of 22.98, which is much lower than the comparable secondary market P/E ratio for the vast majority of IPO firms[14]. Even for firms with issuance P/E less than 22.98, they are still subject to the ceiling of industry average P/E ratio in the secondary market. In addition, only the audited earning last year can be used to calculate the IPO price and no forecast earnings are allowed. All these requirements essentially leave no room for firms and investors to determine IPO price in the vast majority of cases.

Finally, it is also worth noting that China established the Sci-Tech innovation board (STAR) in June 2019, which allows small high-tech firms, with earnings close to zero, to go public to boost the high tech industry. Firms listed on STAR are not subject to any P/E ratio ceiling. We have only provided the outline of the IPO regulation and process in China.

[12] Since April 2021, a very limited amount of qualified individual investors are allowed to participate in the offline phase. According to Gao et. al. (2020), individual investors' impact is almost negligible.
[13] If a firm wants to exceed the ceiling, it has to explain to the CSRC and get approval.
[14] For SOEs, if the P/B ratio is smaller than 1, the P/E ceiling of 22.98 can be lifed to allow for P/B=1. There are also a small number of non-SOE cases broke the P/E ceiling with the special approval of CSRC.

For more detailed discussion, please refer to Allen et al. (2020), Gao et al. (2020), Zhang et al. (2020), etc.

2.1.2. Private Equity Placement

In China, firms mainly use the private equity placement (PEP) to raise capital from stock market after IPO. For instance, PEP accounted for about 98% of the total equity refinancing in 2020. The PEP started in 2006 in Chinese stock market[15]. Since then, it has experienced tremendous growth with total size increasing from 93.8 billion yuan (about 11.8 billion US dollar) in 2006 to 784.2 billion yuan (120 billion US dollar) in 2020. Firms use PEP rather than public equity offer due to the stringent regulation on public equity offering. For instance, public equity offering requires a firm to have paid dividends consecutively in the past three years.

PEPs also need permission from the CSRC, but with much less requirement. PEPs can only be sold to a maximum of 10 investors, who may belong to any investor category, including controlling shareholders, institutional investors, wealthy individuals, and other legal investment organizations. The investors are not allowed to resell newly issued PEP shares in secondary market for at least 12 months. If the shareholders or any other firm owned by the controlling shareholders bought the PEP shares, the shares have to be locked for 36 months[16]. The PEP pricing is much more flexible than IPO. The only limitation is that the issuing price cannot be lower than 90% of the average stock price over the 20 trading day period prior to the base day for pricing.[17]

2.1.3. Stock secondary market open and close price

Both Shenzhen and Shanghai stock exchanges (SSE and SZSE) adopt a batched call auction for setting the open price of a stock. In the auction, market participants can freely place orders to buy or sell stocks between 9:15 am and ends at 9:25 am. The orders are essentially pairs of price and amount, which are not immediately executed but batched together. These orders are automatically matched and executed at the price that forms the best overall match at 9.25am. The detailed mechanism is provided in the Appendix.

The batched call auction has been adopted for determining the close price since July 1st, 2006 for stocks traded in the SZSE and August 20th, 2018 for stocks traded in the SSE. The stock close price auction starts at 14:57 pm and ends at 15:00 pm and the mechanism is exactly the same as the open price auction. Prior to the introduction of call auction, the close price of each stock was calculated as the volume weighted average of transaction prices within the last one-minute time before the last market transaction.

2.2. Chinese Bond Market

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[15] On May 8, 2006, the China Securities Regulatory Commission (CSRC) issued the policy "The Administration of the Issuance of Securities by Listed Companies"

[16] The CSRC shortened this period by half in 2020 with 6 months and 18 months for the regular investors and investors inside the SEO listed firms (shareholders and owners).

[17] The latest regulation set by the CSRC in 2020 has set the lower bound of issuing price from 90% to 80%. Investors have some flexibility to choose the base day.

China has two bond markets: the interbank and the exchange market. The interbank market is an over-the-counter market, which only allows banks and qualified non-bank institutional investors including large mutual funds, insurance companies, and security firms to participate. By December 2018, the total number of interbank market members reached 6,543. The People's Bank of China (PBOC) oversees the interbank market through National Association of Financial Market Institutional Investors (NAFMII), which is directly responsible for drawing rules to govern institutional participants in the interbank market. In comparison, the exchange market is a centralized market, in which individuals and non-bank institutions all trade debt securities through centralized trading platforms. Banks are strictly forbidden from participating in the exchange market. The exchange market is under the regulation of CSRC. The interbank market is the dominant market place for the issuance and transaction of debt securities in China. For instance, the interbank market hosts for 87.2% of the outstanding bonds by the end of 2019.

In this paper, the fixed-income securities in China's bond market are divided into five categories based on issuing entities in general: Treasury Bonds, Government Policy Bank Bonds, Local Government Bonds, Financial Bonds, public Non-Financial Corporate Bonds (NFC) and private NFC. The Treasury Bonds are risk free securities issued periodically by China's Treasury Department. The National Policy Banks include China Development Bank (CDB), Agricultural Development Bank of China (ADBC) and Export-Import Bank of China. The goal of these banks is to implement government economic policies, including infrastructure, poverty reduction, industrial organization, etc. They have the explicit guarantee from the central government, and therefore the National Policy Bank Bonds are risk-free assets.

The Local Government Bonds are issued by provincial governments[18]. Before March 2009, the local governments are strictly forbidden to issue debt securities. Since then, they are allowed to issue debt securities with the approval of the Treasury and Local Government Bonds have been growing rapidly since then. Although the local government debt securities could default in theory, it is widely believed that they have the implicit guarantee from the higher level government and there has never been any default on local government debt securities.

The Financial Bonds are mainly issued by financial institutions, including commercial banks, trusts, brokerage firms, leasing companies, etc. They have to get the approvals of their respective regulators before issuing any debt securities. Since the financial institutions are under much more stringent regulation than non-financial corporates, their credit default risk is much smaller than that of non-financial corporates.

The NFC bonds can be broadly divided into public and private placement bonds. The public NFC bonds mainly include Enterprise Bonds, Exchange-traded Corporate Bonds, Medium-Term Notes, Commercial Papers and Super Commercial Paper.

[18] The city governments are not allowed to directly issue bonds, but have to request the provincial government to issue on their behalf.

The Enterprise Bonds are issued by large state-owned enterprises (SOE) in both the interbank and exchange market (predominantly in the interbank market). The issuance of Enterprise Bonds is regulated by National Development and Reform Commission (NDRC). The Exchange-Traded Corporate Bonds are issued in the exchange market and regulated by the CSRC. When first launched in 2007, Exchange-Traded Corporate Bonds could only be issued by publicly listed companies. In 2015, the CSRC loosened the restriction by allowing all firms registered as “corporations” to issue Exchange-Traded Corporate Bonds.

The Medium-Term Notes, Commercial Papers and Super Commercial Paper are all issued in the interbank market and regulated by NAFMII. The Medium-Term Notes usually have a maturity longer than one year, while the Commercial Papers and Supper Commercial papers are both short-term financing instruments with maturity shorter than one year and 270 days, respectively.

The private NFC bonds include both Private Placement Notes issued in the inter-bank market, and the Private Placement Exchange Bonds issued in the exchange market. They are very similar except for the issuance venue. The private NFC bonds are issued to a relatively small number of selective institutional investors, who then may transfer these securities among themselves before maturity. For more detailed background information of the development and structure of China’s debt security markets, please refer to the Amstad and He (2020).

2.2.1. The bond primary market

The public debt securities in China are issued in primary market participated by qualified institutional investors. The issuance of the Treasury Bonds use both single price auction and hybrid auction. Treasury Bonds with maturity longer than 10 years are issued by the single price auction. Treasury bonds with maturity shorter or equal than 10 years are issued through the hybrid auction, in which the winning bidders pay different price according to their bidding price and the weighted average yields of all the winning bids would be set as the coupon rate[19].

The issuance of National Policy Bank Bonds, Local Government Bonds, Financial Bonds, and public NFC Bonds all take the form of single-price auction. In a single price auction, the participating institutions submit sealed bids of rate-quantity pairs that specify the amount to be purchased at a specified minimum yield to the underwriter. The clearing yield is identified by equating the aggregate demand submitted by all bidders to the total issuance amount. All winning bidders pay the same clearing yield, which would be set as the coupon rate of the bond.

Different from those public debt securities, the issuance of private NFC bonds is much more flexible and is subject to less stringent regulation. Issuers can negotiate with a small group of selective investors and adopt the particular way of information disclosure,

[19] While winning bidders with bidding yield lower than the coupon rate would pay price corresponding to the coupon rate, winning bidders with bidding yield larger than the coupon would pay price corresponding to their bidding yield.

which could alleviate the issuer's concern of information disclosure. The issuance yield is decided through the negotiation between the issuers and the investors.

In this section, we have briefly introduced the issuance mechanism of different types of debt securities, especially how the coupon rate is determined. For more detailed description, please refer to the Amstad and He (2018).

2.2.2. The bond secondary market

The bonds are traded in both the interbank and exchange markets. The interbank market uses a quote-driven over-the-counter trading system in which the terms of trades are determined through bilateral negotiation. There are also brokers and dealers to facilitate trading. In comparison, the transaction in the exchange market is facilitated by an order-driven mechanism, with electronic order books aggregating orders from all participants who observe these orders publicly and matching them following the rule of price and time priority. The interbank market is composed of not only banks, but also the largest NBFIs, including pensions, investment funds, insurance companies, and securities firms. In contrast, the exchange market hosts both NBFIs and retail investors. Given the different investor composition, the interbank market satisfies large wholesale transaction needs while the exchange accommodates small retail trades. In the interbank market, the daily close price for each bond is the clean price of the last trade in the day. In the exchange market, the daily close price is calculated as the weighted average clean price during the one minute before the last transaction of the bond in the day[20]. Since the bond market is illiquid for most bonds, the bond close price is most often just the clean price of the last transaction of the day.

3. Data description and summary statistics

3.1. Sample formation

3.1.1. Stock IPO and SEO data

Our stock market IPO data is collected from China Stock Market & Accounting Research (CSMAR) database. The data sample is from January 1, 1995 to March 31, 2021. During the sample period, we collect 4,032 firm IPO cases, among which, 2,865 are listed on the main board, 926 are listed on the Growth Enterprise Market (GEM)[21], and 241 are listed on the Sci-Tech innovation board (STAR). From the summary statistics reported in Table 1 Panel A, the main board IPO firms are bigger in terms of book value and have larger IPO issuance size than firms in GEM and STAR. In addition, the main board IPO firms are more likely to be SOE and have lower PE ratio.

In addition to IPO, we have also collected the seasoned equity offering (SEO) data

[20] According to the Trading Rules of the Shanghai Stock exchange and Trading Rules of the Shenzhen Stock exchange, 2001 and the revised versions in 2020. There has not been any change for bond close price calculation. For more details, please refer to http://finance.sina.com.cn/y/20010831/102379.html.

[21] The IPO price setting policies implemented by the China Securities Regulatory Commission (CSRC) for GEM stock IPOs undergo three phases: prior to 7/1/2014, GEM IPO price is not subject to 22.98 P/E ratio ceiling, between 7/1/2014 and 8/24/2020, GEM IPO price is subject to 22.98 P/E ratio ceiling, from 8/24/2020 to the end of our sample period, 22.98 P/E ratio ceiling has been eliminated again. There are 68 GEM stock IPOs that are after 8/24/2020. For the consistency with the main board, we exclude those 68 GEM stock IPOs from our analysis. Adding these stocks back will not change our result qualitatively.

from CSMAR. Due to the strict regulation on public SEO, private equity placement (PEP) is the dominant form of SEO. Among the 4,982 SEO cases from 2,366 listed firms during the period from January 1, 1998 to March 31, 2021, 4752 cases are PEP and only 230 cases are pubic SEO. Given the scarcity of public SEO, we mainly focus on the PEP in this paper. By comparing the Panel A and Panel B of Table 1, it can be seen that firms raise more capital through PEP than IPO on average. This result is likely driven by much higher PE ratio of PEP, which is 65.40 compared to 31.89 of IPO.

3.1.2. Bond issuance data

Our bond issuance data are collected from CSMAR during the period from January 1, 1991 to March 31, 2021. There are 566 Treasury Bonds with an aggregated face value of 31.21 trillion yuan; 642 National Policy Bank Bonds, with a total face value of 19.54 trillion yuan; 8,081 Local Government Bonds with a total face value of 34.19 trillion yuan; 4,772 Financial Bonds with a total face value of 16.50 trillion yuan; 48,450 public NFC Bonds with a total face value of 59.60 trillion yuan; and 12,551 private NFC Bonds with a total face value of 10.67 trillion yuan. As shown in Table 1 Panel C, the Treasury, National Policy Bank and Local Government Bonds all have larger issuance size and longer maturity than Financial and NFC bonds (both public and private). It is also worth noting that, the public NFC Bonds tend to have lower coupon rate and larger issuance size than private NFC Bonds due to the fact that issuers of public NFC are more transparent and have lower credit risk. We have collected other bond characteristics, including credit rating, coupon rate and maturity also from CSMAR.

3.1.3. The stock and bond secondary market data

In addition to the primary market issuance data, we have also collected the secondary market trading data for both stock and bonds. In particular, we have collected the daily open and close prices for stocks traded in both Shanghai and Shenzhen stock exchange from CSMAR during the period of July 1, 2006 and September 30, 2021. Our sample has covered 4,443 stocks and 3,713 transaction days in total. To complement the trading data, we have also collected daily and monthly stock return and accounting information from CSMAR.

Similarly, we have also collected bond trading data from WIND, a major data vendor in China's financial market. In particular, our daily close price data include 311 Treasury Bonds from March 25, 1994 to September 30, 2021, 417 National Policy Bank Bonds from June 12, 2000 to September 30, 2021, 747 Local Government Bonds from April 3, 2009 to September 30, 2021, 1,434 Financial Bonds from October 20, 2004 to September 30, 2021, 18,082 public NFC Bonds from June 30, 1995 to September 30, 2021. Given the different trading mechanism of the interbank and exchange market, we have collect the close price for the two markets separately.

3.1.4. The foreign exchange market data

Our foreign exchange data are the interbank foreign exchange market daily close spot rate for four major currencies against Chinese yuan, i.e. USD, EUR, JPY, and HKD.

We collect data from the CSMAR and WIND. The trading volume of these four foreign currencies against Chinese yuan accounts for about 99% of the aggregate trading volume of all foreign currencies in 2021. The trading volume for USD against CNY are 61.89 trillion yuan in 2021, as compared to 1.76 trillion yuan for EUR against CNY, 273.58 billion yuan for JPY against CNY, and 151.92 billion yuan for HKD against CNY. The USD, EUR, JPY and HKD spot rate start from April 4, 1994, April 1, 2002, March 1, 1995 and April 5, 1994, respectively. All the data end on September 30, 2021. The close exchange rate is measured in the form of direct quotation, i.e., how much CNY in exchange of one unit of foreign currency[22]).

3.1.4. The commodities futures data

We obtain the daily open and close price of the commodities futures from January 4, 2000 to September 30, 2021 from the WIND. Our data include 59 commodities traded in Dalian Commodity Exchange (DCE), Zhengzhou Commodity Exchange (ZCE) and Shanghai Futures Exchange (SHFE). We require that all the digits, 0 to 9, must be allowed to be the last digit of the quoted price for each commodity. For instance, since the pork futures have a minimum price quotation unit of 5 Yuan and the last digit of the quoted price could only be 0 and 5, we exclude pork futures from our sample. We have excluded 27 commodities for this reason. In addition, we exclude 3 commodities launched in 2020 due to short trading period following the literature. The cleaning process results in a final sample of 29 commodities. We focus on the price of main contract for each commodity as they have the largest trading volume. We have outlined the commodity tickers, contract size, exchange, first price date in the internet appendix Table A1.

3.2. Variable Definitions

In Chinese financial market, a standard security price is reported as a number with two digits after the decimal point, if the hundredths digit is nonzero. In this case, the hundredths digit is the last digit. For instance, when the IPO price is 20.58 Yuan per share, the last digit is 8. If the hundredths digit of the price is zero, the price would be reported with only one digit after the decimal point and the last digit would then be the tenths digit. For instance, if the IPO price is 20.5, the last digit would be taken as 5 rather than 0 according to the Chinese custom[23].

In the Chinese culture, a price ending with digit 8 is taken as lucky price while a price ending with digit 4 is taken as an unlucky. To quantitatively measure the magnitude of the numerological superstition, we divide the sample into the hundredths-digit and the tenths-digit subsamples based on whether the last digit of the price is at the hundredths or tenths place. In this paper, we have mainly focused on the conditional probability distribution of digit 1 to 9 in the hundredths-digit subsample, H_1-H_9, as it is more likely to be affected by superstition belief[24]. In particular, the conditional probabilities of the digit

[22] Except for the JPY, which is measure in 100 units.
[23] In the extremely rare cases, when both the hundredths and tenths digits are 0, the price would be reported ending at the ones digit.
[24] For some asset classes, we have also reported the conditional probability distribution of digit 1 to 9 at the tenths-digit group, T_1-T_9.

8 and 4, H_8 and H_4, are our primary measures of the superstition effect. We refer to a price with the hundredths digit being 8 (4) as lucky (unlucky) price. H_8 (H_4) is the likelihood of an asset having lucky (unlucky) price. In the situation of no superstition effect and the last digit of asset price determined by chance, H_8 and H_4 should be equal to 1/9. We measure the deviation of H_8 and H_4 from 1/9 to gauge the magnitude of the superstition effect.

4. Stock primary market

In this section, we explore the impact of superstition on IPO and PEP prices. As introduced in the institutional background, the CSRC's regulation on IPO price was relatively flexible before the implementation of the strict P/E ceiling of the minimum between 22.98 and industry average in July 2014. The tight P/E ceiling has substantial impact on IPO pricing[25] during the period of July 2014 to March 2021. We refer to the period of January 1995 to June 2014 as the flexible price control period and the period of July 2014 to March 2021 as the strict price control period.

In the flexible price control period, if investors and firms were subject to the numerological superstition, they would be more (less) likely to set lucky (unlucky) IPO price. That is, the probability of IPO price ending with digit 8 (4) should be higher (lower) than that determined by chance. In contrast, in the strict price control period, since the price was not set by market freely, the probability of lucky (unlucky) IPO price should be close to that determined by chance. For stock PEP, since the price has been determined by the market with minimal CSRC intervention, there should be disproportionately high (low) probability of lucky (unlucky) price in the whole sample, if investors and firms are subject to the numerological superstition.

4.1. The existence of superstition in IPO and PEP

We divide the IPO sample in the main board and GEM into the flexible price control period and strict price control period. The conditional probability distribution of 1 to 9 as the hundredths digit of the IPO price, H_1 to H_9, is reported in Table 2 Panel A. The results demonstrate a strong superstition effect in the flexible price control period. As can be seen that the probability of digit 8, H_8, reached to an astonishingly high magnitude of 33.2%, which is substantially larger than 1/9. Meanwhile, the probability of digit 4, H_4, is only 4.63%, which is the lowest among all digits. We conduct formal t-test for the null hypothesis that the conditional probability of digit 8 and 4 is equal to 1/9 has been rejected.

In sharp contrast, the superstition effect does not exist during the strict price control period. As can be seen that the conditional probability of digit 4 at the hundredths place, H_4, is 11.7%, while the conditional probability of digit 8 at the hundredths place, H_8, is 10.92%. The t-test for the null hypothesis that the conditional probability of digit 8 and 4 is equal to 1/9 cannot be rejected. We have plotted the time series of the H_8 and H_4 calculated in each year (except for the year 2014, which is split into first and second half

[25] Over 60 percent of the IPO cases were directly affected by the P/E ratio of 22.98. Even for those with the P/E ratio less than 22.98, they are still subject to industry average P/E ratio.

as the policy was launched in July) in Figure 1. Both H_8 and H_4 have demonstrated the superstition effect in years (including the first half of 2014) prior to the adoption of the tight P/E ceiling policy in July 2014. As can be seen that the gap between H_8 and H_4 immediately narrowed after July 2014, implying the disappearance of the superstition effect since then.

We find that the effect is so strong in the flexible price control period that it even exists in the tenths digit place. We repeat the same test of the conditional probability distribution of 1 to 9 at tenths place, T_1 to T_9, for IPOs with the tenths-digit as the last one (the hundreds digit is equal to zero) in Table 2 Panel B. The results are very similar to that of H_1 to H_9. For the flexible price control period, January 1995 to June 2014, T_8 reached to as high as 23.04% (t=7.0), while T_4 went to as low as only 6.21% (t=-5.02). In contrast, during the strict price control period of July 2014 to March 2021, T_8 and T_4 become 12.78% (t=0.58) and 9.77% (t=-0.52) respectively. These results consolidate the existence of strong superstition effect in IPO pricing when not intervened by the regulator.

In Panel C, we further examine the IPO cases in the STAR, which was established in 2019. Since the stocks listed on STAR are exempted from the P/E ceiling regulations, we indeed find the existence of the superstition effect. Due to the limited number of IPO cases (only 241), we only examine the subsample with the hundredths-digit as the last one and find that H_8=15.05% (t = 1.58) and H_4 = 5.34% (t = -3.68%).

In Panel D, we turn to the superstition effect in the seasoned equity offering, PEP in particular. As can be seen that the H_8=13.86% (t = 4.94) and H_4 = 8.24% (t = -6.50). There is clear superstition effect in PEP, but the magnitude is much smaller than IPO. Figure 2 plots the annual H_8 and H_4 for each year. It shows the persistency of the superstition effect over time. PEP is different from IPO in that it is only participated by a small group of highly sophisticated investors and the uncertainty of the issuers is much smaller. Our evidence highlights the fact that even very sophisticated professional investors are still subject to the superstition effect, albeit with a smaller magnitude. The findings are consistent with the uncertainty hypothesis in the notion that stocks with less uncertainty and more sophisticated investors are subject to weaker superstition effect.

4.2. The cross-sectional variation of superstition effect

In this section, we explore the cause of the superstition effect in the stock primary market by examining the cross-sectional variation of the effect during the flexible price control period of 1/1/1995—6/30/2014. More specifically, we divide the IPO sample into three subsamples according to the magnitude of the firm P/E ratio, total asset and ownership, respectively. The High group contains 30% of the sample with the largest sorting variable, while the Low group contains 30% of the sample with the smallest sorting variable. The rest 40% of the sample belong to the Middle group. The subsample results are reported in Table 3.

As can be seen, we also divide the IPOs and PEPs by firm size and find that the superstition effect exists in both large, medium, and small size subsample without any significant difference. Similarly, the superstition effect is also observed in both SOE and non-SOE IPO subsample without any difference. All these results indicate the prevalence and robustness of the superstition effect in our sample.

It is important to note that when the sorting variable is the P/E ratio, although the superstition effect prevails in all three groups at both the hundredths place and the tenths place, the higher PE group is associated with stronger superstition effect. For instance, the conditional probability of the hundredths digit being 8 (4), H_8, (H_4) for the High P/E, Mid P/E and Low P/E groups are 46.03% (1.98%), 30.32% (4.96%), and 29.30% (6.25%) respectively. In comparison, there is no significant difference of the superstition effect among the high PE, Mid PE and low PE groups for PEP prices as shown in Table 3. Since the PEP investors are much more sophisticated than IPO investors, all these results lend support to the overoptimism hypothesis in IPO and uncertainty hypothesis in the PEP.

4.3. The implications of superstition effect

The findings in the prior section naturally lead to the question of whether investors have mispriced the stocks with lucky IPO/PEP price. We run a Fama–MacBeth regression to shed light on this question. Following previous literature using data from China (e.g., Hirshleifer, Jian and Zhang 2018, Fan et al. 2007, Peng et al. 2011, Liu, Stambaugh and Yuan, 2019), our Fama–MacBeth regression uses monthly market-adjusted return as the dependent variable. The independent variables include the natural logarithm of the book-to-market ratio (*logBM*), the natural logarithm of the market value (*logMV*), the percentage of shares held by the largest shareholder, (*Ownership*), total accruals, computed as net income minus cash flow from operating activities divided by total assets, (*TAccrual*), and our test dummy variables, *No.4* and *No.8*. These dummy variables are equal to 1, if the hundredths digit of the stock issuance price is 4 and 8 respectively; otherwise, they are equal to 0. We include *logMV* and *logBM* to control for the size and book-to-market effects (Fama and French 1993, 1997). We also control for ownership concentration (*Ownership*), and earnings management (*TAccrual*) as they may potentially affect future returns according to prior literature (Sun and Tong 2003, Teoh et al. 1998, Hirshleifer, Jian and Zhang 2018). Our sample is consist of monthly stock return of all IPO firms during the three years after IPO.

The Fama-MacBeth regression results of post-IPO return tests in the flexible price control period are reported in Table 4 column (1). We find that firms with lucky IPO prices have lower returns during the three years after IPO. This finding is consistent with investors correcting the initial lucky-number premium over time. The coefficient on the dummy variable *No.8* is -0.469 (with t-value=-3.63), indicating that firms with digit 8 at the hundredths place of their IPO price have lower monthly return than other firms by about 0.469% per month. Thus, the cost to a trader of investing superstitiously is about 5.6% per year for the following three years, which is substantial. In comparison, the coefficient on the unlucky IPO price dummy, No.4, is positive and marginally significant implying that investors of IPOs with unlucky prices are less likely to be biased by numerological superstition and they tend to avoid overvaluing IPO price. For robustness, we run the same Fama-MacBeth regression for IPOs during the strict price control period, when there is no superstition effect, as a placebo test. As expected, the coefficients on both *No.8* and *No.4* are insignificant. These results are consistent with the overvaluation hypothesis in that superstition belief leads to overvaluation of the IPO price among less sophisticated investors.

We further conduct the Fama-MacBeth regression for the PEP cases and report the results in the Table 4 Column (3). As can be seen, the coefficients on *No.8* and *No.4* are both statistically insignificant, indicating that the superstition effect observed in PEP pricing is not associated with systemic mispricing. This result is consistent with the anchoring hypothesis given that the investors in PEP are sophisticated. Overall, our results suggest that the superstition belief affects IPO and PEP pricing through different channels depending on the sophistication of investors.

5. Stock secondary market

5.1. The existence of superstition effect

In this section, we shift our attention to the numerological superstition in the stock secondary market price, namely the open and close prices of stocks. If the superstition effect observed in the primary market pricing is driven by deeply grained culture heritage, it should also exist in the secondary market. As introduced in the institutional background section, the open price is determined by the call auction. The calculation of close price has experienced two stages. In the first stage, which was before July 1, 2006 for SZSE and before August 20, 2018 for SSE, the close price is calculated as the weighted average of transaction price during the last minute before the last trade; in the second stage, the close price is determined by batched call auction as the open price.

When the open/close price is determined by auction, if investors are more (less) likely to bid and ask with lucky (unlucky) price ending with digit 8 (4), the probability of lucky (unlucky) open/close price would be higher (lower) than that determined by chance. In contrast, when the close price is determined by the weighted average of transaction price during the last minute, even if investors are more (less) likely to bid and ask with price ending with 8 (4), it will not lead to higher (lower) probability of digit 8 (4) being the last digit of close price than otherwise determined by chance.

In Table 5 Panel A, we have reported the frequency and conditional probability distribution of digit 1 to 9 at the hundredths place of stock close prices, H_1 to H_9. Our sample include all the publically traded stocks and are from July 1, 2006 to September 30, 2021, covering 3,713 trading days and 4,443 stocks in total. As can be seen, the conditional probability of digit 8 (4), H_8 (H_4), reaches 13.59% (8.56%), which is significantly higher (lower) than 1/9, implying the existence of superstition effect in the open price.

For close prices, which are determined by auction, we find similar evidence of superstition effect with H_8=12.42% and H_4=9.93%. Both are significantly different from 1/9. The results are reported in Table 5 Panel B. As a placebo test, we have also calculated the conditional probability distribution of the hundredths digit for those close prices determined by the weighted average transaction price before the last trade in Table 5 Panel C. As can be seen, the conditional probabilities of digit 8 and 4 are 11.51% and 10.93% respectively, which are both very close to 1/9, indicating that the superstition effect is not significant in this situation. We plot the monthly H_8 and H_4 of close price around the adoption of the call auction for Shenzhen and Shanghai stock exchange in Figure 3.1 and Figure 3.2, respectively. As can be seen, the gap between H_8 and H_4 widened right away after the adoption of batched call auction in both markets. In Table 5 Panel D, we further divide open price and close price (those determined by auction) into subsamples according to firm's market capitalization and find that the superstition effect exists for both large and small firms. For close prices, which are determined by the weighted average of transactions prices, there is no superstition effect in any subsample. All these results lend strong support to the existence of superstition effect in the secondary stock market.

5.2. The mechanism of superstition effect

Our uncertainty hypothesis stipulates that the magnitude of a stock's superstition effect depends on the uncertainty of the asset. Although uncertainty is conceptually different from risk, it is challenging to disentangle uncertainty with risk and measure uncertainty empirically. In this section, we employ the method developed by Brenner and Izhakian (2018) to measure stock uncertainty. We first create 40 non-overlapping bins over (-10%, 10%) with the width of each bin being 0.5%. Using these discretized bins, we count the number of daily returns falling into each bin for a stock in each month as an estimation of the daily return distribution. Finally, we construct the uncertainty measure, *Ambiguity*, at the firm-year level by using the estimated daily return distribution in each month during the past 24 months following Brenner and Izhakian(2018).

We run a panel data regression at the firm-year level using the annual conditional probability of the lucky and unlucky price of each stock as the depended variables. The two most important independent variables are the *Ambiguity* and the logarithm of book-to-market ratio (BM), which is a proxy for overoptimism. We also control for the risk of stock return, *Risk*, which the standard deviation of daily returns over the past two years, and other commonly used firm characteristics as in Table 4, i.e., the logarithm of firm market capitalization (*Size*), the leverage (*Leverage*), *ROA* and ownership (*Ownership*). We also control for firm and year fixed effect and the standard errors are double clustered at the firm and year level.

The regression results are reported in Table 6. As can be seen in the Columns (1)(2), when the conditional probability of lucky (unlucky) price in open price is the dependent variable, the coefficient on *Ambiguity* is positive (negative) and statistically significant even after controlling for the proxy of risk, *Risk*. In the Columns (3)(4), the results are very similar for close prices determined by call auction. We also run placebo tests by using the close prices determined by weighted average in Column (5)(6). The coefficients on *Ambiguity* are insignificant for neither the lucky and unlucky prices as expected. These results lend direct support to the uncertainty hypothesis. In addition, the coefficients on *BM* in Columns (1)-(4) are significant and the signs of the coefficients indicate that firms with more overoptimistic investors have stronger superstition effect, which is consistent with the overoptimism hypothesis.

5.3. The implications of superstition effect

To examine the asset pricing implications of superstition effect in the secondary market, we construct long-short portfolios. More specifically, we construct a lucky index by calculating the frequency difference between the lucky and unlucky close price during the past month for each stock. We then sort stocks into quintiles based on the lucky index and go long stocks in the quintile with the smallest lucky index and sell short stocks in the quintile with the largest lucky index. The long-short portfolio is held for a month before a new portfolio is constructed again. In essence, the portfolio strategy is used to examine the return difference between stocks with the strongest superstition effect and stocks with the weakest. We divide our sample into two groups based on the firm size and apply the long-short portfolio strategy respectively[26]. We find that the strategy can generate an abnormal return of 0.48% per month after controlling for the Fama-French three factors for small stocks, for stocks with close prices determined by batched call auction. In comparison, for large stocks, the long-short strategy does not generate any significant abnormal return, although there is superstition effect for large stocks as well. The results are reported in Table 7 Column (1) and (2).

As a placebo test, we also examine the abnormal return of the same long-short strategy for both small and large stocks with close price determined by weighted average transaction prices during the last minute. As could be seen in the Column (3) and (4) of Table 7, the abnormal returns are insignificant for both small and large firms.

6. Bond primary market

6.1. The existence and mechanism of superstition effect

We have found strong superstition effect in the stock market, which exists in both the primary and secondary market. Since stock market is participated by many naïve individual investors, it is more likely to be affected by the numerological superstitions. In this section, we turn to the bond primary market, which is dominated by institutional investors. As introduced in the background section, China's bond market includes both the interbank and exchange market. The interbank market is a wholesale market accessed primarily by large financial institutions, including commercial banks, insurance companies, major mutual funds and brokerage firms, while the exchange market is composed of nonbank financial institutions and wealthy individuals. In Table 8, we have reported the probability distribution of the hundredths digit of the issuance coupon conditional on that the hundredths digit is the last digit, H_1 to H_9, for different types of the bonds. The Treasury Bonds are auctioned directly by the Ministry of Finance (MOF), which allow all

[26] Both equal and valued weighted portfolio returns are calculated. Since they are similar, we only report the value weighted results.

qualified interbank and exchange market investors to participate. Similarly, the Local Government Bonds also allow investors from both the interbank and exchange market to bid in auctions. Although the National Policy Bank Bonds are issued separately in the interbank and exchange market, the vast major of them are issued in the interbank market[27]. Given these institutional setup, we report the full sample distribution, H_1 to H_9, for Treasury Bonds, Local Government Bonds and National Policy Bank Bonds. For Financial Bonds, public NFC and private NFC Bonds, we report the interbank and exchange market distribution separately.

As shown in Table 8, for the Treasury Bonds, National Policy Bank bonds, and Local Government Bonds, there is no superstition effect as both the probability of digit 8 and 4 are close to 1/9. Since the Treasury Bonds auction takes the form of hybrid auction for bonds with maturity less or equal to 10 years, and single price auction for those with maturity longer than 10 years, we have also reported the subsample probability distribution, H_1 to H_9. The subsample results are similar to the full sample result.

In sharp contrast, the Financial Bonds, public NFC Bonds and private NFC Bonds have all demonstrated strong superstition effect in both the exchange and interbank market. More specifically, the conditional probability of lucky coupon rate for Financial Bonds, public NFC Bonds and private NFC Bonds in the interbank (exchange) market reaches to 16.15% (19.88%), 19.57% (24.19%) and 22.29% (25.44%), respectively. The conditional probability of unlucky coupon rate for these three types of bonds in the interbank (exchange) market are 8.14% (5.50%), 7.38% (7.93%) and 5.51% (5.04%).

For robustness, we have also calculated the probabilities of lucky and unlucky coupon rates annually for Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Bonds, public NFC Bonds and private NFC Bonds. The time series of the annual probabilities have been plotted in Figure 4.1 to Figure 4.6 As can be seen, the superstition effect exists persistently in every year for Financial Bonds, public NFC Bonds and private NFC Bonds, but never exists robustly among Treasury Bonds, National Policy Bank Bonds and Local Government Bonds.

By comparing the magnitude of the superstition effect across different types of the bonds, one can find the following two patterns. First, the bonds with more uncertain fundamentals tend to have stronger superstition effect. The risk-free bonds, including the Treasury Bonds, National Policy Bank Bonds and Local Government Bonds, do not demonstrate any superstition effect. In contrast, the bonds with credit risk, including the Financial Bonds, the public NFC Bonds and the private NFC Bonds all demonstrate strong superstition effect. In addition, since the financial institutions are under strong supervision and therefore expose to minimal credit default risk, the Financial Bonds have weaker superstition effect than public and private NFC Bonds. Finally, private NFC bonds are subject to the strongest superstition effect given that they are more opaque than other bonds.

[27] Only 29 National Policy Bank bonds are issued in the exchange market as compared to 476 bonds issued in the interbank market in our sample period.

All these results are consistent with the uncertainty hypothesis in that superstition is used by investors to alleviate uncertainty concern and the effect is stronger for assets exposed to more uncertainty.

Second, bonds issued in the exchange market have stronger superstition effect than those issued in the interbank market as demonstrated in Financial Bonds, public NFC Bonds and private NFC Bonds. Given the fact that interbank market is a wholesale market and populated by large financial institutions, the weaker superstition effect in the interbank market is consistent with the uncertainty hypothesis in that more sophisticated investors are less likely to resort to superstition. In fact, the existence of superstition effect in the interbank market indicates that even the most sophisticated institutional investors are influenced by the numerological superstition.

We further divide the sample of Financial Bonds, public NFC Bonds and private NFC Bonds by credit rating, and conduct the subsample analysis in Table 9. In China, the short-term bonds have different rating system as compared to long-term bonds (Similar to the US). In reality, all the short-term bonds have the same highest short-term rating, A-1, as long as they could be issued successfully. For long-term bonds, the credit rating includes AAA, AA+, AA, AA-, A+, A, A-, with the number of AAA-rated bonds dominates bonds with any other rating[28].

We divide bonds into three categories according to their credit rating: A-1, AAA and below AAA (including AA+, AA, AA-, A+, A, A-) for public NFC Bonds, private NFC Bonds and Financial Bonds, respectively. The bonds in A-1 group have the lowest credit risk, while those in the below AAA group have the highest credit risk. As shown in Table 9, although there is superstition effect in all rating groups, the effect is more significant for bonds with higher default risk. For public NFC Bonds rated A-1, AAA, below AAA, the conditional probability of lucky (unlucky) coupon rates are 18.20% (8.24%), 20.64% (8.29%) and 24.05% (6.79%), respectively. For private NFC Bonds rated AAA and below AAA[29], the conditional probability of lucky (unlucky) coupon rates are 24.34% (3.75%) and 30.58% (3.51%). For Financial Bonds rated A-1, AAA, below AAA, the conditional probability of lucky (unlucky) coupon rates are 17.37% (11.31%), 19.23% (6.84%) and 19.54% (7.74%), respectively. Since lower rated bonds are more uncertain, these results provide strong support to the uncertainty hypothesis.

6.2. The price impact of superstition effect

To examine the asset pricing implications of numerological superstition in the bond market, we collect detailed bond issuance information for public NFC Bonds, private NFC Bonds and Financial Bonds issued in exchange and interbank markets from the data vendor WIND following Ding, Xiong, and Zhang (2021)[30]. We run a multivariable regression by

[28] For more detailed information, please refer to the Amstad and He (2020).
[29] There is no short term private NFC Bond being issued.
[30] One caveat of the data is that for private NFC Bonds, the accounting information about the issuer is voluntarily disclosed.

using the issuance yield spread as the dependent variable. The issuance yield spread is the difference between a bond's issuance yield (coupon rate) and the official bank loan rate of similar maturity at the issuance time. The independent variable of most interest is the dummy variable *No. 8*, which is equal to 1, if the hundredths digit of the coupon rate is 8; and 0, otherwise. We control for firm characteristics at issuance including the logarithm of total asset, ROA, and leverage. In addition, we control for bond characteristics, including the issuance size, *Log* (*Issuance*), the bond maturity, *Maturity*, and the callable (puttable) dummy, *Callable* (*Puttable*), which is equal to 1 if the bond is callable (puttable); and 0, otherwise. Finally, we add the issuer fixed effect, bond rating and month fixed effect in all the regressions. The standard errors are clustered at the issuance month.

We have run the regression for exchange issued public NFC Bonds, interbank issued public NFC Bonds and private NFC Bonds, separately.[31] As shown in Table 10 Column (1), for exchange issued public NFC bonds, the estimated coefficient of *No.8* is -0.0536, which is statistically significant. This result indicates that, in exchange market, the lucky coupon rate is associated with lower issuance yield of 5.36bps, on average. In contrast, the lucky coupon rate has no similar significant impact on issuance yield for interbank public NFC Bonds as shown in the Column (2). Similar results also hold for Financial Bonds in Columns (3) and (4). Since the interbank investors are more sophisticated than exchange investors, these findings lend support to both the overconfidence and anchoring hypothesis. While superstition affects unsophisticated investors through the channel of overconfidence leading to overvaluation of asset price, it affects sophisticated investors through the channel of anchoring with no systemic price impact. We conduct the same tests for private NFC Bonds, but find no significant results for either exchange or interbank market issued bonds as shown in the Column (5) and (6). Given the fact that investors of private NFC Bonds are the most sophisticated, the anchoring hypothesis can explain the superstition effect in the issuance pricing of private NFC Bonds well.

7. Bond secondary market

In this section, we examine the superstition effect in the bond secondary market. Different from the stock market, bonds are not traded as frequently as stocks. Although the Treasury Bonds and the National Policy Bank Bonds are more liquid when they are on-the-run, most Local Government Bonds, Financial Institution Bonds and NFC Bonds are only traded shortly after issuance and are seldom traded thereafter. We have collected the close price for different types of bonds traded in exchange market from WIND. The daily close price for a bond is calculated by the exchange as the weighted average clean price during the one minute before the last transaction of the bond in the day. According to our interview with experts in Shanghai and Shenzhen exchange, due to the illiquidity, the bond close price is most often the clean price of the last transaction of the day[32]. Therefore, if

[31] Since no interbank issued private NFC bond disclose the issuer characteristics, all the private NFC bonds used in the regression are exchange issued.
[32] If there is no trade in the day, the close price for the bond is missing.

the traders are subject to the influence of the numerological superstition belief, the conditional probability of lucky (unlucky) close price should be larger (smaller) than that purely determined by chance.

In Table 11, we report the conditional probability distribution of the hundredths digit of the close price in the exchange market. The probability of lucky (unlucky) price H_8 (H_4) for the Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Institution Bonds, and public NFC Bonds are 13.08% (8.48%), 12.28% (9.58%), 10.76% (8.03%), 12.23% (7.55%) and 13.95% (7.46%) respectively. Except for Local Government Bonds, the superstition effect is significant for all bond classes. One possible reason for the lack of superstition effect in the Local Government Bonds is the limited number of observations. There are only 2816 bond-day observations corresponding to 322 bonds during the period of April 3rd, 2009-September 30th, 2021, as compared to 747 Local Government Bonds issued in the same period. More than half of the Local Government Bonds have no secondary market transactions at all and there is only about 9 trading days for each bond on average. The number of observations for Local Government Bonds is only a fraction of other types of bonds. For instance, the public NFC Bonds have 238370 observations.

We further divide the close prices of public NFC Bonds into two subsamples based on the credit rating of the bond at the time of transaction: the AAA rated bonds and below AAA rated bonds. The probabilities of the lucky and unlucky prices are reported in Table 12. As can be seen, the superstition effect always exists with the probabilities of lucky (unlucky) price in AAA and below AAA subsamples reaching 13.13% (7.83%) and 14.31% (7.29%) respectively. The superstition effect is stronger for the below AAA group, which is consistent with the uncertainty hypothesis in that the below AAA rated bonds bear more credit default risk[33].

In the interbank market, there is no superstition effect in the bond close price due to the trading and pricing mechanism. As an over-the-counter market, the interbank market transactions are conducted through either direct communication between the two traders or the intermediation of broker/dealer. If the transaction involves broker/dealer, the final price reported would include a proportion of commission fee, which varies across bonds and times. The price superstition effect would then be concealed by the commission fee. In addition, according to our interview with the interbank market traders, among direct transactions without broker/dealer, although the officially recorded and reported transaction price is clean price, many traders actually use yield to conduct negotiation. For these traders, even if they are subject to the superstition belief, it would be reflected in yield rather than clean price.

8. Foreign exchange market

[33] We conduct the same test for Financial Bonds as well, but find no significant difference of the superstition effect between the AAA and below AAA subsample. This result could due to the limited observations, as there is only 6331 observations for Financial Bonds in total. Among them, only 1033 observations are in the below AAA subsample.

The transaction of foreign exchange in China is conducted in two markets. One is the over-the-counter (OTC) market, the other is the interbank foreign exchange market. The OTC market is a retail market between qualified banks and their clients, including individual investors, non-financial corporates, etc. The interbank foreign exchange market is a wholesale market for banks and qualified large non-bank financial institutions. The interbank foreign exchange market is the dominant market accounting for 85% of the foreign exchange transactions in China in 2021. The trading volume in the interbank market and OTC market reached 31.35 trillion USD and 5.52 trillion USD in 2021, respectively.

In this paper, we have focused on the interbank market, where the financial institutions have traded foreign currencies since 1994. The market is supervised by the State Administration of Foreign Exchange. By the end of 2021, there have been 25 market makers out of 748 qualified market participants. The market makers are all large banks, which are responsible for continuously quoting bid and ask prices in response to trading initiatives, so as to provide liquidity and alleviate the exchange rate fluctuation.

Since the USD, Euro, Yen and HKD against CNY transactions account for more than 99% of the total trading volume[34], we focus on the exchange rates of these four currencies. In particular, we calculate the probability distribution of the non-zero digits on the ten-thousandths place of the daily close exchange rate, conditional on the ten-thousandths place as the last digit. The USD against CNY, EUR against CNY, JPY against CNY, and HKD against CNY data start from April 4, 1994, April 1, 2002, March 1, 1995 and April 5, 1994, respectively. All the data end on September 30, 2021. The close exchange rate is measured in the form of direct quotation (how much CNY in exchange of one unit of foreign currency[35]).

As shown in Table 13, we find strong superstition effect in the daily close exchange rate for all four currencies. More specifically, the probabilities of lucky (unlucky) exchange rate for CNY-USD, CNY-EUR, CNY-JPY and CNY-HKD are 12.52% (9.65%), 12.21% (10.90%), 12.35% (9.41%), and 12.75% (9.58%), respectively. The probabilities of lucky (unlucky) price are all significantly higher (lower) than 1/9. [36]

9. Commodities market

China's commodity futures markets have experienced tremendous growth in the past twenty years. The trading volume of commodity futures has grown from 3 trillion yuan in 2000 to 322 trillion Yuan in 2020[37]. China's three major commodity future exchanges, Dalian commodity exchange (DCE), Shanghai Futures Exchange (SHFE), and Zhengzhou Commodity Exchange (ZCE) ranked 7, 9 and 12 among all the derivative markets in the

[34] For instance, the CNY-USD, CNY-EUR, CNY-JPY and CNY-HKD transactions account for 95.93%, 2.73%, 0.42%, and 0.24% of the total trade volume, respectively, in 2021.

[35] Except for the JPY, which is measure in 100 units.

[36] We have also check on the open price but find no similar results. This could due to the fact that every morning before the transaction, the regulator would publish the *central parity rate* for each currency, which is a benchmark to guide the transaction price when market is open. Although the investors do not need to follow the *central parity rate* literarily, it has exerted significant influence on investor's behavior.

[37] According to the *China Future Markets Annual Reports 2020,* published by China Futures Association

world in terms of transactions[38]. Along with China's colossal demand for commodity, surging investor interests and the ongoing liberalization, the once extraneous market in the global commodities trade has become a significant force in determining the international commodity prices[39]. For more detailed institutional background information, please refer to Fan and Zhang (2020).

In China's commodities futures markets, the open price is determined by the batched call auction during the 5 minutes period before transaction starts, while the close price is the last transaction price before market closure. As introduced in the data description section, we have collected daily main contract open and close price of 29 commodities futures, which allow all the ten digits from 0 to 9 to be the last digit of the quoted prices. We pool the open (close) prices of these commodities together and calculate the conditional probabilities of lucky (unlucky) price as we did in other asset classes. In Table 14, the probabilities of lucky (unlucky) open and close price are 13.72% (8.72%) and 12.09% (11.56%), respectively. For open price, the conditional probability of lucky (unlucky) price is significantly larger (smaller) than 1/9. For close price, while the conditional probability of lucky price is significantly higher than 1/9, the conditional probability of unlucky price is close to 1/9. Overall, the superstition effect is stronger in the open price than in the close price.

10. Conclusions

It is well documented that social norm and religious belief could have fundamental political and social impact. In this paper, we have studied how the deeply rooted numerological superstition belief, which has nothing to do with the asset fundamentals, could affect investors' trading behavior and asset prices. We find that the impact of the numerological superstition belief is prevalent across the asset classes and exists in both the primary and secondary markets. The probability of lucky (unlucky) stock, bond, foreign currency and commodity prices are significantly larger (smaller) than would be decided by chance. These findings suggest that there is an intentional effort by investors to trade at lucky prices and to avoid unlucky ones.

Our evidence implies that the superstition effect is driven by uncertainty and overoptimism. On the one hand, the numerological superstition is used by investors to alleviate uncertainty concern as the superstition effect is stronger for assets with more uncertain fundamental value and for assets traded by more unsophisticated investors. On the other hand, the numerological superstition is also closely linked to the overoptimism of unsophisticated investors. For assets traded by sophisticated investors, the numerological superstition provides a natural reference to settle down price without causing any systemic mispricing. In comparison, for assets involving more unsophisticated investors, the superstition effect implies overpricing.

[38] According to the statistics of Futures Industry Association (FIA) 2020

[39] Bloomberg. (2018). China sets new records for gobbling up the world's commodities. Retrieved from https://www.bloombergquint.com/global-economics/world-s-commodity-engine-roars-to-another-record-with-xi-at-helm

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Table 1. Summary Statistics

This table presents the summary statistics of key variables for the IPO and Private Equity Placement (PEP) and bond issuance. Panel A. reports summary statistics for the stock market IPOs. Panel B report summary statistics for PEP. Panel C reports summary statistics for bond issuance. For the stock market IPO data, we divide our sample into stocks listed on Main board, Growth Enterprise Market (GEM) board and Sci-Tech innovation board (STAR). In Panel A and B, we report the sample mean, standard deviation, 25% percentile, 50% percentile and 75% percentile of P/E ratio, book value, gross value raised (Issuance) and SOE dummy. For bond issuance, we report the summary statistics for Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Bonds, public Non-Financial Corporate (NFC) Bonds and private NFC Bonds, respectively. We report the sample mean, standard deviation, 25% percentile, 50% percentile and 75% percentile of the coupon rate, maturity and total value raised (Issuance).

Panel A. Stock market IPO

	Mean	St.D	25%	50%	75%	Obs.
			Full Sample			
P/E	31.89	37.37	21.13	22.99	36.06	3,643
Book value (million)	417.36	1459.08	128.11	193.20	308.00	3,943
Issuance (million)	978.50	3310.70	272.53	448.03	784.00	4,031
SOE	0.26	0.44	0	0	1	3,938
			Main board			
P/E	27.25	17.55	19.37	22.98	29.97	2,491
Book value (million)	479.22	1653.22	127.12	197.21	329.22	2,776
Issuance (million)	1077.09	3762.39	256.00	431.80	784.00	2,864
SOE	0.34	0.47	0	0	1	2,779
			GEM			
P/E	36.35	21.86	22.98	22.99	46.63	926
Book Value (million)	214.40	302.80	121.80	165.32	241.25	926
Issuance (million)	573.91	680.83	290.52	418.05	657.72	926
SOE	0.09	0.28	0	0	0	918
			STAR			
P/E	64.86	125.77	35.32	43.59	56.80	226
Book Value (million)	484.61	167.46	201.74	272.25	395.69	241
Issuance (million)	1361.52	3536.07	525.52	828.33	1252.00	241
SOE	0.05	0.22	0	0	0	241

Panel B. Seasoned equity offering

	Mean	St.D	25%	50%	75%	Obs.
P/E	65.40	63.20	24.52	42.18	77.57	4,236
Book Value (billion)	100.59	106.50	5.12	9.04	19.22	4,482
Issuance (million)	2204.39	5080.98	436.57	850.00	1959.24	4,982
SOE	0.39	0.49	0	0	1	4,889

Panel C. Bond issuance market

	Mean	St. D	25%	50%	75%	Obs.
			Treasury Bonds			
Coupon Rate (%)	3.52	1.59	2.79	3.34	3.90	1,314
Maturity (year)	8.02	7.32	3.00	5.00	10.00	1,314
Issuance (billion)	57.28	69.92	26.00	28.41	60.00	1,314
			National Policy Bank Bonds			
Coupon Rate (%)	3.91	1.75	2.99	3.70	4.24	643
Maturity (year)	5.58	4.72	3.00	5.00	7.00	643
Issuance (billion)	30.45	41.69	10.00	15.00	28.00	643
			Local Government Bonds			
Coupon Rate (%)	3.44	0.48	3.14	3.43	3.82	15,022
Maturity (year)	8.61	5.50	5.00	7.00	10.00	15,022
Issuance (billion)	4.36	5.07	0.89	2.50	6.00	15,022
			Financial Bonds			
Coupon Rate (%)	4.70	1.26	3.78	4.60	5.50	14,985
Maturity (year)	2.84	3.77	1.00	1.00	3.00	14,985
Issuance (billion)	1.93	5.73	0.18	0.64	2.00	14,985
			Public NFC			
Coupon Rate (%)	4.72	1.56	3.55	4.62	5.80	48,971
Maturity (year)	3.80	5.21	0.75	1.00	5.00	48,971
Issuance (billion)	1.23	1.43	0.50	1.00	1.50	48,971
			Private NFC			
Coupon Rate (%)	5.97	1.27	4.94	6.00	7.00	12,551
Maturity (year)	3.92	2.12	3.00	3.00	5.00	12,551
Issuance (billion)	0.86	0.73	0.50	0.63	1.00	12,551

Table 2. The superstition effect of stock IPO and PEP price

This table presents the probability distribution of the last digit for IPO and PEP prices, respectively. Panel A reports the probability distribution of the last digit at the hundredths place (the hundredths digit is nonzero) for IPO prices on the main board and GEM board. Panel B reports the probability distribution of the last digit at the tenths place (the hundredths digit is zero) for IPO prices on the main board and GEM board. Panel C reports the probability distribution of the last digit at the hundredths place (the hundredths digit is nonzero) for IPO prices on STAR board. Panel D reports the probability distribution of the last digit at the hundredths place (nonzero) for PEP prices. We report the number counts and the conditional probability (in %) in each panel. The t-statistics for each digit is derived from a standard sample mean t-test against 1/9.

Panel A. A share and GEM, hundredths place

				Period: 1/1/1995 —— 6/30/2014						
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	57	77	77	48	133	128	55	344	117	1,036
%	5.50	7.43	7.43	4.63	12.84	12.36	5.31	33.20	11.29	100
t-stats	-7.91	-4.51	-4.51	-9.91	1.66	1.22	-8.33	15.09	0.19	
				Period: 7/1/2014 —— 3/31/2021						
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	129	141	149	150	134	146	156	140	137	1,282
%	10.06	11.00	11.62	11.70	10.45	11.39	12.17	10.92	10.69	100
t-stats	-1.25	-0.13	0.57	0.66	-0.77	0.31	1.16	-0.22	-0.49	

Panel B. A share and GEM, tenths place

				Period: 1/1/1995 —— 6/30/2014						
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	40	71	46	38	122	80	30	141	44	612
%	6.54	11.60	7.52	6.21	19.93	13.07	4.90	23.04	7.19	100
t-stats	-4.58	0.38	-3.37	-5.02	5.46	1.44	-7.11	7.00	-3.75	
				Period: 7/1/2014 —— 3/31/2021						
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	13	15	15	13	18	18	13	17	11	133
%	9.77	11.28	11.28	9.77	13.53	13.53	9.77	12.78	8.27	100
t-stats	-0.52	0.06	0.06	-0.52	0.81	0.81	-0.52	0.58	-1.18	

Panel C. STAR, hundredths place

#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	22	21	25	11	21	27	18	31	30	206
%	10.68	10.19	12.14	5.34	10.19	13.11	8.74	15.05	14.56	100
t-stats	-0.20	-0.43	0.45	-3.68	-0.43	0.85	-1.20	1.58	1.40	

Panel D. Private Equity Placement, Hundredths place

				Period: 1/1/1998 —— 3/31/2021						
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	493	412	396	306	485	419	344	508	342	3,705
%	13.31	11.12	10.69	8.26	13.09	11.31	9.28	13.71	9.23	100
t-stats	3.93	0.02	-0.83	-6.31	3.57	0.38	-3.83	4.60	-3.95	

Table 3. Cross-sectional superstition effect of IPOs and PEP price

This table reports the cross-sectional probabilities of digit 4 (unlucky) and 8 (lucky) as the last digit of IPO and PEP prices at the hundredth and tenths place, respectively. For IPO prices, our sample include all the main board and GEM IPOs during the period of flexible price control from 1/1/1995 to 6/30/2014. For PEP prices, the sample covers the entire period from 1/1/1998 to 3/31/2021. We divide the full sample into three subsamples (High 30%; Middle 40%; Low 30%) based on firms' P/E ratio, total asset and state ownership, respectively. Within each subsample, the table reports both the probability of digit 4 & 8 in percentage points and the t-statistics in parenthesis. The t-statistics are derived from performing a sample mean t-test against 1/9.

		IPO				PEP	
		Hundredths (%)		Tenths (%)		Hundredths (%)	
		4	**8**	**4**	**8**	**4**	**8**
P/E Ratio	High. 30%	1.98 (-10.37)	46.03 (11.10)	2.65 (-6.45)	33.11 (5.73)	8.27 (-3.14)	13.53 (2.16)
	Mid. 40%	4.96 (-5.24)	30.32 (7.73)	5.21 (-3.67)	23.44 (4.02)	7.33 (-5.12)	13.20 (2.18)
	Low 30%	6.25 (-3.21)	29.30 (6.38)	9.26 (-0.81)	17.28 (2.07)	9.01 (-2.24)	14.38 (2.84)
Total Asset	High. 30%	4.03 (-6.21)	32.89 (7.99)	5.03 (-3.71)	21.23 (3.30)	8.20 (-3.50)	14.09 2.82
	Mid. 40%	5.76 (-4.58)	33.33 (9.40)	8.33 (-1.55)	23.33 (4.47)	8.56 (-3.47)	14.01 3.18
	Low 30%	4.35 (-5.73)	34.78 (8.58)	3.89 (-5.00)	26.11 (4.57)	8.19 (-3.51)	13.43 2.42
State Owned	SOE	4.37 (-7.06)	33.62 (10.19)	7.98 (-1.78)	23.53 (4.51)	8.83 (-3.00)	14.36 3.45
	Non SOE	4.91 (-6.61)	33.77 (11.02)	4.93 (-5.30)	24.06 (5.62)	7.81 (-5.84)	13.58 3.42

Table 4. Post IPO and PEP performance of stocks with lucky (unlucky) price

This table presents the Fama-MacBeth regression results on the monthly market adjusted abnormal return three years after stock's IPO and PEP. The dependent variable is the market adjusted abnormal return at monthly frequency. It is obtained by subtracting the market return from each stock's raw return. The main independent variable includes *No.4* and *No.8*, which are dummy variables indicating whether the hundredths place of a price is digits 4 and 8, respective. Additional control variables include *Log* (*BM*), which is the logarithm of book-to-market ratio. *Log* (*MktVal*) is the logarithm of market value. Ownership is a firm's the largest shareholder's ownership on the first day of trading. *TAccrual* is defined as in Hirshleifer et al. (2016), which is computed as the net income minus cash flow from operating activities divided by total assets. Industry fixed effects are controlled. ***, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	IPO (%)		PEP (%)
	Flexible price control	Strict price control	
No. 4	0.441*	-0.274	-0.151
	(1.83)	(-1.44)	(-0.88)
No. 8	-0.469***	0.045	-0.167
	(-3.63)	(0.09)	(-1.52)
Log (BM)	-7.755	-10.564	-1.328***
	(-1.26)	(-1.15)	(-2.89)
Log (MktVal)	-0.611	-0.600	-0.214**
	(-0.64)	(-0.51)	(-2.43)
Ownership	1.473	-0.356	0.014***
	(0.60)	(-0.74)	(3.31)
TAccrual	-2.888	-0.905	0.388
	(-1.01)	(-0.42)	(0.52)
Industry FE	Yes	Yes	Yes
R2	0.05	0.08	0.04
Obs.	60,629	35,210	74,087

Table 5. The superstition effect in stock secondary market

This table reports the probability distribution of the hundredths digit of stock open and close price conditional on that the hundredths digit is the last one (nonzero). The sample is from July 1st, 2006 to September 30th, 2021. We report the probability distribution of the hundredths digit of open price in Panel A. Since the close price was originally calculated as the weighted average trading price before market closure and then was determined through batched call auction[40], we divide the sample of close price into two subsamples according to how they are determined. The probability distribution of the close price determined by batched call auction is reported in Panel B. The probability distribution of the close price determined by weighted average is reported in Panel C. We report the number counts and the conditional probability (in %) in each panel. The t-statistics for each digit is derived from a standard sample mean t-test against 1/9.

Panel A: Open price										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	775,967	709,964	675,326	586,906	1,063,477	716,495	616,445	927,662	753,483	6,825,725
%	11.37	10.40	9.89	8.56	15.58	10.50	9.03	13.59	11.04	100
t-stats	21.17	-60.75	-110.00	-230.00	321.96	-52.35	-190.00	189.04	-6.02	
Panel B: Close price determined by batched call auction										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	548,197	562,220	553,613	517,644	702,089	563,382	531,152	647,270	586,936	5,212,503
%	10.52	10.79	10.62	9.93	13.47	10.81	10.19	12.42	11.26	100
t-stats	-44.22	-23.93	-36.33	-90.10	157.71	-22.27	-69.52	90.45	10.77	
Panel C: Close price determined by weighted average										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	248,575	242,281	239,587	245,035	251,461	240,152	242,940	257,957	273,692	2,241,680
%	11.09	10.81	10.69	10.93	11.22	10.71	10.84	11.51	12.21	100
t-stats	-1.06	-14.62	-20.51	-8.65	5.05	-19.27	-13.18	18.59	50.22	

[40] Shenzhen Exchange changed on July 1, 2006 and Shanghai Exchange changed on August 20, 2018

Table 6. The superstition effect and uncertainty

This table presents the regression results in testing the relationship between numerological superstition, risk and uncertainty in the secondary stock market. The dependent variables are annual conditional probability of digit 4 and 8 at the hundredths place of stock open price and close price. The *Ambiguity* is calculated by the methodology of Izhakian and Brenner (2018) and the *Risk* is calculated as the standard deviation of daily returns over the past 2 years. In addition, we control for the logarithm of the book-to-market ratio (*BM*), the logarithm of market value (*Size*), *Leverage, ROA, and Ownership* at the end of last year. All the independent variables are normalized with the sample mean and standard deviation. The standard errors are double clustered at the firm and year level. The t-statistics are reported in the parenthesis. ***, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	Open price		Close price (call auction)		Close price (average)	
	No. 4 (%)	No. 8 (%)	No. 4 (%)	No. 8 (%)	No. 4 (%)	No. 8 (%)
Ambiguity	-0.0431*	0.0841**	-0.0557**	0.0644***	-0.0045	-0.0197
	(-1.82)	(2.80)	(-2.27)	(3.30)	(-0.06)	(-0.46)
Risk	-0.0322	0.0485*	-0.0053	0.0281	-0.0744	0.0198
	(-1.13)	(1.93)	(-0.36)	(1.35)	(-1.12)	(0.27)
BM	0.5328***	-0.4659***	0.3777***	-0.3217***	0.1681***	-0.0516
	(11.25)	(-10.40)	(7.22)	(-6.25)	(3.41)	(-0.91)
Size	-0.1039	0.0790	-0.1215***	0.0080	0.0068	-0.0689
	(-1.43)	(1.17)	(-1.62)	(0.10)	(0.08)	(-0.84)
Leverage	0.6404***	-0.5354***	0.4511***	-0.5881***	0.1385	0.1498
	(6.97)	(-4.14)	(3.20)	(-4.43)	(0.68)	(1.24)
ROA	-0.6144***	0.6280***	-0.1044	0.4666**	0.1644	0.0209
	(-3.87)	(3.95)	(-0.95)	(2.74)	(0.33)	(0.05)
Ownership	-0.0896**	0.1334**	-0.1333**	0.1878***	-0.0006	-0.0326
	(-2.48)	(2.74)	(-2.72)	(4.20)	(-0.01)	(-0.42)
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Double clustering	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.29	0.26	0.24	0.24	0.15	0.15
Obs.	29,307	29,307	20,112	20,112	7,768	7,768

Table 7. Superstition portfolio returns

This table shows the short-run predictability of lucky and unlucky price in the secondary stock market. Specifically, we calculate a luck proxy for each stock, which is equal to the frequency difference between daily close price ending with 8 and 4 at the hundredths place in each month. The stocks are divided into two groups (Small and Large) based on their total market value. For each group, we then sort stocks into five portfolios based on the luck proxy. The monthly long-short portfolio is constructed by going long stocks in the quintile with the smallest luck proxy and selling short stocks in the largest quintile. The long-short portfolio is held for one month. Column (1) and (2) use the subsample of stocks with close price determined by batched call auction. In the Column (3) and (4) use the subsample of stocks with close price determined by weighted average. We control for Fama-French 3 factors in each regression analysis. The t-statistics derived from Newey-West standard error with 6 lag is shown in parenthesis. The respective sharpe ratio is also shown in the bottom of the table. ***, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	Call auction (in %)		*Placebo* (in %)	
	Small	Large	Small	Large
	(1)	(2)	(3)	(4)
Alpha	0.478***	0.264	0.239	-0.370
	(3.53)	(1.58)	(1.62)	(-1.10)
Risk Premium	2.565	7.459**	1.654	1.781
	(1.35)	(2.18)	(0.83)	(0.41)
SMB	5.273	14.999***	-1.318	7.378
	(1.55)	(3.60)	(-0.39)	(1.33)
HML	18.140***	32.753***	4.218	11.725
	(2.87)	(4.88)	(0.89)	(0.96)
Sharpe Ratio	1.00	0.49	0.44	-0.25
Obs.	182	182	145	145

Table 8. The superstition effect in bond coupon rate

This table presents the probability distribution of digit 1 to 9 at the hundredths place of coupon rate conditional on that the hundredths digit is the last one (nonzero) for different types of bonds, including Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Bonds, public Non-Financial Corporate (NFC) Bonds and private NFC Bonds. We divide the Treasury Bonds into subsamples according to whether the maturity is larger than 10 years. We also divide the Financial Bonds, Public NFC Bonds, and Private NFC Bonds into subsamples according to whether they are issued in the exchange market (Exchng) or interbank market (Interbk). We report the conditional probability (in %) and the t-statistics for each digit. The t-statistics is derived from a standard sample mean t-test against 1/9.

	Treasury Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Full (%)	9.72	14.69	11.02	10.80	12.53	10.58	10.80	9.94	9.94	463
t-stats	-1.01	2.17	-0.07	-0.22	0.92	-0.37	-0.22	-0.84	-0.84	
>10 Y (%)	6.76	12.16	10.81	9.46	12.16	14.86	12.16	12.16	9.46	74
t-stats	-1.48	0.27	-0.08	-0.48	0.27	0.90	0.27	0.27	-0.48	
≤10 Y (%)	10.28	15.17	11.05	11.05	12.60	9.77	10.54	9.51	10.03	389
t-stats	-0.54	2.23	-0.04	-0.04	0.88	-0.89	-0.37	-1.07	-0.71	
	National Policy Bank Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	8.32	10.10	11.09	10.89	21.78	7.72	7.72	10.89	11.49	505
t-stats	-2.27	-0.75	-0.02	-0.16	5.80	-2.85	-2.85	-0.16	0.26	
	Local Government Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	10.18	9.86	11.15	10.44	11.96	11.37	11.85	11.86	11.33	7,158
t-stats	-2.59	-3.54	0.10	-1.87	2.21	0.70	1.93	1.95	0.58	
	Financial Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Exchng (%)	0.76	3.79	6.32	6.83	36.54	3.03	8.34	22.25	12.14	791
t-stats	-33.54	-10.77	-5.53	-4.77	14.84	-13.24	-2.81	7.53	0.88	
Interbk (%)	2.50	6.92	6.98	9.42	31.19	4.47	7.33	16.52	14.67	1,677
t-stats	-22.55	-6.77	-6.64	-2.37	17.74	-13.15	-5.93	5.96	4.12	
	Public NFC Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Exchng (%)	1.99	4.62	6.97	7.93	26.52	3.98	10.13	22.93	14.93	2,813
t-stats	-34.62	-16.39	-8.63	-6.25	18.51	-19.34	-1.72	14.91	5.68	
Interbk (%)	2.92	6.12	7.78	7.38	25.87	5.57	9.93	20.01	14.42	24,716
t-stats	-76.55	-32.76	-19.55	-22.41	52.97	-37.97	-6.22	34.97	14.82	
	Private NFC Bonds									
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Exchng (%)	1.08	2.46	5.12	5.04	27.69	4.00	9.70	25.44	19.48	2,402
t-stats	-47.49	-27.40	-13.32	-13.61	18.15	-17.80	-2.34	16.12	10.36	
Interbk (%)	2.00	3.26	5.64	5.51	30.18	5.13	9.33	22.29	16.66	1,597
t-stats	-25.96	-17.68	-9.49	-9.81	16.60	-10.82	-2.45	10.73	5.95	

Table 9. Cross-sectional superstition effect in bond coupon rate

This table examines the superstition effect across different credit rating categories for public Non-Financial Corporate (NFC) Bonds, private NFC Bonds and Financial Bonds. The table presents the probability of digit 4 and 8 at the hundredths place of coupon rate conditional on that the hundredths digit is the last one (nonzero) for A-1, AAA and below AAA rated bonds. We report the conditional probability (in %) and the t-statistics, which is derived from a standard sample mean t-test against 1/9.

	Public NFC				
	No. 4			No. 8	
Credit Rating	N	Mean (%)	t-Stat.	Mean (%)	t-Stat
A-1	4,758	8.24	-7.21	18.20	12.67
AAA	6,525	8.29	-8.26	20.64	19.02
Below AAA	6,956	6.79	-14.34	24.05	25.25
	Private NFC				
	No. 4			No. 8	
Credit Rating	N	Mean (%)	t-Stat.	Mean (%)	t-Stat
AAA	267	3.75	-6.33	24.34	5.03
Below AAA	484	3.51	-9.07	30.58	9.29
	Financial Bonds				
	No. 4			No. 8	
Credit Rating	N	Mean (%)	t-Stat.	Mean (%)	t-Stat
A-1	875	11.31	0.19	17.37	4.89
AAA	775	6.84	-4.71	19.23	5.73
Below AAA	517	7.74	-2.87	19.54	4.83

Table 10. Credit spread and superstition in bond issuance

This table presents the regression results in testing the asset pricing implication of superstition. The dependent variable is the bond's yield spread at issuance, which is the difference between a bond's coupon rate and the Treasury bond yield of similar maturity at the issuance. The main independent variable is *No. 8* which is a dummy variable indicating whether the hundredths place of a bond's coupon rate is number 8. In addition, we control for both the firm and bond characteristics including the logarithm of total asset *Log*(*Asset*), ROA, leverage ratio, the logarithm of issuance amount *Log*(*Issuance*), bond maturity, and the callable (puttable) dummy variable, which takes the value of 1 if the bond is callable (puttable), and 0 otherwise. In all the regressions, the issuer fixed effect and the rating-month joint fixed effects are controlled. The t-statistics derived from standard error clustering by month are reported in the parenthesis. ***, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	Public NFC (%)		Financial (%)		Private NFC (%)	
	Exchange	Interbank	Exchange	Interbank	Exchange	Interbank
No. 8	-0.0539**	-0.0215	-0.0808*	-0.0261	-0.0757	-0.0323
	(-2.45)	(-1.60)	(-1.86)	(-0.64)	(-1.20)	(-1.20)
Log (Asset)	-0.1147**	-0.1550***	-0.6285***	-0.0024	0.2212	
	(-1.99)	(-4.67)	(-5.02)	(-0.01)	(0.94)	
ROA	-0.0117	-0.0002	0.0006	-0.1365**	0.0007	
	(-1.55)	(-1.03)	(0.03)	(-2.06)	(0.18)	
Leverage	-0.0036	0.0024***	0.0446*	-0.108	0.0253	
	(-0.38)	(3.53)	(1.73)	(-0.84)	(0.96)	
Log (Issuance)	-0.0321*	-0.0168	-0.0067	0.0281	-0.0044	-0.0463**
	(-1.83)	(-1.21)	(-0.28)	(1.23)	(-0.15)	(-2.33)
Maturity	0.0070	0.0280***	-0.0116	-0.0152	-0.0558*	0.0015
	(1.04)	(5.62)	(-0.65)	(-1.29)	(-1.72)	(0.09)
Callable	0.1300**	0.6829***	0.0014	0.5187***	-0.0127	0.3046
	(2.32)	(13.29)	(0.02)	(5.89)	(-0.10)	(1.50)
Puttable	-0.2034***	-0.1241***	-0.3449***	0.1393*	0.0281	-0.0728**
	(-6.50)	(-4.61)	(-5.96)	(1.94)	(0.41)	(-2.15)
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating x *month FE*	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by month	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.91	0.85	0.84	0.89	0.90	0.86
Obs.	5,440	10,423	1,335	981	1,742	3,954

Table 11. The superstition effect in bond secondary market

This table reports the probability distribution of the hundredths digit of the bond's close clean price, conditional on that the hundredths digit is the last one (nonzero), in the exchange market. The different types of bonds include Treasury Bonds, National Policy Bank Bonds, Local Government Bonds, Financial Bonds, public NFC Bonds and private NFC Bonds. We report the conditional probability (in %) and the standard t-statistics, which is calculated by performing a sample mean t-test against the 1/9.

Treasury Bonds										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	10.91	10.09	8.90	8.48	16.52	9.76	8.98	13.08	13.28	71,536
t-stats	-1.68	-9.08	-20.75	-25.25	38.97	-12.19	-19.96	15.60	17.08	
National Policy Bank Bonds										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	9.20	9.34	9.39	9.58	17.58	9.82	9.74	12.28	13.07	8,686
t-stats	-6.17	-5.68	-5.48	-4.85	15.84	-4.04	-4.31	3.33	5.41	
Local Government Bonds										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	15.13	11.01	7.42	8.03	20.10	8.91	6.64	10.76	12.00	2,816
t-stats	5.95	-0.17	-7.47	-6.03	11.90	-4.09	-9.53	-0.60	1.46	
Financial Bonds										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	10.73	8.48	8.55	7.55	20.79	8.53	8.99	12.23	14.17	6,331
t-stats	-0.99	-7.51	-7.30	-10.72	18.97	-7.35	-5.91	2.71	6.98	
Public NFC Bonds										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
(%)	10.14	8.33	7.51	7.46	20.14	8.46	8.21	13.95	15.81	238,370
t-stats	-15.75	-49.04	-66.76	-67.80	109.9	-46.54	-51.65	39.95	62.84	

Table 12. Cross-sectional superstition effect in bond secondary market

This table examines the superstition effect across different credit rating categories for public Non-Financial Corporate (NFC) Bonds. The table presents the probability of digit 4 and 8 at the hundredths place of close clean price, conditional on that the hundredths digit is the last one (nonzero), for AAA and below AAA rated bonds. We report the sample size, conditional probability and the t-statistics, which is derived from a standard sample mean t-test against 1/9.

	Public NFC				
	No. 4			No. 8	
Credit Rating	N	Mean (%)	t-Stat.	Mean (%)	t-Stat.
AAA	72,668	7.83	-32.96	13.13	16.09
below AAA	165,345	7.29	-59.69	14.31	37.16

Table 13. The superstition effect in foreign exchange market

This table reports the probability distribution of the non-zero digits at the ten-thousandth place of the daily close exchange rate, conditional on the ten-thousandth place as the last digit for different currency pairs. Panel A, B, C, D report the results for the currency pairs of USD-CNY, EUR-CNY, JPY-CNY and HKD-CNY, respectively. We report the number counts and the probability distribution (in %) in each panel. The t-statistics for each digit is derived from a standard sample mean t-test against 1/9.

Panel A: Close price USD										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	476	566	515	529	1,095	548	514	686	551	5,480
%	8.69	10.33	9.40	9.65	19.98	10.00	9.38	12.52	10.05	100
t-stats	-6.37	-1.90	-4.35	-3.65	16.42	-2.74	-4.40	3.15	-2.60	
Panel B: Close price EUR										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	430	451	448	443	493	470	398	496	434	4,063
%	10.58	11.10	11.03	10.90	12.13	11.57	9.80	12.21	10.68	100
t-stats	-1.09	-0.02	-0.17	-0.43	2.00	0.91	-2.82	2.13	-0.89	
Panel C: Close price JPY										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	527	502	465	411	631	428	399	539	464	4,366
%	12.07	11.50	10.65	9.41	14.45	9.80	9.14	12.35	10.63	100
t-stats	1.95	0.80	-0.99	-3.84	6.28	-2.91	-4.52	2.48	-1.04	
Panel D: Close price HKD										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	575	613	620	564	728	637	687	751	715	5,890
%	9.76	10.41	10.53	9.58	12.36	10.81	11.66	12.75	12.14	100
t-stats	-3.49	-1.77	-1.46	-4.00	2.91	-0.73	1.32	3.77	2.42	

Table 14. The superstition effect in commodity markets

This table reports the probability distribution of the non-zero digits in the daily open and close price of commodity future contracts (main contracts). The probabilities are conditional on that the last digit of the reported price is non-zero. Panel A is for the open price and Panel B is for the close price. We report the number counts and the probability distribution (in %) in each panel. The t-statistics for each digit is derived from a standard sample mean t-test against 1/9.

Panel A: Open price										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	5,290	5,601	4,561	4,241	7,892	5,475	4,043	6,670	4,840	48,613
%	10.88	11.52	9.38	8.72	16.23	11.26	8.32	13.72	9.96	100
t-stats	-1.17	2.99	-12.56	-18.41	29.04	1.33	-21.76	16.39	-8.35	
Panel B: Close price										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Count	5,574	6,465	5,674	6,434	6,365	6,435	5,867	6,726	6,110	55,650
%	10.02	11.62	10.20	11.56	11.44	11.56	10.54	12.09	10.98	100
t-stats	-9.03	3.74	-6.54	3.70	1.88	3.06	-4.53	7.15	-0.71	

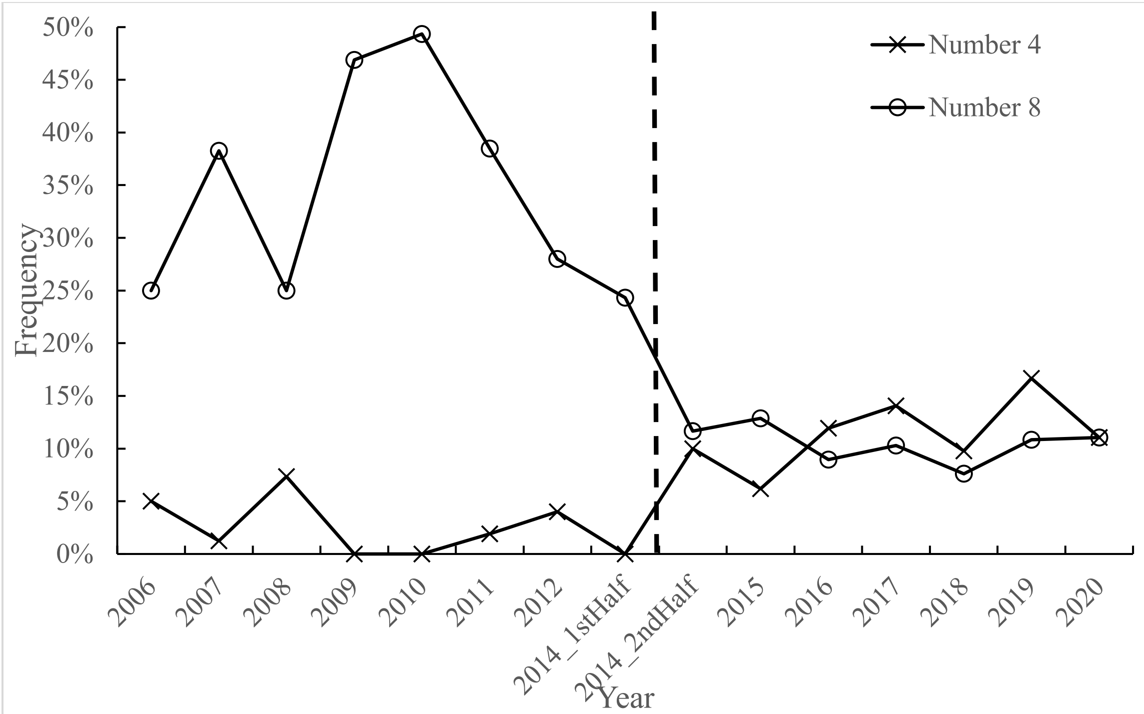

Figure 1. Superstition effect in stock IPO price

This figure plots the annual probability (in %) of number 4 and 8 on the hundredths place of stock IPO price, conditional on that the hundreds digit is the last one (nonzero), for stocks listed on the main board and GEM board from 2006 to 2020. The strict IPO price control was implemented in the middle of 2014, which is shown as the black dashed vertical line.

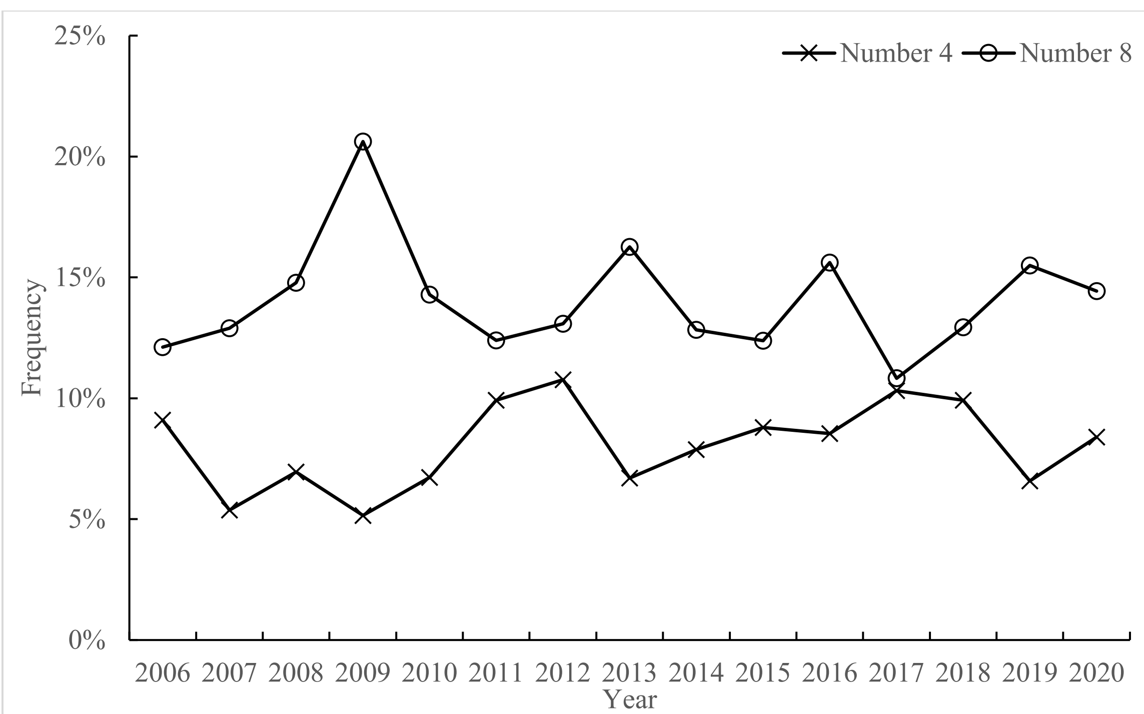

Figure 2. Superstition effect in PEP price

This figure plots the annual probability of number 4 and 8 on the hundredths place of PEP price, conditional on that the hundredths digit is the last one (nonzero), for stocks listed on the main board and GEM board stocks from year 2006 to year 2020.

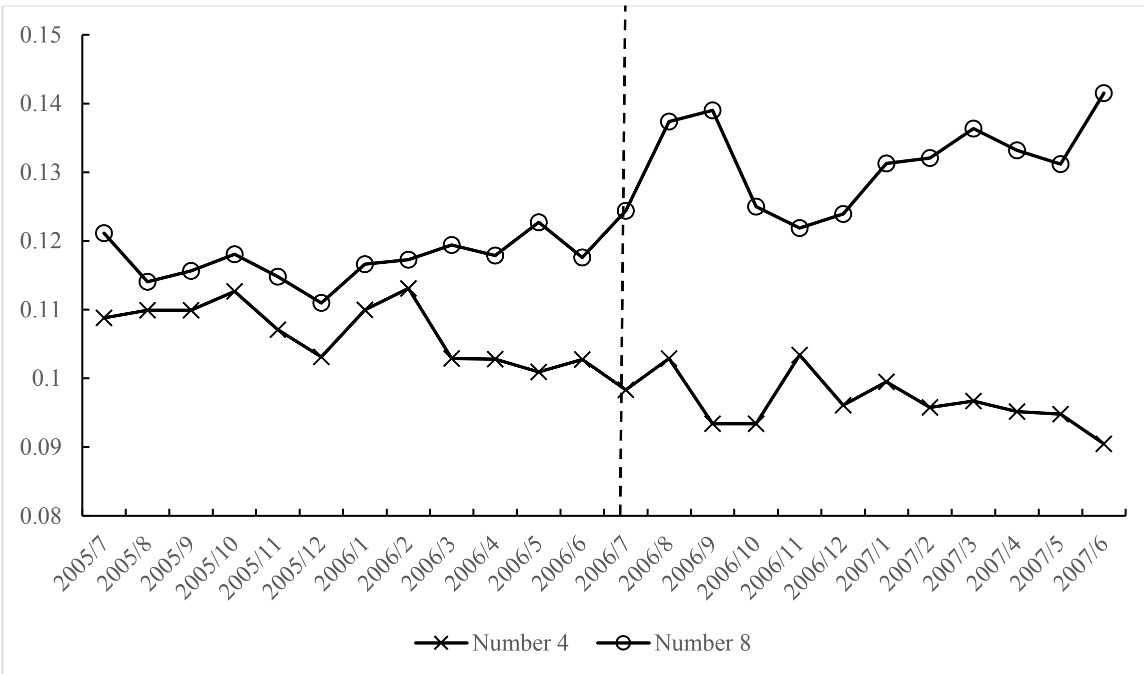

Figure 3.1. The probability of the hundredths digit being 4 & 8 for the close price of stocks listed on the main board at Shenzhen Exchange.

This figure plots the monthly probability of number 4 and 8 at the hundredths place of close price, conditional on that the hundredths digit is the last one (nonzero), for main board and GEM board stocks listed at the Shenzhen Exchange. The vertical dashed line is the time (July 1st, 2006) when the batched call auction was first introduced to determine daily close price.

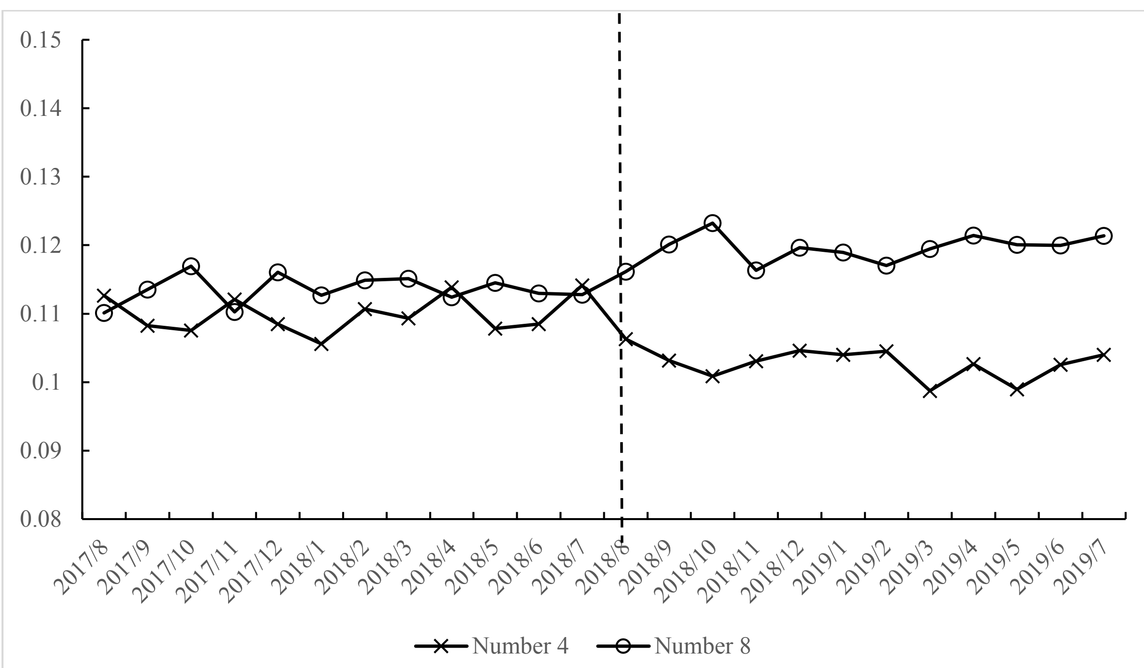

Figure 3.2. Frequency plot of hundredths place digit being 4 & 8 for the closing price of stocks listed on Shanghai Exchange.

This figure plots the monthly probability of number 4 and 8 at the hundredths place of close price, conditional on that the hundredths digit is the last one (nonzero), for main board stocks listed at the Shanghai Exchange. The vertical dashed line is the time (August 20th, 2018) when the batched call auction mechanism was first introduced to determine daily close price at Shanghai Exchange.

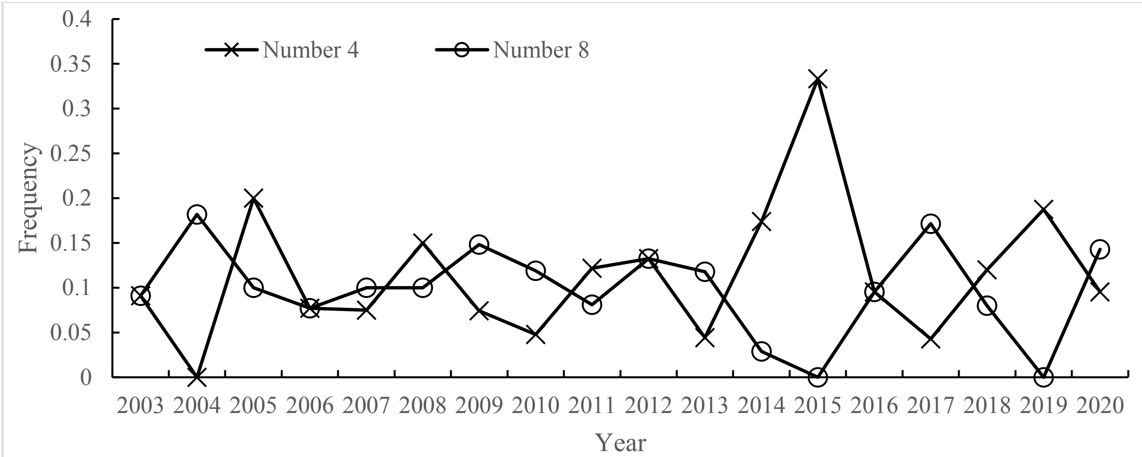

Figure 4.1. Superstition effect in Treasury Bonds

This Figure plots the annual probability of number 4 and 8 on the hundredths place of Treasury Bonds' coupon rates, conditional on that the hundredths place is nonzero.

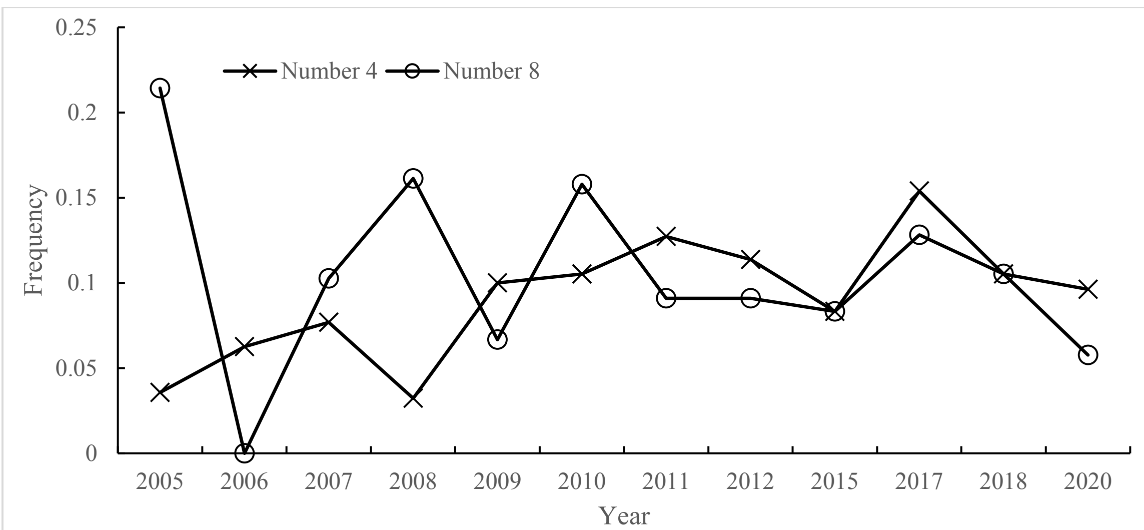

Figure 4.2. Superstition effect in National Policy Bank Bonds

This Figure plots the annual probability of number 4 and 8 on the hundredths place of National Policy Bank Bonds' coupon rates, conditional on that the hundredths place is nonzero.

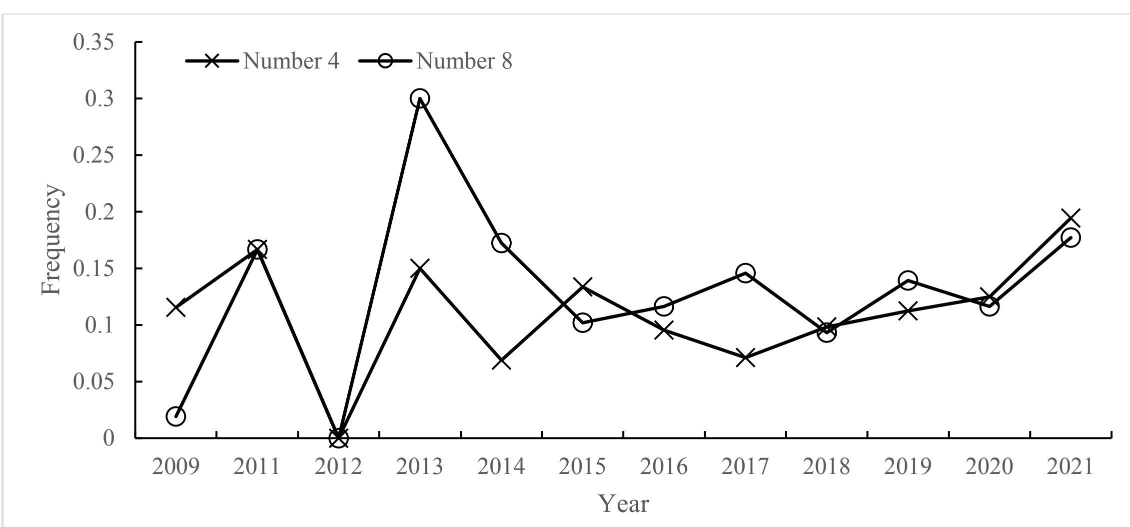

Figure 4.3. Superstition effect in Local Government Bonds

This Figure plots the annual probability of number 4 and 8 on the hundredths place of Local Government Bonds' coupon rates, conditional on that the hundredths place is nonzero.

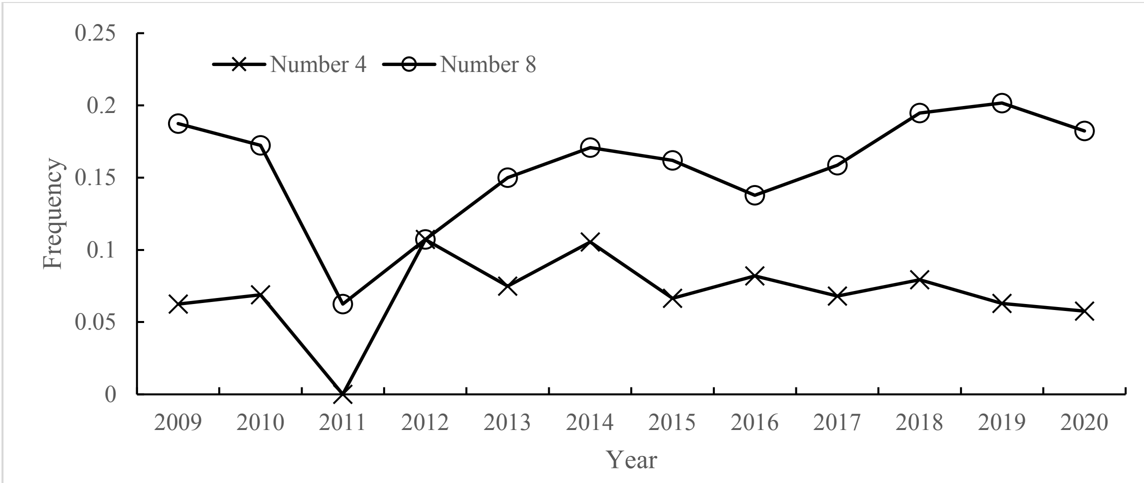

Figure 4.4. Superstition effect in Financial Bonds.

This Figure plots the annual probability of number 4 and 8 on the hundredths place of Financial Bonds' coupon rates, conditional on that the hundredths place is nonzero.

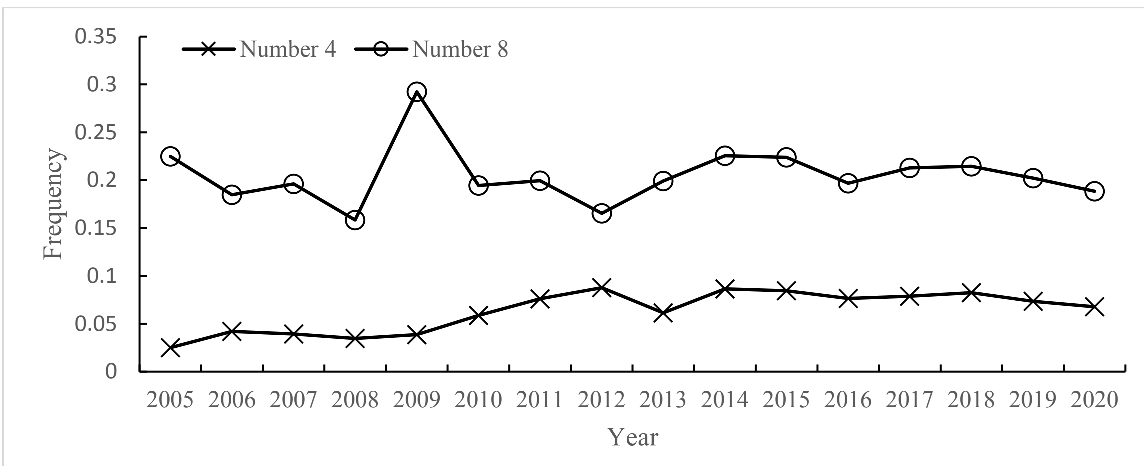

Figure 4.5. Superstition effect in public NFC Bonds

This Figure plots the annual probability of number 4 and 8 on the hundredths place of public NFC Bonds' coupon rates, conditional on that the hundredths place is nonzero.

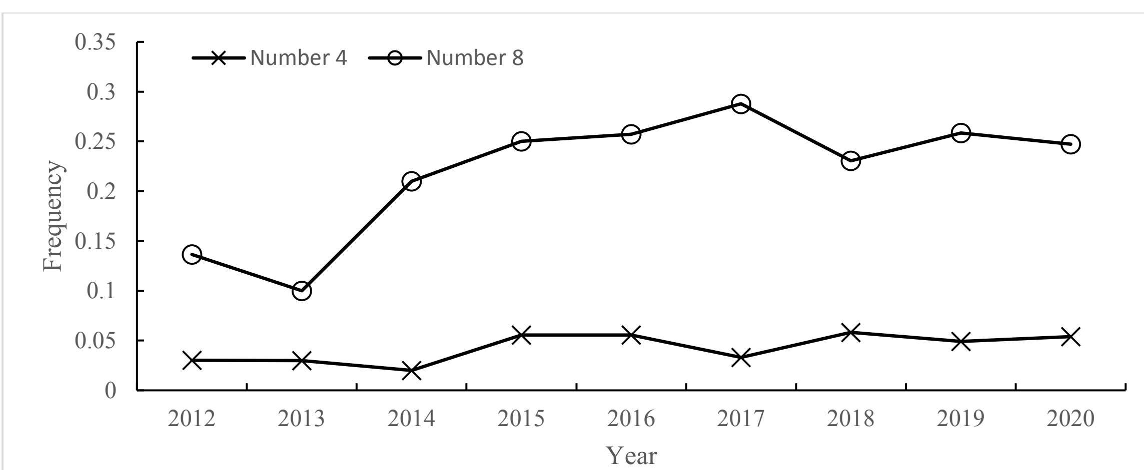

Figure 4.6. Superstition effect in private NFC Bonds

This Figure plots the annual probability of number 4 and 8 on the hundredths place of private NFC Bonds' coupon rates, conditional on that the hundredths place is nonzero.

Appendix

The mechanism of the batched call auction

The mechanism of a batched call auction can be illustrated by an example. The following table describes all the bid and ask orders during a call auction before the market opens. The buy orders are ranked by the descending order of bid prices from 10.22 to 9.90 as B1 to B4. Whereas the sell orders are ranked by the ascending order of offer prices from 10.00 to 10.31 as S1 to S4. For each reference price listed in the table, there is a set of buy/sell orders that can be potentially matched. All the buy (sell) orders, which bid (offer) higher (lower) prices than, or equal to, the reference price can be matched at the current reference price. The matched trading volume for a given reference price is the minimum of the aggregate buy and sell volumes of all the matched orders. Taking a reference price of 10.18 for example, at this reference price, the potentially matched buy orders are B1 and B2 and potentially matched sell orders are S1 and S2. The aggregate volume from the buy orders are 300 shares (150+150) and the aggregate volume from the sell orders are 350 shares (250 + 100). Therefore, the matched volume for the reference price of 10.18 is 300, which is the minimum of the two aggregate volumes.

Buy order: volume	Price	Sell order: volume	Matched volume
	10.31	S4: 500	0
B1: 150	10.22	S3: 300	150
B2: 150	10.18	S2: 250	300
B3: 200	10.00	S1: 100	100
B4: 300	9.90		0

The system will calculate the matched volume for each price in a call auction, and the final price is the price which can achieve the largest matched trading volumes. In the case of the above example, as shown in the last column, the open price will be determined as 10.18, which achieves the highest volume.

Table A1 The list of commodities futures

No.	Ticker	Commodity	Exchange	Contract size	Quote units	First price date
1	A.DCE	No.1 Soybean	DCE	10 tons/lot	1 yuan/ton	2000/01/04
2	M.DCE	Soybean Meal	DCE	10 tons/lot	1 yuan/ton	2000/07/17
3	C.DCE	Corn	DCE	10 tons/lot	1 yuan/ton	2004/09/22
4	CS.DCE	Corn Starch	DCE	10 tons/lot	1 yuan/ton	2014/12/19
5	JD.DCE	Egg	DCE	5 tons/lot	1 yuan/500kg	2013/11/08
6	RR.DCE	Round-grained Rice	DCE	10 tons/lot	1 yuan/ton	2019/08/16
7	PP.DCE	PP	DCE	5 tons/lot	1 yuan/ton	2014/02/28
8	EG.DCE	Ethylene Glycol	DCE	10 tons/lot	1 yuan/ton	2018/12/10
9	EB.DCE	Ethenylbenzene	DCE	5 tons/lot	1 yuan/ton	2019/09/26
10	WH.CZC	Strong Gluten Wheat	ZCE	20 tons/lot	1 yuan/ton	2003/03/31
11	PM.CZC	Common Wheat	ZCE	50 tons/lot	1 yuan/ton	2012/01/20
12	SR.CZC	White Sugar	ZCE	10 tons/lot	1 yuan/ton	2006/01/06
13	OI.CZC	Rapeseed Oil	ZCE	10 tons/lot	1 yuan/ton	2007/06/08
14	RM.CZC	Rapeseed Meal	ZCE	10 tons/lot	1 yuan/ton	2012/12/28
15	RS.CZC	Rapeseed	ZCE	10 tons/lot	1 yuan/ton	2012/12/28
16	RI.CZC	Early Rice Indica	ZCE	10 tons/lot	1 yuan/ton	2009/04/20
17	AP.CZC	Apple	ZCE	10 tons/lot	1 yuan/ton	2017/12/22
18	MA.CZC	Methanol	ZCE	10 tons/lot	1 yuan/ton	2011/10/28
19	UR.CZC	Urea	ZCE	20 tons/lot	1 yuan/ton	2019/08/09
20	FG.CZC	Flat Glass	ZCE	20 tons/lot	1 yuan/ton	2012/12/03
21	SA.CZC	Soda Ash	ZCE	20 tons/lot	1 yuan/ton	2019/12/06
22	CU.SHF	Copper	SHFE	5 tons/lot	10 yuan/ton	2000/01/04
23	SN.SHF	Tin	SHFE	1 ton/lot	10 yuan/ton	2015/03/27
24	NI.SHF	Nickel	SHFE	1 ton/lot	10 yuan/ton	2015/03/27
25	RB.SHF	Steel Rebar	SHFE	10 tons/lot	1 yuan/ton	2009/03/27
26	WR.SHF	Wire Rod	SHFE	10 tons/lot	1 yuan/ton	2009/03/27
27	FU.SHF	Fuel Oil	SHFE	10 tons/lot	1 yuan/ton	2004/08/25
28	AG.SHF	Silver	SHFE	15 kgs/lot	1 yuan/kg	2012/05/10
29	SC.INE	Crude Oil	INE	1000 barrels/lot	0.1 yuan/barrel	2018/03/26