Evidence about Bubble Mechanisms: Precipitating Event, Feedback Trading, and Social Contagion[*]

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Abstract

Shiller's feedback loop theory of bubbles involves three elements: a precipitating event that causes an increase in prices, positive feedback trading, and social contagion that draws in new investors. We use brokerage account records from a large Chinese stock brokerage firm to show that all three components of the Shiller feedback loop are found during the Chinese put warrants bubble. An increase in the stock transaction tax made warrants relatively more attractive for speculative trading and was the precipitating event for the extreme phase of the bubble, causing immediate sharp increases in trading by new and existing investors and a jump in warrant prices. Hazard rate regressions show that there was positive feedback trading, and the period of heavy feedback trading coincided with the extreme phase of the bubble following the increase in the transaction tax. Proxies for social contagion explain the entry of new investors, and estimates of the trading volume due to feedback trading and the numbers of new investors drawn in by social contagion help explain the size of the bubble.

JEL codes: G12, G13, G14, O16, P34

Key words: Speculative bubble, feedback loop, precipitating event, feedback trading, social contagion.

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Abstract

Shiller's feedback loop theory of bubbles involves three elements: a precipitating event that causes an increase in prices, positive feedback trading, and social contagion that draws in new investors. We use brokerage account records from a large Chinese stock brokerage firm to show that all three components of the Shiller feedback loop are found during the Chinese put warrants bubble. An increase in the stock transaction tax made warrants relatively more attractive for speculative trading and was the precipitating event for the extreme phase of the bubble, causing immediate sharp increases in trading by new and existing investors and a jump in warrant prices. Hazard rate regressions show that there was positive feedback trading, and the period of heavy feedback trading coincided with the extreme phase of the bubble following the increase in the transaction tax. Proxies for social contagion explain the entry of new investors, and estimates of the trading volume due to feedback trading and the numbers of new investors drawn in by social contagion help explain the size of the bubble.

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1. Introduction

Shiller's extensive writings about speculative asset price bubbles discuss how three components combine to create and reinforce asset price bubbles (see for example, Shiller 1995, 2008, 2015).[1] First, a precipitating event causes an increase in prices. This precipitating event need not be related to the assets' fundamental values; for example, Shiller (2015; Chapter 4) argues that rapid growth in corporate earnings in 1994, 1995, and 1996 contributed to the initiation of the internet bubble of the late 1990s even though the earnings growth had little to do with the internet. Second, there is a positive feedback loop in which past price increases encourage investors to continue buying, creating further upward pressure on prices (Shiller 2015; Chapter 5). Third, social contagion draws in additional investors. In some places Shiller focuses on the role of the media in spreading stories about asset price increases (for example, Shiller 2015, Chapter 6), while in others he emphasizes the role of direct word of mouth communication, for example writing "the single most important element to be reckoned in understanding this or any other speculative boom is the social contagion of boom thinking, mediated by the common observation of rapidly increasing prices…" (Shiller 2008, p. 41; see also Shiller 2015, Chapter 10).

We use brokerage account records from a large Chinese stock brokerage firm to document that all three components of the Shiller feedback loop are found during the Chinese put warrants bubble, and that they contributed to the bubble. We are able to identify the exogenous event that precipitated the extreme phase of the bubble, and the date on which this event occurred. The brokerage account records allow us to document positive feedback trading throughout the bubble, including its extreme phase. Using the results of hazard rate regressions that predict the reentry into the market of investors who have previously traded put warrants, we estimate the buying due to positive feedback trading during the bubble and find that it was positive and large following the precipitating event, exacerbating the extreme phase of the bubble. We also use the brokerage account records to construct the proxies for social contagion used by Kaustia and Knupfer (2012) and use the proxies to show that social contagion drives the

[1] See also Case and Shiller (1988, 1994, 2003), Akerlof and Shiller (2009, Chapter 9), and Shiller (1984, 2003, 2007, 2009, 2011, 2014). Shiller (2015, p. 84) summarizes the feedback mechanism: "Initial price increases … lead to more price increases as the effects of the initial price increases feedback into yet higher prices through increased investor demand. This second round of price increase feeds back again into a third round, and then into a fourth, and so on. Thus the initial impact of the precipitating factors is amplified into much larger price increases than the factors themselves would have suggested."

entry of new investors. The predicted level of trading due to positive feedback trading and the predicted numbers of investors drawn in by social contagion explain warrant price levels, especially during the extreme phase of the bubble. These results are the first to find direct evidence of the three components of Shiller's feedback loop in a large dataset of investor trades, and also the first to show that they explain the size of a bubble.

The Chinese put warrants bubble occurred on the Shanghai and Shenzhen stock exchanges during 2005–2008. Between November 2005 and June 2007 18 Chinese companies issued put warrants with maturities of between six months and two years.[2] These warrants gave their holders the right to sell the issuing companies' stocks at predetermined strike prices during specified exercise periods. The 2006–2007 boom in Chinese stock prices caused most of these put warrants to be so far out of the money that they were almost certain to expire worthless. Despite this, the put warrants traded very actively at non-trivial prices, causing many to interpret the warrant trading as a speculative bubble, and Xiong and Yu (2011) build a compelling case that it was a bubble.[3] Among other evidence and arguments, Xiong and Yu (2011) document that many of the put warrants traded at prices far in excess of estimates of their values computed using the Black-Scholes formula, some of the warrants at times traded at prices that exceeded their strike prices, and that toward the end of their lives, some put warrants traded at non-trivial prices even though they were certain to expire out-of-the money even if their underlying stocks traded limit down for every trading day until the warrants' expiration dates.

This speculative bubble is an interesting event to study for at least two reasons. First, we have access to the trading records of a large group of Chinese investors who traded the put warrants during the bubble. Using these trading records we are able to identify the exogenous event that precipitated the extreme phase of the bubble, and the subsequent warrant purchases. The trading records also allows us to study how investors' warrant purchases are related to covariates including the returns on the investors' own previous warrant purchases and the warrant returns of other geographically proximate investors with whom the investors might have had social contact. In contrast, most previous empirical research on bubbles has relied on market data such as prices, returns, and trading volumes or turnover (for example, Hong and Stein 2007,

[2] There were also 36 call warrants. The first call warrant, on BaoGang stock, was issued on August 22, 2005.
[3] In addition to Xiong and Yu (2011), researchers who have interpreted the put warrant trading as a speculative bubble and/or provided evidence that the put warrants were overvalued include Liao, Li, Zhang, and Zhu (2010), Chang, Luo, Shi, and Zhang (2013), Powers and Xiao (2014), and Liu, Zhang and Zhao (2016).

Mei, Scheinkman, and Xiong 2009, and Xiong and Yu 2011), surveys of comparatively small numbers of investors (for example, Case and Shiller 1988, 2003), or limited documentary evidence (for example, Garber 1989, 1990, 2000).[4]

Second, due to Xiong and Yu (2011) one can be confident that the investor trades we study are bubble phenomenon and not some mixture of bubble behavior and rationally motivated trading based on fundamental information. For example, because the prices of Chinese put warrants cannot be rationalized in terms of fundamentals one can be confident that the relations between trades and lagged returns we find are not caused by rational learning or updating of beliefs about fundamental information. In contrast, most other bubbles are controversial, with serious scholars offering arguments that they were not bubbles. For example, Hall (2001) and Li and Xue (2009) argue that the run-up in the prices of technology stocks during 1996–2000 can be explained by technology shocks and Bayesian updating of beliefs about possible future technology shocks. Garber (1989, 1990, 2000) has even offered explanations of the Dutch tulipmania, the Mississippi Bubble, and South Sea Bubble in terms of fundamentals.

Using the stock brokerage account records, we are able to identify that a tripling of the stamp duty (transaction tax) imposed on stock trades that was announced at midnight on May 29, 2007 and took effect immediately at the opening of trading on May 30 precipitated the extreme phase of the put warrants bubble, which began on May 30. Because warrants were exempt from the stamp duty it made warrants more attractive than stocks for short-term speculative trading and caused striking increases in the both entry of new investors into the warrant market and the reentry of investors who had previously traded warrants. Market data show a more than 12-fold increase in warrant turnover on May 30 and an average warrant return of 57.6%, followed by further large positive returns over the next 15 days. The differences between warrant prices and estimates of their fundamental values were much higher on and after May 30, 2007 than before.

Turning to the second element of the Shiller feedback loop, we use hazard rate regressions to show that, for the investors who have previously traded put warrants, the probability that they buy again is positively related to their previous put warrant returns. This positive feedback trading occurs throughout the warrants' lives, including during the extreme bubble period. The combination of the positive coefficients on investors' previous returns and the large price increases beginning on May 30, 2007 due to the increase in the stamp duty lead to

[4] An exception is Gong, Pan and Shi (2016) who use investor trade data for the BaoGang call warrant.

a burst of positive feedback trading beginning on this date and continuing for more than a month, throughout the extreme phase of the bubble.

We provide evidence of social contagion by following Kaustia and Knüpfer (2012) and using the brokerage firm data to construct, for each date and investor who has never previously traded warrant *k*, estimates of the lagged returns that geographically proximate investors have achieved by trading warrant *k*. The lagged returns of geographically proximate investors can provide evidence about social contagion because these are the other investors with whom a given investor is most likely to have social contact. We find that the cross-sectional average of the positive parts of the lagged returns of such same-branch investors and the interaction of the average of the positive parts with the numbers of such same-branch investors predict the numbers of investors who make their first purchases of warrant *k* on each date.

In addition to showing that the three components of the Shiller feedback loop are found in the data, we provide evidence that feedback trading and social contagion contributed to the bubble by reexamining the Xiong and Yu (2011) panel regressions showing that put warrant prices were positively correlated with volatility and turnover, consistent with the resale option theory. Specifically, we use the feedback hazard rate regressions and social contagion (linear) regressions to develop estimates of the trading volume and number of new investors due to feedback trading and social contagion, respectively, during each day of the Xiong and Yu (20110 "zero fundamental period" in which the fundamental values of the put warrants were close to zero. We then include these estimates as additional covariates in the panel regressions estimated by Xiong and Yu (2011) and find that the additional covariates predict put warrant prices.

The Shiller feedback loop is not the only theory of speculative asset price bubbles. Scheinkman and Xiong (2003) have proposed a resale option theory of overvaluation, and, as indicated above, Xiong and Yu (2011) present evidence that put warrant prices are correlated with volatility and turnover as predicted by the resale option theory. This theory or the related model of Hong, Scheinkman and Xiong (2006) has found support in other data (Hong, Scheinkman and Xiong 2006, Hong and Stein 2007, and Mei, Scheinkman, and Xiong 2009). Blanchard and Watson (1983), Allen and Gorton (1993), and Allen and Gale (2000) have proposed other theories of asset price bubbles. The various theories are not mutually exclusive, and our findings that the components of the Shiller feedback loop are found during the Chinese put warrants bubble does not imply that other mechanisms such as the resale option theory did not also contribute to the bubble.

In addition to Xiong and Yu (2011), several other papers explore possible causes of the overvaluation of Chinese warrants. Powers and Xiao (2014) find that estimates of the overvaluation of put warrants are correlated with measures of liquidity and volatility, consistent with the resale option theory. They also find that the overvaluation is greater after the May 30, 2007 change in the stamp duty, though they do not recognize that the change in the stamp duty was the precipitating event that caused the extreme phase of the bubble. Liao, Li, Zhang, and Zhu (2010) present evidence that overpricing of call and put warrants traded on the Shanghai Stock Exchange, where issuance of additional warrants was possible, was less severe than in warrants traded on the Shenzhen Stock Exchange, where issuance of additional warrants was not possible. Their finding that warrant prices are decreasing in warrant supply and possible future supply would seem to be consistent with almost any theory of security valuation. Gong, Pan and Shi (2016) provide evidence that the BaoGang call warrant was consistently overvalued, and use account level data to show that on most trading days a majority of purchases were made by investors who had never previously held the warrant and that the ratio of purchases by new investors to total purchases was contemporaneously positively correlated with changes in a measure of overvaluation. They interpret these results to mean that the bubble was created and sustained by new investors, but do not attempt to determine the factors that might cause new investors to buy the warrant. None of these papers provide evidence about any of the three elements of the Shiller feedback loop.

Several papers also explore other aspects of the Chinese warrant market. Liu, Zhang and Zhao (2016) study the spillover effect from the warrant market to the stock market and find that the previous day's unexpected turnover and over-valuation of warrants predict positively the next day's turnover and volatility of the underlying stocks. Liao, Li, Zhang, and Zhu (2010) show that exercise decisions in 0.64% of call and put warrants are irrational in that the investors either exercise are out-of-the-money warrants or fail to exercise in-the-money warrants. Chang, Luo, Shi, and Zhang (2013) show that warrant prices were generally much higher than Black-Scholes values and that changes in warrant price were not highly correlated with changes in the prices of the warrants' underlying common stocks.

The next section of the paper describes the data we use, focusing on the brokerage account records. Section 3 presents evidence that an exogenous shock that precipitated the extreme phase of the bubble occurred on May 30, 2007. Section 4 presents the results about positive feedback trading, while Section 5 presents regression results showing that social contagion contributed to the entry of new investors. Section 6 presents evidence that estimates of the trading volume due to positive feedback trading and the number of new investors due to social contagion help explain put warrant prices during the bubble, and Section 7 briefly concludes.

2. Data Description and Summary Statistics

2.1 Background

The put warrants we study were created as part of the Chinese share structure reform initiated in 2005. In this reform, non-tradable shares held by management, the state, or other state-owned enterprises were made tradable. Because this was expected to adversely affect the prices of the tradeable shares held by investors, holders of non-tradable shares were required to compensate holders of tradable shares, usually with cash or additional shares. In a few cases the compensation included warrants, leading to the creation of 36 call warrants and the 18 put warrants that are the focus of this study. In some cases additional warrants were subsequently issued by special purpose vehicles established by financial institutions.

The warrants were listed on either the Shanghai or Shenzhen stock exchanges, and traded like stocks, with one important difference. The difference was that a warrant could be sold on the same day it was purchased. In contrast, a Chinese stock purchased on day t may not be sold until the next trading day $t + 1$, i.e. it must be held for at least one overnight period in a practice referred to as $t + 1$ settlement. This difference from the trading of Chinese stocks enabled intraday speculative trading in the warrants and made it possible for the put warrants to have extremely high trading volumes, and they sometimes did. One might also hypothesize that this contributed to the bubble in the prices of put warrants. An important way in which the warrants were similar to stocks is that, like stocks, short-selling was not permitted. This prevented investors who believed the warrants to be overvalued from entering into short transactions to take advantage of the overvaluation.

2.2 Warrant and Stock information

We focus on the 18 put warrants in which Xiong and Yu (2011) document the existence of a speculative asset price bubble. Like Xiong and Yu (2011), we obtain the warrant daily price and volume, intraday price and volume, numbers of warrants issued, trading period, exercise period, strike price, and exercise ratio, from CSMAR. We obtain daily and intra-day stock price and trading volumes from the same source. We also checked some of the data by obtaining data from a different Chinese financial data vendor, RESSET. Panels A and B of Table 1 provide some information about the put warrants, include the beginning and end of their trading periods, there terms, and their average prices, daily turnover, and daily trading volume.

2.3 Brokerage account data

The main data we use are the trading records of a large set of investors who traded the put warrants. We obtain these data from a comprehensive set of brokerage account records from a securities firm in the People's Republic of China. The brokerage account records come from a total of 42 branch offices located in 17 different regions across China where a “region” can be either a province (e.g., Fujian), a municipality (e.g., Shanghai), or autonomous region (e.g., Xinjiang). Some of the brokerage customers traded the put warrants, among other securities, and we analyze the records of the put warrant trades.

In China, individuals are restricted to have only one brokerage account, and are required to present their national identity cards when opening a brokerage account. This on its face would seem to rule out having multiple brokerage accounts. However, it is possible for one individual to control multiple brokerage accounts by gathering identity cards from friends or neighbors and opening brokerage accounts in their names. To address this, we combine the records from brokerage accounts that share the same “funding account,” which is an internal securities firm code that links a single individual to one or more brokerage accounts. Therefore, the unit of our analysis is the funding account, and multiple brokerage accounts linking to the same funding account are treated as a single investor.

We identify a total of 5,692,241 put warrant trades from November 23, 2005, the date when the first put warrant was listed, to December 31, 2009, the end of the data. There were 81,811 investors who traded put warrants, consisting of 80,089 individual investors and 1,722 institutional investors. These “institutional investors” are not large financial institutions such as mutual funds, as large institutional investors typically have direct access to the exchanges and do not trade through brokerage firms. Many and perhaps most of the institutional investors in the brokerage firm data are likely to be privately held companies.

Many investors held and traded more than one warrant at the same time. Investors traded an average of 4.9 different warrants. Individuals who traded the put warrants executed a total of 69.3 purchase transactions, on average, lower than the institutional investors' average of 79.8.

One component of Shiller's feedback look theory, positive feedback trading, speaks to purchases and sales of transactions. For example, if an investor experiences a gain from previous trading, the probability that the investor reenters the market is higher. But in actual data, an investor might use multiple buys to build up a position, and then liquidate the position using multiple sell orders. This raises the issue of how to treat sets of transactions in which multiple buys or sells are used to build up or liquidate a position. A similar issue arises in empirical analyses of the disposition effect.

We resolve this issue by introducing a notion of a transaction cycle. Starting from a holding of zero units of warrant *k*, a transaction cycle begins with a purchase of some non-zero amount of warrant *k*. It then continues through possibly multiple purchases and sales, until the investor's position in warrant *k* returns to zero. This ends a single transaction cycle, which we treat as a single transaction. The length of the transaction cycle is the time elapsed from the first purchase that begins the cycle to the last sale that ends it. In the case that investors open and close positions on warrant *k* more than once within the same day, we treat these transactions as a single cycle. The rationale for this treatment is that we want to study the impact of an exogenous shock on investors' positive feedback trading, which is an important mechanism in Shiller's theory, and at times we use date fixed effects to capture the effect of the shock. Therefore, we do not allow multiple transactions within a single day.

The return to a transaction cycle is the weighted sum of the sale prices, weighted by the quantities sold in the various sells, divided by the weighted sum of the purchase prices, where again the weights are the quantities purchased in the various buys, minus one.

We define a new investor in warrant *k* on date *t* as one who executes his or her first trade in warrant *k* on date *t*. We define a reentry investor in warrant *k* on date *t* as one who trades in warrant *k* before date *t* and opens a new transaction cycle on date *t*.

Some of our analyses also use the branch office where an investor trades. In China, an investor must place trades through the branch office at which he originally opened the brokerage account. Chinese investors usually open accounts close to where they live.

Panel C in Table I reports the numbers of investors trading each of the 18 put warrants and the average length of the transaction cycles. The majority of transaction cycles are completed ones and there are only a small portion of uncompleted cycles, which occur when investors open a position and hold it until the warrant expiration day or the last date in our dataset.

3. The May 30, 2007 Precipitating Event

Of the18 put warrants, 12 expired prior to May 30, 2007 and one was issued in June 2007, leaving five that were trading on May 30, 2007. Panels A-E of Figure I show the daily closing prices (black line, left-hand axis) and turnover (dashed green line, right-hand axis) of these five warrants for a six-month period roughly centered on May 30, 2007, that is the months March through August, 2007. The five panels clearly show that turnover increased remarkably on May 30. For the five warrants, the ratios of the turnover on May 30 to the turnover on May 29 were 19.11, 12.72, 11.70, 3.47, and 14.70. The average of these five ratios is 12.34, that is on average there was a more than 12-fold increase in turnover on May 30, 2007. The visual impression is of a discontinuous change on that date. Turnover remained high after May 30; while the turnovers of HuaLing, WuLiang, and JongJi declined from their peaks in early June, the turnovers remained above the levels prior to May 30. JiaFei's turnover drops through the middle of June and then picks up again prior to the last trading date of June 22, 2007, at which point the series ends. ZhaoHang's turnover generally declines until the middle of August, at which point it increases again prior to the last trading data of August 24, 2007. For all five warrants turnover was much more variable after May 30 than it was prior to May 30.

Prices of all five warrants were reasonably stable prior to May 30, 2007, rose sharply for a few days starting on May 30, and then were highly volatile after May 30. The prices of HuaLing, WuLiang, and JongJi declined from the middle of June through early July and then rebounded somewhat, always remaining well above their prices prior to May 30.

Panels A-E of Figure II use the brokerage account data to show that both new and returning investors increased their trading on May 30, 2007. Specifically, each panel shows the daily closing price (black line, left-hand axis), the number of new investors on each date (dashed red line, right-hand axis), and the sum of the number of new and returning investors on each date (dotted blue line, right-hand axis). A new investor in warrant k on date t is one who has not previously traded warrant *k*, while a returning investor is one who has previously traded warrant *k*. The difference between the dotted blue line and the dashed red line is the number of returning investors. The five panels show that for all five put warrants the numbers of both new and returning investors jumped sharply on May 30. Similar to the changes in turnover shown in Figure I, the visual impression is of a discontinuous change.[5]

Table II provides additional evidence to verify that the bubble was more pronounced after May 30, 2007 than before. The three panels report some statistics related to the severity of the bubble for three different combinations of warrants and time periods. The statistics are the average and maximum daily turnover; the average and maximum bubble size, where the bubble size is the difference between the warrant closing price and an estimate of the warrant fundamental value computed using the Black-Scholes formula, and the average and maximum volatility computed from intra-day five minute returns. Panel A reports these statistics for the 12 warrants that expired before May 30, 2007, Panel B reports them for the period prior to May 30 for the five warrants that traded both before and after May 30, and Panel C reports them for the period on and after May 30 for the five warrants that traded after May 30 and a sixth warrant (NanHang) that was issued in June 2007.

Comparison of the results in the Panels A and B of Table II to those in Panel C make it clear that the bubble was much more pronounced after May 30, 2007 than before. The average bubble sizes in Panel A for the 12 warrants that expired before May 30 range from –0.113 yuan (HuChang) to 0.606 yuan (HaiEr), and the average bubble size in Panel B for the five warrants that traded both before and after May 30, 2007 during the period before May 30 ranged from 0.129 yuan (HuaLing) to 1.188 yuan (JiaFei). In contrast, in Panel C the average bubble size after May 30 ranged from 0.948 yuan (ZhaoHan) to 3.410 yuan (JiaFei). The average daily turnover and volatility display are also much greater after May 30 than before. In fact, the maxima of the average daily turnovers and volatilities before May 30 in Panels A and B are less than the minima of the average daily turnovers and volatilities after May 30 in Panel C. After May 30 the bubble is clearly more pronounced than it was before May 30.

[5] Sections 4 and 5 below report the results of various regression models that provide evidence of both positive feedback trading and social contagion. The date fixed effects in these regression models are large and significant starting on May 30, 2007. This provides additional evidence of an important event on May 30, even controlling for the impact of other covariates.

Something important happened on May 30, 2007. The more than 12-fold increase in turnover on May 30, and the jump in the purchases by both new and returning investors, pins down the date exactly. The fact that put warrant trading volume and volatility were high starting from the opening of trading on May 30 indicates that the precipitating event happened sometime between the close of trading on May 29 and the opening on May 30. What happened before the opening of trading on May 30?

There is only one candidate. Prior to May 30, 2007, a stock transaction tax of 0.1% of the value of the shares transacted was imposed on each side of a stock transaction, for a total tax of 0.2%. Warrants were exempt from the tax and also exempt from $t + 1$ settlement, making them attractive to investors interested in short-term speculation. The Chinese regulatory authorities had become concerned about the 2006-2007 boom in stock prices, and there were rumors that they would attempt to dampen the boom by increasing the transaction tax. At about midnight on May 29 the Ministry of Finance announced a tripling of the transaction tax to 0.3% of the value transacted on each side of a transaction, for a total of 0.6%, effective immediately at the opening of trading on May 30.[6]

The transaction tax had an immediate negative impact on the stock market, with the Shanghai and Shenzhen stock indexes falling by 6.15% and 5.78%, respectively, on May 30. Because the transaction tax was not imposed on warrants it increased the relative attractiveness of the warrants for short term speculation, causing the significant increase in trading of put warrants on May 30. This was the precipitating event that exacerbated the put warrants bubble.

The fact that there was no change in the transaction tax on warrant trades is consistent with Shiller's argument that the precipitating event need not be related to the fundamentals of the asset in which it triggers a bubble. For example, Shiller argues that the “spectacular U.S. corporate earnings growth” in 1994, 1995, and 1996 was a precipitating factor for the 1996-2000 technology bubble even though the earnings growth “in fact had little to do with the internet” and “it could not have been the Internet that caused the growth in profits [because] the fledgling Internet companies were not making much of a profit yet” (Shiller 2015, p. 42). Similarly, some of the other technology bubble precipitating factors that Shiller cites, for example the growth in media reporting of business news, the expansion of defined contribution pension plans, and the

[6] http://www.mof.gov.cn/zhengwuxinxi/caizhengxinwen/200805/t20080519_26343.html, website of Ministry of Finance.

growth in mutual funds were not directly related to the fundamentals of technology companies. The latter two factors however plausibly created increased demand for the stocks of technology companies, similar to how the Chinese stock transaction tax created additional demand for warrants.

Looking at the comparative stability of the warrant prices before May 30 in Figures I and II, one wonders if the bubble would have received so much attention absent the increase in its magnitude due to the May 30, 2007 increase in the stock transaction tax.

4 Positive Feedback Trading

The second component of Shiller's feedback loop theory of speculative bubbles is positive feedback trading in which an investor is more likely to trade again if his or her past returns were positive. As shown by Daniel, Hirshleifer, and Subrahmanyam (1998) and discussed by Shiller (2003), the psychological principle of biased self-attribution can promote positive feedback trading because it leads people to attribute their past success to skill rather than luck, making them more likely to trade again.

We explore feedback effect by estimating Cox proportional hazard models of the probability of a subsequent purchase of warrant *k* by an existing investor who has previously completed at least one transaction cycle in warrant *k*, that is we model the reentry of investors into warrant *k*. The covariates of main interest are the investor's returns on his or her previous purchases of warrant *k*, and, to allow for a discontinuity at a return of zero, dummy variables that take the value one if the investor's return was positive. We choose a proportional hazards model because its specification takes account of the time that has elapsed since an investor completed the last transaction cycle. Specifically, consider an investor A who had a large positive return yesterday and another investor B who had a large positive return three months ago but has not yet traded again. Investor A is more likely to trade on date *t* than investor B, who has probably left the warrant market and is unlikely to trade on date *t*.

The proportional hazards model specifies that $\lambda_{i,k,t}(\tau)$, the hazard function of starting a new transaction cycle for existing investor *i* in warrant *k* at day *t*, τ trading days after the end of the investor's last transaction cycle, takes the form

$$\lambda_{i,k,t}(\tau) = \lambda(\tau) \times e^{x_{i,k,t}\beta}, \tag{1}$$

where $\lambda(\tau)$ is the baseline hazard rate and $x_{i,k,t}$ is a vector of covariates that proportionally shift the baseline hazard. For investors who have previously completed one transactions cycle $x_{i,k,t}\beta$ is given by

$$x_{i,k,t}\beta = \beta_1 \times Return\_lag1_{i,k,t} + \beta_2 \times \mathrm{I}\left(Return\_lag1_{i,k,t} > 0\right) + \text{Controls} + \alpha_m + \alpha_k + \alpha_t \quad (2)$$

where $Return\_lag1_{i,k,t}$ is the return of the most recent transaction cycle of investor *i* in warrant *k* before date *t*. The dummy variable $\mathrm{I}\left(Return\_lag1_{i,k,t} > 0\right)$ takes the value one if $Return\_lag1_{i,k,t} > 0$, and otherwise is zero. This variable is included to allow for the possibility of a discontinuity at a return of zero. The variables α_m, α_k and α_t are maturity, warrant, and date fixed effects, respectively.

The control variables include three lags of $\text{WarrantReturn}_{k,t}$, the daily market return of warrant *k* on date *t*, three lag of $\text{TurnoverRatio}_{k,t}$, the market trading volume in warrant *k* on date *t* divided by number of warrants outstanding on date *t*, and one lag of $\text{AdjustedFundamental}_{k,t}$, which is an estimate of the fundamental value of warrant *k* on date *t* computed as

$$\text{Adjusted fundamental Value} = \left(\frac{Stock\ Price - Strike\ Price}{Stock\ Price}\right)/Maturity.$$

We use the adjusted fundamental value rather than the Black-Scholes value because we hypothesize that investors should be more sensitive to the difference between the underlying stock price and the strike price when making an investment decision in warrant *k* than the warrant's Black-Scholes theoretical value, which is less accessible to investors.

The model also includes both maturity and date fixed effects. The results in the previous section indicate that date fixed effects are important around May 30, 2007; we include them for all dates to allow for the possibility that they are important on other dates as well. Maturity fixed effects are included because, as noted by Xiong and Yu (2011), warrant turnover tends to increase as the maturity date approaches, which suggests that hazard rates become larger as the maturity date approaches. The warrant fixed effects allow for the possibility that hazard rates differ across warrants for reasons that are not captured by the other variables.

The feedback loop theory implies that the coefficient β_1 on the return on the investor's previous transaction cycle should be greater than zero. Also, if the coefficient β_2 on the dummy variable for a positive transaction cycle return is non-zero, we expect it to be positive.

The specification for investors who have previously completed two cycles is similar to the one-cycle model, except that we add the variables $Return\_lag2_{i,k,t}$ and $\mathrm{I}(Return\_lag2_{i,k,t})$ to the model to capture the effect of the returns on the second most recent transaction cycle. For investors with three or more previous cycles we also include $Return\_lag3_{i,k,t}$ and I($Return\_lag3_{i,k,t}$>0), where $Return\_lag3_{i,k,t}$ is the average return of the transaction cycles of investor *i* in warrant *k* prior to the second most recent transaction cycle before date *t*.

We estimate the models using the partial likelihood method (Cox 1972). The estimation results are reported in Table III, and show that positive returns on previous transaction cycles predict a higher probability that investors open a new transaction cycle for all the three versions of the model. The coefficients on *Return_lag*1 are large and highly significant, with *p*-values less 0.0001. The coefficients on *Return_lag*2 and *Return_lag*3 in the second and third models are smaller, as expected, and the estimates in the third model are highly significant, with *p*-values less than 0.0001. Additionally, the estimated coefficient β_2 on the dummy variable for a positive return is large and highly significant, indicating that a warrant investor is more likely to return to the market if his or her previous warrant return was positive. These results indicate the presence of positive feedback trading. The estimated coefficients on the control variables also have the expected signs, with varying but generally very high levels of statistical significance.

Figure III plots the calendar date fixed effects for a six-month window approximately centered on May 30, 2007. One can see an obvious jump on May 30, capturing the effect of the shock of the increased transaction tax on existing investors' trading behavior. This is consistent with the conclusion in the preceding section that the tripling of the stock transaction tax had an important effect on the warrant market.

The May 30, 2007 shock that caused a jump in warrant prices, combined with the positive coefficients on lagged returns, suggest that positive feedback trading might have been important during the extreme phase of the bubble immediately following May 30. To explore this further, we calculate the fitted investor's reentry probability in warrant *k* on date *t* as

$$\hat{P}_{i,k,t} = 1 - \exp\{-\lambda(\tau)\exp\{x_{i,k,t}\hat{\beta}\}\}. \tag{3}$$

We then calculate $\bar{P}_{i,k,t}$ using equation (3) again but setting the previous return variables (such as $Return\_lag1_{i,k,t}$ and $\mathrm{I}(Return\_lag1_{i,k,t} > 0)$) to zero. Letting $\bar{Q}_{i,k}$ be the average trade size of investor *i* in warrant *k*, we use $(\widehat{P}_{i,k,t} - \bar{P}_{i,k,t})\bar{Q}_{i,k}$ to measure the effect of positive feedback on the trading behavior of investor *i*. We then calculate the sum $(\widehat{P}_{i,k,t} - \bar{P}_{i,k,t})\bar{Q}_{i,k}$ for each of the five warrants on each day across all the existing one-cycle investors and plot the time series in Panel A of Figure IV. Similarly, Panels B and C plot the corresponding quantities for the two and three-cycle investors. One can see clearly that the effect of positive feedback becomes important starting from May 30, 2007. Comparing Figure IV to Figures I and II, one can also see that the period when the effect of positive feedback trading was important is exactly the extreme phase of the bubble.

5. Social Contagion

Various writings by Shiller, sometimes with coauthors, have emphasized the role of social contagion in speculative booms and bubbles (Shiller 1984, 1990, 2010, 2015; Akerlof and Shiller 2009; Case and Shiller 1988, 2003). For example, Shiller (2015; Chapter 10) asserts that after millions of years of evolution word of mouth communication and its importance are “hard-wired into our brains.” He argues that people do not give other sources of information the same emotional weight, and cannot remember or use information from these other sources as well. Relatedly, Shiller (2010; p. 41) claims that “…the single most important element to be reckoned in understanding … any … speculative boom is the social contagion of boom thinking.”

Recently, Shive (2010) and Kaustia and Knüpfer (2012) have used Finnish data to study the effect of social contagion on purchases of individual stocks and the decision to enter the stock market, respectively. Kaustia and Knüpfer (2012) focus on distinguishing between two plausible channels by which stock market outcomes of peers might influence individuals’ entry decisions. In the first channel, individuals might use peer outcomes to update beliefs about long-term fundamentals, such as the equity premium. In the second channel, people cannot directly observe peer outcomes and rely on “word of mouth” verbal accounts and possibly other indirect information. Such verbal accounts are likely be biased toward reporting positive outcomes, as investors are unlikely to benefit from discussing their negative outcomes with their peers. As Kaustia and Knüpfer (2012) discuss, investors might enjoy discussing their positive stock market experiences more than their negative ones. Second, appearing to be a competent investor might carry private benefits. Third, various theories in psychology predict that people have self-serving biases in recalling and interpreting the factors involved in their successes and failures. To the extent such selective reporting is present, peer outcomes will have a stronger influence on the entry of new investors when the outcomes have been better.

Kaustia and Knüpfer (2012) distinguish between the two channels by estimating panel regression models explaining the entry of new stock market investors in which the key variables of interest are transformations of the previous month's average return experienced by investors in the same postal code, as other investors sharing an investor's postal code are those most likely to interact with and influence the entry decision of an investor. Kaustia and Knüpfer (2012) find that the lagged average return affects entry decisions when it is positive, but it unrelated to entry decisions when it is negative. This is consistent with selective reporting and peer returns affecting entry via word of mouth communication.

We also look for evidence of social contagion by estimating panel regression models that explain the entry of new investors in the warrant market. An investor who trades warrant k on date t is considered a new investor in warrant k on date t if date t is the first day that he or she trades warrant k. The unit of observation is branch-warrant-day. Similar to Kaustia and Knüpfer (2012), in our regression models the key variables of interest are transformations of the past returns of other local investors, though in our case the other local investors are those who trade through the same branch office of the brokerage firm rather than those who share the same postal code. A potential warrant investor is more likely to have social interactions and word-of-mouth communication with other investors who trade using the same branch office, as two investors trading at the same branch office are more likely to live and/or work near each other than are two investors trading through different branch offices. In larger cities in which the brokerage firm has multiple branch offices trading through the same branch office is a proxy for living and/or working in the same or a nearby district. In smaller cities in which the brokerage firm has only one branch office trading through the same branch office is a proxy for living and working in the same city.

For each branch-warrant-day in the data we construct a variable $\text{BranchAveragePosReturn}_{jkt}$, which is the average of the positive parts of the returns of the branch j investors who have positions in warrant k on date t. As discussed above the motivation for this variable is that social contagion effects via word-of-mouth communication are likely to be stronger if other branch j investors have experienced positive returns in warrant k, because investors are more likely to discuss their past investment successes with their friends and colleagues than their past failures. In contrast, the performance of investors who trade at other branches is less likely to affect the entry of branch j investors into the warrant market.

To compute the variable $\text{BranchAveragePosReturn}_{jkt}$ we consider the trades and positions of all branch j investors who either traded or held warrant k on day t. For each such investor i in warrant k on date t, we first compute X_{ikt}, equal to the sum of: (a) the value of the position in warrant k held by investor i at the close of trading on day t–1, where the value is the product of the t–1 closing price and the number of warrants held; and (b) the value of all warrants purchased during day t, where the value is the product of the purchase price and the quantity. Second, we compute Y_{ikt}, equal to the sum of: (c) the value of the position in warrant k that investor i held at the close of trading on day t, where the value is the product of the day t closing price and the number of warrants held; and (d) the value of the warrants sold during day t, where the value is the product of the sale price and the number of warrants sold. The day t return for the investor i in warrant k is then defined as $r_{ikt} = Y_{ikt}/X_{ikt} - 1$. The branch j warrant k day t variable BranchAveragePosReturn$_{jkt}$ is then the average of the positive parts max[r_{ikt},0] over the branch j investors that either traded or held put warrant k on day t.

A second variable that helps capture the potential influence of other investors in the same branch is an interaction term consisting of the product BranchAveragePosReturn$_{jkt}$ × BranchInvestors$_{jkt}$, where BranchInvestors$_{jkt}$ is the number of branch j investors that either traded or held warrant k on date t. This term captures the fact that it is more likely that a potential new investor is influenced by the positive returns of other investors to enter the warrant market if there are more such other investors at the same branch, because these are the other investors with whom a potential new investor might interact. We include up to three lags of the variables in the regression specifications, that is we explain the number of new investors on date t using the variables for dates t–1, t–2, and t–3. We expect to obtain positive coefficient estimates on the first lags of the variables BranchAveragePosReturn$_{jkt}$ and BranchAveragePosReturn$_{jkt}$ × BranchInvestors$_{jkt}$, and non-negative coefficients on the other lags when they are included. We do not expect to obtain a positive coefficient on the lags of BranchInvestors$_{jkt}$ by itself because we expect that the number of existing branch j investors will only impact the entry of new branch j investors into the warrant market if the existing branch j investors experienced positive returns.

We also include a number of control variables. The first, BranchAverageReturn$_{jkt}$, is constructed similarly to BranchAveragePosReturn$_{jkt}$ except that BranchAverageReturn$_{jkt}$ is the average of the returns r_{ikt} of the branch j investors that either traded or held put warrant k on day t rather than the average of the positive parts max[r_{ikt},0]. The other control variables are lags of the number of new investors at branch j in warrant k, NewBranchInvestors$_{jkt}$, lags of the market close-to-close warrant return WarrantReturn$_{kt}$, lags of the turnover ratio TurnoverRatio$_{kt}$ defined as market trading volume divided by number of warrants outstanding, and $\text{BrokerageNewInvestors}_{kt}$, defined as the sum across branch offices of the number of new investors in warrant k on date t. The variable $\text{BranchAverageReturn}_{jkt}$ is highly correlated with the market-wide warrant return $\text{WarrantReturn}_{kt}$ but differs from it because there is considerable intraday trading in warrants and warrant holding periods are often less than one day.

The panel regressions include either one, two, or three lags of the variables. All specifications are estimated with maturity, warrant, calendar date, and branch fixed effects.

Below we find that the first lag of the social contagion proxy $\text{BranchAveragePosReturn}_{jkt}$ and the interaction term $\text{BranchAveragePosReturn}_{jkt} \times \text{BranchInvestors}_{jkt}$ are significantly related to the entry of new warrant investors. Our panel regression design and the controls we include rule out alternative mechanisms based on reverse causality and common unobservables that might explain the relations between the branch-level average positive part of warrant returns and entry of new investors that we find. First, consider reverse causality—the possibility that initial purchases of warrant k causes existing warrant k investors trading through branch j to experience higher returns via "price pressure" on warrant k. While this mechanism might affect the contemporaneous relation between entry and returns, it does not explain the relation between lagged returns and entry. Thus, this mechanism cannot explain our results. Moreover, to the extent that investors anticipate future price pressure due to the entry of new investors, this implies that the entry of new investors should be correlated with the lagged market warrant returns that they observe, not the returns experienced by investors at branch j. Our inclusion of lagged warrant returns in the regressions should capture any such relation.

Common time-invariant unobservables might also generate a positive relation between the branch-level returns and entry into the warrant market. For example, it is conceivable that investors in some branches are more financially sophisticated than those in other branches. This might cause both higher branch-level warrant returns and entry by other investors who trade at the same branch. This possible influence is eliminated by our use of branch-level fixed effects.

Because branch-level returns are correlated with market-wide warrant returns, common time-varying shocks might also produce a positive relation between branch-level returns and entry into the warrant market. For example, high warrant returns are likely to be associated with increased investor attention to warrants, which might cause some investors to enter the warrant market. We control for this possibility and any other market-wide time-varying influences by including lagged warrant returns and the lagged numbers of brokerage-level new investors in the regression specifications.

A remaining issue involves the possibility of branch-level time-varying shocks. Some of the possible channels discussed in Kaustia and Knüpfer (2012) by which branch-level time-varying shocks might explain a correlation between branch-level warrant returns and entry, for example changing prospects of the local economy that work through the stock returns of local companies, are not relevant because the put warrant returns are not plausibly related to the fundamentals of the local economies. Another possibility is that the results are driven by time-varying shocks that are unique to a branch or small subset of branches, e.g. local media coverage or some other source of local information or "noise." This channel seems unlikely because the information or noise would have to be something that caused or was correlated with both branch-level returns and entry but not captured by the warrant returns used as controls, and also not a mechanism of social contagion.[7] Despite our skepticism regarding this possible channel, below we carry out additional analyses on a subsample that drops the observations from branches where this possible channel is most likely to be relevant.

The warrant daily returns are remarkably volatile and sometimes take on extreme values. For example, in our sample, 11 warrant daily returns exceed 100% and eight are less than –95%. (These extremely low warrant returns appear in the last few trading days.) These extreme warrant returns cause the variables BranchAveragePosReturn and BranchAverageReturn also to take on some extreme values, and the kurtoses of the two variables are 52.23 and 233.19, respectively. We winsorize the variables BranchAveragePosReturn and BranchAverageReturn at one percent in each tail in order to avoid the influence of a small number of extreme values.

Table IV reports the results of the panel regressions. The first three columns (1)-(3) report the results of regression specifications estimated using the whole sample that include one, two, and three lags of the covariates, respectively. Consistent with social contagion via word-of-

[7] One possible mechanism is that regional media coverage of the warrant market might be correlated with warrant returns and also cause entry. But if branch-level warrant returns cause the media coverage which then causes entry, this is a mechanism of social contagion, intermediated by the media. That is, investor A does not communicate directly with investor B, but rather with a reporter who then communicates with investor B. Even for this mechanism to explain our results, it must be that local media coverage is driven by the branch-level average returns, not the warrant returns. While it is certainly possible for local media to have knowledge of the warrant returns achieved by some local branch investors, it seems unlikely that they would have access to a large enough sample to have knowledge of the branch-level average return. Given that we control for the warrant return, it seems unlikely that this possible channel can explain our results.

mouth effects, the estimated coefficients on the first lag of $\text{BranchAveragePosReturn}_{jkt}$ and the interaction term $\text{BranchAveragePosReturn}_{jkt} \times \text{BranchInvestors}_{jkt}$ are highly significant in all three specifications. Somewhat surprisingly, some of the coefficients on the other lags are negative and significant at conventional levels; however, in all cases the coefficients on the second and third lags are much smaller than the coefficients on the first lag so that the combined effect of the different lags of $\text{BranchAveragePosReturn}_{jkt}$ and $\text{BranchAveragePosReturn}_{jkt} \times \text{BranchInvestors}_{jkt}$ on the entry of new investors is positive.

Turning to the control variables, the coefficients on the lagged numbers of new investors at branch j are highly significant for all lags that appear in the regressions. In contrast, the coefficients on the lags of $\text{BrokerageNewInvestors}_{kt}$ are much smaller, and the coefficient for the second lag is negative in the two specifications in which at least two lags appear. This finding that the lagged numbers of new investors at branch j are much more strongly related to the arrival of new investors at branch j than are the lagged numbers of brokerage new investors is consistent with social contagion, but is also consistent with the presence of branch-level unobservable variables that affect entry. Unsurprisingly, the first lag of the market warrant return ($\text{WarrantReturn}_{kt-1}$) is also strongly related to the entry of new investors.

The other control variables have varying signs that are difficult to interpret because many of the covariates are highly correlated. For example, the coefficient on the first lag of $\text{BranchAverageReturn}_{jkt}$ is negative and significant, consistent with the coefficients on the lags of $\text{BranchAverageReturn}_{jkt}$ being affected by the multicollinearity because $\text{BranchAverageReturn}_{jkt}$ is highly correlated with $\text{WarrantReturn}_{kt}$. Regardless, the negative coefficient on the first lag of $\text{BranchAverageReturn}_{jkt}$ is not evidence against social contagion because the social contagion mechanism does not have any prediction for the coefficient on this variable.

Overall the results in Tables IV provide evidence consistent with social contagion via word of mouth effects. Notably, the estimated coefficients indicate that the positive part of the branch-level return $\text{BranchAveragePosReturn}_{jkt}$ and the interaction term $\text{BranchAveragePosReturn}_{jkt} \times \text{BranchInvestors}_{jkt}$ are strongly related to the entry of new investors. The panel regression specifications and controls we include rule out the possibility that the relations we find are explained by alternative mechanisms.

There might be, however, a lingering concern that our results are driven by time-varying shocks that are unique to a branch or small subset of branches, for example local media coverage, private information common to investors at one branch, or some other source of local information or "noise." This channel seems unlikely because the information or noise would have to be something that caused or was correlated with both branch-level returns and entry but not captured by the warrant returns used as controls, and also not social contagion. That said, local information, rumors, or "noise" might conceivably be correlated with both branch-level warrant returns and entry.

The combinations of warrants and branches most likely to be subject to this issue are those for which the branch office is either located in the same city as the headquarters of the company whose stock provides the underlying asset of the warrants or located in the city (either Shanghai or Shenzhen) where the underlying stock is listed, because it seems more likely that investors will have access to (possibly incorrect or irrelevant) correlated information if they are in the same city as the headquarters of the company whose stock provides the underlying asset of the warrants or the city where the underlying stock is traded. We address this possibility in one final set of analyses that uses a subsample that excludes the combinations of warrants and branches for which the branch office is either located in the same city as the headquarters of the company whose stock provides the underlying asset of the warrants or located in the city where the underlying stock is listed. If the results are driven by such a mechanism, the results using this subsample should be different from those using the entire sample. The last three columns in Table IV (those headed (4)-(6)) report the results from re-estimating the regression models but using a subsample that drops those combinations of warrants and brokerage branches. The results for this subsample are very close to those reported in the first three columns of Table IV. These results provide evidence that our results are not driven by branch-level time-varying shocks.

Figure V plots the date fixed-effect dummies from the social contagion regressions. We can see that the impact of the date fixed effects on investor entry becomes larger from May 30, 2007, when the stock transactions tax was tripled. This is another piece of evidence that the stock transaction tax had an important impact on the warrant market.

To further investigate the effect of social contagion on new investor entry, we use the regression estimates to compute the difference between the predicted number of new investors and the predicted number using the same estimates but setting the coefficients on the proxies for social contagion (the lags of $\text{BranchAveragePosReturn}_{jkt}$ and $\text{BranchAveragePosReturn}_{jkt} \times \text{BranchInvestors}_{jkt}$) to zero. These differences in the predicted numbers of new investors in the five warrants are plotted in Figure VI. It is clear that the impact of social contagion as identified by $\text{BranchAveragePosReturn}_{jkt-1}$ and $\text{BranchAveragePosReturn}_{jkt}\times\text{BranchInvestors}_{jkt}$ becomes more important after the tripling of the transaction tax.

6. Panel Regressions Showing that Feedback Trading and Social Contagion Explain Prices

For each of the 18 put warrants, Xiong and Yu (2011) determine a zero-fundamental period in which an estimate of the fundamental value of the warrants computed using the Black-Scholes formula and historical volatility is less than ¥0.005. Using data from the zero-fundamental period, they estimate unbalanced panel regressions in which they regress the daily warrant prices (which measure the size of bubble as the fundamental value is nearly zero) on turnover, an estimate of the daily volatility computed from 5-minute intraday returns, the warrant float, and time-to-maturity fixed effects, and obtain positive coefficients on turnover and volatility and a negative coefficient on float. The resale option theory of Scheinkman and Xiong (2003) predicts positive correlations on turnover and volatility, and Xiong and Yu (2011) interpret the panel regression results as supportive of the resale option theory.

We revisit these panel regressions by adding to them variables that Shiller's feedback loop theory predicts should explain the bubble size. We want to see whether the variables predicted by Shiller's feedback loop theory influence the size of the put warrants bubble, controlling for the turnover and volatility variables suggested by the resale option theory and used in the Xiong and Yu (2011) panel regressions.

Columns (1)-(4) of Table V, Panel A replicate the panel regression results reported in the corresponding columns of Xiong and Yu (2011) Table V. The *t*-statistics are based on standard errors that are clustered by date. The first three columns each report the results of regressions that include the variables Turnover, Volatility, and Float one at a time, while column (4) presents the results of a specification that includes all three variables. For completeness, columns (5) and (6) of Panel A report the results of specifications that include two right-hand side variables at a time and are not in Xiong and Yu (2011). The coefficient point estimates and *t*-statistics in columns (1)-(4) of Panel A are very similar, but not quite identical, to those reported in the corresponding columns of Xiong and Yu (2011) Table 5.

Panel B reports the results of the same set of regression models but also adding a Transaction Tax dummy variable that is equal to one for 30 May, 2007 and later dates and equal to zero for dates before May 30. The results in Panel B for the regression specifications that include the dummy variable are quite different than those in Panel A that do not. In the specification that includes Turnover by itself (without Volatility or Float) the point estimate of the coefficient on Turnover is now negative, though not significantly different from zero, in contrast to the positive coefficient in Panel A. In the specification that includes all three variables Turnover is significantly negatively related to the warrant price, whereas the relation in Panel A was positive. Volatility remains significantly positively related to the size of the put warrant bubble, consistent with the resale option theory, though the point estimates are smaller than in Panel A. The coefficient on Float is always negative and highly significant, which is unsurprising since most theories of security valuation would imply that price is decreasing in security supply.[8] The coefficient on the transaction tax dummy is positive and significant in all specifications, consistent with our earlier claim that the tripling of the transaction tax was a precipitating event that had an important impact on the size of the put warrant bubble.

Shiller's feedback loop theory predicts not only that positive feedback trading and social contagion exist but that they impact the size of the bubble. To test this hypothesis, we construct measures of the trading volume due to feedback trading and the numbers of new investors due to social contagion and add these measures to the panel regressions. The measure of positive feedback trading for warrant *k* on date *t* consists of the estimates of trading due to positive feedback constructed in Section 4 based on the hazard rate regressions, but now scaled by the number of warrants outstanding on date *t*. The measure of new investors due to social contagion for warrant *k* on date *t* consists of the estimate of such new investors constructed in Section 5, but again now scaled by the number of warrants outstanding on each date *t*. Table VI reports the results of various panel regressions that include either one or both of these two new variables, called PredictedFeedbackVolume and PredictedSocContInvestors, respectively. The coefficient on PredictedFeedbackVolume, which is the measure of trading due to positive feedback, is

[8] Alternatively, in untabulated results we add date fixed effects to the regression instead of the Transaction Tax dummy to capture the effect of the increase in the transaction tax. The change in the significance of turnover and volatility is similar to that shown in Panel B of Table V. We plot the calendar date fixed effect dummies and find a pronounced change in the calendar date fixed effects around May 30. These results are additional evidence that the May 30, 2007 tripling of the transaction tax had an important impact on the put warrant market.

positive and significant in every specification in which it appears. The coefficient on the variable PredictedSocContInvestors, which is the estimate of new investors due to social contagion, is positive and highly significant in four of the six specifications in which it appears. The coefficient is insignificant (but still positive) in the other two specifications that also include both PredictedFeedbackVolume and Turnover (columns (7) and (9)). Once we include the two new variables PredictedFeedbackVolume and PredictedSocContInvestors in the regression specifications the estimated coefficients on Turnover and Volatility become either insignificant or significantly negatively related to the bubble size.

Next, we investigate whether our estimates of trading volume due to feedback trading (PredictedFeedbackVolume) and the number of new investors due to social contagion (PredictedSocContInvestors) impact the bubble size both before and after the tripling of the transaction tax. We begin by re-estimating the Xiong and Yu (2011) panel regressions on the two subsamples consisting of the observations prior to and subsequent to the tripling of the transaction tax. The results in Table VII show that turnover is unrelated to the bubble size in both subsamples, and volatility is positively related to the bubble size only after the increase in the transaction tax.

Table VIII reports the results of regressions that also include the estimates of feedback trading volume (PredictedFeedbackVolume) and the number of new investors due to social contagion (PredictedSocContInvestors). The predicted feedback volume is significantly and positively related to the bubble size both before and after the tripling of the transaction tax, with larger point estimates in the subsample after the increase in the tax, although in column (3) the estimate is significant at only the 10% level. The point estimates of the coefficients on the predicted number of new investors due to social contagion is positive in every specification in which this variable appears, though the estimated coefficient is significant only in the specification reported in column (5). Once we add the two new variables to the specification then the coefficients on Turnover are either insignificant or significantly negative and the coefficient on Volatility is always negative, though insignificant. These results are consistent with the previous results showing that Shiller's feedback loop theory has explanatory power for the size of the Chinese put warrant bubble.

7. Conclusion

There is compelling evidence that the Chinese put warrants bubble was in fact a bubble (Xiong and Yu 2011). The extreme period of the bubble began on May 30, 2007 with the tripling of the stock transaction tax. The tax did not apply to warrant trades, and increased the relative attractiveness of warrants for short term speculative trading. This increase in the transaction tax served as a precipitating event for the extreme phase of the bubble. It caused a sudden, sharp increase in the numbers of investors buying put warrants, abrupt increases in turnover and volatility, and a sudden rise in the prices of the five put warrants that were trading on that date.

We use hazard rate regressions to document the existence of positive feedback trading throughout the period that the put warrants were available for trading. In these hazard rate regressions, the probability that an investor reenters the warrant market is positively related to the past returns he has achieved trading warrants. Using the estimates of the hazard rate regressions, we show that the feedback trading causes heavy buying during the extreme period of the bubble. The period of heavy buying due to feedback trading coincides with the extreme period of the bubble.

Turning to new investors, we show that entry of new investors into the warrant market is positively related to the positive parts of the returns of the geographically proximate investors with whom the new investors might plausibly have had social contact. Following the arguments in Kaustia and Knüpfer (2012), this provides evidence that social contagion contributed to the entry of new investors into the put warrant market.

Finally, we show that estimates of the trading volume due to feedback trading and the number of new investors due to social contagion help explain the size of the bubble.

These results provide evidence that the three elements of the Shiller feedback loop theory—a precipitating event, positive feedback trading, and social contagion—are found in the Chinese put warrants bubble, and that they help explain the size of the bubble. To our knowledge we are the first to identify the three components of Shiller's feedback loop theory in a large dataset of investor trades. The evidence that the period in which feedback trading was important coincided with the extreme phase of the bubble is particularly striking.

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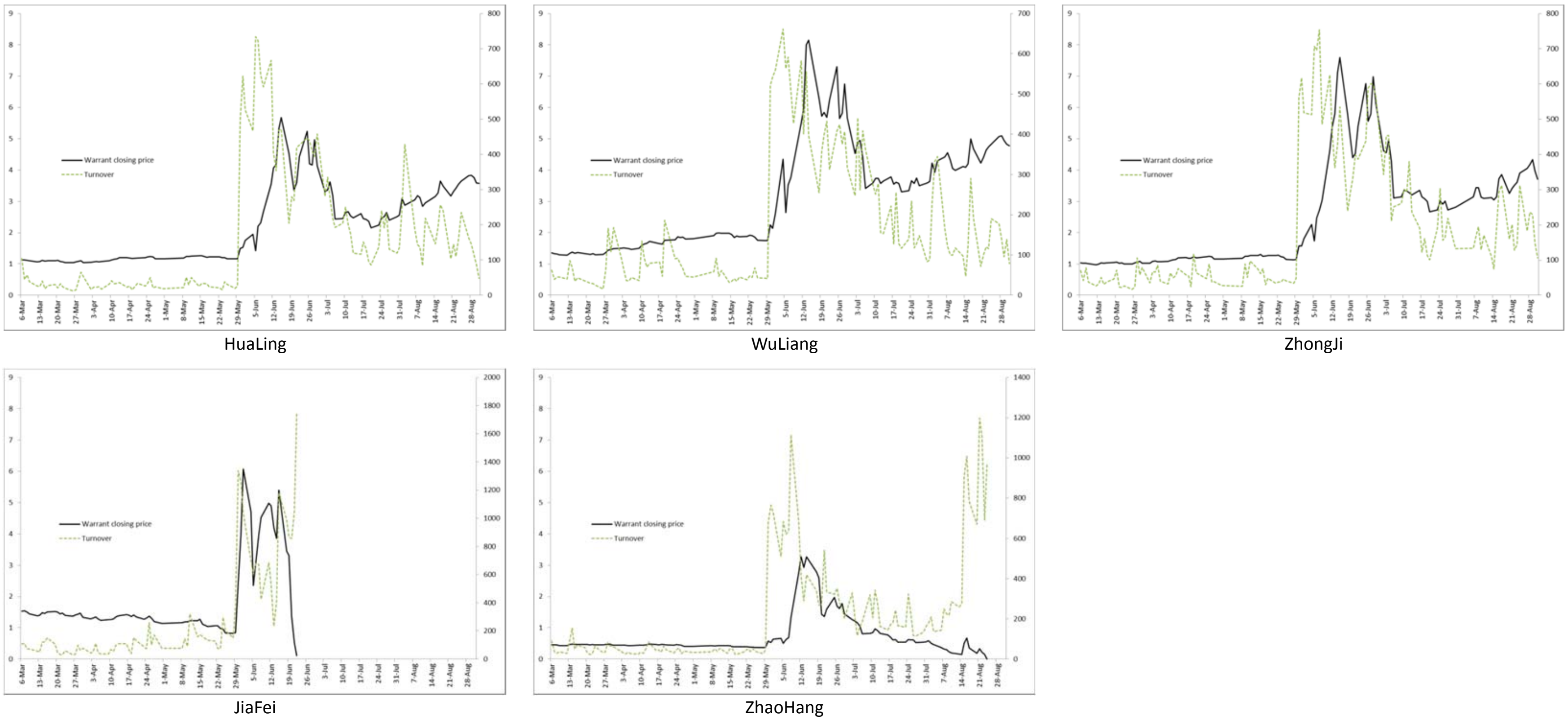


Figure I. Price and turnover of 5 put warrants. Daily closing price and turnover of the five put warrants that traded both before and after the tripling of the stock transaction tax (the stamp duty) that took effect on May 30, 2007. The series are shown from March 2007 to August 2007, a six month window approximately centered on the date of the tripling of the transaction tax. The five panels show that for all five put warrants the turnover jumped sharply on May 30 and price rose sharply either on or shortly after May 30.

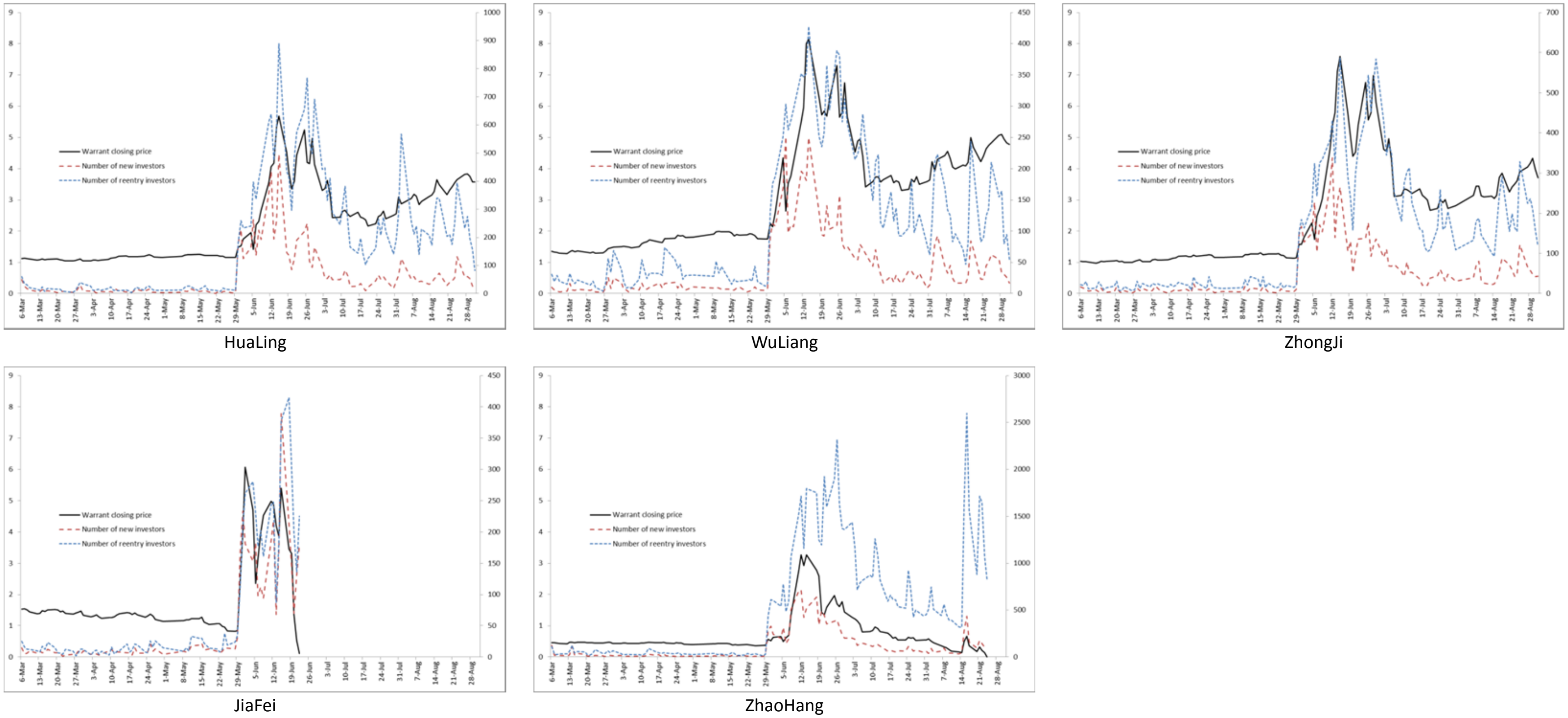
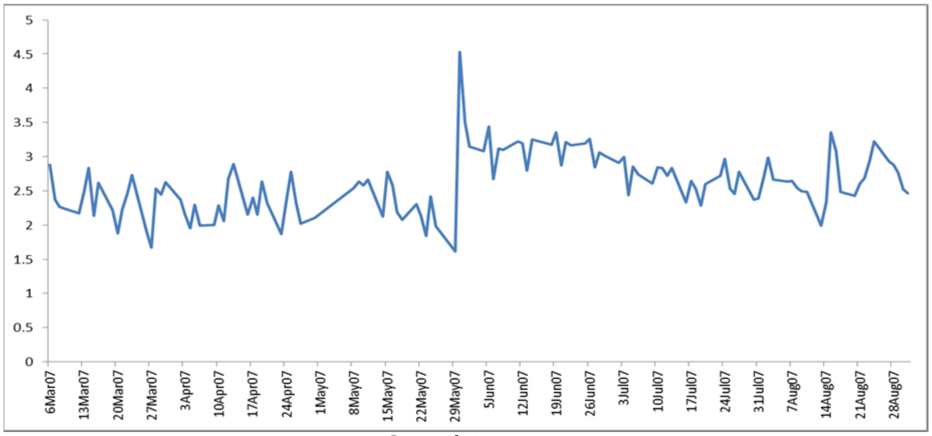
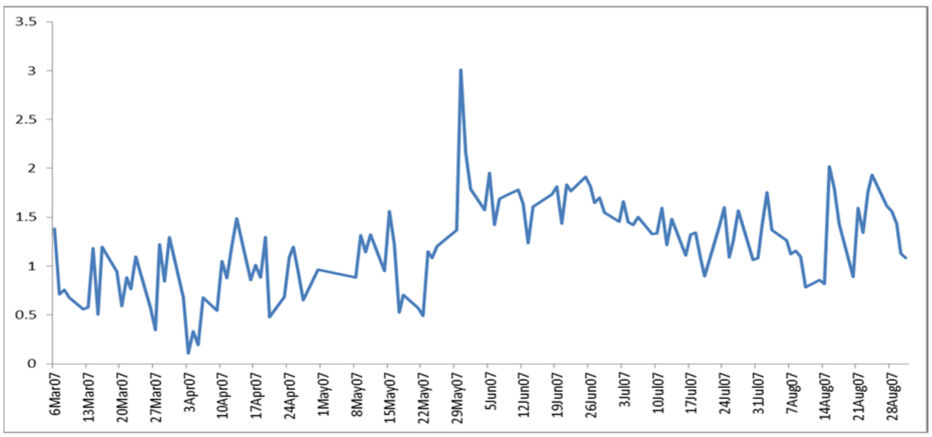


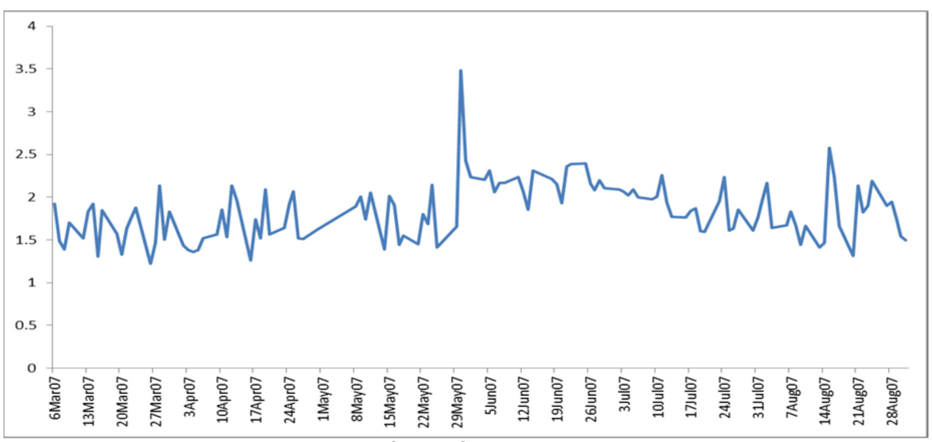
Figure II. Price of and number of investors buying each of 5 put warrants. Each panel shows the daily closing price (black line, left-hand axis), the number of new investors (dashed red line, right-hand axis), and the sum of the number of new and returning investors (dotted blue line, right-hand axis) on each date for the five put warrants that traded both before and after the tripling of the transaction tax on May 30, 2007. The difference between the dotted blue line and the dashed red line is the number of returning investors. A new investor in warrant *k* on date *t* is one who has not previously traded warrant *k*, while a returning investor is one who has previously traded warrant *k*. The five panels show that for all five put warrants the numbers of both new and returning investors jumped sharply on May 30.



One-cycle investors



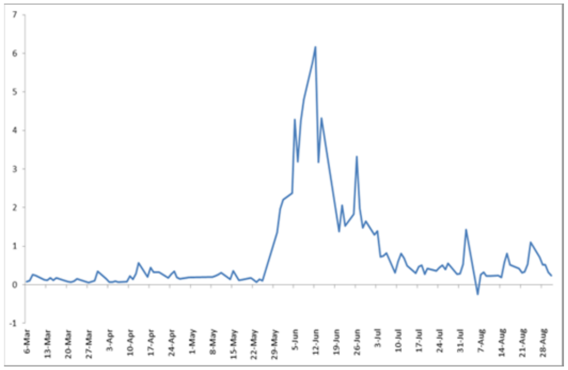
Two-cycle investors



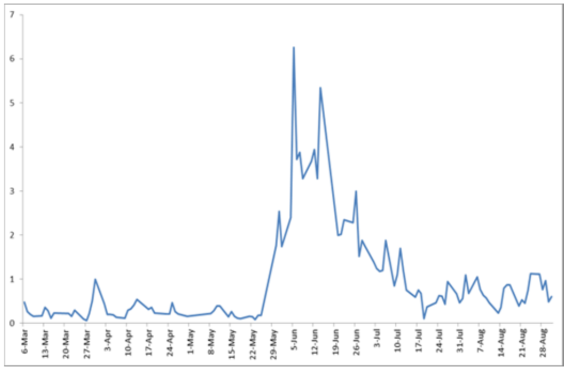
Three-cycle investors

Figure III. Date fixed effects from the positive feedback regressions by investor type. Calendar-date fixed effects from the hazard rate regressions reported in Table III that use investors' previous warrant returns to predict reentry into the warrant market. The three panels show the fixed effects from three different regressions estimated using investors who have previously completed one, two, and three or more transaction cycles. The fixed effects are shown for a six-month window approximately centered on May 30, 2007, the date when the stock transaction tax was tripled.

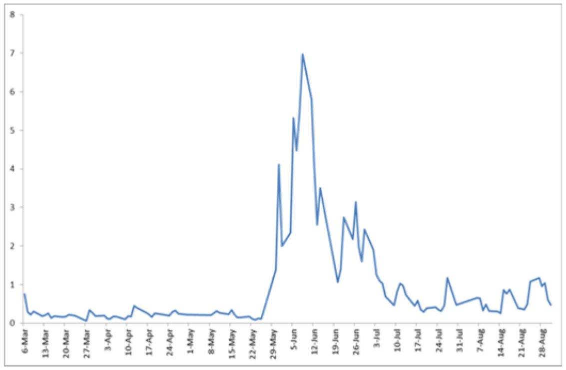
Panel A. One-cycle investors



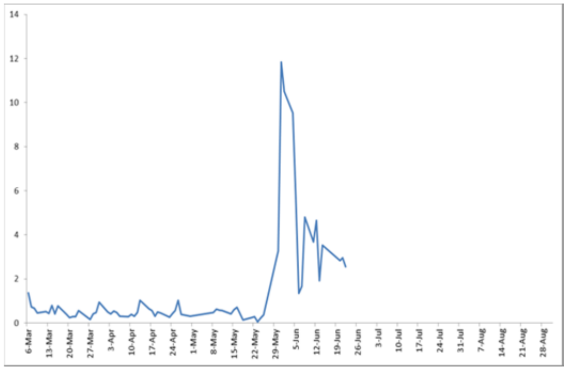
HuaLing



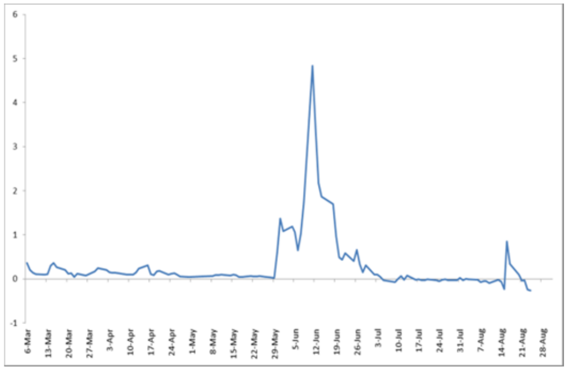
WuLiang



ZhongJi

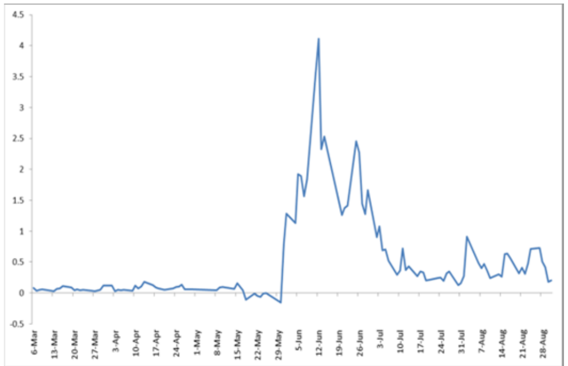


JiaFei



ZhaoHang

Panel B. Two-cycle investors



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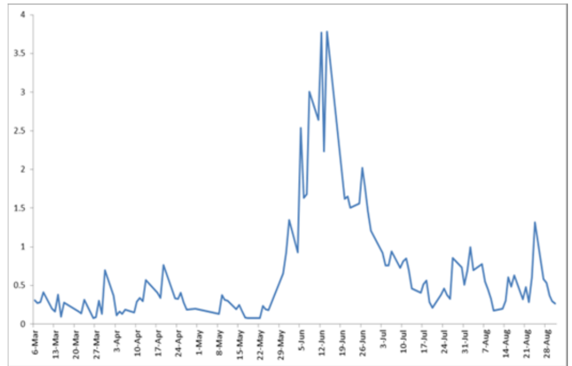

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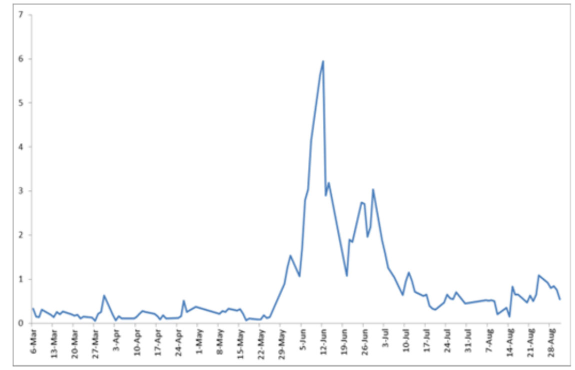

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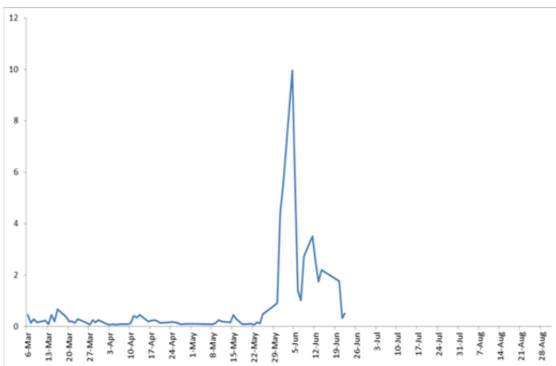
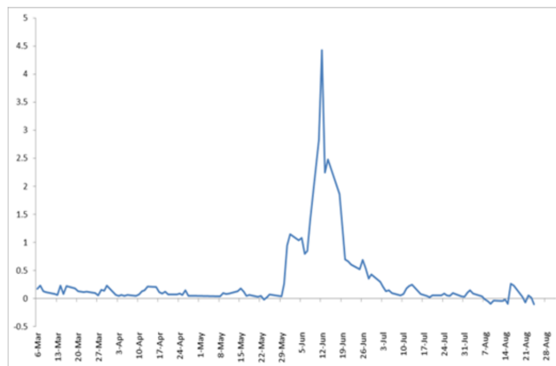
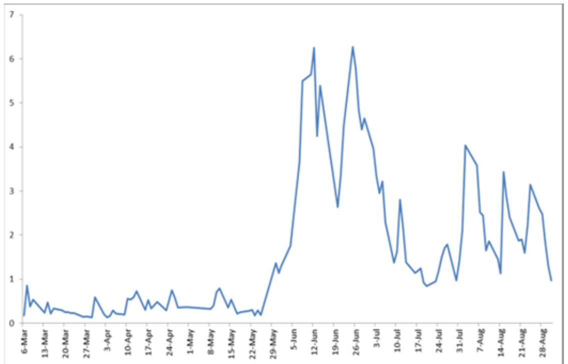


JiaFei

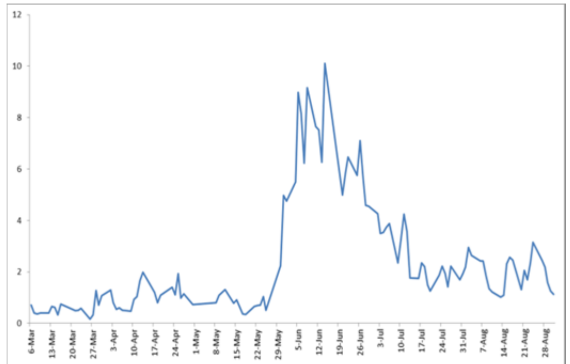


ZhaoHang

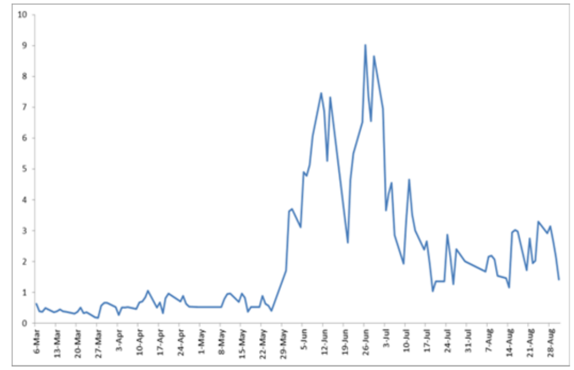
Panel C. Three-cycle investors



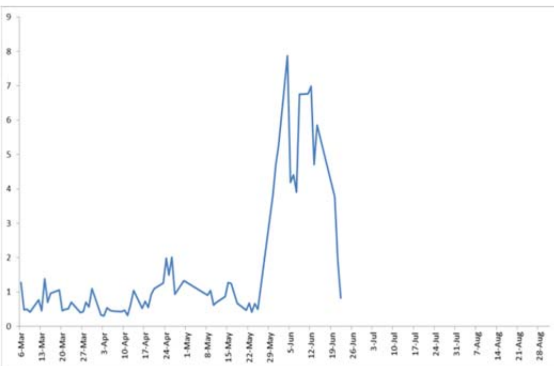
HuaLing



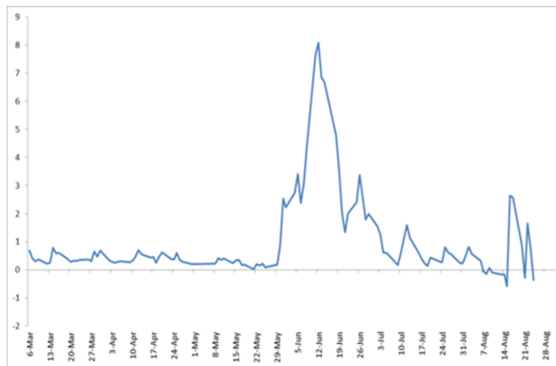
WuLiang



ZhongJi



JiaFei



ZhaoHang

Figure IV. Estimates of trading volume due to positive feedback effect trading. Estimates of trading volume due to positive feedback trading are shown for the five warrants that traded before and after May 30, 2007, when the stock transaction tax was tripled. The estimates are computed by first using the estimates of the hazard rate regressions reported in Table III to compute for each investor, warrant, and date the probability that the investor reenters the warrant market. Then, these probabilities are recomputed after setting the coefficients on the previous return variables (Return_{ikt-1}, Return_{ikt-2}, Return_{ikt-3}, $\text{I}(\text{Return}_{\text{ikt}-1}>0)$, $\text{I}(\text{Return}_{ikt-2}>0)$ and $\text{I}(\text{Return}_{ikt-3})>0)$ to zero. For each investor, warrant, and date the estimate of the volume due to positive feedback trading is the difference in probabilities multiplied by the investor's average trade size. For each warrant and date these estimates are summed across investors, yielding estimates of the trading volume due to positive feedback trading. Panels A, B and C display these estimates for investors who have previously completed one, two, and three or more transaction cycles, respectively.

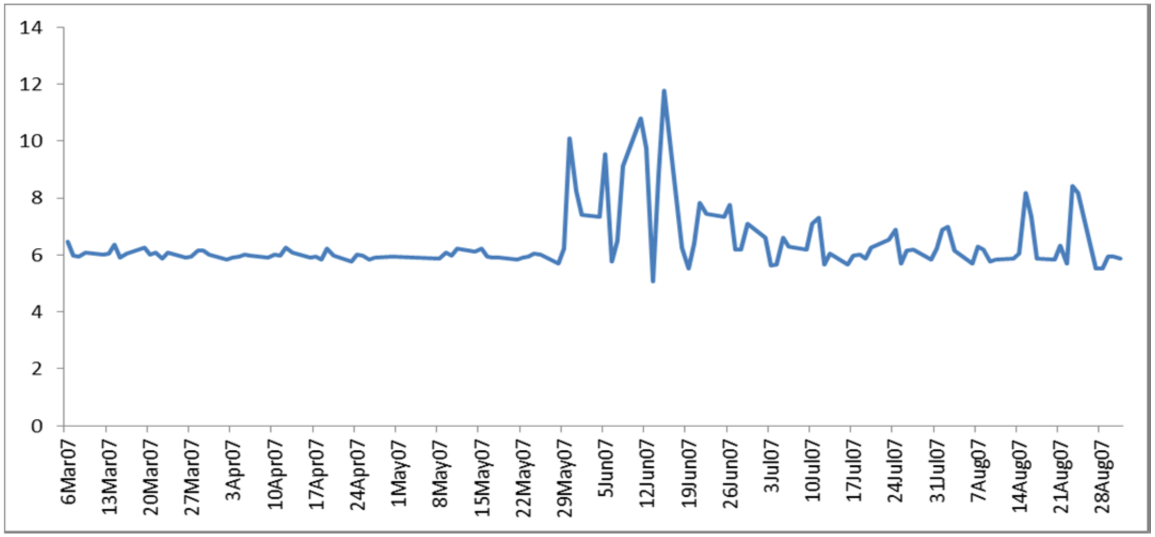


Figure V. Date fixed effects in the social contagion regressions. Calendar-date fixed effects from the social contagion regressions reported in Table IV that use warrant returns of geographically proximate investors to predict investors' entry into the warrant market. The fixed effects are shown for a six-month window approximately centered on May 30, 2007, when the stock transaction tax was tripled.

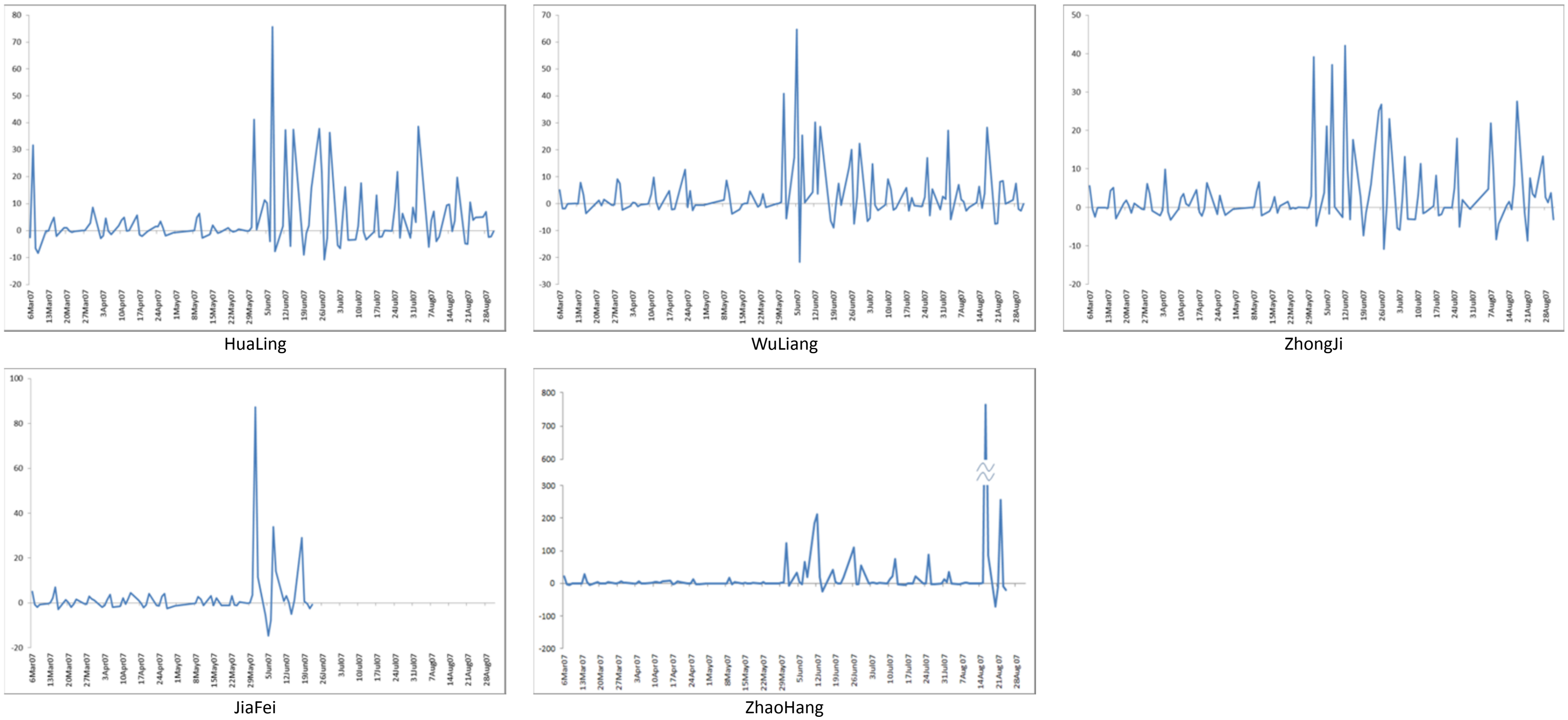


Figure VI. Estimates of the number of new investors entering the warrant market due to social contagion. Estimates of the numbers of new investors entering the warrant market due to social contagion are shown for the five warrants that traded before and after May 30, 2007, when the stock transaction tax was tripled. The estimates are computed by first using the estimates of the regressions reported in Table IV to compute for each branch office, warrant, and date the predicted number of investors who enter the warrant market. Then, these predicted numbers of entering investors are recomputed after setting the coefficients on the proxies for social contagion (BranchAveragePosReturn$_{jkt-1}$, BranchAveragePosReturn$_{jkt-2,\ ikt-2}$, BranchAveragePosReturn$_{jkt-3}$, BranchAveragePosReturn$_{jkt-1}$×BranchInvestors$_{jkt-1}$, BranchAveragePosReturn$_{jkt-2}$×BranchInvestors$_{jkt-2}$ and BranchAveragePosReturn$_{jkt-3}$×BranchInvestors$_{jkt-3}$) to zero. For each branch, warrant, and date the estimate of the number of new investors due to social contagion is the difference in the two estimates. For each warrant and date these estimates are summed across branch offices, yielding estimates of the numbers of new investors due to social contagion.

Table I
Summary Information and Statistics for the 18 Put Warrants

This table shows summary information and statistics for each of the 18 put warrants. Panel A provides the warrant name, trading period, total trading days, closing price of underlying stock on the first and last trading day, strike price and exercise ratio on the first and last trading day, and the total shares outstanding at the start and the end of warrant trading. Panel B reports, for each warrant, the time-series average and maximum of its daily stock closing price, warrant closing price, daily warrant price, daily turnover rate (in percent) and daily trading volume (in million yuan). Panel C presents summary statistics on the brokerage firm investor trading for each warrant, including the total number of investors, completed and uncompleted transaction cycles ,and the average length of the transaction cycles (in calendar days).

Panel A: Summary market information

	Trading period			Warrant information at trading start				Warrant information at trading end			
Name	Begin	End	Trading Days	Shares	Stock price	Strike price	Exercise Ratio	Shares	Stock price	Strike price	Exercise Ratio
WanKe	2005/12/5	2006/8/28	174	2140	3.78	3.73	1	2140	6.79	3.64	1
ShenNeng	2006/4/27	2006/10/19	102	438	6.31	7.12	1	438	7.25	6.69	1
WuGang	2005/11/23	2006/11/15	235	474	2.77	3.13	1	474	3.35	2.83	1
JiChang	2005/12/23	2006/12/15	234	240	6.77	7	1	267	7.94	6.9	1
YuanShui	2006/4/19	2007/2/5	194	280	4.27	5	1	359	6.54	4.9	1
HuChang	2006/3/7	2007/2/27	235	568	11.85	13.6	1	584	25.52	13.36	1
BaoGang	2006/3/31	2007/3/23	233	715	2.1	2.45	1	834	5.7	2.37	1
WanHua	2006/4/27	2007/4/19	236	85	16.42	13	1	189	38.75	9.22	1.41
GangFan	2005/12/5	2007/4/24	331	233	3.3	4.85	1	233	10.72	3.16	1.53
HaiEr	2006/5/22	2007/5/9	231	607	4.74	4.39	1	757	15.79	4.29	1
YaGe	2006/5/22	2007/5/14	237	635	6.8	4.25	1	734	26.44	4.09	1
MaoTai	2006/5/30	2007/5/22	234	432	48.39	30.3	0.25	766	94.84	30.3	0.25
JiaFei	2006/6/30	2007/6/22	232	120	20.3	15.1	1	120	45.21	15.1	1
ZhaoHang	2006/3/2	2007/8/24	359	2241	6.37	5.65	1	5482	39.04	5.45	1
ZhongJi	2006/5/25	2007/11/16	352	424	13.98	10	1	424	24.11	7.3	1.37
HuaLing	2006/3/2	2008/2/22	442	633	3.64	4.9	1	633	12.45	4.72	1
WuLiang	2006/4/3	2008/3/26	468	313	7.11	7.96	1	313	25.92	5.63	1.4
NanHang	2007/6/21	2008/6/13	239	1400	8.99	7.43	0.5	1637	8.48	7.43	0.5

Panel B. Summary statistics of market variables

Name	Stock price		Warrant Price		Daily turnover (percent)		Yuan volume(million)	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
WanKe	5.58	6.98	0.433	0.893	66	547	504	3832
ShenNeng	7.23	8.32	0.810	1.78	135	616	396	1669
WuGang	2.77	3.63	0.691	1.86	88	1695	371	3455
JiChang	6.65	8	1.176	2.05	104	725	339	1583
YuanShui	5.31	7	0.994	2.084	110	1471	362	2589
HuChang	15.68	29.94	1.164	1.906	84	991	453	2602
BaoGang	2.80	5.7	0.563	0.939	115	1406	485	2969
WanHua	21.39	38.83	1.482	4.202	101	1438	221	1700
GangFan	4.28	10.72	1.229	2.252	79	1316	215	1307
HaiEr	7.41	16.26	0.725	1.611	65	1072	306	2165
YaGe	9.13	28.92	0.685	1.76	79	972	354	4123
MaoTai	69.09	113.2	1.030	3.465	65	815	382	4683
JiaFei	25.51	47.2	1.650	6.07	122	1741	353	7990
ZhaoHang	14.53	39.04	0.515	3.269	106	1198	3179	45683
ZhongJi	21.53	36.18	1.724	7.12	131	1662	1352	17053
HuaLing	7.24	14.3	1.647	5.33	105	1306	1349	14364
WuLiang	26.02	51.04	2.119	8.15	137	1841	1049	12047
NanHang	18.25	28.73	0.994	2.359	139	1261	10041	45419

Panel C. Summary statistics of brokerage investors trading

Name	Investor number	Completed cycles		Uncompleted cycles	
		Number	Average length	Number	Average length
WanKe	6270	21038	6.71	540	52.76
ShenNeng	2727	7860	3.07	101	26.04
WuGang	5259	14959	6.65	695	64.76
JiChang	3966	12162	3.65	448	50.72
YuanShui	3796	11454	3.51	297	73.89
HuChang	4081	12708	3.92	290	66.09
BaoGang	5135	16997	4.08	383	84.94
WanHua	2627	7816	3.94	157	80.39
GangFan	4206	12720	3.94	153	67.03
HaiEr	4612	11338	6.28	331	78.98
YaGe	4668	13016	6.23	357	87.91
MaoTai	5399	14756	8.96	476	87.32
JiaFei	4893	11964	1.70	134	25.88
ZhaoHang	20377	95401	4.30	1168	122.34
ZhongJi	11447	42520	3.12	349	35.25
HuaLing	13543	54199	3.70	402	73.79
WuLiang	11364	44722	3.45	318	82.96
NanHang	24975	150195	7.91	922	85.31

Table II

Statistics Related to the Bubble During Periods Before and After May 30, 2007

Time-series average and maximum of daily turnover, bubble size, and volatility of the 18 put warrants during periods before and after May 30, 2007, the date of the tripling of the transaction tax. Daily turnover is daily trading volume divided by the number of outstanding warrants, bubble size is the warrant price minus the Black-Scholes value, and the volatility is computed from intraday 5-minute warrants returns, and then annualized. Panel A reports these statistics for the 12 warrants that expire before May 30, 2007, Panel B reports them for the five warrants that traded both before and after May 30, for the period before May 30, and Panel C reports them for the 6 warrants that traded after May 30, for the period after May 30.

Panel A. 12 warrants that expired before May 30, 2007

	Daily turnover (percent)		Bubble Size		Volatility (percent)	
Name	Average	Maximum	Average	Maximum	Average	Maximum
WanKe	66	547	0.309	0.659	116	2327
ShenNen	135	616	0.424	1.192	140	1447
WuGang	88	1695	0.233	1.235	104	2287
JiChang	104	725	0.489	1.146	91	441
YuanShu	110	1471	0.604	1.658	111	1426
HuChang	84	991	-0.113	1.158	92	1249
BaoGang	115	1406	0.107	0.627	99	1018
WanHua	101	1438	1.108	3.952	109	1717
GangFan	79	1316	0.261	1.439	86	1456
HaiEr	65	1072	0.606	1.327	90	1569
YaGe	79	972	0.498	1.492	91	1375
MaoTai	65	815	0.351	1.943	90	1617

Panel B. 5 warrants that expired after May 30, 2007, for the period before May 30, 2007

	Daily turnover (percent)		Bubble Size		Volatility (percent)	
Name	Average	Maximum	Average	Maximum	Average	Maximum
JiaFei	74	415	1.188	2.344	68	359
ZhaoHan	44	279	0.207	0.510	64	703
ZhongJi	40	243	0.748	1.997	65	245
HuaLing	34	143	0.129	1.255	49	387
WuLiang	62	302	0.978	2.525	84	368

Panel C. 6 warrants that expire after May 30, 2007, for the period after May 30, 2007

	Daily turnover (percent)		Bubble Size		Volatility (percent)	
Name	Average	Maximum	Average	Maximum	Average	Maximum
JiaFei	814	1741	3.410	6.070	729	1623
ZhaoHan	404	1198	0.948	3.269	331	1716
ZhongJi	331	1662	3.075	7.120	213	1166
HuaLing	221	1306	2.345	5.316	148	1261
WuLiang	238	1841	3.099	8.149	141	1467
NanHang	139	1261	0.948	2.184	131	1963

Table III
Positive Feedback Regressions for Three Groups of Investors

Results of proportional hazard regressions explaining the reentry of investors who have previously traded put warrants using the investors' previous transaction cycle returns for three groups of investors. For each warrant and date, the three groups of investors are those who have previously completed one, two, and three or more transaction cycles in the warrant. The unit of observation is an investor-warrant-date, and for investor *i* in warrant *k* on date *t* the left-hand side variable takes the value one if investor *i* begins a new transaction cycle in warrant *k* on date *t*, and otherwise is zero. The main explanatory variables are $Return\_lag1_{i,k,t}$, and $Return\_lag2_{i,k,t}$, investor *i*'s returns on the two most recent transaction cycles in warrant *k* before date *t*, $Return\_lag3_{i,k,t}$, the average return of the transaction cycles before the second most recent cycle, and dummy variables I($Return\_lag1_{i,k,t}$ >0), I($Return\_lag2_{i,k,t}$ >0), and I($Return\_lag3_{i,k,t}$ >0) that take the value one if the return is positive. The control variables are $Maturity_{k,t}$, the number of calendar days remaining on date *t* before the end of trading in warrant *k*, $WarrantReturn_{k,t}$, the daily market return of warrant *k* on date *t*, $TurnoverRatio_{k,t}$, the market trading volume in warrant *k* on date *t*, divided by number of warrants outstanding on date *t*, and $AdjustedFundamental_{k,t}$,the adjusted fundamental value of warrant *k* on date *t*, which is defined in the text.

	One-cycle investors		Two-cycle investors		Three-cycle investors	
	(1)		(2)		(3)	
Explanatory Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
$Return\_lag1_{i,k,t}$	0.47513	<0.0001	0.54859	<.0001	0.54542	<.0001
$Return\_lag2_{i,k,t}$			0.05874	0.0696	0.231	<.0001
$Return\_lag3_{i,k,t}$					0.11094	<.0001
I($Return\_lag1_{i,k,t}$ >0)	0.35023	<.0001	0.29162	<.0001	0.22315	<.0001
I($Return\_lag2_{i,k,t}$ >0)			0.03093	0.0033	0.02545	<.0001
I($Return\_lag3_{i,k,t}$ >0)					-0.01923	<.0001
$WarrantReturn_{k,t-1}$	0.0011	0.0045	0.00173	0.0003	0.0005037	0.0264
$WarrantReturn_{k,t-2}$	0.0005384	0.0681	0.00118	0.0006	0.0005921	0.0002
$WarrantReturn_{k,t-3}$	0.0002835	0.0075	0.0006553	<.0001	0.0007301	<.0001
$TurnoverRatio_{k,t-1}$	0.0005238	<.0001	0.0002567	0.0006	0.0001929	<.0001
$TurnoverRatio_{k,t-2}$	0.0001543	0.0081	0.0001568	0.0264	0.0000647	0.0501
$TurnoverRatio_{k,t-3}$	0.0002848	<.0001	0.000254	<.0001	0.0001289	<.0001
$AdjustedFundamental_{k,t-1}$	-2.08853	<.0001	-2.0252	<.0001	-1.5269	<.0001
Maturity fixed effects	Yes		Yes		Yes	
Warrant fixed effects	Yes		Yes		Yes	
Date fixed effects	Yes		Yes		Yes	
Observations	7,967,035		3,469,331		6,601,550	

Table IV

Regressions Explaining Entry of New Investors Using Proxies for Social Contagion

Panel regressions using proxies for social contagion to explain the entry of new investors. The dependent variable is $NewBranchInvestors_{j,k,t}$, the number of branch *j* investors who trade warrant *k* for the first time on date *t*. A branch *j* investor who trades warrant *k* on day *t* is considered to be a new investor if date *t* is the first date on which the investor trades warrant *k*. The main explanatory variables are lags of $BranchAveragePosReturn_{j,k,t}$, which is the average return across the positive parts of the returns of branch *j* investors on their positions in warrant *k* at date *t*, and lags of the interaction between this variable and $BranchInvestors_{j,k,t}$, which is the number of branch *j* investors who either held or purchased warrant *k* on date *t*. The control variables are $BranchAverageReturn_{j,k,t}$, the average date *t* return on the positions in warrant *k* of branch *j* investors who either held or purchased warrant *k* on date *t*, $BrokerageInvestors_{k,t}$, the number of brokerage firm investors who either hold or purchased warrant *k* on date *t*, $WarrantReturn_{k,t}$, the (close-to-close) return of warrant *k* on date *t*, and $TurnoverRatio_{k,t}$, the market trading volume in warrant *k* on date *t*, divided by number of warrants outstanding. The regressions in the columns headed (1)-(3) use the whole sample, while those reported in the columns (4)-(6) exclude observations for which the branch office is either located in the same city as the headquarters of the company whose stock provides the underlying asset of the warrant or located in the city (either Shanghai or Shenzhen) where the underlying stock is listed. All the regressions include maturity, warrant, date and branch fixed effects, and the *t*-statistics (in parentheses) are based on standard errors computed by clustering by branch and warrant (the cross-section).

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
$BranchAveragePosReturn_{jkt-1}$	7.703	3.912	4.111	7.990	4.082	4.295
	(4.19)	(3.37)	(3.61)	(4.19)	(3.38)	(3.67)
$BranchAveragePosReturn_{jkt-2}$		-0.796	-1.460		-0.937	-1.580
		(-1.85)	(-3.18)		(-2.07)	(-3.31)
$BranchAveragePosReturn_{jkt-3}$			-1.547			-1.562
			(-2.99)			(-2.96)
$BranchAveragePosReturn_{jkt-1}$	0.111	0.111	0.105	0.111	0.111	0.105
$\times BranchInvestors_{jkt-1}$	(3.83)	(3.75)	(3.62)	(3.76)	(3.68)	(3.57)
$BranchAveragePosReturn_{jkt-2}$		-0.00439	0.00693		-0.00437	0.00671
$\times BranchInvestors_{jkt-2}$		(-0.71)	(0.76)		(-0.67)	(0.71)
$BranchAveragePosReturn_{jkt-3}$			0.00306			0.00318
$\times BranchInvestors_{jkt-3}$			(0.20)			(0.20)
$NewBranchInvestors_{jkt-1}$	0.568	0.404	0.397	0.571	0.406	0.400
	(8.93)	(10.24)	(8.59)	(8.83)	(10.15)	(8.62)
$NewBranchInvestors_{jkt-2}$		0.276	0.259		0.277	0.260
		(14.21)	(10.10)		(14.09)	(10.04)
$NewBranchInvestors_{jkt-3}$			0.0922			0.0913
			(1.88)			(1.84)
$BranchAverageReturn_{jkt-1}$	-3.956	-3.237	-3.277	-4.125	-3.313	-3.345
	(-7.84)	(-5.65)	(-6.19)	(-7.65)	(-5.19)	(-5.66)

$BranchAverageReturn_{jkt-2}$		0.261	1.149		0.466	1.184
		(0.77)	(2.60)		(1.39)	(2.52)
$BranchAverageReturn_{jkt-3}$			0.968			1.059
			(3.63)			(3.77)
$BranchInvestors_{jkt-1}$	-0.000983	0.0115	0.0171	-0.00114	0.0109	0.0163
	(-0.18)	(1.02)	(1.70)	(-0.21)	(0.93)	(1.56)
$BranchInvestors_{jkt-2}$		-0.0103	-0.0514		-0.00978	-0.0513
		(-0.93)	(-3.23)		(-0.85)	(-3.12)
$BranchInvestors_{jkt-3}$			0.0336			0.0342
			(4.36)			(4.37)
$BrokerageNewInvestors_{kt-1}$	-0.00276	-0.000184	0.00106	-0.00294	-0.000137	0.00129
	(-2.16)	(-0.20)	(1.26)	(-2.18)	(-0.14)	(1.45)
$BrokerageNewInvestors_{kt-2}$		-0.000865	0.000267		-0.000925	0.000195
		(-2.63)	(0.44)		(-2.62)	(0.30)
$BrokerageNewInvestors_{kt-3}$			-0.00247			-0.00273
			(-3.54)			(-3.72)
$WarrantReturn_{kt-1}$	0.0104	0.0122	0.0123	0.0111	0.0120	0.0122
	(5.58)	(3.49)	(3.44)	(5.31)	(3.09)	(3.04)
$WarrantReturn_{kt-2}$		-0.00757	-0.0128		-0.00877	-0.0129
		(-3.34)	(-3.83)		(-3.89)	(-3.58)
$WarrantReturn_{kt-3}$			-0.00243			-0.00283
			(-2.94)			(-3.01)
$TurnoverRatio_{kt-1}$	-0.00180	-0.000630	-0.000769	-0.00184	-0.000603	-0.000784
	(-8.72)	(-2.98)	(-2.79)	(-8.56)	(-2.70)	(-2.64)
$TurnoverRatio_{kt-2}$		-0.000400	0.0000602		-0.000379	0.0000598
		(-2.23)	(0.22)		(-1.97)	(0.20)
$TurnoverRatio_{kt-3}$			-0.000223			-0.000179
			(-1.21)			(-0.96)
Constant	4.718	18.11	-5.011	4.576	18.07	-5.157
	(1.70)	(4.98)	(-3.74)	(1.63)	(4.94)	(-3.79)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Warrant fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Date fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Branch fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	187,685	185,817	184,320	178,983	177,315	175,954
Within R^2	0.483	0.609	0.615	0.484	0.611	0.616

Table V
Panel Regressions Explaining Put Warrant Prices

Results of regressions of daily warrant closing prices on Turnover, Volatility, Float and a Transaction Tax dummy using the zero-fundamental sample defined in Xiong and Yu (2011) as the set of warrant-dates for which the Black-Scholes value is less than ¥0.005 (or for the cash settled NanHang warrant if the settlement price will exceed the strike price even if the stock trades limit down every day until the expiration date). The zero-fundamental sample contains 863 observations, 42 of which are missing the value of Volatility. Turnover is market trading volume divided by the number of outstanding warrants, Volatility is computed from intraday 5-minute returns, and then annualized, Float is the daily total number of shares outstanding, in billions, and the Transaction Tax dummy takes the value one if the date is May 30, 2007 or later. Columns (1)-(4) of Panel A replicate the results in Xiong and Yu (2011), Table 5, while columns (5) and (6) reported the results of additional specifications. Panel B reports results including the Transaction Tax dummy. All of the regressions include maturity fixed effects. The *t*-statistics (in parentheses) are based on standard errors clustered by date to adjust for heteroscedasticity and correlation within a trading day.

Panel A: Without Transaction Tax dummy

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
Turnover	0.212			0.146	0.225	
	(8.31)			(4.91)	(8.43)	
Volatility		21.93		15.06		26.93
		(5.19)		(2.78)		(5.66)
Float			-0.301	-0.281	-0.316	-0.291
			(-11.38)	(-10.17)	(-11.40)	(-10.95)
Constant	-2.513	-3.185	0.323	-3.671	-2.385	-3.648
	(-6.40)	(-4.59)	(3.26)	(-4.71)	(-5.35)	(-4.72)
Maturity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	863	821	863	821	863	821
Adjusted R^2	0.181	0.177	0.209	0.322	0.301	0.295

Panel B: With Transaction Tax dummy

Explanatory Variable	(7)	(8)	(9)	(10)	(11)	(12)
Turnover	-0.0127			-0.0776	-0.00882	
	(-0.49)			(-2.41)	(-0.38)	
Volatility		7.375		17.40		12.10
		(2.13)		(4.25)		(3.68)
Float			-0.355	-0.344	-0.355	-0.335
			(-20.74)	(-17.83)	(-20.85)	(-18.00)
Transaction Tax	1.677	1.387	1.749	1.588	1.765	1.486
	(16.92)	(16.64)	(19.54)	(15.28)	(18.13)	(15.77)
Constant	-0.398	-1.534	-0.244	-1.821	-0.143	-1.949
	(-1.09)	(-2.66)	(-1.09)	(-3.31)	(-0.42)	(-3.38)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	863	821	863	821	863	821
Adjusted R^2	0.476	0.450	0.627	0.613	0.626	0.607

Table VI
Panel Regressions Explaining Warrant Prices Using Predicted Feedback Volume and the Predicted Number of New Investors

Results of panel regressions explaining daily warrant closing prices using the predicted volume due to positive feedback trading (PredictedFeedbackVolume) and the predicted number of new investors due to social contagion (PredictedSocContInvestors). The sample is the zero-fundamental sample defined in Xiong and Yu (2011), restricted to the set of five warrants that traded both before and after May 30, 2007, the date when the stock transaction tax tripled. The zero-fundamental sample for the five warrants contains 510 observations, of which 42 have missing values for Volatility and one of which is missing the values of PredictedFeedbackVolume and PredictedSocContInvestors. The main variables of interest PredictedFeedbackVolume and PredictedSocContInvestors are defined in Section 6. Other variables are as in Table V. All regressions include maturity fixed effects. The *t*-statistics (in parentheses) are based on standard errors clustered by date to adjust for heteroscedasticity and correlation within a trading day.

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PredictedFeedbackVolume	0.0397	0.0346	0.0398				0.0340	0.0242	0.0348
	(10.72)	(9.16)	(8.84)				(5.66)	(4.21)	(5.56)
PredictedSocContInvestors				0.239	0.236	0.233	0.0498	0.112	0.0475
				(9.71)	(8.48)	(8.24)	(1.30)	(2.87)	(1.16)
Turnover	-0.226		-0.207	-0.0533		-0.0411	-0.208		-0.183
	(-5.85)		(-5.14)	(-1.41)		(-0.88)	(-5.13)		(-4.36)
Volatility		-11.25	0.0904		-1.904	1.504		-12.27	-1.629
		(-2.44)	(0.02)		(-0.36)	(0.23)		(-2.34)	(-0.29)
Float	-0.219	-0.186	-0.191	-0.227	-0.197	-0.203	-0.216	-0.173	-0.185
	(-10.41)	(-7.87)	(-8.39)	(-10.59)	(-8.50)	(-8.36)	(-10.18)	(-7.44)	(-8.02)
Transaction Tax	2.022	1.696	1.791	2.297	2.063	2.091	2.062	1.814	1.830
	(16.77)	(13.53)	(14.30)	(20.08)	(17.50)	(17.30)	(16.87)	(14.16)	(14.47)
Constant	-0.123	-1.377	-0.238	-2.052	-2.372	-2.259	-0.361	-1.307	-0.337
	(-0.20)	(-1.94)	(-0.31)	(-2.20)	(-2.33)	(-2.20)	(-0.57)	(-1.53)	(-0.43)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	509	467	467	510	468	468	509	467	467
Adjusted R^2	0.719	0.672	0.705	0.676	0.650	0.651	0.721	0.685	0.706

Table VII

Panel Regressions Explaining Warrant Prices Before and After May 30, 2007

Results of regressions of daily warrant closing prices on Turnover, Volatility, Float and a Transaction Tax dummy using the zero-fundamental sample defined in Xiong and Yu (2011) before and after the tripling of the transaction tax on May 30, 2007. The zero-fundamental sample contains 863 observations, of which 42 are missing the value of Volatility. Among these, 486 observations are from before May 30, 2007 and 377 observations are on or after that date. Columns (1)-(3) use the dates before May 30, 2007, and (4)-(6) use the dates on or after May 30. All regressions include maturity fixed effects. The *t*-statistics (in parentheses) are based on standard errors clustered by date to adjust for heteroscedasticity and correlation within a trading day.

	Before May 30, 2007			On or after May 30, 2007		
	(1)	(2)	(3)	(4)	(5)	(6)
Turnover	-0.00781	-0.00752		-0.0648	0.0606	
	(-0.56)	(-0.89)		(-1.10)	(1.57)	
Volatility	0.0606		-0.385	24.56		19.49
	(0.04)		(-0.33)	(3.82)		(4.05)
Float	-0.368	-0.368	-0.364	-0.189	-0.201	-0.181
	(-23.69)	(-22.60)	(-20.83)	(-5.52)	(-6.59)	(-5.85)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.370	0.376	0.351	-2.258	-0.576	-2.496
	(3.21)	(3.08)	(2.57)	(-3.12)	(-0.84)	(-3.58)
Observation	486	486	486	335	377	335
Adjusted R^2	0.697	0.698	0.697	0.493	0.451	0.491

Table VIII
Panel Regressions Explaining Warrant Prices Before and After May 30, 2007 Using Predicted Feedback Volume and the Predicted Number of New Investors

Results of panel regressions explaining daily warrant closing prices using the predicted volume due to positive feedback trading (PredictedFeedbackVolume) and the predicted number of new investors due to social contagion (PredictedSocContInvestors) using the zero-fundamental sample defined in Xiong and Yu (2011) before and after the tripling of the transaction tax on May 30, 2007, restricted to the set of five warrants that traded both before and after that date. The zero-fundamental sample for the five warrants contains 510 observations, of which 42 have missing values for Volatility and one of which is missing the values of PredictedFeedbackVolume and PredictedSocContInvestors. The main variables of interest PredictedFeedbackVolume and PredictedSocContInvestors are defined in Section 6. Other variables are as in Tables V, VI, and VII. The regressions reported in columns (1)-(3) use the zero-fundamental sample before May 30, 2007, and those in columns (4)-(6) use the zero-fundamental sample from on or after that date. All regressions include maturity fixed effects. Those reported in columns (1)-(3) use weekly maturity fixed effects because the number of observations does not allow the use of daily fixed effects, and those reported in columns (4)-(6) use daily maturity fixed effects. The *t*-statistics (in parentheses) are based on standard errors clustered by date to adjust for heteroscedasticity and correlation within a trading day.

	Before May 30, 2007			On or after May 30, 2007		
	(1)	(2)	(3)	(4)	(5)	(6)
PredictedFeedbackVolume	0.00630		0.00543	0.0401		0.0333
	(2.26)		(2.37)	(9.00)		(5.25)
PredictedSocContInvestors		0.0796	0.0659		0.240	0.0618
		(2.29)	(2.26)		(8.40)	(1.45)
Turnover	0.0124	0.00356	-0.000910	-0.195	-0.0255	-0.163
	(0.78)	(0.25)	(-0.06)	(-4.68)	(-0.52)	(-4.03)
Volatility	-4.583	-1.171	-3.591	-1.825	-1.572	-4.095
	(-1.62)	(-0.47)	(-1.43)	(-0.35)	(-0.25)	(-0.79)
Float	-0.405	-0.408	-0.406	-0.0785	-0.0770	-0.0682
	(-60.71)	(-43.08)	(-49.86)	(-3.27)	(-3.14)	(-2.96)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.995	1.003	0.974	1.479	-0.159	1.392
	(26.89)	(33.40)	(28.66)	(2.11)	(-0.16)	(1.91)
Observation	136	136	136	331	332	331
Adjusted R^2	0.993	0.993	0.994	0.731	0.665	0.735