Speculation Spillovers

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First draft: December 15, 2008
This version: Nov 3, 2011

Acknowledgments: We are grateful to two referees and the Editor for detailed comments that substantially improved the paper.

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Abstract

This paper demonstrates that investor irrationality can be contagious across markets. Supplementing existing studies on resale option theory, we illustrate that warrant speculation could spill over to the underlying stock market. Our findings indicate that high turnover of underlying stocks is associated with previous day's high unexpected turnover of warrants, or previous day's larger price deviation of warrants from theoretical prices. The results are robust with alternative measures, regression specifications and various samples. In addition, this paper highlights the mechanisms of speculation spillovers. Our evidence shows that speculation in warrants may fuel speculation in underlying stocks through limited attention.

I. Introduction

The field of finance is missing an important chapter which examines how thoughts and behaviors in assets markets are contagious (Hirshleifer and Teoh (2008)). The recent financial turmoil in 2008 involving credit derivatives revealed that the convenient features of derivatives may encourage excessive speculation. Such speculation can ultimately lead to a destabilization of financial markets.

Our goal in this study is to test whether speculative trading in the derivatives market is contagious to speculative trading in the stock market. Existing behavioral theories model speculative behaviors where short sales of assets are constrained and investors hold heterogeneous beliefs about an asset's fundamentals (Miller (1977), Harrison and Kreps (1978), and Scheinkman and Xiong (2003)). Xiong and Yu (2010) have reliably documented speculative behavior in the Chinese warrants market. In complement to Xiong and Yu (2010)，our study illustrates that speculation in the Chinese warrants market can be spilled over into the underlying stock market.

The other purpose of this paper is to identify potential channels of explanation of speculation spillovers. We propose that speculation spillovers can be explained by the story of limited attention. Huberman and Regev (2001) argue that investor inattention may explain contagious speculation. While Huberman and Regev (2001) investigate contagious speculation across stocks in one industry, we document the contagious speculation from derivatives markets into the underlying stock markets. We empirically investigate how limited attention explains contagious speculation. Our paper contributes to the literature by demonstrating that a potential mechanism through which the speculation is spilled over comes from a behavioral perspective.

Our findings are summarized as follows. First, we present evidence of the existence of speculation spillovers by examining the effect that warrant speculation has on stock turnover and stock return volatility. This paper adopts unexpected warrant turnover (turnover controlling for liquidity and time series pattern of warrant turnovers) and warrant overpricing (the implied price difference (IPD)) as proxies for warrant speculation. Here, we use the Black-Scholes option pricing model and the option GARCH model, respectively, to derive IPD.

We find strong evidence that stock turnover is positively associated with previous day's unexpected turnover of warrants. The results are robust when we replace stock turnover with stock volatility as the dependent variable or when we replace previous day's unexpected warrant turnover with previous day's IPD as the independent variable in the regression models. Furthermore, our results in the original and alternate regression specifications remain the same when we control for warrant characteristics (put dummy, covered dummy and duration), stock market capitalization, stock liquidity, market turnover (market volatility) and industry effect. We call the positive

association mentioned above ‘speculation spillover’.

Our findings are robust when we sample the deep-out-of-the-money put warrants in the same way that Xiong and Yu (2010) did. We find that stock trading is more intense when warrant speculation is more severe. Additionally, we use A-B share premium and A-H share premium to replace stock turnover (volatility) to run our test again[1]. The results confirm the existence of contagious speculation between the warrants and the stock markets.

What is the nature of the spillover effect in the stock market? We further show that the speculation spillover effect is stronger when the number of outstanding shares of stocks is smaller, or when the stock market is driven by optimistic beliefs. Hong, Scheinkman and Xiong (2006) argue that an optimism effect and a resale option effect both exist in a stock bubble. They predict that a stock bubble becomes larger when the asset float is smaller and when conditions of heterogeneous beliefs and short-sale constraints are met. Our results suggest that the speculation spillover imparts a bubble component in stocks.

We propose several potential mechanisms of speculation spillovers. We empirically show that speculation spillover may be due to limited investor attention in China’s stock market. Investors trading the underlying stocks may be attracted to events in the warrants market. In order to measure limited attention, we use warrant media coverage, extreme price change, and extreme volume in warrants as variables. We find that when the attention level in warrants is high, the speculation spillover effect is more profound.

The speculation spillovers could also be the result of information transmission and hedging ((Back (1993), Stein (1987)). Using the probability of information-based trading (PIN) measure developed by Easley, Hvidkjaer and O’Hara (2002) as a proxy for private information arrival, we show that the PIN measure of warrants has no significant impact on the speculation spillovers in any specification. We also calculate the change in hedge ratios and investigate whether speculation spillover is more intense when hedging is more active. Our evidence suggests that hedging is not a source of speculation spillover. In summary, our results suggest that information transmission and hedging motives have little impact on the speculation spillover effect from warrants to stocks.

This study corroborates existing studies by highlighting investor irrationality as the critical driver of asset market dynamics. There have been theoretical frameworks (Sims (2003), Hirshleifer and Teoh (2003), Peng and Xiong (2006),) and empirical studies (Barber and Odean (2008), Hou, Peng, and

[1] A-shares, which can only be held by domestic investors, and B-shares, which can only be traded by foreigners, have identical rights. Therefore, the A-B share premium largely captures the non-fundamental component. A-B share premium can also help explain speculative motives by trading (Mei, Scheinkman, and Xiong (2009), Hwang, Zhang and Zhu (2006)). Therefore, additional evidence along this line of speculation measure is A-B (-H) premium (the price difference between the dual-class shares A-B (A-H) shares).

Xiong (2009), Yuan (2008)) that suggest that limited attention affects returns. Recent work by Menkulasi (2009) outlines a theory, and a paper by Brandt, Brav, Graham and Kumar (2010) provides empirical evidence showing that limited attention has a significant effect on volatility changes. In addition to the aforementioned studies, we show that the effect of investor behavior is not necessarily contained in one market, but can be contagious to other markets as well.

The rest of the study proceeds as follows. In the next section, we describe the institutional background of China's warrants market. Section III presents the theories and related hypotheses on speculation spillovers and potential causes of spillovers. Section IV describes the empirical models, variables and data. Section V is the empirical analysis. Section VI checks for the robustness of the analysis, and Section VII concludes the paper.

II. Institutional Backgrounds

China's stock market was established around 1992,[2] while derivatives appeared much later. The establishment of China's warrants market traces back to August 2005 when the first warrant, BaoGang JTB1 (trading code 580000.SH), was issued. As the first derivative product in China's financial markets, warrants quickly become a favorite target for speculators. Less than three months later, on December 6, 2005, the total value of warrants transacted reached 10.18 billion Yuan with only six warrants issued. The total trading volume of more than 1,300 listed stocks was just 7.89 billion Yuan on the same day. In the first year after being issued, NanHang JTP1 (580989.SH) had a trading volume of 2,391.2 billion Yuan which is nearly 10% of China's GDP. [3]

Short sale restrictions and the lack of other financial instruments make attempts to arbitrage price deviations from fundamentals extremely difficult, if not impossible, in China's stock market. Limited arbitrage opportunities prevent rational arbitrageurs from profiting on trades against noise traders.

Individual investors who trade heavily are attracted by the speculative features of warrants but lack experience in using them. Reports show that more than 50% of accounts have annual asset turnover ratios that are higher than 500%, and are thus classified by stock exchanges as dangerous or extremely risky. In our sample, the median of daily warrant turnovers is 0.540, or 10800% annually. This is much higher than the median of daily stock turnovers of 0.025, or 500% annually.

In China's warrants market, covered warrants are issued by an investment bank or a similar financial institution, and investors are allowed to buy or sell a specific amount of equities from the

[2] Please see Mei, Scheinkman, Xiong (2009) and Baily, Cai, Cheung and Wang (2006), among others, for a thorough introduction of China's stock market.
[3] Xiong and Yu (2010) provide a detailed discussion of China's warrants market.

issuer at a specific price and time. In contrast to covered warrants, equity warrants are standard warrants issued by firms. Under a controversial rule, a covered warrant is traded under the same trading code as its corresponding equity warrant.

To summarize, China's warrants market is a highly speculative market where individual investors are the dominating players. The warrant was the first equity derivative in China's capital markets, and many investors do not fully understand the nature of warrants. As a retail-dominated market that has limits to arbitrage, the warrants market provides us with an opportunity to directly study the impact of speculation on the underlying market.

III. Literature and Hypotheses

1. Speculation Spillovers

Given the traditional argument that rational speculators stabilize asset prices, there are theoretical models that address the question of destabilizing speculation in financial markets. Stein (1987) develops a model showing that even when imperfectly informed rational speculators make the best possible use of their available information, their trading may create a misinformation effect. This misinformation effect can result in more noise in stock prices.

In related literature, speculative trading has been associated with recent financial bubbles. By ruling out short sales, Harrison and Kreps (1978) demonstrate that asset prices may exceed their fundamental value when agents disagree about the probability distributions of dividend streams. Scheinkman and Xiong (2003) later attribute overconfidence as a source of disagreement that can cause bubbles in asset prices. Given the challenging task of measuring asset fundamentals, there is a limited amount of empirical studies on speculative trading. One existing empirical study by Xiong and Yu (2010) uses the unique characteristics in China's warrants market to document the greater fool theory, reliably creating a sample with warrants' fundamental values of zero. Inspired by Xiong and Yu (2010), we further investigate whether a warrants bubble potentially fuels the speculation of underlying stocks.

Regarding speculation spillover, Huberman and Regev (2001) focus on the existence of contagious speculation among different stocks in one market. They provide an illuminating example of investor inattention in the case of a single biotechnology firm, EntreMed. Our paper is different from Huberman and Regev's (2001) paper in that we are the first to empirically investigate contagious speculation from derivatives into the underlying stock markets.

This paper argues whether warrant speculation has an impact on stock speculation. Different

from previous literature that focuses on the introduction effect of derivatives on the underlying assets[4], we are interested in the impact of warrants speculation on stock trading behavior. Theoretical models predict that the magnitude of a price bubble is positively correlated with turnover (Scheinkman and Xiong (2003) and Hong, Scheinkman and Xiong (2006)). If there is a speculation spillover effect, we expect to see that speculation in the warrants market, measured by warrant turnover, will be spilled over to the stock market and results in higher stock turnovers.

Speculation Spillover Hypothesis I: Higher speculative stock trading is associated with higher warrants speculation.

Regarding the nature of speculation spillovers, we further discuss that speculation spillovers impart a bubble component in stocks. Hong, Scheinkman and Xiong (2006) argue that when investors have heterogeneous beliefs and are short-sale constrained, the resale option component in stock prices decreases with the asset float. Harris and Raviv (1993) and Kandel and Pearson (1995) discuss that a dispersion of heterogeneous beliefs occurs when investors have different economic models that lead them to interpret the news differently. The complexity of warrants may also contribute to heterogeneous beliefs in stocks. If speculation is spilled over to the stock market, we expect the speculation spillover effect will be stronger when the asset float, number of tradable shares (*float*), is smaller.

Speculation Spillover Hypothesis II: The speculation spillover effect is stronger when the stock has a smaller number of tradable shares.

Next, speculation spillovers are likely to be enhanced when investor sentiment is high. Harrison and Kreps (1978) show that in a dynamic setting, an optimistic investor is willing to pay more than his already optimistic value of asset fundamentals. This shows that the investor anticipates the possibility of reselling the asset in the future to even more optimistic investors. Scheinkman and Xiong (2003) and Hong, Scheinkman and Xiong (2006) show that overconfident investors trade assets with each other under short-sales constraints.

China's stock market experienced a historical bull run from 2005 to mid 2007. In this period, the Shanghai Composite Index increased from 998 to 6,124 and reached the highest point in its history on October 16, 2007. The market quickly dropped after that, and by the end of our sample period in 2008, the index was around 2,736. We divide our sample into bull market and bear market periods, using October 16, 2007 as the cutting point. We expect to see that in a bull market, optimists may drive out pessimists more easily, resulting in higher speculation spillover.

Speculation Spillover Hypothesis III: The speculation spillover effect is stronger in a bull

[4] See Mayhew (2000) for a survey.

market than in a bear market.

2. Channels for Speculation Spillovers

How do speculation spillovers happen? Recent empirical evidence suggests that behavioral biases exist in derivatives markets (Heath et al. (1999), Poteshman (2001), Horst and Veld (2008), Haigh and List (2005), Liu, Wang and Zhao (2010)). In addition to the causal factors of information and hedging, our study indentifies investor irrationality as another critical driver of assets market transmission. We illustrate the potential causes of speculation spillovers as follows.

We propose that limited investor attention is a behavioral bias that may drive speculation spillovers from warrants to the underlying stocks. Evidence from behavioral literature suggests that people often fail to incorporate all relevant information when they make decisions. Kahneman (1973) suggests that attention is a scarce cognitive resource, and investors have limited attention. Most empirical studies present a limited attention bias in trading decisions (Barber and Odean (2008), Seasholes and Wu (2007), Huddart, Lang and Yetman (2009)).

Recently, some papers show that limited attention has extensive effects on asset markets. Specifically, these papers find that the under-reaction is more severe when there are more inattentive investors. Sims (2003), Hirshleifer and Teoh (2003) develop a theoretical framework in which limited attention can affect asset pricing statics and dynamics. Hirshleifer, Lim and Teoh (2009) find that investors under-react to earnings announcements. DellaVigna and Pollet (2009) suggest that investors are more distracted from the task of stock valuation and are therefore less attentive to earnings information on Fridays.

Furthermore, some studies argue that when investors pay too much attention to the markets, the effect of investor behavior on the prices can be exacerbated. Peng and Xiong (2006) combine speculation with investor overconfidence to show that limited attention underlies return co-movement. Hirshleifer and Teoh (2008) propose that limits to attention may pressure individuals to herd or cascade even when private and public information are available. Recently, Menkulasi (2009) offers a theory of time variation in the volatility of aggregate economic activity. Menkulasi shows that firms are limited in their ability to process information, and they allocate their limited attention across aggregate and idiosyncratic states. Brandt, Brav, Graham and Kumar (2010) provide empirical evidence that volatility changes around “attention-grabbing” events. Their findings are consistent with a retail trading effect that played an important role in the rise and the fall of the idiosyncratic volatility levels over the past two decades.

The warrant is the first type of derivative to be introduced into China’s capital markets. Due to the extreme speculative behavior in the warrants market (Xiong and Yu (2010)), warrants may attract much investor attention in China’s capital markets. Events in the warrants market can in turn

attract investors who usually only trade in the stock market. Because the warrants and the underlying stocks share the same first two Chinese characters in their trading tickers, investors who only trade in the stock market can also be attracted by events in the warrants market. For example, when a warrant's name such as Wu Liang Quan Zheng appears in a news title, investors would not only pay attention to the warrant, but also to the underlying stock since the name of the underlying stock is Wu Liang Ye. Thus, we propose that speculation spillovers can be explained by the limited attention concept.

Media coverage, extreme price changes, extreme volume, and other extreme events are variables that have been used while studying investor attention (Barber and Odean (2008), Hou, Peng, and Xiong (2009) and Yuan (2008)). Such extreme events may happen more often in the warrants market than in the stock market. Therefore, we expect that speculation spillover is more profound in a sample with more investor attention in an individual-dominated market.

Attention Channel Hypothesis: There is stronger speculation spillover when there is more investor attention (*media coverage, extreme warrant volume, and extreme warrant price range*) in the warrants market.

Information and hedging are other explanations for the association between warrant trading and stock trading suggested by theoretical models (e.g. Back (1993), Stein (1987)). Informed traders might take advantage of the high leverage and low trading costs associated with derivatives. Therefore, warrant trading may contain more information than stock trading. If information is a channel of speculation spillover, we should expect that speculation spillover will be mitigated with higher information dissemination.

Information Channel Hypothesis: There is less speculation spillover when there is more information dissemination in the warrants market.

Hedging is a potential channel of the speculation spillover effect because investors may use warrants to construct option-like strategies such as a protective put strategy. To hedge with such strategies, investors need to rebalance their position simultaneously in both stock and warrants markets. Therefore, if hedging is indeed the link between the stock market and the warrants market, there should be a stronger link between stock speculation and warrant turnover when hedging needs are intensified.

Hedge Channel Hypothesis: There is stronger association between unexpected warrant turnover and stock speculation when hedging needs are more active.

IV. Empirical Design

1. Empirical Model

Many economists believe that turnover plays a central role in generating speculative bubbles (Galbraith (1997), Hong and Stein (2007) and Hong and Yu (2009)). Therefore, we use stock turnover to measure stock speculation. To substantiate the importance of speculation spillovers, we also use other measures of speculation effects on stock prices- stock return volatility.[5] Our main model is a pooling regression:

$$\begin{aligned} Turn^{stock}{}_{it}\ (Vol^{stock}{}_{it}) = {} & \beta_0 + \beta_1 Unexpected\ Turn^{warrant}{}_{it-1}\ (Unexpcted\ \ IPD\ _{it-1}) \\ & + \beta_2\, put_i + \beta_3 covered_{it} + \beta_4 duration_{it} + \beta_5 stockcap_{it} + \beta_6 liquidity_{it} \\ & + \beta_7 market\ turnover_{it}\ (market\ volatility_{it}) + \beta_8 industry\ dummy_i + \varepsilon_{it} \end{aligned}$$

Here, we choose the daily stock turnover rate ($Turn^{stock}$) and daily stock volatility (Vol^{stock}) as the dependent variables. Stock turnover ($Turn^{stock}$) is the trading volume divided by the total tradable shares. To provide additional measures of speculation effects on stock prices, we define stock volatility (Vol^{stock}) as the difference between the highest intraday price and the lowest intraday price divided by the closing price. $Unexpected\ Turn^{warrant}$ and *Unexpected IPD* are our main measures of warrant speculation, which we use with a one-day lag in our regressions.

We use unexpected warrant turnover ($Unexpected\ Turn^{warrant}$) as one measure of warrant speculation. First, we calculate warrant turnover ($Turnr^{warrant}$) by dividing trading volume by the outstanding warrants shares. Then we regress $Turnr^{warrant}$ against the daily warrant bid-ask spread and the one-day lagged warrant turnover. We define $Unexpected\ Turn^{warrant}$ as the residual of the regression above. This measure controls the liquidity component embedded in turnover and also considers the time series pattern of warrant turnovers. The results are not sensitive to the choice of lags.

For each warrant, we also calculate the daily implied price differences (IPDs):

$$IPD = \log\left(\frac{warrant\_market\_price}{warrant\_theoretical\_price}\right).$$

We choose two models to calculate the warrant theoretical prices. The first model is the Black-Scholes option pricing model. Most of the warrants are nominally Bermudan, but they are

[5] Regarding volatility, Baele (2005) investigates volatility spillover from the aggregate European (EU) and U.S. market to 13 local European equity markets and finds evidence for a contagion from the U.S. markets to some European financial markets during periods of high world market volatility. Christiansen (2007) finds that there is a strong statistical evidence of volatility spillover from the US and aggregate European bond markets.

essentially European options, as they can only be exercised within five days of their maturity. Thus, we use the Black-Scholes option pricing formula to calculate theoretical prices. We define volatility as the standard deviation of daily stock returns in a 250 trading day period ending 10 days before the warrant announcement.[6] We also consider stochastic volatility in China's stock market and adopt an option GARCH model (Duan (1995))[7] as our second model. Noticeably, the option GARCH model sometimes cannot generate the theoretical prices. It is either due to the difficulty of estimating parameters of the GARCH process or due to the convergence problem of the pricing program. Any observation with a theoretical price below 0.05 pennies is excluded from our sample.

The average warrant's IPD^{BS} is 1.36 in our sample, which means that on average, warrants are traded at prices 290% higher than their theoretical Black-Scholes prices. The median warrants are still 99% overpriced compared to their Black-Scholes prices. On average, IPD^{GARCH} is higher when we use the option GARCH model to calculate the theoretical prices. IPD^{GARCH} does show more extreme values on both ends. The correlation between IPD^{BS} and IPD^{GARCH} is 0.852. In summary, we find that warrants are extremely overpriced compared to their theoretical prices calculated by the Black-Scholes option pricing formula or the option GARCH model. We then perform an auto regression with one-day lag for each measure of IPDs and denote the residuals as *Unexpected* IPD^{BS} and *Unexpected* IPD^{GARCH}.

Our control variables are specified as covered dummy (*covered*) is set to 1 if the stock has a covered warrant and is set to 0 otherwise. The put dummy (*put*) is set to 1 if the stock has a put warrant and is set to 0 otherwise. Warrant duration (*duration*) is the time left to maturity for warrants (days/365). Stock market capitalization (*stockcap*) is calculated as the A-share stock price multiplied by the total tradable A-shares. Stock liquidity (*liquidity*) is measured by the bid-ask spread or the Amihud-illiquidity measure (Amihud (2002)). The bid-ask spread is the daily average of intraday percentage-quoted spreads. Amihud-illiquidity is defined as the absolute daily stock return divided by the daily trading value in billions RMB. Market turnover (*market turnover*) is the total stock turnover of the market. *Market volatility* is the market median of stock volatilities. Industry dummies (*industry*) are included. The variables are in a daily basis.

2. Measurements of Channels.

Attention:

The attention variables that we adopt are defined as follows:

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[6] Other trading periods are also used to calculate the volatility. The results are similar in scale and do not change our subsequent results.

[7] The option GARCH model in Duan (1995) relaxes the constant volatility assumption in the Black-Scholes model and considers the changes in the conditional volatility of the underlying stocks. A GARCH(1,1) process is estimated for the stock returns. The option GARCH model is then applied for the theoretical prices of warrants.

Media coverage: We use BAIDU news as our media coverage search engine.[8] For each warrant, we note the date when the warrant name appears in any news title. BAIDU news includes media coverage from traditional media such as newspapers and magazines, as well as web-based news media. In our sample, we find 620 warrant-days with media coverage. We consider the day of media coverage as the event day, and we define the media coverage window as the period [0, 1] and no coverage window as [-2,-1]. In a robustness check, we exclude any date when the underlying stock name also appears in a news headline. The results remain the same.

Extreme warrant volume: In general, warrants have high trading volume. To highlight the attention effect, we focus on whether there are significant extreme changes in warrant trading volume. For each day, we examine the difference between the previous day's warrant volume and the maximum daily warrant volume in the previous week: warrant volume (t-1)- max [warrant volume (t-2 to t-6)]. Next, we sort the stocks by their corresponding differences in warrant volume as defined above to compare the speculation spillover effect in the top 30% and in the bottom 30% groups.

*Extreme warrant price change***:** Extreme intraday price changes attract investors' attention. We calculate the daily warrant price range (*(the highest intraday price-the lowest intraday price)/the daily closing price*) and sort the underlying stocks using the same method we used to sort extreme warrant volume.

Information:

Private Information: We use the measure PIN as a proxy for private information arrival. PIN is the probability of information-based trading developed by Easley, Hvidkjaer and O'Hara (2002). The likelihood function of the microstructure model in Easley, Hvidkjaer and O'Hara (2002) is estimated across every month using intraday warrant data. The estimation of the model's structural parameters can be used to calculate the probability that an order is from an informed trader, known as a PIN.

Hedging:

Hedging: We calculate the hedge ratio using the Black-Scholes formula, and we denote the absolute value of the daily change in hedge ratios as *Δ hedge ratio*.

3. Data

The warrant data used in this study are provided by WIND, a commercial financial data provider.[9] The available information on warrant characteristics includes the following: the trading

[8] http://news.baidu.com/. Baidu (NASDAQ: BIDU) provides web search service similar to google. It is the dominating Chinese web search provider.

[9] We verify the data using other data providers such as CCER and CSMAR. The data are consistent.

code of the underlying stocks, the date of warrant listing (or issuance), the expiration date of the warrant, whether the warrant is an equity warrant or a covered warrant, the call/put feature, the exercise price, and the stock exchange listed. Stock-related data are collected from the CCER (China Center for Economic Research) database. Our sample covers the period between August 2005 and June 2008.

As shown in Panel A of Table 1, warrants in the sample are issued on 41 underlying stocks. In total, 23 firms have issued only call warrants, 12 firms have issued only put warrants, and 6 firms have issued both call and put warrants. There are three firms that issued two call warrants. In Panel B, the dataset consists of the complete observations of 50 warrants that are listed in the Shanghai Stock Exchange and the Shenzhen Stock Exchange between August 2005 and June 2008. There are 32 equity warrants and 18 covered warrants in total. For equity warrants, there are more call warrants (25) than put warrants (7). There are 10 covered warrants, and 7 of them have a call feature.

In Table 2, we report the descriptive statistics of the variables used in our study. Normally, warrants issued by Chinese companies have one or two year maturities. Panel B of Table 2 shows that the average maturity of warrants in our sample is 1.3 years. Warrants exhibit a high turnover rate. On average, 65.4% of outstanding warrants are traded every day, whereas the daily turnover rate of the underlying A-shares is only 2.4%. Warrants also appear to be more volatile. We present two measures of volatility in Table 2: the first one is the standard deviation of daily stock (or warrant) returns in the sample period, and the second one is the daily price range normalized by the daily closing price. In both measures, the volatility in warrants is much higher than the volatility in stocks.

The study also examines the change in stock turnovers (volatilities) around the introduction of warrants.[10] We choose the listing date as the event date and find that the *industry-adjusted turnover* of warranted stocks increases significantly in post-event periods. In the comparison between the pre-event and post-event periods, we observe evidence that the stocks are traded more frequently and are more volatile after the introduction of warrants. Are the increased trading and volatility of stocks associated with the corresponding warrants? We need further investigation.

V. Empirical Results

1. Is speculation spilled over?

[10] The results are available upon request.

We document the existence of speculation spillover by investigating whether previous day's unexpected warrant turnover or overpricing have a positive impact on stock turnover and volatility. Our main results are presented in Table 3. Panels A and B report the results where the dependent variables are $Turn^{stock}$ and Vol^{stock}, respectively. In Panel A, the coefficients of *Unexpected* $Turn^{warrant}$ are significantly positive in all specifications, suggesting that higher stock turnover is positively associated with lagged higher unexpected warrant turnover. For example, the coefficient of unexpected warrant turnover is 0.249 with a t-statistic of 7.433 in specification (1). The inclusion of control variables in specifications (4) and (7) does not change the result. Similarly, the coefficients of *Unexpected* IPD^{BS} (*Unexpected* IPD^{GARCH}) are also significantly positive in all specifications. The results are not sensitive to the option pricing model used. Therefore, we only report the results of *Unexpected* IPD^{BS} later on.

In regard to the control variables, because the original intention of regulators for covered warrants was to increase the supply of warrants and mitigate speculation in the warrants market, we control covered warrants. However, the coefficients of *covered* are not statistically significant in most of the specifications, implying that covered warrants do not have a material impact on stock speculation. The coefficients of *put* show negative signs and that are all statistically significant, implying that put warrants may alleviate stock speculation. The coefficient of *duration* is significantly positive.

Both *liquidity* measures show negative signs. In specification (4), *liquidity* (bid-ask spread) has a coefficient of -6.223 with a t-statistic of -22.10, suggesting that large bid-ask spread results in lower turnover rates; this finding is consistent with previous literature. The Amihud illiquidity measure suggests a similar finding. We will only report the results of *liquidity* (bid-ask spread) in the later analysis, since the results are not sensitive to the *liquidity* measure used.

In Panel B, we use stock return volatility to replace stock turnover as the dependent variable, and we find that Vol^{stock} is positively associated to *Unexpected* $Turn^{warrant}$ and *Unexpected* IPD^{BS} (IPD^{GARCH}). In other words, when the warrants have higher unexpected turnover rates, the corresponding stocks exhibit higher daily volatility; this is consistent with the results of Panel A. In summary, we demonstrate that warrant speculation could spill over to the underlying stock market.

This paper further confirms that speculation spillover is a bubble component in stocks in Tables 4 and 5. In Table 4, we construct an interaction between *float* and *Unexpected* $Turn^{warrant}$ (*Unexpected IPD*). We expect the sign of the interaction to be negative; by implying a larger float we expect to reduce speculation spillover. The results show that *Unexpected* $Turn^{warrant}$ (*Unexpected IPD*) is positively associated with $Turn^{stock}$ (Vol^{stock}), and the effect is reduced when the stock has a larger asset float. *Unexpected* $Turn^{warrant}$ is significantly positive as it is in previous results. *Float* is significantly negative in all specifications of Panel A; this is consistent with the prediction in Hong, Scheinkman and Xiong (2006). When the dependent variable is $Turn^{stock}$, the coefficients of the interaction between

float and *Unexpected Turn*^{warrant} (*Unexpected IPD*) are -0.240 and -0.619, in specifications (2) and (4), respectively. The latter one is significant. A similar pattern is found when the dependent variable is *Vol*^{stock}. The coefficients of the interaction are also negative.

Next, we look into market sentiment. We present the results in Table 5. For *Turn*^{stock}, the speculation spillover is significantly positive in both market conditions. The coefficient of *Unexpected Turn*^{warrant} in the bull market period (0.288) is significantly larger than the coefficient in the bear market (0.148). Interestingly, in the bear market period, *Unexpected IPD*, has a coefficient of -0.110 and is no longer positively associated with stock turnover. Meanwhile, in the bull market, *Unexpected IPD* is still significantly positive. Most of the results are similar when the dependent variable is *Vol*^{stock}. Our findings confirm that the speculation spillover effect is stronger when the market is driven by optimistic beliefs.

Our investigation suggests that the speculation spillover effect between the warrants market and the stock market is stronger when the underlying stock has a smaller float or when the market is optimistic in general. Warrants influence the speculative component of the underlying stocks.

2. Limited Attention Channel

There is a need to identify the drivers of speculation spillovers in financial markets, given the existence of contagious bubbles and crashes. To explore the potential causes of speculation spillover, we first identify situations where attention to warrants is either very high or very low. Then we re-run our main model in both situations. Finally, we compare the effects of speculation spillover across different levels of attention.

Table 6 presents the results. In Panel A, we choose media coverage as the measure of attention. We consider the day of and the day after the warrants appear in media coverage as situations where attention to warrants is high. Then, we compare the speculation spillover effect on those days to the effect on the two days before the media coverage. The results show that the coefficients of *Unexpected Turn*^{warrant} (*Unexpected IPD*^{BS}) are significantly positive in both situations. However, the speculation spillover effect is stronger in the sample with media coverage. For example, in the *Turn*^{stock} regression, *Unexpected Turn*^{warrant} has a coefficient of 0.310 in the media coverage sample but only 0.126 in the no coverage sample. The difference is 0.184 and is statistically significant. We obtain similar results for most of the specifications. All the control variables have the same signs and similar significance levels as those in the main model.

Panel A of Table 6 suggests that the speculation spillover effect is stronger when warrants draw more attention due to media appearance. We acknowledge the possibility that the news about warrants is due to news about the underlying stocks. However, we verify that most of the warrant news is only about the warrants and not about the underlying stocks. In an unreported robustness check, we

exclude the days when the underlying stocks' names also appear in news titles. Only a few observations are dropped, and the results are similar.

We also construct the variable, *Extreme warrant volume,* to capture the attention due to sudden jumps in warrant trading volume. Panel B of Table 6 reports the difference in speculation spillover when *Extreme warrant volume* is among the top 30% and the bottom 30% of samples. The positive association between $Turn^{stock}$ （Vol^{stock}） and *Unexpected IPD* is significantly stronger in the top 30% *Extreme warrant volume* sample than in the bottom 30% sample (i.e. 0.279 vs. 0.044 in $Turn^{stock}$, 0.515 vs. 0.195 in Vol^{stock}). *Unexpected* $Turn^{warrant}$ also shows similar findings, but it is not significant when the dependent variable is $Turn^{stock}$.

Warrants allow day-trading, making daily price range an important factor in warrants trading. In the same way that we analyze *Extreme warrant volume*, we analyze *Extreme warrant price range* as another way to separate the level of attention. The results are presented in Panel C of Table 6. The conclusion we can draw is similar to the conclusion we draw in Panel B. In the sample where *Extreme warrant price range* is higher, both *Unexpected* $Turn^{warrant}$ and *Unexpected IPD* have a stronger impact on stock trading.

In summary, we find that the level of attention strongly affects the impact of warrant speculation on stock trading. Generally, when the attention level is high, the speculation spillover effect is more profound. The results suggest that investor irrationality in the warrants market can be contagious to the underlying stock market.

3. Information and Hedging Channels

Speculation spillovers could also result from information dissemination or hedging motives. Table 7 reports the information effect. PIN is significantly positive in Panel A but is insignificant in Panel B. This shows that informed trading in warrants is positively associated with stock turnover ($Turn^{stock}$), while there is no clear relationship between PIN and stock volatility (Vol^{stock}). Noticeably, in all specifications, the coefficients of *Unexpected* $Turn^{warrant}$ and *Unexpected* IPD^{BS} remain significantly positive.

We want to investigate whether information can reduce speculation spillover, so we add the interaction of *Unexpected* $Turn^{warrant}$ (*Unexpected* IPD^{BS})[11] and *PIN* to the base model. If information is the channel that links stock speculation and warrant speculation, we should expect a significant sign in the interaction term, *Unexpected* $Turn^{warrant}$ (*Unexpected* IPD^{BS}) and *PIN*. However, in both Panel A and Panel B, the interactions are not significant in any specification. For example, in specification (2)

[11] *Unexpected* IPD^{GARCH} is also examined. The results are very similar. Thus, from this point on, we only report the results of IPD^{BS}.

of Panel A in Table 7, the interaction between *Unexpected Turn*^{warrant} and *PIN* is 0.158. The effect is not significant with a t-statistic 0.275. Similarly, in Panel B, the interaction term suggests that PIN reduces the impact of *Unexpected Turn*^{warrant} (*Unexpected IPD*^{BS}) on *Vol*^{stock}, But not by a statistically significant amount.

In summary, Table 7 suggests that some information in warrants trading could be incorporated in stock trading. However, information does not serve as a mechanism of speculation spillover, since the speculation spillover effect is not sensitive to informed trading in warrants. In an unreported statistic, we find that the probability of informed trading in the warrants market is 4.7%, while the average PIN in the U.S. stock market is around 20%. This confirms that the warrant market is dominated by individual investors who may not possess information.

Regarding the hedging motive, we are interested in examining the impact of hedging on speculation spillovers. Hence, we add the interaction of *Unexpected Turn*^{warrant} (*Unexpected IPD*^{BS}) and *Δ hedge ratio* into the base model in Table 8. Panel A and Panel B of Table 8 both show that *Δ hedge ratio* is significantly positive, while *Unexpected Turn*^{warrant} (*Unexpected IPD*^{BS}) is still significantly positive. This implies that even if the hedging motive may affect stock trading, warrant speculation could still spill over to the underlying stock market.

However, the interaction terms between *Unexpected Turn*^{warrant} and *Δ hedge ratio* are not significant in Panel A of Table 8. This suggests that hedging needs do not necessarily change the impact of warrants turnover on stock turnovers. Here, the interaction of *Unexpected IPD*^{BS} and *Δ hedge ratio* is significant. This may be due to the large negative correlation between the two variables.

Information and hedging are less likely to have a significant influence because institutional traders account for less than 0.2% of warrant trading and the no-short-sale rule applies to both the stock market and the warrants market in China.[12] We suggest that warrants traders are individual investors who are less likely to pose private information and less sophisticated at hedging. The empirical evidence largely supports this.

VI. Robustness Check

We use a similar sample as the one used by Xiong and Yu (2010) to re-run the above analysis.[13] The advantage of their sample is that there is no need for any information or hedging concern since many deep-out-of-the-money puts were traded at prices so high that they can be explained by irrational behavior. Additionally, the hedging need does not exist since the hedge ratio is zero for this

[12] Source: Shanghai Stock Exchange.

[13] In China's stock price, daily trades are imposed with price limited of 10% on the up and down of stock prices. In our sample of deep-out-of-the-money warrants, we include warrants with the Black-Scholes prices less than 0.05 pennies. However, if we consider the price limit on stock prices, the intrinsic value of the warrants are zero, since it is impossible that the warrant will be exercised with any value.

sample of put warrants. Here, we replace lagged *unexpected IPD* with the lagged *warrant price*. The results are shown in Table 9. In this sample, the warrant turnover and the extent of warrant speculation are still positively associated with $Turn^{stock}$. The warrant price is positively associated with Vol^{stock}. In other words, when the linkage of information or hedging between two markets is irrelevant, we still observe a strong speculation spillover effect in the deep-out-of-the-money put warrants.

In another robustness test, we replace the dependent variable with A/B and A/H stock premiums, respectively. In China's stock market, some firms issue shares in A-share markets as well as in B-share or H-share markets. In our sample period, the B-share market is open to domestic investors. However, the investors need to own a foreign currency account (i.e. USD account) to trade in the B-share market. The H-share market refers to the shares listed in the Hong Kong Stock Exchange. Mei, Scheinkman, and Xiong (2009) consider the A/B share premium as a measure of stock speculation. We adopt a similar measure and also consider the A/H share premium. The results are reported in Table 10. The speculation spillover still exists. For example, *unexpected IPD* still has a significantly positive sign in the A/H premium regression.

There are some observations that have higher theoretical prices than the market prices and exhibit negative *IPD*s. In an unreported test, we exclude the sample with negative IPD^{BS} or IPD^{GARCH}. All of our results remain the same and are stronger in many occasions.

We consider the presence of autocorrelation and heteroskedasticity in the error terms and use the GMM procedure with the Newey-West standard errors. The results from the GMM procedure are similar.

VII. Conclusion

Behavioral biases have been found in both stock markets and derivatives markets. In this paper, we demonstrate that the behavioral bias can be contagious across markets; speculation in the warrants market spreads to the underlying stock market. Stock turnover (volatility) is positively associated with unexpected warrant turnover or warrant overpricing when controlling for other warrant and stock market characteristics such as the liquidity component embedded in turnover and the time series pattern of warrant turnovers. In a robustness test, the speculation spillover effect is strong, even when information or hedging is irrelevant.

We consider our new findings an additional piece added to the big puzzle on speculation behavior. Xiong and Yu (2010) demonstrate some extreme cases where warrants were traded at significantly high prices despite having true values closer to zero. We further show that China's warrants are traded very speculatively, and the frenzied speculation in the warrants market creates some side effects for stock traders. Our study tests whether the incremental part of the resale option value exists and examines if it is due to increased heterogeneity or market sentiment caused by

warrant trading. The finding shows that speculation spillover is stronger when the underlying stock has a smaller asset float or when the market is filled with optimistic investors.

A distinguishing feature of our paper from past studies is that we highlight the potential mechanisms of speculation spillovers. Attention combined with a lack of knowledge about warrants may deteriorate speculation spillover. In our empirical analysis, various variables have been used to measure investor attention in the warrants market, including extreme price ranges, extreme trading volume, and news and headlines adopted by previous studies. This paper documents that warrant speculation could be spilled over more intensively to the underlying stock market when investors pay more attention to the warrants market.

Information revelation from warrant trading, if there is any, is very difficult to account for speculation spillover. Another potential candidate for the channel of speculation spillover is the need for hedging. Our evidence also suggests that hedging may play little role in speculation spillover in China. It is plausible that most investors in China's stock market are not sophisticated enough to understand the link between warrants and their underlying stocks.

By showing that limited attention can explain speculation spillovers, our paper highlights investor irrationality as a critical driver of assets market dynamics. Our findings encourage more discussion on the use of financial derivatives in the financial markets. In a developing market dominated by individual investors, a new financial instrument may not evolve as planned. It is not only the structure of the financial product but also the potential users that will decide its fate. Our study calls for the necessity of considering behavioral factors during the designing of derivatives.

Reference:

Amihud, Y., 2002, Illiquidity and Stock Returns: Cross-section and Time-series Effects. *Journal of Financial Markets* 5(1): 31–56.

Back, K., 1993, Asymmetric Information and Options. *Review of Financial Studies* 6(3): 435-472.

Baele, L., 2005, Volatility Spillover Effects in European Equity Markets. *Journal of Financial and Quantitative Analysis* 40: 373–401.

Bailey, W., J. Cai, Y. L. Cheung, F. Wang, 2009, Stock Returns, Order Imbalances, and Commonality: Evidence on Individual, Institutional, and Proprietary Investors in China. *Journal of Banking and Finance* 33(1): 9-19.

Barber, B. M., T. Odean, 2008, All that Glitters: The Effect of Attention and News on the Buying Behavior of Individual and Institutional Investors. *Review of Financial Studies* 21(2): 785-818.

Brandt, M., A. Brav, J. Graham and A. Kumar, 2010, Idiosyncratic Volatility Puzzle: Time Trend or Speculative Episodes? *Review of Financial Studies* 23 (2), 863-899.

Christiansen, C., 2007, Volatility-Spillover Effects in European Bond Markets. *European Financial Management* 13(5), 923-948.

Della Vigna, S., J. Pollet, 2009, Investor Inattention and Friday Earnings Announcements. *Journal of Finance* 64(2): 709-749.

Duan, J. C., 1995, The GARCH Option Pricing Model. *Mathematical Finance* 5(1): 13-32.

Easley, D., S. Hvidkjaer, M. O'Hara, 2002, Is Information Risk a Determinant of Asset Returns? *Journal of Finance* 57(5): 2185-2221.

Galbraith, J. K., 1997, *The Great Crash 1929*. Houghton Mifflin Company.

Haigh, M., J. A. List, 2005, Do Professional Traders Exhibit Myopic Loss Aversion? An Experimental Analysis. *Journal of Finance* 60(1): 523-534.

Harris, M., A. Raviv, 1993, Differences of Opinion Make a Horse Race. Review of Financial Studies 6(3): 473-506.

Harrison, J. M., D. M. Kreps, 1978, Speculative Investor Behavior in a Stock-market with Heterogeneous Expectations. *Quarterly Journal of Economics* 92(2): 323-336.

Heath, C. S. Huddart and M. Lang,1999, Psychological Factors and Stock Option Exercise. *Quarterly Journal of Economics* 114(2): 601-627.

Hirshleifer, D., S. H. Teoh, 2003, Limited Attention, Information Disclosure, and Financial Reporting. *Journal of Accounting and Economics* 36(1-3): 337-386.

Hirshleifer, D., S. H. Teoh, 2008, *Thought and Behavior Contagion in Capital Markets*. North-Holland.

Hirshleifer, D., S. S. Lim, S. H. Teoh, 2009, Driven to Distraction: Extraneous Events and Underreaction to Earnings News. *Journal of Finance* 64(5): 2289-2325.

Hong, H., J. C. Stein, 2007, Disagreement and the Stock Market. *Journal of Economic Perspectives* 21(2): 109-128.

Hong, H., J. Scheinkman, W. Xiong, 2006, Asset Float and Speculative Bubbles. *Journal of Finance* 61(3): 1073–1117.

Hong, H., J. Yu, 2009, Gone fishin': Seasonality in Trading Activity and Asset Prices. *Journal of Financial Markets* 12(4): 672–702.

Horst, J. T., C. Veld, 2008, An Empirical Analysis of the Pricing of Bank Issued Options Versus Options Exchange Options. *European Financial Management* 14(2): 288-314.

Hou, K., L. Peng, W. Xiong, 2009, A Tale of two Anomalies: The Implications of Investor Attention for Price and Earnings Momentum. Working Paper, Ohio State University.

Huberman, G., T. Regev, 2001, Contagious Speculation and a Cure for Cancer: A Non-event that Made Stock Prices Soar. *Journal of Finance* 56(1): 387-396.

Huddart, S. J., M. H. Lang, M. Yetman, 2009, Volume and Price Patterns around a Stock's 52-Week Highs and Lows: Theory and Evidence. *Management Science* 55:16-31.

Hwang, C. Y., S. J. Zhang, Y. J. Zhu, 2006, Float, Liquidity, Speculation, and Stock Prices: Evidence from the Share Structure Reform in China. Working Paper, Nanyang Technological University.

Kahneman, D., 1973, *Attention and Effort*. Prentice-Hall, Englewood Cliffs, NJ.

Kandel, E., N. D. Pearson, 1995, Differential Interpretation of Public Signals and Trade in Speculative Markets. *Journal of Political Economy* 103(4): 831-872.

Liu, Y. J., M. C. Wang, L. K. Zhao, 2010, Narrow Framing: Professions, Sophistication, and Experience. *Journal of Futures Markets* 30(3): 203-229.

Mayhew, S., 2000, The Impact of Derivatives on Cash Markets: What Have We Learned? Working paper, University of Georgia.

Mei, J., J. A. Scheinkman, W. Xiong, 2009, Speculative Trading and Stock Prices: An Analysis of Chinese A-B Share Premia. *Anuals of Economics and Finance* 10(2): 225-255.

Menkulasi, J., 2009, Rational Inattention and Changes in Macroeconomic Volatility, Working paper, University of Maryland.

Miller, E. M., 1977, Risk, Uncertainty, and Divergence of Opinion. *Journal of Finance* 32(4): 1151-1168.

Peng, L., W. Xiong, 2006, Investor Attention, Overconfidence and Category Learning. *Journal of Financial Economics* 80(3): 563-602.

Poteshman, A. M., 2001, Underreaction, Overreaction, and Increasing Misreaction to Information in the Options Market. Journal of Finance 56(3): 851-876.

Scheinkman, J. A., W. Xiong, 2003, Overconfidence and Speculative Bubbles. J*ournal of Political Economy* 111(6): 1183-1219.

Seasholes, M. S., G. Wu, 2007, Predictable Behavior, Profits and Attention, *Journal of Empirical Finance* 14 (5): 590-610.

Sims, C. A., 2003, Implications of Rational Inattention. *Journal of Monetary Economics* 50(3): 665-690.

Stein, J. C., 1987, Information, Externalities and Welfare-reducing Speculation. *Journal of Political Economy* 95(6): 1123-1145.

Xiong, W., J. Yu, 2010, The Chinese Warrants Bubble. American Economic Review, forthcoming.

Yuan, Y., 2008, Attention and Trading. Working Paper, University of Iowa.

Table 1 Sample distribution

This table reports the sample distribution. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. Equity warrant is a standard warrant issued by a listed company. Covered warrant is a warrant that can be issued by investment banks.

Panel A: The number of sample firms with warrant issue

	Number of Sample Firms
With Call Warrants Issue	23
With Put Warrants Issue	12
With Call and Put Warrants Issue	6
Total Number of Sample Firms	41

Panel B: The number of warrants.

	Covered warrants	Equity warrants
Call Warrant	7	25
Put Warrant	11	7
Total Number of Warrants	18	32

Table 2 Summary statistics

This table reports the descriptive statistics of the sample. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. We collect the variables of the warrants characteristics and the warranted stocks information on a daily basis. In Panel A, *stockcap* is the A-share market capitalization calculated as the stock price multiplied by the total tradable shares. $Turn^{stock}$ is the trading volume divided by the total tradable shares. Volatility is defined in two ways: the first one is the standard deviation of stock returns for the life of warrants; the second is the daily price range defined as (the highest price-the lowest price)/the closing price. *Shares outstanding* is the number of outstanding A-shares in the stock market. Stock liquidity (*liquidity*) is measured by the bid-ask spread or Amihud-illiquidity measure. Stock bid-ask spread is the daily average of intraday percentage quoted spreads. Stock Amihud illiquidity is defined as the absolute daily stock return divided by the daily trading value in billions RMB. In Panel B, *duration* is the time left to maturity for warrants. (days/365). IPD is defined as log(warrant market price/warrant theoretical price), where the warrant theoretical price is calculated using the Black-Scholes model with the volatility as the standard deviation of stock returns in a 250-day trading period ending 10 days before the listing of a warrant (IPD^{BS}), or the option GARCH model in Duan (1995) (IPD^{GARCH}). *PIN* is the probability of informed trading. We estimate the PIN variable every month using the intraday data following the method developed by Easley, Hvidkjaer and O'Hara (2002). *Hedge ratio* is derived from the Black-Scholes model and reports the absolute value. Mean, median, maximum, minimum, 25th percentile, and 75th percentile of the variables are reported.

Panel A: Statistics of stocks

	stockcap (Million Yuan)	$Turn^{stock}$	Volatility (Standard deviation)	Volatility (Daily price range)	*Shares outstanding* (Million share)	*liquidity* (Bid-ask spread)	*liquidity* (Amihud illiquidity)
Mean	21,452	0.024	0.035	0.049	1389	0.002	0.022
Median	12,574	0.025	0.034	0.049	845	0.002	0.017
Max	113,434	0.050	0.041	0.062	5084	0.004	0.092
Min	1,631	0.008	0.027	0.038	208	0.001	0.002
P25	7,886	0.017	0.033	0.046	459	0.001	0.010
P75	24,385	0.028	0.037	0.051	1467	0.002	0.028

Panel B: Statistics of warrants

	duration (Year)	IPD^{BS}	IPD^{GARCH}	$Turn^{warramt}$	Volatility (Standard deviation)	Volatility (Daily price range)	*PIN*	*hedge ratio*
Mean	1.3	1.360	1.701	0.654	0.086	0.069	0.047	0.550
Median	1.0	0.689	0.833	0.540	0.080	0.068	0.044	0.550
Max	2.0	6.215	8.863	1.689	0.185	0.119	0.206	1.000
Min	0.5	-0.119	-0.438	0.062	0.041	0.051	0.023	0.001
P25	1.0	0.250	0.284	0.417	0.059	0.059	0.033	0.336
P75	2.0	1.668	1.326	0.829	0.106	0.076	0.052	0.962

Table 3 Speculation spillover

This table reports the results of the regression specifications. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. $Turn^{stock}$ is the stock turnover rate measured by the trading volume divided by the total tradable shares. Vol^{stock} is the daily price range calculated as the difference between the highest intraday price and the lowest intraday price divided by the closing price. $Turn^{stock}$ and Vol^{stock} have been multiplied by 100. *Unexpected* $Turn^{warrant}$ is the residual of the regression where $Turn^{warrant}$ is regressed on the daily warrant bid-ask spread and the one-day lagged warrant turnover. *IPD* is defined as log(warrant market price/warrant theoretical price), where the warrant theoretical price is calculated using the Black-Scholes model with the volatility as the standard deviation of stock returns in a 250-day trading period ending 10 days before the listing of a warrant (IPD^{BS}), or the option GARCH model in Duan (1995) (IPD^{GARCH}). Two measures of *IPD*s are adjusted by taking the residual in the auto regression with one-day lag and are denoted as *Unexpected* IPD^{BS} and *Unexpected* $IPD^{GARCH.}$. Covered dummy (*covered*) is set to be 1 if the stock has a covered warrant and 0 otherwise. Put dummy (*put*) is set to be 1 if the stock has a put warrant and 0 otherwise. Warrant duration (*duration*) is the time left to maturity for warrants (days/365). Stock market capitalization (*stockcap*) is the A-share market capitalization calculated as the stock price multiplied by the total tradable shares. Stock liquidity (*liquidity*) is measured by the bid-ask spread or Amihud-illiquidity measure. Here, the bid-ask spread is the daily average of intraday percentage-quoted spreads. Amihud-illiquidity is defined as the absolute daily stock return divided by the daily trading value in billions RMB. Market turnover (*market turnover*) is the total stock turnover of the market. *Market volatility* is the market median of stock volatilities. Industry dummies (*industry*) are included. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis.

Panel A: $Turn^{stock}_{t}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
intercept	0.213	0.167	0.397	13.270	13.123	12.608	11.537	11.492	13.737
	(3.774)	(2.939)	(5.512)	(23.191)	(22.802)	(18.016)	(21.193)	(20.866)	(19.270)
Unexpected $Turn^{warrant}_{t-1}$	0.249			0.238			0.222		
	(7.433)			(7.538)			(6.999)		
Unexpected IPD^{BS}_{t-1}		0.216			0.110			0.035	
		(6.455)			(3.387)			(2.055)	
Unexpected IPD^{GARCH}_{t-1}			0.074			0.098			0.083
			(1.286)			(1.871)			(1.684)
put_t				-0.337	-0.342	-0.297	-0.334	-0.340	-0.299
				(-9.122)	(-9.232)	(-6.245)	(-9.026)	(-9.148)	(-6.349)
$covered_t$				0.042	0.044	-0.046	-0.056	-0.056	-0.117
				(1.039)	(1.086)	(-0.797)	(-1.384)	(-1.379)	(-2.007)
$duration_t$				0.323	0.298	0.548	0.407	0.398	0.607
				(9.696)	(8.770)	(12.765)	(12.201)	(11.691)	(14.319)
$stockcap_t$				-0.529	-0.522	-0.528	-0.485	-0.483	-0.595
				(-22.345)	(-21.916)	(-17.596)	(-20.924)	(-20.602)	(-19.275)
$liquidity_t$ *(bid-ask spread)*				-6.223	-6.326	-4.054			
				(-22.104)	(-22.378)	(-12.340)			
$liquidity_t$ *(Amihud Illiquidity)*							-16.209	-16.442	-10.947
							(-20.655)	(-20.881)	(-14.269)
market $turnover_t$	0.680	0.694	0.639	0.656	0.663	0.705	0.663	0.667	0.683
	(63.392)	(63.943)	(36.819)	(62.048)	(62.158)	(41.454)	(62.735)	(62.353)	(39.907)
industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	7594	7594	3665	7594	7594	3665	7594	7594	3665
Adj. R^2	0.387	0.386	0.311	0.456	0.452	0.420	0.451	0.448	0.428

Panel B: Vol^{stock}

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
intercept	0.377	0.356	0.427	-5.267	-5.440	0.603	-7.019	-7.277	-0.837
	(4.435)	(4.157)	(3.941)	(-6.206)	(-6.380)	(0.539)	(-8.674)	(-8.910)	(-0.736)
Unexpected $Turn^{warrant}_{t-1}$	0.375			0.361			0.373		
	(7.942)			(7.686)			(7.947)		
Unexpected IPD^{BS}_{t-1}		0.125			0.187			0.180	
		(2.656)			(3.856)			(3.729)	
Unexpected IPD^{GARCH}_{t-1}			0.525			0.507			0.523
			(3.692)			(3.607)			(3.730)
put_t				-0.253	-0.255	0.318	-0.231	-0.233	0.355
				(-4.568)	(-4.597)	(4.186)	(-4.183)	(-4.201)	(4.693)
$covered_t$				0.134	0.141	-0.950	0.125	0.129	-0.917
				(2.205)	(2.322)	(-10.031)	(2.077)	(2.133)	(-9.692)
$duration_t$				0.005	-0.041	-0.216	-0.002	-0.043	-0.237
				(0.097)	(-0.806)	(-3.254)	(-0.033)	(-0.854)	(-3.584)
$stockcap_t$				0.255	0.264	0.022	0.328	0.339	0.087
				(7.191)	(7.402)	(0.450)	(9.390)	(9.622)	(1.745)
$liquidity_t$ *(bid-ask spread)*				-0.434	-0.679	0.730			
				(-1.069)	(-1.662)	(1.360)			
$liquidity_t$ *(Amihud Illiquidity)*							4.336	3.787	5.915
							(3.766)	(3.284)	(4.721)
market $turnover_t$	0.828	0.832	0.802	0.802	0.809	0.772	0.791	0.799	0.756
	(64.328)	(64.077)	(46.130)	(60.560)	(60.446)	(41.609)	(58.778)	(58.756)	(40.545)
industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	7594	7594	3665	7594	7594	3665	7594	7594	3665
Adj. R^2	0.378	0.373	0.464	0.386	0.383	0.478	0.387	0.383	0.481

Table 4 Difference of opinions: Float shares

This table reports the results when difference of opinions is considered as a mechanism of speculation spillover. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. *Float* is the log of the number of the A-shares outstanding. The other variables are defined in Table 3. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis.

	$Turn^{stock}_t$				Vol^{stock}_t			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
intercept	13.789	13.790	13.647	13.539	-5.058	-5.057	-5.211	-5.398
	(23.685)	(23.687)	(23.321)	(23.091)	(-5.850)	(-5.849)	(-6.002)	(-6.208)
Unexpected $Turn^{warrant}_{t-1}$	0.239	0.334			0.361	0.396		
	(7.567)	(3.572)			(7.691)	(2.842)		
Unexpected $Turn^{warrant}_{t-1}$ * $float_t$		-0.240				-0.088		
		(-1.084)				(-0.266)		
Unexpected IPD^{BS}_{t-1}			0.117	0.383			0.190	0.671
			(3.580)	(3.682)			(3.912)	(4.327)
Unexpected $IPD^{B}_{t-1}{}^{S}$ * $float_t$				-0.619				-1.118
				(-2.697)				(-3.265)
$float_t$	-0.511	-0.511	-0.523	-0.542	-0.206	-0.206	-0.229	-0.263
	(-4.659)	(-4.665)	(-4.755)	(-4.916)	(-1.262)	(-1.263)	(-1.397)	(-1.602)
put_t	-0.342	-0.342	-0.347	-0.348	-0.255	-0.255	-0.258	-0.257
	(-9.285)	(-9.282)	(-9.397)	(-9.413)	(-4.607)	(-4.605)	(-4.638)	(-4.639)
$covered_t$	0.009	0.008	0.010	0.009	0.120	0.120	0.126	0.125
	(0.207)	(0.201)	(0.238)	(0.210)	(1.951)	(1.950)	(2.044)	(2.022)
$duration_t$	0.281	0.280	0.253	0.252	-0.012	-0.013	-0.060	-0.064
	(8.125)	(8.109)	(7.187)	(7.142)	(-0.241)	(-0.245)	(-1.152)	(-1.219)
$stockcap_t$	-0.541	-0.541	-0.534	-0.529	0.251	0.251	0.259	0.267
	(-22.746)	(-22.745)	(-22.322)	(-22.081)	(7.014)	(7.013)	(7.215)	(7.422)
$liquidity_t$ *(bid-ask spread)*	-6.242	-6.247	-6.349	-6.285	-0.440	-0.442	-0.689	-0.581
	(-22.201)	(-22.214)	(-22.488)	(-22.192)	(-1.085)	(-1.088)	(-1.685)	(-1.418)
market $turnover_t$/$volatility_t$	0.656	0.656	0.662	0.663	0.802	0.802	0.809	0.810
	(62.070)	(62.068)	(62.207)	(62.267)	(60.572)	(60.564)	(60.464)	(60.580)
industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	7594	7594	7594	7594	7594	7594	7594	7594
Adj. R^2	0.457	0.457	0.454	0.454	0.386	0.386	0.383	0.384

Table 5 Difference of opinions: Bull/Bear Market

This table reports the results of the regression specifications in a bull and bear market. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. *Market volatility* is the market median of stock volatilities. Industry dummies (*industry*) are included. The variables are in daily basis. We define a bull market as the days before October 16, 2007 and a bear market as the days behind it in our sample. Bull-Bear column reports the difference of the coefficients from the bull market and the bear market regressions. T-statistics of coefficients are reported in parenthesis.

	$Turn^{stock}_{t}$						Vol^{stock}_{t}					
	Bull	Bear	Bull-Bear	Bull	Bear	Bull-Bear	Bull	Bear	Bull-Bear	Bull	Bear	Bull-Bear
intercept	14.664	19.206		14.491	19.257		-5.950	1.159		-6.285	1.218	
	(20.009)	(21.230)		(19.583)	(21.240)		(-5.395)	(0.765)		(-5.648)	(0.803)	
Unexpected $Turn^{warrant}_{t-1}$	0.288	0.148	0.140	.	.		0.459	0.180	0.279			
	(7.543)	(3.252)	(2.353)	.	.		(8.057)	(2.355)	(2.923)			
Unexpected IPD^{BS}_{t-1}				0.050	-0.110	0.161	.	.		0.141	-0.017	0.159
				(1.435)	(-1.212)	(1.648)	.	.		(2.713)	(-0.114)	(0.985)
put_t	-0.414	-0.697		-0.419	-0.728		-0.348	-0.231		-0.351	-0.225	
	(-9.976)	(-5.076)		(-10.019)	(-5.141)		(-5.600)	(-0.997)		(-5.600)	(-0.943)	
$covered_t$	-0.119	2.396		-0.112	2.418		-0.017	2.532		0.002	2.514	
	(-2.744)	(14.928)		(-2.566)	(14.666)		(-0.258)	(9.346)		(0.026)	(9.035)	
$duration_t$	0.631	-0.551		0.611	-0.552		0.162	-0.018		0.110	-0.020	
	(14.972)	(-8.073)		(14.016)	(-8.061)		(2.568)	(-0.158)		(1.688)	(-0.172)	
$stockcap_t$	-0.613	-0.715		-0.606	-0.716		0.284	-0.001		0.299	-0.002	
	(-19.998)	(-20.323)		(-19.553)	(-20.302)		(6.140)	(-0.024)		(6.391)	(-0.027)	
$liquidity_t$ *(bid-ask spread)*	-4.537	-3.689		-4.583	-3.784		-0.897	3.850		-1.072	3.728	
	(-12.633)	(-7.563)		(-12.667)	(-7.758)		(-1.741)	(4.538)		(-2.062)	(4.392)	
market $turnover_t$*/*$volatility_t$	0.718	0.900		0.724	0.903		0.789	0.638		0.801	0.636	
	(55.393)	(20.161)		(55.292)	(20.183)		(46.445)	(26.889)		(46.507)	(26.736)	
industry	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
No. of Obs.	5535	2059		5535	2059		5535	2059		5535	2059	
Adj. R^2	0.504	0.430		0.499	0.428		0.356	0.457		0.349	0.455	

Table 6 Attention

This table reports the results when attention is considered as a mechanism of speculation spillover. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis. In Panel A, we collect 620 warrant-days with media coverage. We consider the day of media coverage as the event day, and define the media coverage window as the period of [0, 1] and no coverage window as [-2,-1]. *Diff.* column reports the difference of the coefficients from the media coverage and no coverage regressions. In Panel B, we define *warrant extreme volume* as: warrant volume(t-1)- max [warrant volume (t-2 to t-6)]. We run the regressions on the samples ranked in the top 30% and bottom 30% by *warrant extreme volume*. *Diff.* column reports the difference of the coefficients. In Panel C, *extreme warrant price change* is defined as *(the highest intraday price-the lowest intraday price)/the daily closing price*. Similarly, we run the regressions on the samples ranked in the top 30% and the bottom 30% of *extreme warrant price change*. *Diff.* column reports the difference of the coefficients.

Panel A: Media coverage

	$Turn^{stock}_{t}$						Vol^{stock}_{t}					
	Media coverage	No coverage	Diff.	Media coverage	No coverage	Diff.	Media coverage	No coverage	Diff.	Media coverage	No coverage	
intercept	17.033	14.452		16.938	14.345		-7.589	-5.291		-7.462	-5.530	
	(11.515)	(10.984)		(11.442)	(10.826)		(-3.473)	(-2.510)		(-3.407)	(-2.613)	
Unexpected $Turn^{warrant}_{t-1}$	0.310	0.126	0.184				0.424	0.118	0.307			
	(4.129)	(1.693)	(1.743)				(3.854)	(0.988)	(1.892)			
Unexpected IPD^{BS}_{t-1}				0.337	0.046	0.291				0.349	0.136	0.214
				(4.168)	(0.652)	(2.698)				(2.923)	(1.194)	(1.295)
put_t	-0.359	-0.247		-0.397	-0.248		-0.186	-0.340		-0.216	-0.331	
	(-3.906)	(-2.945)		(-4.317)	(-2.956)		(-1.362)	(-2.509)		(-1.579)	(-2.439)	
$covered_t$	-0.228	-0.184		-0.235	-0.182		0.061	0.334		0.069	0.341	
	(-2.338)	(-2.082)		(-2.408)	(-2.052)		(0.421)	(2.338)		(0.471)	(2.388)	
$duration_t$	0.355	0.402		0.297	0.391		0.037	0.090		-0.040	0.053	
	(4.093)	(5.102)		(3.391)	(4.858)		(0.286)	(0.715)		(-0.308)	(0.411)	
$stockcap_t$	-0.685	-0.589		-0.683	-0.584		0.371	0.261		0.366	0.271	
	(-11.119)	(-10.723)		(-11.070)	(-10.567)		(4.053)	(2.940)		(3.992)	(3.044)	
$liquidity_t$ *(bid-ask spread)*	-7.139	-6.050		-7.290	-6.094		-1.480	-1.365		-1.956	-1.482	
	(-9.702)	(-9.532)		(-9.930)	(-9.600)		(-1.397)	(-1.381)		(-1.853)	(-1.500)	
market $turnover_t$/$volatility_t$	0.738	0.723		0.765	0.727		0.791	0.777		0.809	0.784	
	(28.014)	(29.724)		(29.288)	(29.584)		(23.603)	(24.778)		(24.119)	(24.692)	
industry	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
No. of Obs.	1352	1352		1352	1352		1352	1352		1352	1352	
Adj. R^2	0.494	0.512		0.494	0.511		0.360	0.385		0.357	0.385	

Panel B: Warrant Extreme Volume

	$Turn^{stock}_{t}$						Vol^{stock}_{t}					
	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.
intercept	11.909	17.692		11.339	17.566		-5.840	-7.486		-6.573	-7.983	
	(9.929)	(12.079)		(9.344)	(11.967)		(-3.068)	(-3.472)		(-3.448)	(-3.685)	
Unexpected $Turn^{warrant}_{t-1}$	0.395	0.081	0.314				0.378	0.498	-0.121			
	(6.510)	(1.071)	(3.234)				(3.917)	(4.464)	(-0.818)			
Unexpected IPD^{BS}_{t-1}				0.279	0.044	0.234	.	.		0.515	0.195	0.320
				(3.612)	(0.826)	(2.490)	.	.		(4.276)	(2.450)	(2.214)
put_t	-0.610	-0.032		-0.575	-0.041		-0.242	-0.123		-0.206	-0.168	
	(-8.071)	(-0.300)		(-7.580)	(-0.382)		(-1.990)	(-0.780)		(-1.709)	(-1.067)	
$covered_t$	0.061	-0.017		0.131	-0.018		0.064	0.589		0.143	0.607	
	(0.696)	(-0.191)		(1.492)	(-0.203)		(0.465)	(4.423)		(1.045)	(4.540)	
$duration_t$	0.312	0.627		0.253	0.613		0.158	0.580		0.065	0.525	
	(4.638)	(7.912)		(3.697)	(7.431)		(1.483)	(4.963)		(0.606)	(4.289)	
$stockcap_t$	-0.489	-0.709		-0.458	-0.703		0.278	0.352		0.316	0.371	
	(-9.732)	(-11.927)		(-8.999)	(-11.799)		(3.456)	(3.978)		(3.923)	(4.170)	
$liquidity_t$ *(bid-ask spread)*	-5.238	-8.985		-5.627	-9.019		0.330	-1.253		-0.245	-1.585	
	(-10.126)	(-11.142)		(-10.802)	(-11.191)		(0.408)	(-1.072)		(-0.303)	(-1.351)	
market $turnover_t$*/*$volatility_t$	0.698	0.564		0.707	0.567		0.726	0.732		0.745	0.741	
	(32.481)	(24.305)		(32.559)	(24.248)		(24.309)	(25.430)		(25.067)	(25.373)	
industry	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
No. of Obs.	1684	1676		1684	1676		1684	1676		1684	1676	
Adj. R^2	0.489	0.422		0.481	0.421		0.342	0.378		0.343	0.372	

Panel C: Warrant Extreme Price Change

	$Turn^{stock}_{t}$						Vol^{stock}_{t}					
	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.	Top30%	Low30%	Diff.
Intercept	13.946	11.898		13.927	11.693		-6.106	-7.941		-6.092	-8.139	
	(11.270)	(9.602)		(11.216)	(9.397)		(-3.401)	(-4.167)		(-3.390)	(-4.243)	
Unexpected $Turn^{warrant}_{t-1}$	0.303	0.125	0.178				0.407	0.399	0.008			
	(4.904)	(1.966)	(2.010)				(4.533)	(4.072)	(0.062)			
Unexpected IPD^{BS}_{t-1}				0.273	0.116	0.157				0.440	0.195	0.245
				(3.704)	(2.058)	(1.699)				(4.120)	(2.239)	(1.777)
put_t	-0.511	-0.208		-0.505	-0.210		-0.444	-0.178		-0.430	-0.196	
	(-6.759)	(-2.514)		(-6.661)	(-2.541)		(-3.980)	(-1.396)		(-3.849)	(-1.532)	
$covered_t$	-0.017	0.076		-0.017	0.082		0.101	0.300		0.101	0.317	
	(-0.205)	(0.920)		(-0.196)	(0.993)		(0.827)	(2.344)		(0.830)	(2.461)	
$duration_t$	0.366	0.357		0.281	0.338		0.049	0.374		-0.081	0.336	
	(5.346)	(4.819)		(4.033)	(4.525)		(0.492)	(3.276)		(-0.802)	(2.905)	
$stockcap_t$	-0.575	-0.462		-0.569	-0.454		0.287	0.371		0.296	0.377	
	(-11.224)	(-9.035)		(-11.066)	(-8.831)		(3.830)	(4.674)		(3.936)	(4.721)	
$liquidity_t$ *(bid-ask spread)*	-5.863	-7.105		-6.152	-7.177		0.208	0.512		-0.310	0.247	
	(-10.033)	(-10.980)		(-10.494)	(-11.095)		(0.249)	(0.525)		(-0.369)	(0.253)	
market $turnover_t$*/*$volatility_t$	0.733	0.568		0.744	0.572		0.764	0.723		0.769	0.737	
	(32.794)	(25.042)		(33.134)	(25.152)		(28.274)	(24.333)		(28.366)	(24.561)	
industry	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
No. of Obs.	1703	1700		1703	1700		1703	1700		1703	1700	
Adj. R^2	0.491	0.391		0.488	0.391		0.401	0.333		0.400	0.329	

Table 7 Information

This table reports the results of the information effect. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. *PIN* is the probability of informed trading. We estimate the PIN variable every month using the warrant intraday data following the method developed by Easley, Hvidkjaer and O'Hara (2002). T-statistics of coefficients are reported in parenthesis.

	$Turn^{stock}_{t}$				Vol^{stock}_{t}			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
intercept	13.106	13.105	12.978	12.938	-5.189	-5.194	-5.344	-5.399
	(22.808)	(22.803)	(22.461)	(22.369)	(-6.096)	(-6.101)	(-6.251)	(-6.310)
PIN_t	0.644	0.651	0.602	0.572	-0.621	-0.595	-0.690	-0.735
	(2.131)	(2.146)	(1.986)	(1.884)	(-1.381)	(-1.317)	(-1.529)	(-1.625)
Unexpected $Turn^{stock}_{t-1}$	0.241	0.233			0.361	0.332		
	(7.615)	(5.508)			(7.679)	(5.285)		
Unexpected $Turn^{stock}_{t-1}$ * PIN_t		0.158				0.583		
		(0.275)				(0.681)		
Unexpected IPD^{BS}_{t-1}			0.106	0.143			0.191	0.246
			(3.249)	(3.506)			(3.911)	(4.049)
Unexpected IPD^{BS}_{t-1} * PIN_t				-0.557				-0.838
				(-1.510)				(-1.528)
put_t	-0.366	-0.367	-0.369	-0.366	-0.229	-0.230	-0.228	-0.222
	(-9.432)	(-9.434)	(-9.479)	(-9.376)	(-3.944)	(-3.954)	(-3.912)	(-3.811)
$covered_t$	0.057	0.057	0.058	0.061	0.115	0.116	0.121	0.125
	(1.378)	(1.382)	(1.401)	(1.462)	(1.852)	(1.862)	(1.945)	(2.011)
$duration_t$	0.322	0.322	0.298	0.299	0.008	0.008	-0.038	-0.036
	(9.646)	(9.647)	(8.741)	(8.790)	(0.156)	(0.160)	(-0.758)	(-0.710)
$stockcap_t$	-0.523	-0.523	-0.517	-0.516	0.253	0.253	0.261	0.264
	(-22.031)	(-22.029)	(-21.644)	(-21.558)	(7.114)	(7.118)	(7.309)	(7.366)
$liquidity_t$ *(bid-ask spread)*	-6.300	-6.300	-6.397	-6.392	-0.343	-0.340	-0.580	-0.579
	(-22.166)	(-22.161)	(-22.415)	(-22.397)	(-0.835)	(-0.828)	(-1.404)	(-1.402)
market $turnover_t$/$volatility_t$	0.658	0.658	0.664	0.664	0.801	0.801	0.808	0.808
	(62.137)	(62.133)	(62.237)	(62.255)	(60.460)	(60.434)	(60.363)	(60.388)
industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	7594	7594	7594	7594	7594	7594	7594	7594
Adj. R^2	0.457	0.457	0.453	0.453	0.387	0.387	0.384	0.384

Table 8 Hedging

This table reports the results when hedging is considered. We collect the complete observations of 50 warrants that are listed in Shanghai Stock Exchange and Shenzhen Stock Exchange between August 2005 and June 2008. The 50 warrants are written on 41 firms. Δ*hedge ratio* is the absolute value of the difference of the daily hedge ratios calculated using the Black-Scholes model. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis.

	$Turn^{stock}_{t}$				Vol^{stock}_{t}			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
intercept	12.387	12.384	12.252	12.265	-6.168	-6.173	-6.303	-6.297
	(21.748)	(21.741)	(21.386)	(21.426)	(-7.257)	(-7.262)	(-7.381)	(-7.378)
Δ*hedge ratio*$_t$	13.371	13.389	13.311	12.922	13.777	13.806	13.484	13.070
	(13.291)	(13.300)	(13.188)	(12.741)	(9.062)	(9.071)	(8.833)	(8.522)
Unexpected $Turn^{stock}_{t-1}$	0.239	0.250			0.363	0.377		
	(7.651)	(6.583)			(7.778)	(6.636)		
Unexpected $Turn^{stock}_{t-1}$ * Δ *hedge ratio*$_t$		-0.819				-1.015		
		(-0.508)				(-0.419)		
Unexpected IPD^{BS}_{t-1}			0.104	0.068			0.169	0.129
			(3.244)	(2.024)			(3.498)	(2.559)
Unexpected IPD^{BS}_{t-1} * Δ *hedge ratio*$_t$				13.318				14.689
				(3.626)				(2.670)
put$_t$	-0.354	-0.354	-0.359	-0.379	-0.279	-0.279	-0.282	-0.304
	(-9.707)	(-9.700)	(-9.815)	(-10.248)	(-5.066)	(-5.065)	(-5.093)	(-5.434)
covered$_t$	0.045	0.045	0.047	0.049	0.131	0.131	0.139	0.141
	(1.117)	(1.113)	(1.163)	(1.222)	(2.178)	(2.173)	(2.287)	(2.326)
duration$_t$	0.276	0.276	0.253	0.249	-0.044	-0.044	-0.085	-0.089
	(8.341)	(8.332)	(7.479)	(7.356)	(-0.890)	(-0.895)	(-1.679)	(-1.765)
stockcap$_t$	-0.495	-0.495	-0.489	-0.488	0.296	0.297	0.303	0.304
	(-21.022)	(-21.015)	(-20.622)	(-20.615)	(8.318)	(8.324)	(8.475)	(8.501)
liquidity$_t$ *(bid-ask spread)*	-6.860	-6.861	-6.957	-7.011	-1.143	-1.144	-1.361	-1.412
	(-24.289)	(-24.291)	(-24.533)	(-24.709)	(-2.778)	(-2.779)	(-3.288)	(-3.410)
market turnover$_t$*/volatility*$_t$	0.668	0.668	0.674	0.673	0.783	0.782	0.789	0.789
	(63.659)	(63.624)	(63.736)	(63.651)	(58.719)	(58.601)	(58.552)	(58.549)
industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	7594	7594	7594	7594	7594	7594	7594	7594
Adj. R^2	0.468	0.468	0.464	0.465	0.393	0.393	0.389	0.390

Table 9 Robustness: Sample with deep-out-of-time put warrants

This table reports the results of the regression specifications using a sample of deep-out-of-the-money put warrants. In this sample, we include only deep-out-of-the-money put warrants that have a Black-Scholes value less than 0.05 pennies. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis.

	$Turn^{stock}_{t-1}$		Vol^{stock}_{t-1}	
intercept	24.749	29.180	-10.172	-8.655
	(7.199)	(7.911)	(-2.577)	(-2.081)
Unexpected $Turn^{warrant}_{t-1}$	0.291		0.259	
	(3.393)		(2.630)	
Warrant Close Price$_{t-1}$		0.122		0.012
		(2.157)		(0.174)
covered$_t$	-0.042	0.168	0.431	0.446
	(-0.272)	(0.926)	(2.514)	(2.210)
duration$_t$	1.070	1.066	1.935	2.032
	(4.624)	(4.511)	(7.284)	(7.484)
stockcap$_t$	-0.937	-1.145	0.436	0.371
	(-6.105)	(-6.844)	(2.482)	(1.988)
liquidity$_t$ *(bid-ask spread)*	-8.750	-9.095	14.084	13.849
	(-6.445)	(-6.668)	(8.796)	(8.627)
market turnover$_t$*/volatility*$_t$	0.310	0.322	0.407	0.411
	(9.796)	(10.147)	(10.521)	(10.408)
industry	Yes	Yes	Yes	Yes
No. of Obs.	850	850	850	850
Adj. R^2	0.362	0.356	0.332	0.326

Table 10 Robustness: AB or AH premium

This table reports the results when the dependent variable is AB or AH premium. We collect the sub-sample that has either B share or H share listed in the B-share market or the Hong Kong Stock Exchange. respectively. *AB premium* is log(A price/B price) and *AH premium* is the log(A price/H price). B price and H price are adjusted by exchange rate. The variables are in daily basis. T-statistics of coefficients are reported in parenthesis.

	$AB\ premium_t$		$AH\ premium_t$	
	(1)	(2)	(3)	(4)
intercept	-12.187	-12.408	2.653	2.630
	(-13.199)	(-13.265)	(12.187)	(12.082)
$Unexpected\ Turn^{warrant}_{t-1}$	0.017		0.002	
	(2.983)		(0.191)	
$Unexpected\ IPD^{BS}_{t-1}$		0.003		0.010
		(0.638)		(1.930)
put_t			0.056	0.053
			(1.793)	(1.712)
$duration_t$	0.413	0.417	-0.032	-0.036
	(12.356)	(12.350)	(-1.380)	(-1.524)
$stockcap_t$	0.544	0.553	-0.070	-0.069
	(14.177)	(14.226)	(-7.915)	(-7.781)
$liquidity_t$ *(bid-ask spread)*	-4.612	-4.582	-1.705	-1.701
	(-30.093)	(-29.675)	(-8.339)	(-8.343)
market volatility$_t$	-3.535	-3.608	-10.321	-10.273
	(-8.964)	(-8.985)	(-17.738)	(-17.682)
industry	Yes	Yes	Yes	Yes
No. of Obs.	442	444	1152	1152
Adj. R^2	0.873	0.871	0.263	0.266