*The Chinese Warrants Bubble: Evidence from Brokerage Account Records

Neil D. Pearson
Zhishu Yang
Qi Zhang
汤潮

2021-04-22

content

- Introduction
- Background and Data
- The May 30,2007 Tax change
- Model and results
- Conclusion

1.Introduction

What we study

- We study about the Chinese put warrants bubble.
- We wonder when the bubble started and what caused it.
- We want to know whether the experience on a transaction in warrant can influence the probability of reenter the market.
- We hope to find that what kind of mechanism can explain the bubble.

1.Introduction

What we done

- We study trading during the Chinese put warrants bubble.
- We find the tax change caused the initial large put warrant returns that started the bubble.
- We use the account records to show that investors engaged in a form of positive feedback trading in which their trading is explained by past returns.
- we use the panel regression approach to show that estimates of the trading volume due to feedback trading explain the size of the bubble.

1.Introduction

Research contents

- Xiong and Yu (2011) study the Chinese put warrants price in 2006-2007 and build a compelling case that it was a bubble
- Barberis et al (2018) found the existence of a positive correlation between trading volume and some measure of past returns.
- Strahilevitz, Odean, and Barber (2011) find that an investor's probability of repurchasing a stock he or she previously held depends on whether the previous transaction resulted in a gain or a loss.
- Shiller (2014, 2015) described that a bubble is created by the interaction of a precipitating event and feedback trading that magnifies the impact of the event

2. Background and Data

Background

- The put warrants gave their holders the right to sell the issuing companies' stocks at predetermined strike prices during specified exercise periods.
- The warrants were listed on either the Shanghai or Shenzhen stock exchanges, The 2006−2007 boom in Chinese stock prices caused most of the 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, leading many to interpret the warrant trading as a speculative bubble

2. Background and Data

Background

- 328% per day turnover indicate very short holding periods, and are inconsistent with investors buying and holding the warrants as long-term hedges (or bets)
- The possibility that investors might have used the warrants as short-term hedges by noting that between the returns of the put warrants and their underlying stocks was only -0.081, and not significantly different from zero.

2. Background and Data

Warrant and stock information

- **Date** : CSMAR database 、 Resset

Panel A: Summary market information

	Trading period			Warrant information at beginning of trading				Warrant information at end of trading			
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

	Stock price		Warrant Price		Daily turnover (percent)		Yuan volume(million)	
Name	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

2. Background and Data

Brokerage account data

- The main data we use are the trading records of a large set of investors who traded the put warrants, data from a set of brokerage account records from a securities firm in China.
- it is possible for one individual to control multiple brokerage accounts， We combined the records from brokerage accounts that share the same “funding account,”
- we use the data on the investors who have previously purchased at least one put warrant because those are the investors for whom we can compute one or more past returns

2. Background and Data

Brokerage account data

- an investor might use multiple buy orders to build up a position, and then liquidate the position using multiple sell orders, We resolve this 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.

Panel C. Summary statistics of brokerage investor trading

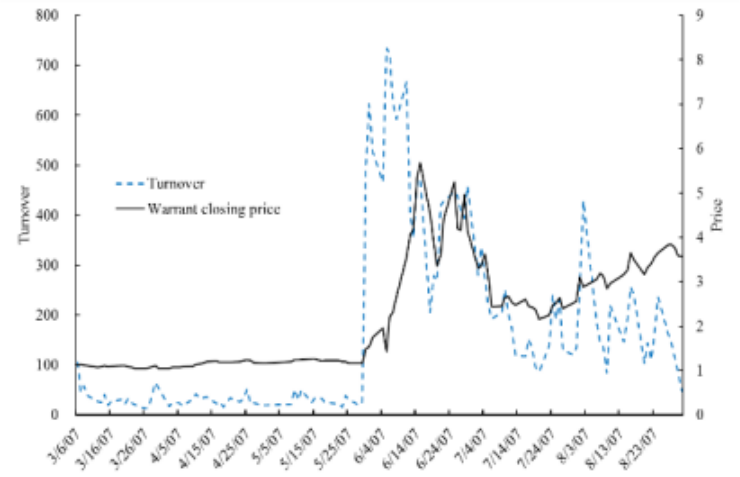
Name	Investor number	Completed cycles		Uncompleted cycles	
		Number	Average length	Number	Average length
Wanke	6270	21038	6.71	540	52.76
Shenneng	2727	7860	3.07	101	26.04
Wugang	5259	14959	6.65	695	64.76
Jichang	3966	12162	3.65	448	50.72
Yuanshui	3796	11454	3.51	297	73.89
Huchang	4081	12708	3.92	290	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

3. The May 30, 2007 Tax Change

- At about midnight on May 30 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
- 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

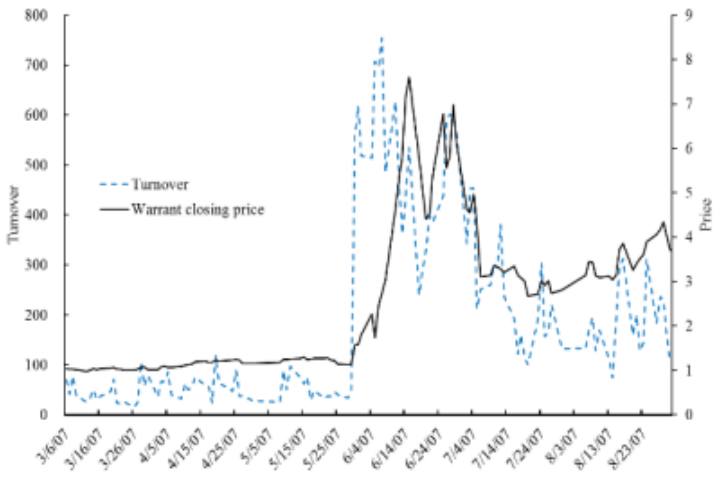
3. The May 30, 2007 Tax Change

- turnover increased remarkably on May 30. For the five warrants, the ratios of turnover on May 30 to turnover on May 29 are 19.11, 12.72, 11.70, 3.47, and 14.70. The average of these five ratios is 12.34， and the impression is of discontinuous changes on that date
- For all five put warrants the numbers of investors who have previously purchased at least one put warrant, jumped sharply on May 30. The visual impression again is of discontinuous changes

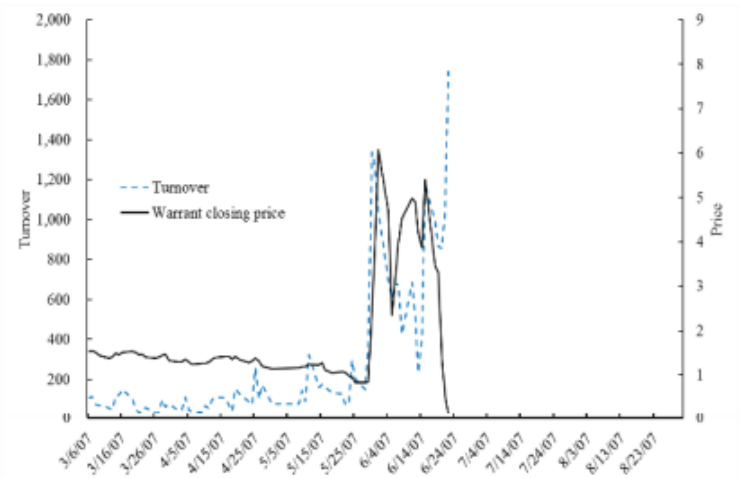


Panel A. Hualing

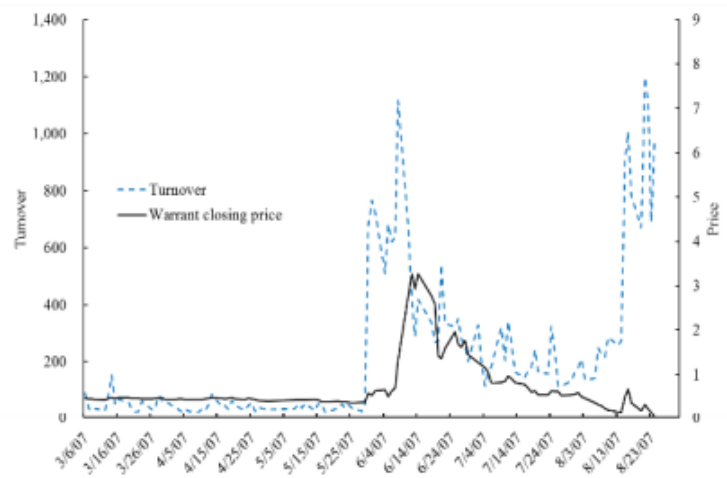
Panel B. Wuliang



Panel C. Zhongji

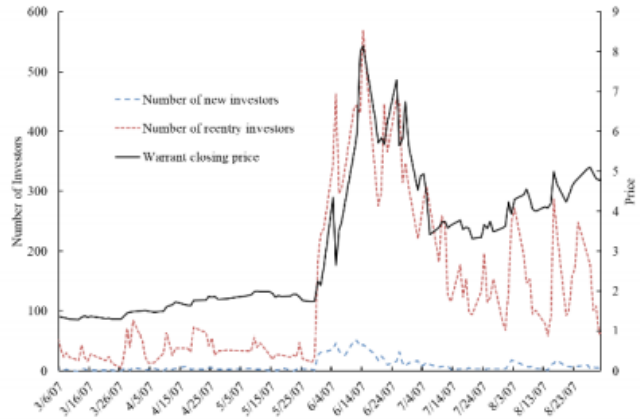


Panel D. Jiafei

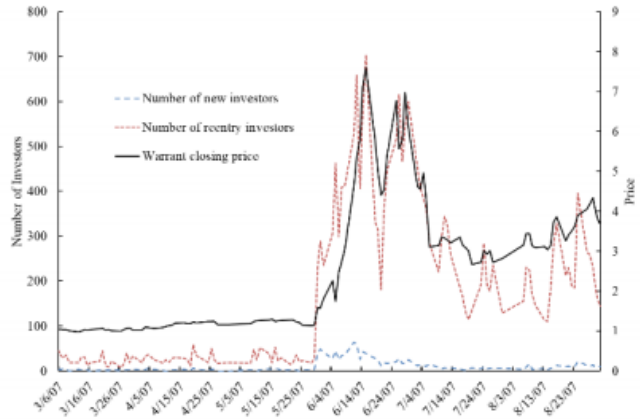


Panel E. Zhaohang

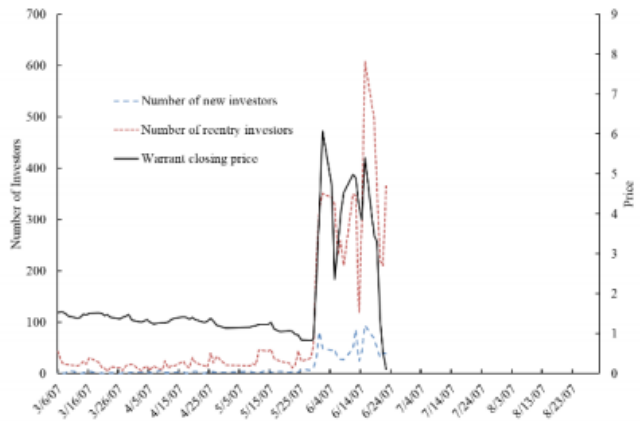
Panel A. Hualing



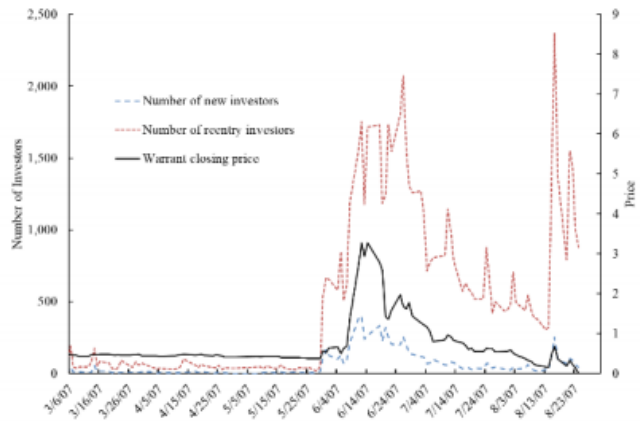
Panel B. Wuliang



Panel C. Zhongji



Panel D. Jiafei



Panel E. Zhaohang

3. The May 30, 2007 Tax Change

- the bubble was more pronounced after May 30, 2007 than before as 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
- The average bubble sizes in Panel A for the 12 warrants that expired before May 30 , the average bubble size in Panel B for the five warrants that traded both before and after May 30, 2007; In contrast, in Panel C the average bubble size 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
Shenneng	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
Yuanshui	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
Zhaohang	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 expired 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
Zhaohang	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

- 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 returning and new investors, pin down the date exactly.

3. The May 30, 2007 Tax Change

- The increase in the tax on stock trades increased the relative attractiveness of the warrants, because they (along with the call warrants) were the only listed financial instruments that were exempt from the tax.
- The put at the time were the only instruments with payoffs negatively related to stock prices that were available for trading. Investors were willing to pay high prices for the warrants to insure against the tail risk of a very large stock price decline.

Holding period length	Frequency	Percentage	Cumulative Percentage
Less than 5 minutes	76,512	0.1039	0.1039
5-10 minutes	63,031	0.0856	0.1895
10min-1hour	228,910	0.3109	0.5004
1hour-1day	180,243	0.2448	0.7452
1day-2day	39,176	0.0532	0.7984
2day-5day	80,701	0.1096	0.9080
5day-10day	27,764	0.0377	0.9457
10day-20day	17,162	0.0233	0.9691
More than 20day	22,758	0.0309	1.0000
Total transaction cycles	736,258		

- From May 30 2007, among investors who held a warrant, only 1.26% of them held the underlying stock at close of trading
- The short holding periods eliminate the possibility that investors bought and held the warrants as long-term hedges against declines
- the correlation between the returns of the put warrants and their underlying stocks was only −0.081, and not significantly different from zero. The warrants could not have been useful hedges of short-term fluctuations in stock prices.

4. Model and results

Samples and covariates

- we estimate the models using on each date only the investors who have previously purchased at least one put warrant because these are the investors for whom we can compute at least one past realized or unrealized return.
- Thus, in modeling the purchase of warrant k on date t we consider the investors who do not hold warrant k as of the close of trading on date t – 1 and have previously purchased and sold warrant k or previously purchased (but not necessarily sold) one of the other put warrants

4. Model and results

Samples and covariates

- For each warrant k and date t, we divide the sample into three groups

one-cycle investors : have previously completed one transaction cycle in warrant k

two-cycle investors: have completed two or more transaction cycles in warrant k

inexperienced investors: have not previously traded warrant k but have purchased some other warrant

4. Model and results

Samples and covariates

- The proportional hazards model specifies that $\lambda_{\mathrm{i},k,t}(\tau)$, the hazard function of starting a new transaction cycle by investor i in warrant k on date t, τ trading days after the end of the investor's last transaction cycle.

$$\lambda_{i,k,t}(\tau) = \lambda(\tau) * \mathrm{e}^{x_{i,k,t}\beta}$$

- $\lambda(\tau)$ is the baseline hazard rate, $x_{i,k,t}$ is a vector of covariates that proportionally shift the baseline hazard.

4. Model and results

Samples and covariates

- For the one-cycle investors: $x_{i,k,t}\beta$ includes:

$\mathrm{Ret}Lag1_{i,k,t}$、$I(\mathrm{Ret}Lag1_{i,k,t} > 0)$
$Other\mathrm{Ret}Lag1_{i,k,t}$、$I(O\mathrm{therRet}Lag1_{i,k,t} > 0)$
$NoOther\mathrm{Ret}Lag1_{i,k,t}$

$Other\mathrm{Ret}Lag2_{i,k,t}$、$I(O\mathrm{therRet}Lag2_{i,k,t} > 0)$
$NoOther\mathrm{Ret}Lag2_{i,k,t}$

$\mathrm{UnRealizedRet}_{i,k,t}$、 $\mathrm{I(UnRealizedRet}_{i,k,t} > 0$、

4. Model and results

Samples and covariates

- For the one-cycle investors: $x_{i,k,t}\beta$ includes:

$\mathrm{Mkt}Ret1Day_{k,t}$、$\mathrm{Mkt}Ret4Day_{k,t}$、$\mathrm{Mkt}Ret3week_{k,t}$

$TurnoverDay_{k,t}$、$Turnover4Day_{k,t}$、$Turnover3week_{k,t}$

$$Fundamental_{k,t} = \left(\frac{stock\ price_{k,t} - Strike\ price_{k,t}}{stock\ price_{k,t}}\right) / Maturity_{k,t}$$

calendar date, time-to-maturity, and warrant fixed effects, denotedα_t, α_m, α_k

4. Model and results

Samples and covariates

- For the two-cycle investors:

adding the variables$\mathrm{Ret}Lag2_{i,k,t}$、$I(\mathrm{Ret}Lag2_{i,k,t} > 0)$

- For the investors who have not previously traded warrant k (the new investors):the model is the same except that the variables

$$\mathrm{Ret}Lag1_{i,k,t}、I(\mathrm{Ret}Lag1_{i,k,t} > 0)$$
$$\mathrm{Ret}Lag2_{i,k,t}、I(\mathrm{Ret}Lag2_{i,k,t} > 0)$$

are not included because they are not available

4. Model and results

Possible unobserved individual heterogeneity

- investors' abilities : use the stratified partial likelihood method and logistic regression models
- time-varying individual heterogeneity: It seems unlikely that there can be many changes in investors' access to information or trading skill at the time scale of the warrant trading.

4. Model and results

Panel A. Results for the Standard Cox Regression Model

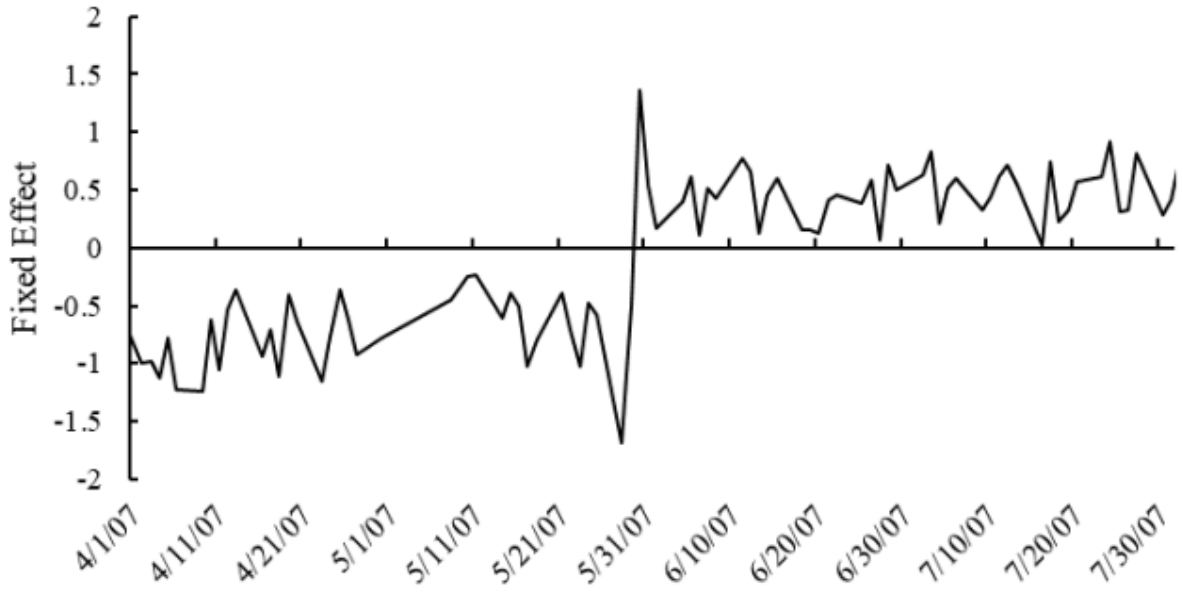
	One-cycle investors		Two-cycle investors		Inexperienced investors	
	(1)		(2)		(3)	
Explanatory Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
$RetLag1_{i,k,t}$	0.4313	<.0001	0.5258	<.0001		
$I(RetLag1_{i,k,t} > 0)$	0.3412	<.0001	0.2353	<.0001		
$RetLag2_{i,k,t}$			0.1394	<.0001		
$I(RetLag2_{i,k,t} > 0)$			0.0233	<.0001		
$OtherRetLag1_{i,k,t}$	0.1536	<.0001	0.2310	<.0001	0.3109	<.0001
$I(OtherRetLag1_{i,k,t} > 0)$	0.1082	<.0001	0.0103	0.0219	0.2412	<.0001
$NoOtherRetLag1_{i,k,t}$	0.0233	0.1425	0.0277	0.0112	-0.1158	<.0001
$OtherRetLag2_{i,k,t}$	0.0521	0.1152	0.3885	<.0001	0.2547	<.0001
$I(OtherRetLag2_{i,k,t} > 0)$	-0.0646	<.0001	-0.0548	<.0001	-0.2893	<.0001
$NoOtherRetLag2_{i,k,t}$	-0.3201	<.0001	-0.2926	<.0001	-1.0768	<.0001
$UnRealizedRet_{i,k,t}$	0.2354	<.0001	0.2627	<.0001	0.3612	<.0001
$I(UnRealizedRet_{i,k,t} > 0)$	0.1832	<.0001	0.1486	<.0001	0.2512	<.0001
$NoUnRealizedRet_{i,k,t}$	-0.0299	0.0132	0.0650	<.0001	-0.4160	<.0001
$MktRet1Day_{k,t}$	0.1730	<.0001	0.1170	<.0001	0.7447	<.0001
$MktRet4Day_{k,t}$	0.1067	<.0001	0.0793	<.0001	0.1126	<.0001
$MktRet3Week_{k,t}$	0.0820	<.0001	0.0639	<.0001	0.0689	<.0001
$TurnoverDay_{k,t}$	0.0006	<.0001	0.0002	<.0001	0.0011	<.0001
$Turnover4Day_{k,t}$	-0.0003	0.0134	0.0001	0.2051	-0.0003	0.0041
$Turnover3Week_{k,t}$	-0.0004	0.0302	-0.0004	<.0001	0.0005	0.0018
$Fundamental_{k,t}$	-2.4471	<.0001	-2.4499	<.0001	-1.4357	<.0001
Maturity fixed effects	Yes		Yes		Yes	
Warrant fixed effects	Yes		Yes		Yes	
Date fixed effects	Yes		Yes		Yes	
Observations	8,011,312		10,116,045		55,390,101	

Panel B. Results for the Stratified Cox Regression Model

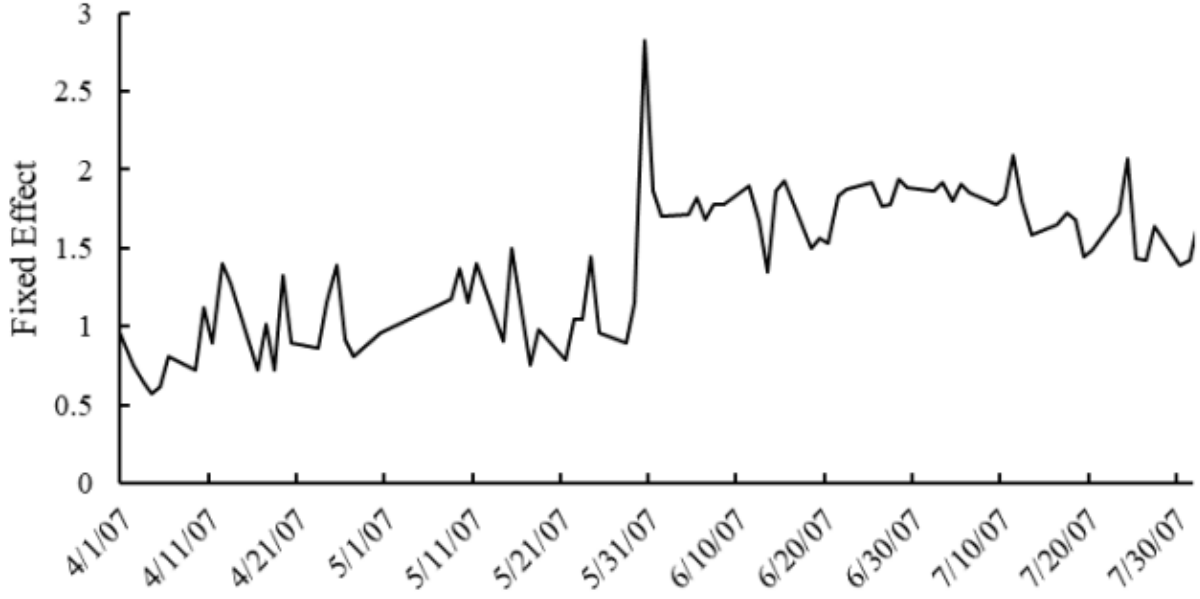
	One-cycle investors		Two-cycle investors		Inexperienced investors	
	(1)		(2)		(3)	
Explanatory Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
$RetLag1_{i,k,t}$	1.0323	<.0001	0.6412	<.0001		
$I(RetLag1_{i,k,t} > 0)$	0.2946	<.0001	0.2239	<.0001		
$RetLag2_{i,k,t}$			0.4107	<.0001		
$I(RetLag2_{i,k,t} > 0)$			0.0979	<.0001		
$OtherRetLag1_{i,k,t}$	0.1486	0.0015	0.1672	<.0001	0.0051	0.9360
$I(OtherRetLag1_{i,k,t} > 0)$	0.1417	<.0001	0.0614	<.0001	0.3292	<.0001
$NoOtherRetLag1_{i,k,t}$	-0.2127	<.0001	0.1103	<.0001	1.8237	<.0001
$OtherRetLag2_{i,k,t}$	0.2549	0.0135	0.1432	0.0068	0.1907	0.1459
$I(OtherRetLag2_{i,k,t} > 0)$	0.1215	<.0001	0.0737	<.0001	0.3329	<.0001
$NoOtherRetLag2_{i,k,t}$	0.4897	<.0001	0.1513	<.0001	2.2125	<.0001
$UnRealizedRet_{i,k,t}$	0.3110	<.0001	0.2430	<.0001	0.3550	0.0018
$I(UnRealizedRet_{i,k,t} > 0)$	0.1301	<.0001	0.0737	<.0001	0.1277	0.0007
$NoUnRealizedRet_{i,k,t}$	0.4286	<.0001	0.3213	<.0001	1.6049	<.0001
$MktRet1Day_{k,t}$	0.0495	0.3783	0.0620	0.2614	0.8879	<.0001
$MktRet4Day_{k,t}$	0.0876	0.0014	0.0798	0.0023	0.0316	0.5128
$MktRet3Week_{k,t}$	0.0727	0.0001	0.0620	<.0001	0.0625	0.1259
$TurnoverDay_{k,t}$	0.0008	<.0001	0.0003	0.0002	0.0011	<.0001
$Turnover4Day_{k,t}$	-0.0003	0.1341	<.0001	0.8593	0.0005	0.0457
$Turnover3Week_{k,t}$	-0.0003	0.3781	-0.0005	0.0556	0.0008	0.0324
$Fundamental_{k,t}$	-2.3735	0.0004	-2.5882	<.0001	-0.3207	0.4565
Maturity fixed effects	Yes		Yes		Yes	
Warrant fixed effects	Yes		Yes		Yes	
Date fixed effects	Yes		Yes		Yes	
Observations	8,011,312		10,116,045		55,390,101	

4. Model and results

Date fixed effects from the positive feedback regressions for two groups of investors



Panel A. One-cycle investors



Panel B. Two-cycle investors

4. Model and results

	One-cycle investors		Two-cycle investors		Inexperienced investors	
	(1)		(2)		(3)	
Explanatory Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
$RetLag1_{i,k,t}$	0.8507	<.0001	0.9990	<.0001		
$I(RetLag1_{i,k,t} > 0)$	0.3491	<.0001	0.2526	<.0001		
$RetLag2_{i,k,t}$			0.3181	<.0001		
$I(RetLag2_{i,k,t} > 0)$			0.0517	<.0001		
$OtherRetLag1_{i,k,t}$	0.2082	<.0001	0.3338	<.0001	-0.0286	0.3448
$I(OtherRetLag1_{i,k,t} > 0)$	0.1276	<.0001	0.0261	<.0001	0.3784	<.0001
$NoOtherRetLag1_{i,k,t}$	-0.1306	<.0001	0.0460	0.0225	0.1163	<.0001
$OtherRetLag2_{i,k,t}$	0.0702	0.3846	0.2113	0.0001	0.4872	<.0001
$I(OtherRetLag2_{i,k,t} > 0)$	-0.0331	0.0489	0.0245	0.0014	-0.0973	<.0001
$NoOtherRetLag2_{i,k,t}$	0.2991	<.0001	-0.0803	<.0001	-0.2483	<.0001
$UnRealizedRet_{i,k,t}$	0.5498	<.0001	0.4573	<.0001	0.1863	<.0001
$I(UnRealizedRet_{i,k,t} > 0)$	0.3663	<.0001	0.2753	<.0001	0.8026	<.0001
$NoUnRealizedRet_{i,k,t}$	-0.0279	0.0629	-0.0004	0.9566	-0.0231	0.1000
$MktRet1Day_{k,t}$	0.6271	<.0001	0.4646	<.0001	1.4419	<.0001
$MktRet4Day_{k,t}$	0.1653	<.0001	0.0939	<.0001	0.5340	<.0001
$MktRet3Week_{k,t}$	0.1061	<.0001	0.0923	<.0001	0.2390	<.0001
$TurnoverDay_{k,t}$	0.0008	<.0001	0.0004	<.0001	0.0021	<.0001
$Turnover4Day_{k,t}$	-0.0002	0.1285	0.0001	0.1230	-0.0002	0.0262
$Turnover3Week_{k,t}$	0.0005	0.0260	0.0004	0.0002	0.0005	0.0124
$Fundamental_{k,t}$	-0.1433	0.7402	-0.1235	0.5895	-0.1757	0.4352
Individual fixed effects	Yes		Yes		Yes	
Maturity fixed effects	Yes		Yes		Yes	
Warrant fixed effects	Yes		Yes		Yes	
Date fixed effects	Yes		Yes		Yes	
Duration fixed effects	Yes		Yes		Yes	
Observations	8,011,312		10,116,045		55,390,101	

4. Model and results

Dynamics of feedback trading volume and put warrant prices around the May 30, 2007 tax change

- We use the coefficient estimates from the appropriate model and the covariates to calculate the fitted probability that investor i purchases warrant k on date t and call the result $\hat{P}_{i,k,t}$
- We set the coefficient estimates on these return variables equal to zero and recalculate the buying probability for each investor i, warrant k, and date t, calling the result$\bar{P}_{i,k,t}$.The difference $\hat{P}_{i,k,t}$ - $\bar{P}_{i,k,t}$ is the part of the buying probability that is due to the investor's own past returns.
- $\hat{Q}_{i,k}$ is the average trade size of investor i in warrant k in the previous cycles

4. Model and results

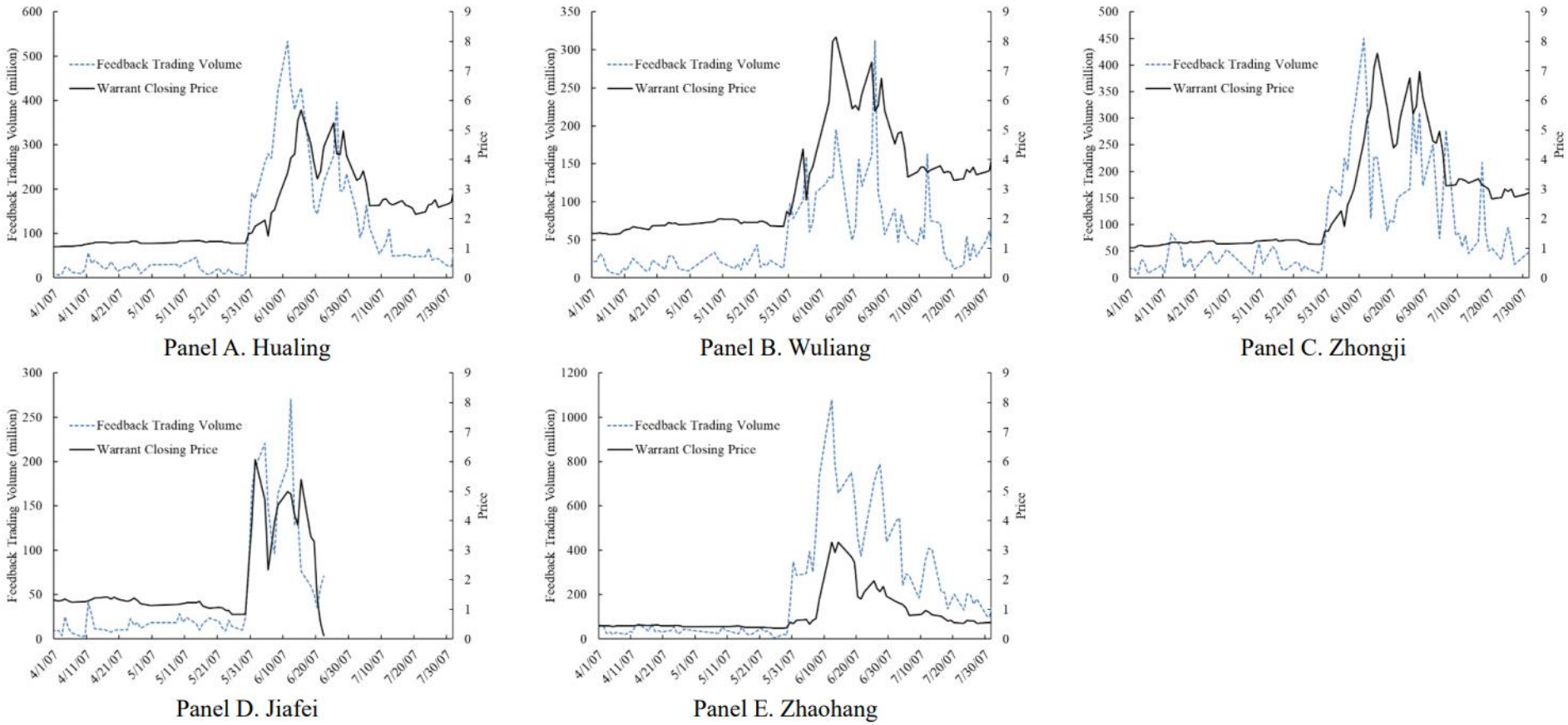
Dynamics of feedback trading volume and put warrant prices around the May 30, 2007 tax change

- $F_{k,t} = (\hat{P}_{i,k,t} - \bar{P}_{i,k,t}) * \hat{Q}_{i,k}$ measures the effect of positive feedback from own returns on the trading volume of investor i in warrant k on date t.

$$FeedbackVolume_{k,t} = F_{k,t} * \left(\frac{Volume_{k,t}^{Market}}{Volume_{k,t}^{Brokage}}\right)$$

- $Volume_{k,t}^{Market}$ is the market trading volume in warrant k on date t and $Volume_{k,t}^{Brokage}$ is the corresponding trading volume of the brokerage firm customers

4. Model and results



it is difficult to escape the conclusion that feedback trading played an important role in the put warrants bubble.

4. Model and results

Panel regressions showing that feedback trading explains put warrant prices

- zero-fundamental period : 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 We estimate unbalanced panel regressions on turnover, an estimate of the daily volatility computed from intraday five-minute returns, the warrant float, and remaining time-to-maturity fixed effects.

Panel A: Without *TransactionTax* dummy

Explanatory Variable	(1)	(2)	(3)	(4)
Turnover	0.212			0.146
	(8.31)			(4.91)
Volatility		21.93		15.06
		(5.19)		(2.78)
Float			-0.301	-0.281
			(-11.38)	(-10.17)
Constant	-2.513	-3.185	0.323	-3.671
	(-6.40)	(-4.59)	(3.26)	(-4.71)
Maturity Fixed Effects	Yes	Yes	Yes	Yes
Observations	863	821	863	821
Adjusted R^2	0.181	0.177	0.209	0.322

Panel B: With *TransactionTax* dummy

Explanatory Variable	(5)	(6)	(7)	(8)
Turnover	-0.0127			-0.0776
	(-0.49)			(-2.41)
Volatility		7.375		17.40
		(2.13)		(4.25)
Float			-0.355	-0.344
			(-20.74)	(-17.83)
TransactionTax	1.677	1.387	1.749	1.588
	(16.92)	(16.64)	(19.54)	(15.28)
Constant	-0.398	-1.534	-0.244	-1.821
	(-1.09)	(-2.66)	(-1.09)	(-3.31)
Maturity fixed effects	Yes	Yes	Yes	Yes
Observations	863	821	863	821
Adjusted R^2	0.476	0.450	0.627	0.613

- The estimates of feedback trading volume from the three models, denoted $FeedbackVolume^{Cox}$, $FeedbackVolume^{stratified}$ $FeedbackVolume^{logit}$
- The estimates of the of the total volume predicted by the hazard rate and logistic regression models, also scaled by shares outstanding $Volume^{Cox}$, $Volume^{stratified}$ $Volume^{logit}$

Panel A: Summary Statistics of the Estimates of Feedback Trading Volume and the Predicted Reentry Volume

Variable	Observations	Mean	Median	Standard Deviation
FeedbackVolume^{Cox} (%)	509	8.68	3.90	20.21
FeedbackVolume^{stratified} (%)	509	13.72	8.59	22.54
FeedbackVolume^{logit} (%)	509	15.29	8.14	31.32
Volume^{Cox} (%)	509	75.89	53.33	107.96
Volume^{stratified} (%)	509	76.07	56.03	101.66
Volume^{logit} (%)	509	93.54	67.23	133.43
Volatility (%)	467	171.77	102.14	221.72
Turnover (%)	509	237.99	141.71	260.77
Float (million)	509	1381.87	424.11	1775.06

Panel B: Correlation Matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) *FeedbackVolume*^{Cox}	1.0000								
(2) *FeedbackVolume*^{stratified}	0.9688	1.0000							
(3) *FeedbackVolume*^{logit}	0.9667	0.9740	1.0000						
(4) *Volume*^{Cox}	0.8981	0.9644	0.9418	1.0000					
(5) *Volume*^{stratified}	0.8632	0.9492	0.9210	0.9908	1.0000				
(6) *Volume*^{logit}	0.8347	0.9154	0.9312	0.9639	0.9647	1.0000			
(7) *Volatility*	0.4072	0.4509	0.4241	0.5239	0.5204	0.4866	1.0000		
(8) *Turnover*	0.3259	0.4076	0.3583	0.5041	0.5215	0.4693	0.8275	1.0000	
(9) *Float*	-0.1961	-0.2636	-0.2324	-0.2574	-0.2884	-0.2659	0.0805	-0.0312	1.0000

4. Model and results

	Cox Regression Model			Stratified Cox Regression Model			Logit Regression Model		
Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FeedbackVolume	3.082***	3.059***	3.036***	3.026***	3.031***	3.027***	2.083***	2.084***	2.075***
	(7.74)	(7.60)	(7.28)	(11.56)	(11.16)	(10.17)	(10.28)	(9.79)	(9.18)
Turnover	-0.0491		-0.0374	-0.0861***		-0.0682*	-0.0745**		-0.0582
	(-1.53)		(-0.82)	(-2.68)		(-1.65)	(-2.40)		(-1.38)
Volatility		-1.401	1.667		-4.959	0.378		-3.890	0.741
		(-0.38)	(0.32)		(-1.18)	(0.07)		(-0.97)	(0.14)
Float	-0.239***	-0.208***	-0.213***	-0.207***	-0.171***	-0.178***	-0.223***	-0.188***	-0.195***
	(-11.60)	(-10.02)	(-9.66)	(-10.02)	(-7.86)	(-7.84)	(-10.68)	(-8.55)	(-8.41)
TransactionTax	2.287***	2.040***	2.066***	2.273***	2.006***	2.053***	2.301***	2.038***	2.079***
	(20.58)	(17.81)	(17.82)	(20.54)	(17.60)	(17.73)	(20.61)	(17.70)	(17.81)
Constant	-1.449**	-1.780***	-1.679***	-1.198*	-1.559**	-1.342*	-1.157**	-1.501**	-1.326**
	(-2.37)	(-3.01)	(-2.77)	(-1.95)	(-2.28)	(-1.96)	(-2.05)	(-2.42)	(-2.15)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	509	467	467	509	467	467	509	467	467
Adjusted R^2	0.701	0.683	0.683	0.711	0.694	0.697	0.705	0.687	0.689

- The coefficient on the estimate of feedback trading volume is positive and highly significant in every specification

- Once we include a measure of feedback volume in the regression the estimated coefficient Volatility becomes insignificant in every specification

4. Model and results

Panel Regressions Explaining Warrant Prices Using Predicted Reentry Volume from Three Models

	Cox Regression Model			Stratified Cox Regression Model			Logit Regression Model		
Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Volume	0.614***	0.602***	0.609***	0.669***	0.640***	0.660***	0.460***	0.437***	0.446***
	(12.59)	(10.45)	(9.95)	(12.08)	(10.37)	(9.97)	(8.96)	(7.71)	(7.53)
Turnover	-0.0993***		-0.0904**	-0.116***		-0.111***	-0.0893***		-0.0966**
	(-2.88)		(-2.29)	(-3.18)		(-2.82)	(-2.66)		(-2.44)
Volatility		-4.658	2.085		-4.881	2.959		-1.401	5.683
		(-0.94)	(0.39)		(-0.91)	(0.54)		(-0.28)	(1.04)
Float	-0.211***	-0.177***	-0.185***	-0.195***	-0.163***	-0.170***	-0.216***	-0.187***	-0.195***
	(-9.73)	(-7.38)	(-7.53)	(-8.87)	(-6.55)	(-6.71)	(-9.78)	(-7.52)	(-7.64)
TransactionTax	2.272***	1.989***	2.052***	2.301***	2.005***	2.082***	2.275***	1.981***	2.047***
	(19.53)	(16.50)	(16.70)	(19.98)	(16.57)	(16.98)	(19.34)	(16.13)	(16.41)
Constant	-1.266**	-1.836**	-1.512**	-1.091*	-1.840**	-1.398*	-1.212**	-2.068***	-1.706**
	(-2.08)	(-2.46)	(-2.06)	(-1.79)	(-2.33)	(-1.80)	(-2.20)	(-2.87)	(-2.47)
Maturity fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	509	467	467	509	467	467	509	467	467
Adjusted R^2	0.682	0.657	0.663	0.678	0.649	0.659	0.661	0.634	0.641

5. Conclusion

- We show how positive feedback trading based on investors' experienced returns interacted with the May 30, 2007 tripling of the transaction tax imposed on stock trades to drive the Chinese put warrants bubble.
- The results regarding feedback trading are consistent with extrapolative models such as Barberis et al (2018) because past returns play an important role in such models
- We revisit the panel regression specifications that Xiong and Yu (2011) use to explain put warrant prices during the bubble and find that volatility is no longer related to returns once we include measures of feedback trading in the regressions