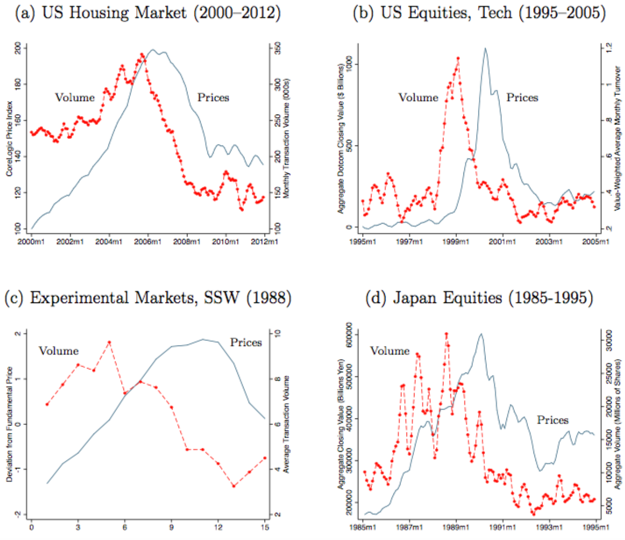
Price and Volume Dynamics in Bubbles

Jingchi Liao, Shenzhen Stock Exchange
Cameron Peng, London School of Economics
Ning Zhu, SAIF

AFA 2020

Prices and volume in historical bubbles



(DeFusco et al. 2018)

Research questions

Questions

1. *prices*: what is the underlying mechanism behind the run-up and crash?
2. *volume*: why do investors trade so much during a bubble?

This paper

1. propose a simple model of bubbles→a novel mechanism for trading volume
2. test its predictions about volume using detailed, account-level data
3. empirically establish the role of extrapolators in driving the run-up and crash

The model

- start with the concept of *extrapolation*
  - forming beliefs about future price changes based on past price changes
  - generate price run-up and crash
- but extrapolation *alone* may not be able to generate sufficiently high volume
  - extrapolators share similar beliefs (Barberis et al. 2018; DeFusco et al. 2018)
  - ownership makes them even more optimistic (Hartzmark et al. 2019)
- couple extrapolation with *the disposition effect*
  - the tendency to sell winners and hold on to losers
  - this combination generates high volume
    - "disposition extrapolators" *buy* after price initially rises, but *sell* if price rises more
  - interaction between beliefs (extrapolation) and preferences (disposition)
- make new predictions about the sources of volume
  - through the interaction of extrapolation and the disposition effect
  - on the extensive-margin (liquidations and initiations)
  - trading of assets investors have never traded before

Empirical set-up

- *data*: detailed, account-level transaction data from a large Chinese brokerage firm
  - around 2 million investors
  - complete trading history since the first day of trading
  - other data: demographics, survey responses, prior trading experience, etc.
- *setting*: the 14-15 Chinese stock market bubble
  - price rose by 100%; volume by 500%$\rightarrow$rich dynamics of prices and volume
- *strategy*: *ex-ante* estimation of extrapolation and disposition from transaction data

Main findings

Sources of volume

- as a group, disposition extrapolators increase volume by almost 800%
  - e.g., pure extrapolators: 500%→300% difference
- mechanism
  - extrapolation: large holdings throughout the run-up
  - disposition: quick reshuffling of portfolio composition
- additional evidence at the investor and stock levels
  - e.g., stocks traded more by disposition extrapolators→higher turnover
- decomposition of aggregate volume
  - 55% from extensive-margin; 68% from trading of new stocks

Extrapolators and prices

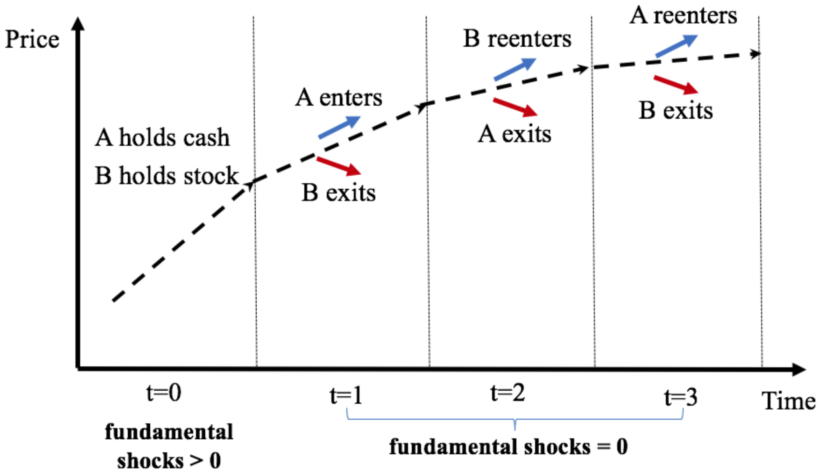
- predictive and IV regressions using panel data
  - address reverse causality concerns
- one s.d. variation in the degree of extrapolation→1% in weekly returns

Overall

- document new, stylized facts about the sources of volume
- support the bubble framework we propose

Intuition

The model's intuition

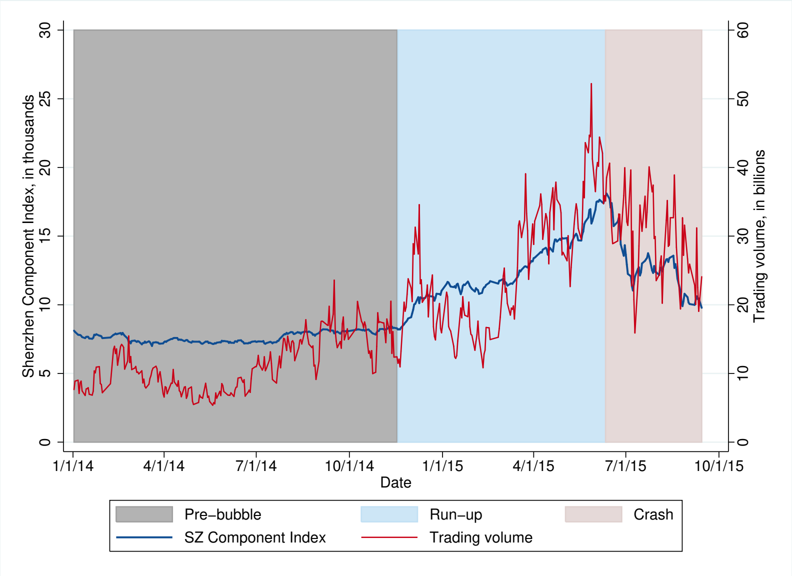


Predictions about volume

- **Prediction 1**
  During a bubble, disposition extrapolators increase their volume more than other investors do
- **Prediction 2**
  During a bubble, a greater fraction of total volume comes from extensive-margin trading (as opposed to intensive-margin trading)
- **Prediction 3**
  During a bubble, a greater fraction of total volume comes from trading stocks investors have not traded before

Background

Background of the bubble



Data

Data and sample

Data

- provided by a one of the largest Chinese brokerage firms
  - branches in almost all of China's provincial-districts
- three main datasets
  1. *transactions*: all transactions since the first day of trading
  2. *demographics*: age, gender, education, etc.
  3. *surveys*: wealth, income, risk tolerance, investment horizon and objective, etc.

Sample selection

- retail investors as opposed to institutions
  - retail accounts: 45% of stock ownership and 90% of total volume
- *regular* accounts with balance between 0.01 to 1 million RMB, excluding
  - *leverage* accounts
  - large accounts *de facto* managed by institutions and take shadow leverage
- final sample size: ~600,000 retail accounts

Measuring extrapolation and disposition

- time frame: 2005-2013; *prior to* the bubble

Degree of extrapolation (DOX)

- volume-weighted average past returns based on all initial buys

$$DOX = \frac{\sum(Buy * PastRet)}{\sum Buy}$$

  - *PastRet*: past one-month return→robust to alternative horizons
  - no momentum in Chinese markets→not rational trading
  - *initial* buys (not *additional* buys)→cleaner source of beliefs
  - consistent with survey-based measures of extrapolative beliefs (Liu et al. 2019)

Degree of disposition (DOD)

- $DOD = \text{PGR}/\text{PLR}$ or $\text{PGR} - \text{PLR}$, where
  - Proportion of Gains Realized (PGR) $= \frac{\text{Realized Gains}}{\text{Realized Gains}+\text{Paper Gains}}$
  - PLR is similarly defined

Evidence on Volume

Evidence I: Group-level

- disposition extrapolators: *DOX* and *DOD* above the median
    - pure extrapolators: only *DOX* above the median

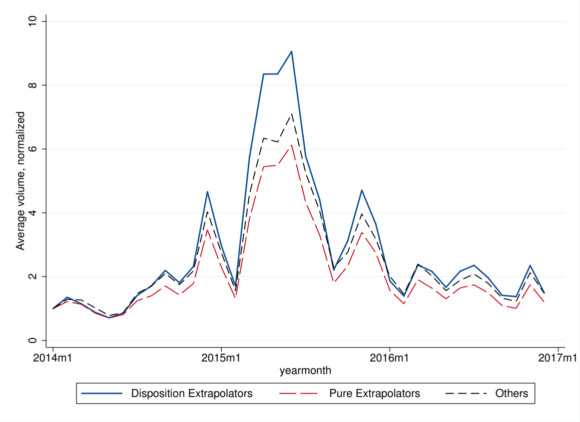
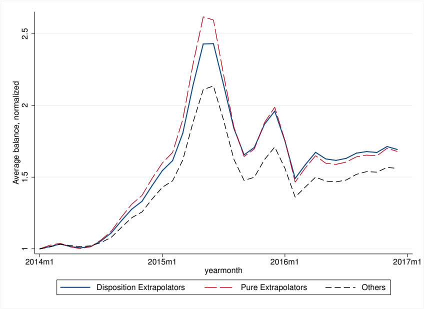
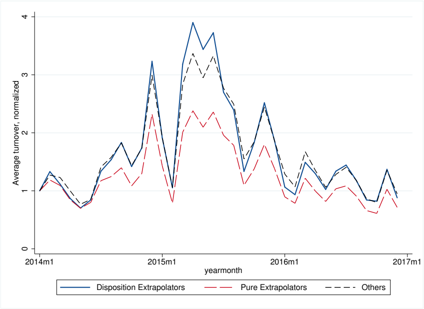


Figure: Total volume

Evidence I: Group-level, cont'd



(a) Holdings



(b) Turnover

Figure: Decomposition of total volume

Evidence II: Investor-level

	ΔVolume	ΔTurnover	ΔBalance
	(1)	(2)	(3)
DOX	**2.64***	**-0.02**	**0.32***
	(5.56)	(-0.10)	(17.33)
DOD	**3.65***	**1.96***	**-0.05***
	(7.84)	(11.24)	(-4.04)
DOX*DOD	**0.76****	**0.27****	**-0.04***
	(2.15)	(1.99)	(-4.61)
BAL	-14.96***	-0.60	-1.39***
	(-13.61)	(-1.45)	(-32.24)
EXP	3.25***	1.33***	0.04***
	(30.55)	(34.34)	(9.14)
HHI	2.70**	-3.67***	1.03***
	(2.08)	(-7.74)	(20.71)
VOL	-80.00***	-69.62***	6.15***
	(-3.91)	(-10.10)	(7.09)
SKEW	1.14*	0.63***	-0.02
	(1.70)	(2.96)	(-0.56)
RET	4.75	6.69***	-2.18***
	(1.11)	(4.45)	(-7.07)
Demographics	YES	YES	YES
Margin account, dummy	YES	YES	YES
Traded warrants before, dummy	YES	YES	YES
Survey-based characteristics	YES	YES	YES
R^2	0.010	0.013	0.016

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Evidence III: Stock-level

- stock-level degree of extrapolation is defined by

$$\overline{DOX}_{j,t} = \sum_{i=1}^{N} \left(\frac{Buy_{i,j,t}}{\sum_{i=1}^{N} Buy_{i,j,t}} \right) DOX_i$$

  - $Buy_{i,j,t}$: number of j shares *bough*t by investor i in week t

- stock-level degree of disposition is defined by

$$\overline{DOD}_{j,t} = \sum_{i=1}^{N} \left(\frac{Sell_{i,j,t}}{\sum_{i=1}^{N} Sell_{i,j,t}} \right) DOD_i$$

  - $Sell_{i,j,t}$: number of j shares *sold* by investor i in week t

- run the following panel regression

$$\text{Turnover}_{j,t} = \beta_0 + \beta_1 \overline{DOX}_{j,t} + \beta_2 \overline{DOD}_{j,t} + \text{Controls} + \varepsilon_{j,t}$$

  - stock fixed effects (robust to time fixed effects)
  - time-clustered standard errors (robust to double-clustered S.E.)

Evidence III: Stock-level, cont'd

$$\text{Turnover}_{j,t} = \beta_0 + \beta_1 \overline{DOX}_{j,t} + \beta_2 \overline{DOD}_{j,t} + \text{Controls} + \varepsilon_{j,t}$$

	Turnover (t)		
	(1)	(2)	(3)
$\overline{DOX}$ (t)	0.04***	0.04***	0.01***
	(14.30)	(9.34)	(2.92)
$\overline{DOD}$ (t)	0.02***	0.01***	0.01***
	(7.76)	(6.32)	(5.53)
Return (t)		0.28***	0.40***
		(3.97)	(7.31)
Return ($t-1$) to ($t-12$)	NO	NO	YES
Turnover ($t-1$) to ($t-12$)	NO	NO	YES
Stock FE	YES	YES	YES
Time-clustered SE	YES	YES	YES
R^2	0.50	0.52	0.70

Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Evidence IV: Prediction 2 and 3

	Volume (in RMB)		
	Run-up	Crash	Quiet
Fraction of extensive-margin trades	55.0%	46.0%	52.2%
disposition extrapolators	58.9%	48.3%	55.6%
pure extrapolators	56.3%	49.2%	54.5%
others	52.9%	43.8%	49.9%
Fraction of trading of "new" stocks	68.3%	52.9%	54.9%

Evidence on Prices

Empirical strategy

- models of extrapolation suggest that extrapolators are responsible for the rising prices
  - e.g., Barberis et al. 2018, DeFusco et al. 2018, and this paper
  - little direct empirical evidence→partially driven by reverse causality concerns
- suppose we run

$$\text{Return}_{j,t+1} = \beta_0 + \beta_1 \overline{DOX}_{j,t+1} + \text{Controls} + \varepsilon_{j,t}$$

  - $\beta_1 > 0$: prices go up→attract trading from extrapolators→higher $\overline{DOX}$

Empirical strategy

- two specifications
  1. predictive regressions: $\text{Return}_{j,t+1} = \beta_0 + \beta_1 \overline{DOX}_{j,t} + \text{Controls} + \varepsilon_{j,t}$
  2. IV regressions: instrument $\overline{DOX}_{j,t+1}$ using $\overline{DOX}_{j,t}$
- key assumption: $\overline{DOX}_{j,t}$ is positively autocorrelated
  - AR(1) efficient of 0.45 at the weekly frequency

Extrapolation and prices

	Return $(t+1)$, run-up (%)			Return $(t+1)$, crash (%)		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	2SLS	OLS	OLS	2SLS
$\overline{DOX}$ $(t+1)$	3.09***		0.98**	3.94***		-4.12**
	(7.65)		(2.09)	(3.87)		(-2.89)
$\overline{DOX}$ (t)		0.48**			-1.68**	
		(2.29)			(-2.60)	
Return (t)	-0.10*	-0.05	-0.07	0.03	0.05	0.06
	(-1.75)	(-0.87)	(-1.05)	(0.18)	(0.29)	(0.36)
BETA (t)	0.08	-0.16	-0.07	-0.10	-1.03	-1.08
	(0.29)	(-0.51)	(-0.20)	(-0.11)	(-1.16)	(-0.98)
Turnover (t)	-2.16	1.19	0.58	-11.63	-5.92	-5.38
	(-1.03)	(0.51)	(0.24)	(-1.63)	(-0.78)	(-0.61)
FLOAT (t)	0.00	0.00	0.00	-0.00	0.00	-0.00
	(0.96)	(1.40)	(0.15)	(-0.05)	(0.13)	(-0.09)
VOL (t)	-0.00	-0.00	0.00	0.00	0.00	0.00
	(-0.30)	(-0.43)	(0.33)	(0.48)	(0.24)	(0.55)
SIZE	YES	YES	YES	YES	YES	YES
B/M	YES	YES	YES	YES	YES	YES
Time-clustered SE	YES	YES	YES	YES	YES	YES
R^2	0.11	0.01	0.06	0.05	0.01	0.03

Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Conclusion

- propose a framework of bubbles based on extrapolation and the disposition effect
  - a new channel for volume
- examine the model's predictions about the sources of volume using detailed, account-level data
  - interaction of extrapolation and disposition
  - extensive-margin
  - the trading of "new" stocks
- empirically confirm the role of extrapolators in driving up prices
  - address reverse causality concerns
- support the model's explanation for the joint dynamics of prices of volume
  - extrapolation drives up prices
  - extrapolation and the disposition effect together generate large volume