Trend Factor in China: The Role of Large Individual Trading

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Overview

Background

- China is the world's second-largest stock market:
  - Equity value, in trillions of US dollar: US(27.4), China(7.3), Japan(5.0)
  - Become increasingly open
- How well asset pricing models previously developed in US work in China?
  - Classic models: Fama and French (FF-3, 1993); Carhart-4 (1997)
  - Poor performance in China (Liu et al., 2019, Cheema et al. 2014)
- Features of Chinese market:
  - Different political and economic environment
  - Tight IPO constraints: Small firms as potential "Shells"
  - ...

Background

- Liu, Stambaugh and Yuan (2019) develop new factor models in China to account for the unique feature of small stocks.
- LSY-3 factor model:
  - Factors: market (MKT), size (SMB), value (VMG)
  - Exclude the smallest 30% stocks because of the shell value
  - Value factor based on EP rather than BM
- LSY-4 factor model:
  - Adding a turnover factor: PMO (Pessimistic-Minus-Optimistic)
  - Abnormal turnover (AbTurn): the past month's turnover divided by the past year's turnover
- Dominates a replication of Fama-French-3 factor model in China

Background

- We find limitations of LSY factor models:
  - PMO captures sentiment in small stocks but NOT in large stocks
  - Fail to explain some anomalies, i.e. reversal, illiquidity, IVOL ...

- We argue that, for models to work well in China, it is important to consider another critical feature of China's stock market: **individual investors contribute over 80% of the total trading volume.**

Main Findings

- We propose a 4-factor model by adding a **Trend** factor to LSY-3, to account for large retail participation in China.
  - Trend exploits both price and volume signals
  - Our model dominates all existing factor models in China
  - Explains all anomalies in China
  - Explains mutual fund, serving as a Carhart model in China

- We provide an economic explanation on the Trend factor.
  - The theoretical model implies noise trading is the driving force
  - Empirical tests show that Trend increases with noise trader participation and noise trader demand volatility
  - International comparison to emphasize the particular importance of volume in China

Methodology

- Our trend factor extends the original price trend factor of Han, Zhou, and Zhu (2016) by adding volume signals to reflect noise trader behavior in China.
- Moving-average (MA) of price and volume of stock i with lag L in month t:

$$M_{i,L}^{P,t} = \frac{P_{i,d}^{t} + P_{i,d-1}^{t} + \ldots + P_{i,d-L+1}^{t}}{L}, \qquad M_{i,L}^{V,t} = \frac{V_{i,d}^{t} + V_{i,d-1}^{t} + \ldots + V_{i,d-L+1}^{t}}{L}. \tag{1}$$

- Normalization of MA signals:

$$\widetilde{M}_{i,L}^{P,t} = \frac{M_{i,L}^{P,t}}{P_{i,d}^{t}}, \widetilde{M}_{i,L}^{V,t} = \frac{M_{i,L}^{V,t}}{V_{i,d}^{t}}. \tag{2}$$

- Following Brock et al. (1992) and HZZ (2016), we use various lag length (L): 3-, 5-, 10-, 20-, 50-, 100-, 200-, 300-, and 400-days.
- We use alternative specifications for robustness check.

Methodology

- At the end of each month, cross-section regression:

$$r_{i,t} = \beta_0 + \sum_j \hat{\beta}_j^{P,t} \widetilde{M}_{i,L_j}^{P,t-1} + \sum_j \hat{\beta}_j^{V,t} \widetilde{M}_{i,L_j}^{V,t-1} + \epsilon_i^t, \quad i = 1, ..., n. \quad (3)$$

- **Trend Expected Return (ER_{Trend})**:

$$ER_{Trend}^{i,t+1} = \sum_j E_t(\beta_j^{P,t+1}) \widetilde{M}_{i,L_j}^{P,t} + \sum_j E_t(\beta_j^{V,t+1}) \widetilde{M}_{i,L_j}^{V,t}, \quad (4)$$

  - where the coefficient forecast:

$$E_t(\beta_j^{x,t+1}) = (1-\lambda) E_{t-1}(\beta_j^{x,t}) + \lambda \hat{\beta}_j^{x,t}, \quad x = P, V. \quad (5)$$

  - $\lambda = 0.02$, and alternative values for robustness check.

- Out-of-sample results: ER_{Trend} only relies on historical information.

Factor Definition

- Following Hou, Xue, and Zhang (2015), we use a 2×3×3 sorting.
- At the end of each month, independently sort stocks into :
  - 2 size groups by size: Small(S), Big(B)
  - 3 EP groups by EP: Growth(G), Neutral(N), Value(Value)
  - 3 trend groups by ER_{Trend}: Low(L), Neutral(N), High(H)
- Use the 18 VW portfolios to construct factor:
  - SMB = (SGL+SGN+SGH+SNL+SNN+SNH+SVL+SVN+SVH)/9 -(BGL+BGN+BGH+BNL+BNN+BNH+BVL+BVN+BVH)/9
  - VMG = (SVL+SVN+SVH+BVL+BVN+BVH)/6 -(SGL+SGN+SGH+BGL+BGN+BGH)/6
  - Trend = (SGH+SNH+SVH+BGH+BNH+BVH)/6 -(SGL+SNL+SVL+BGL+BNL+BVL)/6
- Factors are jointly controlled for each other.

Data

- Domestic stocks on Chinese A-Shares in Shanghai and Shenzhen Stock Exchange
- Period: January, 2005 - June, 2018
- Database: WIND

- Following LSY (2019), exclude the smallest 30% stocks
- Use the most recent available data to calculate valuation ratio
- Portfolios are value-weighted.

Summary Statistics

	MKT	*SMB*	*VMG*	*PMO*	*SMB**	*VMG**	*Trend*
Panel A: Summary statistics							
Mean (%)	0.91	1.00**	1.09***	0.89***	0.90**	1.29***	1.43***
	(1.20)	(2.42)	(4.06)	(3.26)	(2.46)	(5.11)	(6.10)
Std. dev. (%)	8.30	4.96	3.97	3.92	4.32	3.35	3.00
Sharpe ratio	0.11	0.20	0.28	0.23	0.21	0.38	0.48
Skewness	-0.38	-0.05	0.21	-0.73	0.08	0.14	0.33
MDD (%)	69.33	26.06	19.69	25.69	23.09	13.06	13.17
Panel B: Correlation matrix							
MKT	1.00	0.10	-0.26	-0.28	0.08	-0.16	-0.12
SMB	0.10	1.00	-0.63	0.10	0.96	-0.56	0.13
VMG	-0.26	-0.63	1.00	-0.03	-0.62	0.94	0.04
PMO	-0.28	0.10	-0.03	1.00	0.09	-0.05	0.47
SMB*	0.08	0.96	-0.62	0.09	1.00	-0.58	0.10
VMG*	-0.16	-0.56	0.94	-0.05	-0.58	1.00	0.09
Trend	-0.12	0.13	0.04	0.47	0.10	0.09	1.00

Comparison of *PMO* vs *Trend*

- Triple sort: 2(size)×3(EP)×3(AbTurn or ER_{Trend})
- PMO is weak in large stocks, while Trend is persistent

	PMO			*Trend*		
Panel A: Control for Size and EP						
Size:	Small	Big	Average	Small	Big	Average
EP-Low	1.56***	0.51	1.04***	2.22***	1.35***	1.78***
	(5.74)	(1.10)	(2.92)	(8.61)	(2.93)	(6.09)
EP-Mid	1.31***	0.40	0.85**	1.73***	1.14***	1.44***
	(3.92)	(0.88)	(2.41)	(6.30)	(3.35)	(5.53)
EP-High	1.23***	-0.07	0.58*	1.31***	0.82*	1.07***
	(2.99)	(-0.17)	(1.89)	(4.27)	(1.94)	(3.54)
Average	1.37***	0.28	0.82***	1.76***	1.10***	1.43***
	(4.51)	(0.83)	(2.82)	(7.51)	(3.45)	(6.10)

Comparison of *PMO* vs *Trend*

- Triple sort: 2(size)×3(AbTurn)×3(ER_{Trend})
- PMO is subsumed by Trend

	PMO			*Trend*		
Panel B: Control for Size and ER_{Trend}						
Size:	Small	Big	Average	Small	Big	Average
Trend-Low	0.71**	0.35	0.53			
	(2.17)	(0.73)	(1.60)			
Trend-Mid	0.64**	-0.94**	-0.15			
	(2.05)	(-2.00)	(-0.47)			
Trend-High	1.29***	-0.25	0.52			
	(3.15)	(-0.49)	(1.47)			
Average	0.88***	-0.28	0.30			
	(2.98)	(-0.79)	(1.07)			
Panel C: Control for Size and AbTurn						
Size:	Small	Big	Average	Small	Big	Average
AbTurn-Low				1.89***	0.96**	1.42***
				(4.70)	(2.35)	(4.09)
AbTurn-Mid				1.16***	0.51	0.83***
				(4.75)	(1.13)	(3.25)
AbTurn-High				1.31***	1.55***	1.43***
				(4.17)	(2.85)	(4.50)
Average				1.45***	1.01***	1.23***
				(5.78)	(3.00)	(5.13)

Explaining Power

- Model competitors:
  - Our 4-factor model: Our-4
  - Liu, Stambaugh, and Yuan (2019): LSY-3, LSY-4
  - Hou, Xue, and Zhang (2015): q-4
  - Fama and French (2015): FF-5
- Comparing model performance in:
  - Explaining other models
  - Explaining anomalies
  - Explaining mutual fund portfolios

Explaining Other Models

- Our 4-factor model dominates existing models in explaining each other.

	Panel A: LSY-3 vs Our-4		*Panel B: LSY-4 vs Our-4*	
Measure	LSY-3	Our-4	LSY-4	Our-4
Average $\lvert\alpha\rvert$	0.53	0.05	0.45	0.15
Average $\lvert t\rvert$	2.86	0.43	2.99	0.67
Δ	0.24	0.01	0.20	0.02
GRS	9.37***	0.29	7.46***	0.62
	[$<10^{-5}$]	[0.75]	[$<10^{-3}$]	[0.60]
	Panel C: q-4 vs Our-4		*Panel D: FF-5 vs Our-4*	
Measure	q-4	Our-4	FF-5	Our-4
Average $\lvert\alpha\rvert$	0.80	0.06	0.77	0.12
Average $\lvert t\rvert$	4.49	0.32	3.55	0.31
Δ	0.39	0.00	0.36	0.01
GRS	16.64***	0.13	14.96***	0.16
	[$<10^{-8}$]	[0.94]	[$<10^{-7}$]	[0.96]

Explaining Anomalies

- Anomalies in China: 10 Categories, 18 anomalies in total.
  - Size: Market capitalizaiton
  - Value: EP, BM, CP
  - Turnover: Turnover, AbTurn
  - Trend: *TrendPV*, *TrendP*, *TrendV*
  - Illiquidity: Amihud (2002) illiquidity
  - Past return: Reversal, Momentum
  - Profitability: ROE
  - Volatility: VOL, IVOL, MAX
  - Accrual: Accrual
  - Investment: Asset gorwth
- Including all the anomalies tested in LSY (2018).
- Anomalies is defined as the spread between extreme decile portfolios.

Explaining Anomalies

- Our 4-factor model dominates existing models by explaining all the anomalies, including those that failed to be explained by LSY factor models.

Measure	Unadjusted	LSY-3	LSY-4	q-4	FF-5	Our-4
Average $\lvert\alpha\rvert$	1.29	0.88	0.53	1.25	0.94	0.35
Average $\lvert t\rvert$	2.66	2.05	1.33	2.92	2.36	0.77
Δ	0.55	0.35	0.30	0.47	0.38	0.18
GRS	5.41***	2.50***	2.04**	3.75***	2.91***	1.08
	[$<10^{-8}$]	[0.00]	[0.02]	[$<10^{-4}$]	[$<10^{-3}$]	[0.38]

Explaining Mutual Funds

- Our 4-factor model dominates existing models by producing smaller pricing error in explaining mutual fund performance.

Measure	Unadjusted	LSY-3	LSY-4	q-4	FF-5	Our-4
Average $\lvert\alpha\rvert$	1.47	0.38	0.34	0.41	0.50	0.26
Average $\lvert t\rvert$	2.04	1.42	1.14	1.51	1.87	0.89
Δ	0.11	0.05	0.04	0.04	0.08	0.03
GRS	1.67*	0.56	0.45	0.53	1.01	0.24
	[0.09]	[0.84]	[0.92]	[0.86]	[0.44]	[0.99]

Sharpe Ratio Tests

- Sh^2 of Barillas and Shanken (2017) is the squared Sharpe ratio of the tangency portfolio spanned by the factor.
- Assume $Sh^2(f_1) > Sh^2(f_2)$, then

$$Sh^2(f_1, f_2, R) - Sh^2(f_1) < Sh^2(f_1, f_2, R) - Sh^2(f_2), \qquad (6)$$

- A higher Sh^2 suggests greater explanatory power regardless of the test assets.

	LSY-3	LSY-4	q-4	FF-5	Our-4
Panel A: Sh^2					
Sh^2	0.363	0.417	0.215	0.246	0.598
Panel B: Sh^2 difference					
LSY-3		0.054	-0.148**	-0.117	0.235**
		[0.386]	[0.045]	[0.247]	[0.018]
LSY-4	-0.054		-0.202**	-0.171*	0.181**
	[0.386]		[0.016]	[0.084]	[0.012]
q-4	0.148**	0.202**		0.031	0.383***
	[0.045]	[0.016]		[0.768]	[0.000]
FF-5	0.117	0.171*	-0.031		0.352***
	[0.247]	[0.084]	[0.768]		[0.000]
Our-4	-0.235**	-0.181**	-0.383***	-0.352***	
	[0.018]	[0.012]	[0.000]	[0.000]	

A Theoretical Model

- An explanation for the trend factor in China: extending the equilibrium model of Han, Zhou, and Zhu (2016).
- One risky asset:
  - D_t: Dividend stream
  - π_t: Long-term mean growth rate of dividend
- Three types of investors with asymmetric information
  - Informed: Risk-averse arbitrageurs, limited arbitrage due to noise trader.
  - Uniformed: Use MA of price (A_t) to infer information.
  - **Noise traders**: Liquidity demand θ_t is given by a exogenous process

$$d\theta_t = -\alpha_\theta \theta_t dt + \sigma_\theta dB_{3t}, \tag{7}$$

- σ_θ is the noise trader liquidity demand fluctuation and thus measures the noise trading

A Theoretical Model

- Additional assumption: the noise trader demand (θ_t) can be partially observed by another observable variable Y_t, which is exogenous to the model:

$$E[\theta_t | Y_t] = \xi_0 + \xi_1 Y_t. \tag{8}$$

- Based on Theorem 1 of Han, Zhou, and Zhu (2016), we have

$$R_{t+1} = \gamma_0 + \gamma_1 D_t + \gamma_2 \pi_t + \gamma_3 Y_t + \gamma_4 A_t,$$

  - where γ's are determined by the model parameters.
  - Y_t and A_t can predict return

A Theoretical Model

- Noise trader demand is correlated with trading volume:
  - Campbell et al. (1993) theoretically imply that the liquidity demand of noise traders must reveal itself with high trading volume.
  - Lee and Rui (2001) empirically verify the implication.
  - Bloomfield, OHara, and Saar (2009) experimentally show the increase of uninformed traders, who behave largely as noise traders, dramatically increases the trading volume

- Especially true for China, given the retail trading dominance.
  - Use MA of volume over various horizons to reflect noise trading activity
  - Our trend factor is constructed through $\gamma_3 Y_t + \gamma_4 A_t$

A Theoretical Model

- **What is the influence of noise trader risk (σ_θ) on the trend factor?**
- Trend measure: $\gamma_3 Y_t + \gamma_4 A_t$
  - Y_t: Volume signals
  - A_t: Price signals

σ_θ	1.0	1.5	2.0	2.5	3.0	3.5	4.0
γ_3	0.29	0.30	0.31	0.33	0.36	0.40	0.47
γ_4	0.94	0.95	0.95	0.95	0.96	0.96	0.97
γ_3/γ_4	0.31	0.32	0.33	0.35	0.38	0.42	0.48

- Model implication:
  - $\gamma_3, \gamma_4 \Uparrow$ with σ_θ: Trend effect increases with noise trader risk.
  - $\gamma_3/\gamma_4 \Uparrow$ with σ_θ: The role of volume increases with noise trader risk.

Empirical Test

	Low	2	3	4	High	Trend	Δ *Trend*
Panel A: Trend and the participation of retail investors							
$Retail_{Low}$	1.09	1.63*	1.75**	2.10***	2.23***	1.14**	0.81*
	(1.37)	(1.83)	(2.02)	(2.67)	(2.69)	(2.52)	(1.77)
$Retail_{Mid}$	0.44	0.93	1.22	1.73**	1.85*	1.42***	
	(0.52)	(1.04)	(1.56)	(1.98)	(1.96)	(3.19)	
$Retail_{High}$	-0.78	0.35	0.98	0.94	1.17	1.95***	
	(-0.86)	(0.38)	(1.07)	(0.95)	(1.24)	(4.13)	
Panel B: Trend and the volatility of noise trader demand							
Vol_{Low}	0.98	1.24	1.70*	1.88**	1.80*	0.81**	0.90**
	(1.09)	(1.39)	(1.88)	(2.04)	(1.96)	(2.44)	(2.51)
Vol_{Mid}	0.80	1.20	1.82**	2.11**	1.92**	1.12***	
	(0.89)	(1.32)	(2.05)	(2.27)	(2.11)	(2.92)	
Vol_{High}	0.30	1.01	1.38	1.77*	2.01**	1.71***	
	(0.34)	(1.11)	(1.57)	(1.92)	(2.22)	(4.04)	

Empirical Test: the US, 1945-2018

Panel A: Summary statistics for the trend factors in the US					
	TrendPV	*TrendP*	*TrendV*	$\Delta^{TrendPV}_{TrendP}$	$\Delta^{TrendPV}_{TrendV}$
Mean (%)	1.15***	1.06***	0.25***	0.09***	0.90***
	(14.31)	(13.37)	(4.16)	(3.34)	(11.74)
Std. dev. (%)	2.32	2.36	1.94	0.80	2.43
Sharpe ratio	0.50	0.45	0.13	0.12	0.37

Panel B: Trend and the participation of retail investors							
	Low	2	3	4	High	Trend	Δ *Trend*
$Retail_{Low}$	0.55**	0.92***	1.11***	1.29***	1.53***	0.98***	0.97**
	(2.06)	(4.09)	(4.94)	(5.83)	(5.89)	(4.70)	(2.36)
$Retail_{Mid}$	0.29	0.96***	1.12***	1.48***	1.78***	1.49***	
	(0.98)	(4.24)	(5.40)	(6.18)	(6.07)	(5.83)	
$Retail_{High}$	-0.11	0.84***	1.29***	1.65***	1.84***	1.95***	
	(-0.35)	(3.16)	(5.70)	(6.18)	(4.06)	(4.47)	

Panel C: Trend and volatility of noise trader demand							
	Low	2	3	4	High	Trend	Δ *Trend*
Vol_{Low}	0.26	0.78***	1.00***	1.32***	1.51***	1.25***	0.30**
	(1.38)	(5.03)	(7.27)	(8.77)	(8.91)	(9.20)	(2.06)
Vol_{Mid}	0.25	0.82***	1.12***	1.24***	1.68***	1.43***	
	(1.34)	(5.49)	(7.37)	(7.73)	(8.54)	(10.27)	
Vol_{High}	0.26	0.84***	0.96***	1.31***	1.81***	1.55***	
	(1.18)	(5.18)	(6.07)	(7.25)	(7.67)	(8.60)	

Empirical Test: International Evidence

- What is the importance of volume trend in China vs the US?
- Use Sharpe (1988) style regression to identify the contribution of volume.
  - $TrendPV_t = \alpha + \beta_V TrendV_t + \beta_P TrendP_t + \epsilon_t$,
  - s.t. $\beta_V \geq 0, \beta_P \geq 0, \beta_V + \beta_P = 1$.

- International evidence in 12 markets
  - 5 major emerging markets in Asia:
    - China, India, Malaysia, S.Korea, Taiwan
  - 7 developed markets in G7:
    - US, Canada, UK, Germany, France, Italy, Japan

Empirical Test: International Evidence-1

- Cross-markets comparison:
  - Volume contributes the highest in China, and the lowest in the US
  - Volume is more important in emerging markets

	Emerging markets					Developed markets						
	China	India	Malaysia	S.Korea	Taiwan	US	Canada	UK	Germany	France	Italy	Japan
Panel A: Coefficients of TrendV in each market												
TrendV	0.48***	0.22***	0.33***	0.27***	0.38***	0.05***	0.13***	0.17***	0.08***	0.15***	0.20***	0.09***
	(14.56)	(8.74)	(9.61)	(5.73)	(6.74)	(5.57)	(3.82)	(8.43)	(2.93)	(6.99)	(7.18)	(6.21)
Δ_{China}	–	-0.26***	-0.15***	-0.21***	-0.10	-0.43***	-0.35***	-0.31***	-0.40***	-0.33***	-0.28***	-0.39***
	–	[$<10^{-3}$]	[0.03]	[0.00]	[0.48]	[$<10^{-5}$]	[$<10^{-4}$]	[$<10^{-4}$]	[$<10^{-4}$]	[$<10^{-4}$]	[$<10^{-4}$]	[$<10^{-3}$]
Δ_{US}	0.43***	0.17***	0.28***	0.22***	0.33***	–	0.07*	0.12***	0.03	0.10***	0.15***	0.04
	[$<10^{-5}$]	[$<10^{-3}$]	[$<10^{-4}$]	[$<10^{-3}$]	[0.00]	–	[0.09]	[0.00]	[0.41]	[0.00]	[0.00]	[0.33]

Empirical Test: International Evidence-2

- IMF (2005): the importance of institutional investors are growing globally.
- Time-series comparison within each market:
  - Volume is more important in the earlier period in emerging markets
  - Volume is persistently important in China
  - Volume contributes almost the same in most of developed markets

	Emerging markets					Developed markets						
	China	India	Malaysia	S.Korea	Taiwan	US	Canada	UK	Germany	France	Italy	Japan
Panel B: Coefficients of TrendV in different periods												
Earlier	0.47***	0.29***	0.46***	0.37***	0.44***	0.05***	0.14***	0.19***	0.09*	0.24***	0.29***	0.08***
	(8.81)	(7.38)	(8.27)	(4.55)	(4.70)	(4.33)	(2.65)	(6.35)	(1.89)	(7.23)	(5.98)	(3.49)
Recent	0.49***	0.08***	0.13***	0.17***	0.22***	0.06***	0.12***	0.11***	0.06**	0.03	0.10***	0.10***
	(11.59)	(2.99)	(4.54)	(3.45)	(4.49)	(3.46)	(2.81)	(3.76)	(1.99)	(1.17)	(3.80)	(7.09)
$\Delta^{Earlier}_{Recent}$	-0.02	0.21***	0.33***	0.20**	0.22	-0.01	0.02	0.08	0.03	0.21***	0.19***	-0.02
	[0.82]	[$<10^{-2}$]	[$<10^{-3}$]	[0.03]	[0.24]	[0.68]	[0.73]	[0.25]	[0.74]	[0.00]	[0.00]	[0.67]

- In the US, volume contributes 22%, 16%, 7%, 5% in the four sub-periods during 1945 to 2018.

Incremental Explanatory Power

- *TrendP* adds strong explanatory power in both China and the US.
- *TrendPV* further enhances the pricing ability in China, but not in the US.

Panel A: Explaining anomalies in China			
Measure	LSY-3	*TrendP*-4	*TrendPV*-4
Average $\lvert\alpha\rvert$	0.88	0.57	0.35
Average $\lvert t\rvert$	2.05	1.31	0.77
Δ	0.35	0.25	0.18
GRS	2.50***	1.61*	1.08
	[0.00]	[0.08]	[0.38]
Panel B: Explaining anomalies in the US			
Measure	*FF*-3	*TrendP*-4	*TrendPV*-4
Average $\lvert\alpha\rvert$	0.61	0.43	0.39
Average $\lvert t\rvert$	3.30	2.19	2.00
Δ	0.29	0.18	0.17
GRS	8.21***	4.67***	4.20***
	[0.00]	[0.00]	[0.00]

Conclusion

- We extend LSY model into a 4-factor model by adding a Trend factor to account for large individual participation in China.
  - Trend factor exploits both price and volume trends
  - Our model dominates all existing models in China
  - Promising candidate for Carhart model in China

- Economic explanations on the Trend factor
  - Theoretical model and empirical test suggest noise trading is the key driving force
  - International comparison highlights the particular importance of volume in China

- Thanks !