Sticky Expectations and the Profitability Anomaly

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Jean-Philippe Bouchaud, Philipp Kruger,Augustin Landier, David Thesmar

Presenter: Yue Yang

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Contents

1.Introduction

Background

- The existence of stock-return predictability is a central theme in the asset pricing literature;
- A long-lasting debate pertains to the origin of such abnormal returns and to how they can exist in equilibrium without being arbitraged away.
- Mispricing relies on investors making systematic expectation errors, while rational arbitrageurs are unable to fully accommodate their demand because arbitrage is not risk-free.

1.Introduction

Background

- Investors are not reacting fast enough to information, so the expectations generated are biased;
- Profitability has recently emerged in the academic literature as one of the stock-return anomalies with the largest economic significance.

1.Introduction

Literatures

- Stocks with high profitability ratios tend to outperform on a risk-adjusted basis (Novy-Marx, 2013, 2015).
- Abarbanell and Bernard (1992): analysts underreact to past earnings
- Mankiw and Reis (2001): agents update beliefs infrequently due to fixed costs, which in turn leads to sticky prices.
- Coibion and Gorodnichenko (2012): the model of expectations dynamics

1.Introduction

Motivations

- If the profitability anomaly can be directly related to a simple model of sticky expectations, in which investors update their beliefs too slowly?

1.Introduction

Contributions

- This paper is mostly a contribution to the behavioral finance literature;
- The article verifies the foundation of the profit anomaly from a theoretical point of view.

2.Data

- 3,000 largest stocks of NYSE, Amex, or Nasdaq(closing price exceeds $5)
- EPS(actual & forecasts) from I/B/E/S
- signals for profitability, profitability momentum, and price momentum:
  - Cash flows (cf): net operating cash flow normalized by total assets.
  - ΔCash flow (Δ_{cf}): the difference between cf_t and cf_{t-1}.
  - Momentum (mom): the cumulative return between months t_{12} and t_2
- Sorted into quintiles

	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5	(6) Q5-Q1
Panel A: Excess returns						
cf	0.55	0.73**	0.88***	0.97***	1.11***	0.56**
	(1.35)	(2.35)	(3.22)	(3.62)	(4.14)	(2.33)
Δcf	0.84**	0.77***	0.71***	0.91***	1.04***	0.20***
	(2.52)	(2.75)	(2.70)	(3.29)	(3.24)	(2.83)
mom	0.43	0.65**	0.80***	1.00***	1.44***	1.01***
	(1.14)	(2.24)	(3.28)	(3.93)	(3.66)	(2.89)
Panel B: CAPM						
cf	-0.27	0.06	0.25	0.34*	0.45**	0.72***
	(-1.26)	(0.33)	(1.41)	(1.78)	(2.41)	(3.14)
Δcf	0.08	0.13	0.14	0.28	0.29	0.21***
	(0.41)	(0.75)	(0.78)	(1.65)	(1.48)	(2.94)
mom	-0.40*	0.03	0.25	0.44**	0.70***	1.10***
	(-1.76)	(0.15)	(1.46)	(2.51)	(2.60)	(3.48)
Panel C: FF1993						
cf	-0.28*	-0.07	0.13	0.23**	0.38***	0.66***
	(-1.84)	(-1.03)	(1.59)	(2.36)	(3.33)	(3.23)
Δcf	0.02	0.01	-0.00	0.17**	0.23**	0.21***
	(0.22)	(0.13)	(-0.06)	(2.35)	(2.28)	(3.04)
mom	-0.53***	-0.12	0.13	0.34***	0.70***	1.23***
	(-3.11)	(-1.11)	(1.46)	(4.36)	(3.30)	(3.68)
Panel D: Carhart						
cf	-0.24	0.01	0.20**	0.30***	0.46***	0.70***
	(-1.54)	(0.09)	(2.48)	(3.36)	(3.73)	(3.56)
Δcf	0.11	0.09	0.06	0.24***	0.29**	0.18***
	(1.06)	(1.28)	(0.68)	(3.40)	(2.52)	(2.87)

- The performance of the 3 signals:
- All of them do significant forecast returns
- predictability is robust to risk adjustment

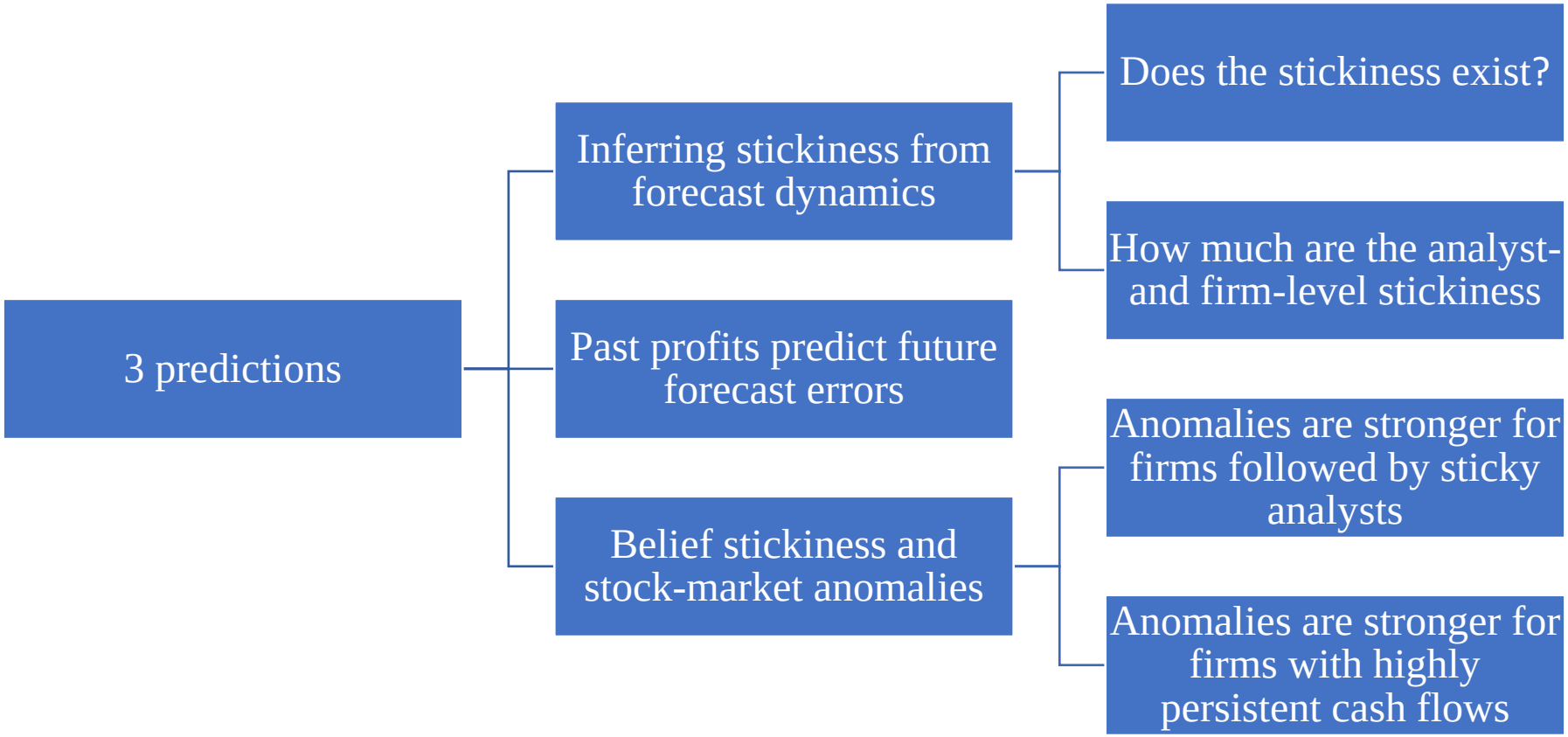
3.Method

Expectation stickiness

$$F_t\pi_{t+h} = (1-\lambda)E_t\pi_{t+h} + \lambda F_{t-1}\pi_{t+h}(1)$$

- $F_t\pi_{t+h}$: the expectation formed at t about profits at $t+h$
- $E_t\pi_{t+h}$: rational expectation of π_{t+h} conditional on information available at date t
- λ: the extent of expectation stickiness
- underreaction $(0 < \lambda < 1)$; overreaction $(\lambda < 0)$

3.Method


3 predictions
Inferring stickiness from forecast dynamics
Does the stickiness exist?
How much are the analyst- and firm-level stickiness
Past profits predict future forecast errors
Belief stickiness and stock-market anomalies
Anomalies are stronger for firms followed by sticky analysts
Anomalies are stronger for firms with highly persistent cash flows

3.Method

Prediction 1: expectations are sticky

- Forecast errors should be predicted by past revisions:

$$E_t(\pi_{t+1} - F_t\pi_{t+1}) = \lambda/(1-\lambda) * (F_t\pi_{t+1} - F_{t-1}\pi_{t+1})$$

- Revisions are autocorrelated over time:

$$E_{t-1}(F_t\pi_{t+1} - F_{t-1}\pi_{t+1}) = \lambda\,(F_{t-1}\pi_{t+1} - F_{t-2}\pi_{t+1})$$

3.Method

- **Prediction 1:** firm profits π_{t+1} can be predicted with a signal St:

$$\pi_{t+1} = s_t + \varepsilon_{t+1}$$
$$s_{t+1} = \rho s_t + u_{t+1} (\rho < 1)$$

- St: a sufficient statistic capturing all public information useful to predict future profits

- Rewrite Eq1: $F_t \pi_{t+h} = (1-\lambda) E_t \pi_{t+h} + \lambda F_{t-1} \pi_{t+h}$:

$$F_t\, \pi_{t+1} = (1-\lambda) \sum_{k\geq 0} \lambda^k\, E_{t-k}\, \pi_{t+1} = (1-\lambda) \sum_{k\geq 0} (\lambda\rho)^k\, s_{t-k}$$

3.Method

- **Prediction 2:** Past profits predict future forecast errors
- Assuming expectations are sticky in the sense of equation (1), and profits can be forecast using an autoregressive signal s_t, then earnings surprises should follow:

$$E_t(\pi_{t+1} - F_t\pi_{t+1} | \pi_t) = \frac{\rho\lambda^2(1-\rho^2)}{1-\lambda\rho^2} \frac{\sigma_u^2}{\sigma_u^2+(1-\rho^2)\sigma_\epsilon^2} \pi_t$$

- If expectations are rational ($\lambda = 0$), the earnings surprise should be uncorrelated with past realizations of profits.

3.Method

- all investors are risk-neutral and have the same expectation stickiness parameter λ

$$P_t = \sum_{k \geq 1} \frac{F_t \, \pi_{t+k}}{(1+r)^k}$$

$$R_{t+1} = (P_{t+1} + \pi_{t+1}) - (1+r)P_t$$

3.Method

$$m = \frac{1-\lambda}{1+r-\rho}$$

- **Prediction 3:** Belief stickiness and stock-market anomalies
- Past profits predict future returns ("profitability"):

$$cov(R_{t+1}, \pi_t) = (1 + m\rho)\frac{\rho}{1-\lambda\rho^2}\lambda^2\sigma_u^2$$

- Increases in past profits predict future returns ("earnings momentum"):

$$cov(R_{t+1}, \Delta_{\pi_t}) = (1 + m\rho)\frac{\rho}{1+\lambda\rho}\lambda^2\sigma_u^2$$

- Past returns predict future returns ("price momentum"):

$$cov(R_{t+1},\ R_t) = (1 + m\rho)(m+\rho\lambda)\frac{\lambda\sigma_u^2}{1-\lambda^2\rho^2}$$

4.Result

- **Prediction 1:** measuring stickiness
- Forecast errors should be predicted by past revisions:

$$E_t(\pi_{t+1} - F_t\pi_{t+1}) = \lambda/(1-\lambda) * (F_t\pi_{t+1} - F_{t-1}\pi_{t+1})$$

- Revisions are autocorrelated over time:

$$E_{t-1}(F_t\pi_{t+1} - F_{t-1}\pi_{t+1}) = \lambda\,(F_{t-1}\pi_{t+1} - F_{t-2}\pi_{t+1})$$

$$\frac{\pi_{f,t} - F_{t-1}\pi_{f,t}}{P_{f,t-2}} = a + b * \frac{F_{t-1}\pi_{f,t} - F_{t-2}\pi_{f,t}}{P_{f,t-2}} + c * \frac{\pi_{f,t-1} - \pi_{f,t-2}}{P_{f,t-2}}$$

$$\frac{F_{t-1}\pi_{f,t} - F_{t-2}\pi_{f,t}}{P_{f,t-3}} = a + b * \frac{F_{t-2}\pi_{f,t} - F_{t-3}\pi_{f,t}}{P_{f,t-3}}$$

Panel A: Dependent variable: $(\pi_{f,t} - F_{t-1}\pi_{f,t})/P_{f,t-2}$

	(1)	(2)	(3)
$(F_{t-1}\pi_{f,t} - F_{t-2}\pi_{f,t})/P_{f,t-2}$	0.165***		0.176***
	(10.28)		(9.99)
$F_{t-1}\pi_{f,t}/P_{f,t-2}$		0.156***	
		(9.65)	
$F_{t-2}\pi_{f,t}/P_{f,t-2}$		-0.201***	
		(-11.30)	
$(\pi_{f,t-1} - \pi_{f,t-2})/P_{f,t-2}$			-0.011
			(-0.83)
Observations	54,090	54,090	45,545
R^2	0.030	0.036	0.032

Panel B: Dependent variable: $(F_{t-1}\pi_{f,t} - F_{t-2}\pi_{f,t})/P_{f,t-3}$

	(1)	(2)	(3)
$(F_{t-2}\pi_{f,t} - F_{t-3}\pi_{f,t})/P_{f,t-3}$	0.063**		0.087**
	(2.27)		(2.33)
$F_{t-2}\pi_{f,t}/P_{f,t-3}$		0.048	
		(1.61)	
$F_{t-3}\pi_{f,t}/P_{f,t-3}$		-0.103***	
		(-3.76)	
$(\pi_{f,t-2} - \pi_{f,t-3})/P_{f,t-3}$			-0.027
			(-1.25)
Observations	16,118	16,118	14,646
R^2	0.005	0.015	0.008

- Panel A:
- regress the one year forecast error on the forecast revision between dates $t-1$ and $t-2$
- b = 0.165→ λ = 0.14
- c=-0.011<0
- Panel B:
- Regress the change in forecasts at time t on the change in forecasts at time t-1
- b = λ =0.063

4.Result

- **Prediction 1:** measuring stickiness
- estimate analyst- and firm- level stickiness parameters $\lambda_a$andλ_f.
- test whether certain analyst– and/or firm– level characteristics are correlated with higher levels of stickiness.

$$\frac{\pi_{f,t} - F_{a,t-1}\pi_{f,t}}{P_{f,t-2}} = a_a + b_a \cdot \frac{F_{a,t-1}\pi_{f,t} - F_{a,t-2}\pi_{f,t}}{P_{f,t-2}} + \epsilon_{a,f,t}$$

- $\lambda_a = b_a/(1 + b_a) \quad \lambda_f = b_f/(1 + b_f)$

$$\frac{\pi_{f,t} - F_{t-1}\pi_{f,t}}{P_{f,t-2}} = a_f + b_f \cdot \frac{F_{t-1}\pi_{f,t} - F_{t-2}\pi_{f,t}}{P_{f,t-2}} + \epsilon_{f,t}$$

4.Result

Panel A: Analyst-level												
	count	mean	sd	min	p5	p10	p25	p50	p75	p90	p95	max
λ_a	6938	0.16	0.56	-2.26	-0.78	-0.42	-0.05	0.18	0.40	0.66	0.91	2.61
N_{λ_a}	6885	22.96	27.68	2.00	2.00	2.00	4.00	11.00	31.00	62.00	85.00	151.00
Experience	6938	6.25	4.38	0.00	1.29	1.71	2.86	5.09	8.48	12.89	15.52	20.18
	count	mean	sd	min	p5	p10	p25	p50	p75	p90	p95	max
Firm experience	6908	2.25	1.37	0.00	0.67	0.82	1.19	1.91	3.00	4.18	4.97	7.64
Industry experience	6799	4.44	2.97	0.00	1.03	1.32	2.09	3.70	6.07	8.81	10.56	14.28
Covered industries	6887	3.19	1.97	1.00	1.00	1.00	1.71	2.72	4.19	5.90	7.16	11.68
Covered firms	6913	12.29	6.43	1.00	2.63	4.13	7.98	11.88	15.78	19.97	23.11	51.94
Panel B: Firm-level												
	count	mean	sd	min	p5	p10	p25	p50	p75	p90	p95	max
λ_f	5916	0.13	0.68	-2.67	-1.02	-0.57	-0.11	0.15	0.39	0.76	1.16	2.97
N_{λ_f}	5916	8.87	6.71	2.00	2.00	2.00	3.00	7.00	13.00	20.00	24.00	26.00
ρ_f	5916	0.19	0.49	-3.29	-0.56	-0.36	-0.08	0.22	0.49	0.70	0.83	3.45
N_{ρ_f}	5916	13.09	7.46	2.00	3.00	4.00	7.00	11.00	19.00	25.00	26.00	26.00
Firm size	5899	6.10	1.82	-0.74	3.32	3.85	4.78	5.99	7.29	8.48	9.28	13.34
EPS volatility	5842	0.05	0.04	0.00	0.01	0.02	0.02	0.04	0.07	0.10	0.13	0.32
Firm-level forecast dispersion	5689	0.12	0.11	0.00	0.02	0.03	0.05	0.08	0.15	0.26	0.37	0.66
Within-industry forecast dispersion	5897	0.06	0.02	0.01	0.03	0.04	0.04	0.05	0.06	0.07	0.09	0.11
Within-industry EPS dispersion	5897	0.07	0.02	0.01	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.13

Panel A: Dependent variable λ_a (analyst-level)						
	(1)	(2)	(3)	(4)	(5)	(6)
Experience	-0.005***					-0.002
	(-3.20)					(-0.61)
Firm experience		-0.019***				-0.012*
		(-4.26)				(-1.65)
Industry experience			-0.010***			-0.001
			(-4.64)			(-0.13)
Covered industries				0.011***		0.020***
				(3.44)		(5.05)
Covered firms					-0.003***	-0.005***
					(-2.73)	(-4.25)
Constant	0.185***	0.197***	0.200***	0.116***	0.191***	0.196***
	(14.43)	(14.24)	(15.02)	(8.85)	(11.67)	(9.34)
Observations	6,938	7,054	6,890	7,036	7,063	6,716
R^2	0.001	0.002	0.003	0.002	0.001	0.007

- Stickiness tends to decrease with the analyst's years of experience
- Analysts can form better forecasts either by specializing on fewer sectors, or by extracting the industry component of profitability.

Panel B: Dependent variable λ_f (firm-level)

	(1)	(2)	(3)	(4)	(5)	(6)
Firm size	-0.010**					-0.007
	(-2.04)					(-1.26)
EPS volatility		2.210***				2.460***
		(8.93)				(8.82)
Firm level forecast dispersion			-0.037			-0.134
			(-0.42)			(-1.33)
Within industry forecast dispersion				-2.563***		-3.210*
				(-4.42)		(-1.81)
Within industry EPS dispersion					-2.010***	-0.221
					(-3.47)	(-0.12)
Constant	0.193***	0.016	0.132***	0.275***	0.273***	0.248***
	(5.89)	(1.05)	(9.77)	(8.44)	(6.71)	(3.70)
Observations	6,009	5,940	5,788	6,007	6,007	5,737
R^2	0.001	0.015	0.000	0.004	0.002	0.021

- Stickiness is higher for firms with more volatile EPS——analysts "giving up" on trying to make accurate forecasts for such firms.

4.Result

- Prediction 2: Past signals predict forecast errors
- Signals:
  - cf
  - Δ_{cf}
  - mom

$$\frac{\pi_{f,t} - F_{t-h}\pi_{f,t}}{P_{f,t-2}} = a + b_{t-h} \cdot s_{f,t-h} + \epsilon_{f,t}$$

Panel A: Dependent variable $(\pi_{f,t} - F_{t-1}\pi_{f,t})/P_{f,t-2}$			
	(1)	(2)	(3)
$cf_{f,t-1}$	0.018^{***}		
	(6.31)		
$\Delta cf_{f,t-1}$		0.016^{***}	
		(5.96)	
$mom_{f,t-1}$			0.006^{***}
			(7.97)
Observations	63,547	61,166	39,290
R^2	0.027	0.024	0.037
Panel B: Dependent variable $(\pi_{f,t} - F_{t-2}\pi_{f,t})/P_{f,t-2}$			
	(1)	(2)	(3)
$cf_{f,t-2}$	0.040^{***}		
	(7.75)		
$\Delta cf_{f,t-2}$		0.017^{***}	
		(3.96)	
$mom_{f,t-2}$			0.007^{***}
			(5.14)
Observations	52,614	47,443	34,083
R^2	0.036	0.030	0.040

- the forecast error is systematically positively related to all three signals.
- analyst expectations are nonrational, they tend to underreact to some persistent signals that predict future profits.

4.Result

- **Prediction 3:** Belief stickiness and stock-market anomalies
- When a firm is followed by stickier analysts, the three anomalies (profitability, change in profitability, and price momentum) should be more pronounced.
- The three anomalies should also be more pronounced for firms with more persistent cash flows.
- Dependent sorted

	s_{low}				s_{high}
λ_{low}					
λ_{middle}					
λ_{high}					

	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5	(6) Q5-Q1
Panel A: Cash flows (cf)						
T1	-0.18	0.03	0.21**	0.26**	0.33**	0.51**
	(-1.00)	(0.34)	(2.29)	(2.30)	(2.37)	(2.42)
T2	0.12	0.16*	0.31***	0.41***	0.59***	0.47**
	(0.76)	(1.74)	(3.50)	(4.50)	(4.39)	(2.40)
T3	-0.58***	-0.18*	0.12	0.20*	0.44***	1.02***
	(-3.56)	(-1.81)	(1.39)	(1.80)	(3.74)	(4.94)
T3 - T1	-0.40**	-0.21**	-0.09	-0.06	0.11	0.51***
	(-2.36)	(-2.45)	(-0.99)	(-0.78)	(1.11)	(3.18)
Panel B: Change in cash flows (Δcf)						
T1	0.12	0.10	0.09	0.19**	0.16	0.04
	(0.89)	(1.21)	(0.86)	(2.27)	(1.19)	(0.47)
T2	0.32***	0.23***	0.21***	0.29***	0.55***	0.23**
	(2.71)	(2.78)	(2.81)	(3.48)	(3.79)	(2.21)
T3	-0.10	-0.11	-0.08	0.17**	0.21**	0.31***
	(-1.00)	(-1.09)	(-0.65)	(2.03)	(2.10)	(3.93)
T3 - T1	-0.22**	-0.21*	-0.17*	-0.02	0.05	0.27***
	(-2.19)	(-1.96)	(-1.81)	(-0.19)	(0.43)	(2.65)
Panel C: Momentum (mom)						
T1	-0.51***	-0.08	0.10	0.32***	0.60**	1.11***
	(-3.08)	(-0.68)	(1.06)	(3.44)	(2.38)	(3.28)
T2	-0.20	-0.01	0.24**	0.39***	0.79***	0.99***
	(-1.00)	(-0.08)	(2.49)	(4.51)	(3.61)	(2.76)
T3	-0.87***	-0.25**	0.05	0.34***	0.65***	1.51***
	(-4.94)	(-1.97)	(0.41)	(3.41)	(3.56)	(4.79)
T3 - T1	-0.36***	-0.17*	-0.05	0.01	0.05	0.41***
	(-3.16)	(-1.87)	(-0.57)	(0.12)	(0.30)	(2.64)

- Panel A/B: Carhart 4
- Panel C: FF3
- Compared to the least sticky stocks, the long-short profitability strategy is significantly stronger for the stickiest stocks.

	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5	(6) Q5-Q1
Panel A: Cash flows (cf)						
T1	-0.34**	-0.11	0.14	0.23**	0.30**	0.64***
	(-2.27)	(-0.89)	(1.38)	(2.38)	(2.36)	(3.48)
T2	-0.09	0.06	0.19**	0.38***	0.42***	0.51**
	(-0.60)	(0.66)	(2.20)	(3.72)	(3.25)	(2.48)
T3	-0.26*	0.04	0.27***	0.33***	0.65***	0.91***
	(-1.69)	(0.49)	(2.78)	(3.65)	(4.61)	(4.27)
T3 - T1	0.08	0.15	0.13*	0.10	0.35***	0.27**
	(0.86)	(1.12)	(1.71)	(1.58)	(4.61)	(2.18)
Panel B: Change in cash flows (Δcf)						
T1	0.15	0.03	-0.03	0.04	0.09	-0.06
	(1.38)	(0.36)	(-0.22)	(0.41)	(0.85)	(-0.61)
T2	0.03	0.21**	0.04	0.29***	0.39***	0.36***
	(0.29)	(2.55)	(0.38)	(3.27)	(2.82)	(3.79)
T3	0.07	0.07	0.14*	0.37***	0.45***	0.37***
	(0.57)	(0.83)	(1.92)	(4.65)	(3.42)	(3.71)
T3 - T1	-0.08	0.04	0.16*	0.33***	0.36***	0.43***
	(-0.73)	(0.43)	(1.80)	(3.87)	(4.55)	(3.49)
Panel C: Momentum (mom)						
T1	-0.55***	-0.18	0.05	0.27**	0.48**	1.03***
	(-3.26)	(-1.50)	(0.54)	(2.49)	(2.55)	(3.39)
T2	-0.52***	-0.06	0.21**	0.32***	0.69***	1.21***
	(-2.98)	(-0.48)	(2.23)	(4.68)	(3.29)	(3.52)
T3	-0.49**	-0.13	0.14	0.41***	0.88***	1.37***
	(-2.59)	(-1.12)	(1.64)	(5.31)	(3.66)	(3.76)
T3 - T1	0.06	0.06	0.08	0.14*	0.40***	0.34**
	(0.56)	(0.65)	(1.32)	(1.87)	(3.28)	(2.08)

$$cf_{f,t} = a + \rho \cdot cf_{f,t-1} + \epsilon_{f,t}$$

- Panel A/B: Carhart 4
- Panel C: FF3
- alphas for all three anomalies are higher for firms with more persistent cash-flow, that is higher ρ_f.

5.Conclusion

- Analysts are on average too pessimistic regarding the future profits of high-profit firms.
- The profitability anomaly is stronger for stocks which are followed by stickier analysts.
- It is also stronger for stocks with more persistent profits.
- Less experienced analysts and busier analysts (i.e., those who follow more industries) tend to have stickier beliefs.