Online appendix to

Market Development, Information Diffusion and the Global Anomaly Puzzle

Online Appendix I. Alternative Explanations for Developed–Emerging Anomaly Differences

One of the rational explanations for pricing anomalies is the *q*-theory approach, which studies the investment return relationship from a production-based asset pricing or a firm's optimal investment standpoint (e.g., Cochrane, 1991, 1996; Li, Livdan and Zhang, 2009; Li and Zhang, 2010). The basic argument is that firms with low discount rates (expected returns) have high net present values and high investment, whereas firms with high discount rates have low net present values and low investment.

Watanabe et al. (2013) and Titman, Wei and Xie (2013) argue that *q*-theory can account for the difference in the asset growth effect across markets. The former authors suggest that the increase or decrease in assets depends on stock price efficiency: that is, firm managers rely on an efficient price to make decisions on asset expansion or reduction. As a result, developed markets show a stronger asset growth anomaly. The latter authors propose that managers in less developed markets put less weight on the maximization of shareholder value when they make investment decisions, which results in a weaker link between investment and expected returns in these markets.

Following the above argument, *q*-theory can be used to explain the difference between emerging and developed markets in most of the investment-based anomalies. However, it does not serve to explain non-investment based anomalies such as those that are market-based[1].

Online Appendix II. Time Series Pattern of Momentum Strategy Return in the U.S.

To further demonstrate the evolution of anomalies overtime, we study one of the long-standing anomalies - the momentum anomaly from 1926. The momentum anomaly has a mixed feature of accounting and market-based elements (Chordia and Shivakumar, 2006). The results are

[1] Arguably, our empirical results show that *q*-theory cannot help in reconciling all of the difference between emerging and developed markets. Particularly, in our robustness checks we study the alpha that is calculated after including an investment factor that is justified by *q*-theory. The difference we find between emerging and developed markets is the one that remains *after* considering the *q*-theory explanation. Nevertheless, we also control for the effect of market efficiency variables in our later regression analysis.

reported in Figure OA.1 and show that momentum profits peak in 1956 and steadily decline thereafter[2]. Overall, these findings support our conjecture that as markets become more mature over time, we will observe a rise and fall of anomaly returns.

Figure OA.1

Online Appendix III. Empirical Analysis Excluding the U.S. Market.

Since most of the anomalies are first documented in the U.S. market there is a strong time series nonlinear effect in the U.S. as demonstrated in Table 4 in the main text. To alleviate the possibility that our finding is driven mainly by the inclusion of the U.S. market, we repeat our main analysis excluding the U.S.

Table OA.1

The results shown in Table OA.1 are qualitatively the same as those in Table 3. The nonlinearity between market development and anomaly remains observable in most of the cases.

Online Appendix IV. Persistence of Newswatcher Measures

We study the stability of the cross-sectional country level newswatcher overtime with the two time series variables including analyst dispersion (DISP) and differenced volatility (DV). Table OA.2 shows that the diagonal probability is the highest, suggesting that countries are most likely to stay in the same group between periods. This especially true for the two extreme groups (1 and 3).

Table OA.2

Online Appendix V. Additional evidence on the U.S. market

Green, Hand, and Zhang (2017) plot the time series anomaly return and observe there is a decline after 2003. They attribute this change from 2003 onwards to a changing information

[2] This pattern is independent of the phenomenon of momentum crashes documented by Daniel and Moskowitz (2016). They capture momentum crashes by conditioning on previous market declines (2-year) and contemporaneous (current month) rebound with an event-study like approach. Such crashes occur infrequently. Among the 15 crashes they identified in their Table 2, they are evenly featured in both the increasing periods (before 1956 with 7 cases) and decreasing period (after with 8 cases).

environment and improved technology in a general discussion without formal tests being conducted between returns and information/technology. Their observation is consistent with our subperiod analysis in Table 8 and Figure 7 where the most recent period's return is lower in general.

To study Green, Hand, and Zhang's (2017) observation and our explanation, we add a post-2003 dummy to our time series analysis of the US. The result can be found in Table O.A3. The nonlinearity of the newswatcher effect is still observable in four out of the six regressions. The finding that the anomaly return is weaker in more recent periods is consistent with our argument that the information condition is improved over time with technology and regulations. Indeed, we can see that the time-varying variables improve over time and are significantly different before and after 2003 as we show in Table O.A4. So we do not only echo their findings but also give a direct test and theoretical explanation as to how information conditions affect the return generating process.

Tables OA.3 and 4

References

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Table O.A1 - Regression Analysis Excluding the U.S.

This table reports regression results excluding the U.S. from the sample. The dependent variable is monthly long-short spreads based on the mispricing scores (constructed for all anomalies) for each market. The independent variables include the quadratic term of newswatcher efficiency and other control variables. Eight proxies of newswatcher are used: investor sophistication (SOPHI), institutional ownership (INSTOWN), accounting standard index (ACCT), earnings management score (EMS), analyst dispersion (DISP), information opacity (OPA), number of news article (NEWS) and differenced volatility (DV). The control variables include a market development dummy (DEV), idiosyncratic volatility (IVOL), R squared (R^2), a common law dummy (LAW), efficiency of the judgement system (EFFJUD), anti-director (ANTDIR) and the ownership of the three largest private shareholders (C3PRI). We report pooled OLS regressions and standard errors are double-clustered by market and month. ***, ** and * indicate significance at the 1%, 5% and 10% levels.

Panel A: equal-weighted

	SOPHI	INSTOWN	ACCT	EMS	DISP	OPA	NEWS	DV
Intercept	-0.0925***	0.0265***	-0.3356***	0.0247***	-0.0323	0.0214***	0.0198***	0.0245***
	(-3.60)	(3.53)	(-3.11)	(2.86)	(-0.82)	(3.14)	(3.52)	(2.78)
Newswatcher^2	-0.0062***	-0.0371	-0.0213***	0.2609	-0.0074*	-4.8631**	-0.5144*	-0.0133
	(-4.64)	(-1.08)	(-2.81)	(0.71)	(-1.73)	(-2.29)	(-1.87)	(-1.40)
Newswatcher	0.0540***	0.0228	0.1745***	-0.0247	0.0434	0.3978*	0.0960	0.0109
	(4.65)	(0.87)	(3.05)	(-0.27)	(1.61)	(1.68)	(1.46)	(1.38)
DEV	-0.0016	-0.0008	-0.0001	-0.0027	-0.0011	0.0001	0.0018	-0.0004
	(-0.81)	(-0.24)	(-0.03)	(-1.16)	(-0.49)	(0.07)	(1.22)	(-0.17)
IVOL	0.0504	0.0532	0.0866	0.0185	0.0503	0.0165	0.0366	0.0546
	(0.80)	(0.86)	(1.57)	(0.29)	(0.96)	(0.26)	(0.60)	(0.88)
R^2	-0.0092	-0.0124	-0.0113	-0.0186*	-0.0196*	-0.0144	-0.0139	-0.0120
	(-1.06)	(-1.43)	(-1.12)	(-1.79)	(-1.65)	(-1.53)	(-1.49)	(-1.38)
LAW	-0.0044***	-0.0064***	-0.0045**	-0.0043***	-0.0069***	-0.0059***	-0.0056***	-0.0054***
	(-2.89)	(-4.92)	(-2.42)	(-2.76)	(-3.54)	(-3.65)	(-3.15)	(-3.20)
EFFJUD	0.0009	-0.0007	-0.0009	0.0010	0.0001	-0.0016	-0.0028	-0.0010
	(0.64)	(-0.33)	(-0.35)	(0.79)	(0.03)	(-0.50)	(-1.32)	(-0.59)
ANTDIR	-0.0002	-0.0005	0.0001	-0.0008**	-0.0007	-0.0002	0.0008	-0.0001
	(-0.47)	(-0.66)	(0.19)	(-1.97)	(-1.35)	(-0.28)	(1.38)	(-0.17)
C3PRI	-0.0126	-0.0157*	-0.0086	-0.0047	-0.0146*	-0.0109	-0.0031	-0.0122
	(-1.65)	(-1.78)	(-1.00)	(-0.61)	(-1.73)	(-1.23)	(-0.46)	(-1.06)
Obs	10436	10436	9453	8127	7338	9689	9834	10436
R square	0.0061	0.004	0.007	0.0051	0.0074	0.0047	0.0046	0.004

Panel B: equal-weighted

	SOPHI	INSTOWN	ACCT	EMS	DISP	OPA	NEWS	DV
Intercept	-0.0868**	0.0088	-0.4231***	0.0075	-0.0498	0.0133	0.0014	0.0037
	(-2.07)	(0.91)	(-3.81)	(0.80)	(-1.01)	(1.38)	(0.17)	(0.40)
Newswatcher^2	-0.0054**	0.0270	-0.0271***	0.5434	-0.0063	1.3009	-0.7956**	-0.0270***
	(-2.31)	(0.69)	(-3.69)	(1.52)	(-1.24)	(0.44)	(-2.49)	(-2.79)
Newswatcher	0.0451**	-0.0252	0.2149***	-0.1071	0.0377	-0.1892	0.1507**	0.0309***
	(2.32)	(-0.88)	(3.81)	(-1.29)	(1.18)	(-0.55)	(1.96)	(3.75)
DEV	-0.0013	0.0014	-0.0008	-0.0011	-0.0035	0.0010	0.0019	-0.0027
	(-0.54)	(0.43)	(-0.30)	(-0.39)	(-1.36)	(0.40)	(0.73)	(-1.00)
IVOL	0.0039	0.0079	0.0455	-0.0234	0.0078	-0.0307	-0.0149	-0.0013
	(0.06)	(0.12)	(0.89)	(-0.32)	(0.15)	(-0.41)	(-0.22)	(-0.02)
R^2	-0.0043	-0.0070	-0.0018	-0.0094	-0.0088	-0.0074	-0.0058	-0.0055
	(-0.43)	(-0.71)	(-0.16)	(-0.74)	(-0.66)	(-0.70)	(-0.55)	(-0.57)
LAW	-0.0002	-0.0004	-0.0008	0.0004	0.0007	-0.0026	-0.0009	0.0003
	(-0.13)	(-0.22)	(-0.41)	(0.26)	(0.44)	(-1.40)	(-0.49)	(0.18)
EFFJUD	0.0027	0.0003	0.0027	0.0022	0.0021	0.0020	-0.0026	-0.0010
	(0.95)	(0.09)	(0.78)	(0.90)	(0.89)	(0.49)	(-0.94)	(-0.37)
ANTDIR	0.0005	0.0011	0.0009	0.0009	0.0010**	0.0005	0.0020***	0.0009
	(0.81)	(1.39)	(1.29)	(1.46)	(2.02)	(0.67)	(2.84)	(1.42)
C3PRI	-0.0088	-0.0014	-0.0054	-0.0001	-0.0042	-0.0058	0.0041	-0.0008
	(-1.00)	(-0.15)	(-0.62)	(-0.01)	(-0.48)	(-0.65)	(0.55)	(-0.08)
Obs	10436	10436	9453	8127	7338	9689	9834	10436
R square	0.0014	0.0007	0.0017	0.0011	0.0013	0.0008	0.0013	0.001

Table O.A2 - Transition Matrix

This table reports a transition matrix of time series newswatcher efficiency including analyst dispersion and differenced volatility. For a given newswatcher proxy, we first rank them into three groups and we count the number of states, [rank_t-1, rank_t]. For example, [3,3] means that the market is located in high rank group in both t-1 and t. Then we compute the probability of each transition state. For analyst dispersion (DISP), we compute the standard deviation of the one-year earnings forecast divided by the absolute value of the mean forecast, and then scaled by the square root of the number of analysts. We use 1 divided by the dispersion so that the larger the value the greater the newswatcher efficiency. We then compute the average for each market in each year. For differenced volatility (DV), it is the difference between average abnormal earnings announcement event volatility and the average abnormal volatility during 55 days before and 55 days after the event. The abnormal volatility is the absolute value of excess return of stock return and value-weighted market return. For idiosyncratic volatility, it is the standard deviation of residuals from regressions of daily stock returns on market returns in each month and we require at least 15 days in that month. We then calculate the average for each market in each year.

Panel A: DISP

		Rank(t)		
		1	2	3
Rank(t-1)	1	83.9%	15.3%	0.7%
	2	16.6%	66.0%	17.4%
	3	0.7%	15.8%	83.5%

Panel B: DV

		Rank(t)		
		1	2	3
Rank(t-1)	1	50.2%	32.2%	17.6%
	2	34.6%	40.8%	24.6%
	3	16.3%	25.2%	58.4%

Table OA3: Adding a post-2003 dummy

This table repeats Table 8 but adds a dummy variable for post 2003. It reports the time-series regression of anomaly returns on squared newswatcher efficiency and newswatcher efficiency with controls for idiosyncratic volatility, R squared and a post 2003 dummy variable. Three newswatcher efficiency proxies are constructed, institutional ownership, analyst dispersion and differenced volatility. The dummy variable of post 2003 is a year dummy, and it is 1 if before 2003 and 0 otherwise. See Table 8 for the construction of other variables. ***, ** and * indicate significance at the 1%, 5% and 10% levels.

Panel A: equal-weighted returns

	INSTOWN	DISP	DV
Intercept	-0.1473**	-0.4856*	0.0006
	(-2.18)	(-1.69)	(0.06)
Newswatcher^2	-2.2642*	-0.0271	-360.8672*
	(-1.74)	(-1.45)	(-1.78)
newswatcher	1.5269**	0.2401*	8.5827**
	(2.41)	(1.63)	(2.48)
IVOL	-1.8467***	-0.5426*	-0.3921*
	(-2.64)	(-1.78)	(-1.78)
R^2	0.0748	0.0396	-0.0023
	(1.43)	(1.40)	(-0.08)
post-2003	-0.0629***	-0.0277***	-0.0317***
	(-3.58)	(-5.86)	(-3.96)
Adj. R squared	0.113	0.075	0.321
Obs	147	429	45

Panel B: value-weighted returns

	INSTOWN	DISP	DV
Intercept	-0.1524**	-0.9464**	0.0054
	(-2.29)	(-2.29)	(0.47)
Newswatcher^2	-2.1861**	-0.0578**	-337.4490
	(-1.76)	(-2.25)	(-1.44)
newswatcher	1.4865**	0.4780**	8.3122**
	(2.30)	(2.30)	(2.49)
IVOL	-1.6711**	-0.5412*	-0.6019*
	(-2.08)	(-1.67)	(-1.87)
R^2	0.0407	-0.0043	-0.0398
	(0.80)	(-0.14)	(-1.42)
post-2003	-0.0591***	-0.0208***	-0.0304***
	(-3.05)	(-3.53)	(-3.66)
Adj. R squared	0.114	0.068	0.235
Obs	147	429	45

Table OA4. News efficiency measures before and after 2003.

This table reports the mean of the newswatcher variables and their difference between the two periods. Newswatcher proxies include INSTOWN (institutional ownership), DISP (analyst forecasts dispersion and DV (differenced volatility). We divide the sample into two sub-samples: before 2003 and after 2003. We then compute the mean of each variable for both of the two sub-periods and the difference between the two sub-periods.

	PRE2003	POST2003	diff (post-pre)	t
INSTOWN	0.213	0.309	0.096	19.87
DISP	3.840	4.100	0.260	11.11
DV	0.005	0.011	0.006	11.47

Figure O. A1 – U.S. Momentum from 1926 to 2016

This figure plots momentum profits from 1926 to 2016 for the U.S. market. In each month we divide stocks into quintiles based on the past 6-month return, skipping the most recent month. Then we compute the spread between quintile 5 and quintile 1 in each month and plot the time-series average of spread in each 10-year period. The figure also reports the fitted line and the fitted equation.