Media Narratives and Price Informativeness

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September 2023

Motivation

- Abundant evidence supports media's role in price discovery.
- Few studies explore media's potential harm to financial markets.
- We study **media's attention to narratives**, not information content.

Questions Asked...

Link: Exposure to media narratives → prices, information, trading

- **Prices and their information content**
  - Why are stock returns sensitive to media attention to narratives?
    Note: we talk about attention, and not about news/ information
  - If stock return co-moves with attention to narratives, is stock price more or less informative about future fundamentals?
  - How is the narrative exposure linked to noise in returns?
  - Is there more trading in exposed stocks?

Insights...

▶ Main Insights

- Stock returns do *co-move with media attention to narratives* in a time-variant and heterogeneous fashion — **Narrative Exposure**
- High Narrative Exposure translates to high non-systematic volatility
  — accounts for over 80% of cross-sectional variation in non-systematic volatility
- Stocks with high Narrative Exposure end up with less informative prices
  — sharp $\uparrow$ in Narr. Exposure $\rightarrow \downarrow$ price informativeness relative to comparable firms
- Narrative Exposure is positively related to trading volume, suggesting the former as a proxy of investor disagreement
- A stylized trading model featuring biased media and some unsophisticated investors rationalizes our findings on the basis of disagreement across investor groups

Quantifying Narrative Attention and Narrative Exposure I

1. Use LDA to optimally identify 33 narratives from *Wall Street Journal (WSJ)* archive with daily articles
   - Compute $\theta_{i,l,\tau}$, attention level to narrative l in article i on day τ
   - Aggregate attention to narrative l on day τ: $\theta_{l,\tau} = \frac{\frac{1}{n}\sum_i^n \theta_{i,l,\tau}}{D_\tau}$
2. Compute narrative l beta for year t using shocks to attention $\tilde{\theta}_{l,\tau}$:

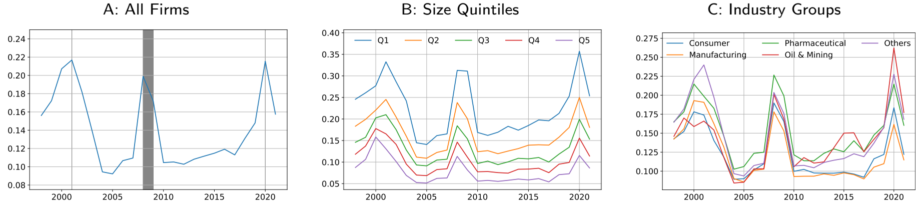
$$r_{n,\tau} = \alpha + \beta_{n,t}^{\top} F_\tau + \beta_{n,t}^{narr} \tilde{\theta}_{l,\tau} + \varepsilon_{n,\tau}$$

3. Stock n's weighted-average exposure to narratives is given by

$$\textit{Narrative Exposure}_{n,t} = \frac{\sum_l |\beta_{n,t,l}^{narr}| \times \sigma_t(\theta_l)}{\sum_l \sigma_t(\theta_l)}$$

Quantifying Narrative Attention and Narrative Exposure II

Evolution of average $\textit{Narrative Exposure}_{n,t}$



- **Note:**
  — $\textit{Narrative Exposure}_{n,t}$ is fundamentally different from stock-specific news coverage — correlation between them < 0.09

  — $\textit{Narrative Exposure}_{n,t}$ reflects the intensity of a stock's co-movement with media attention to different *generic narratives*

Narrative Exposure and Information Channels I

- First, decompose stock return variation as follows:
  1. Total return variance $\rightarrow$ $SysVar + IdVar$
     using factor-model-based decomposition (MM, FF3, FF4, FF5)
  2. Total return variance $\rightarrow$ $MktVar + PrivateInfo + PublicInfo + Noise$
     using Brogaard, Nguyen, Putnins, and Wu (2022) VAR-based decomposition

	$SysVar_{i,t}$	$IdVar_{i,t}$	$MktInfo_{i,t}$	$PrivateInfo_{i,t}$	$PublicInfo_{i,t}$	$Noise_{i,t}$
$SysVar_{i,t}$	1.000	0.043	0.551	0.135	0.096	0.002
$IdVar_{i,t}$	0.043	1.000	0.342	**0.783**	**0.891**	**0.841**
$MktInfo_{i,t}$	0.551	0.342	1.000	0.363	0.407	0.184
$PrivateInfo_{i,t}$	0.135	0.783	0.363	1.000	0.722	0.502
$PublicInfo_{i,t}$	0.096	0.891	0.407	0.722	1.000	0.643
$Noise_{i,t}$	0.002	0.841	0.184	0.502	0.643	1.000

- Use two-stage regression, CRS & TS, to relate each component and $Narrative\ Exposure_{n,t}$ conditioning on other characteristics

Narrative Exposure and Information Channels II

	$Var_{n,t}$	$SysVar_{n,t}$	$IdVar_{n,t}$	$MktInfo_{n,t}$	$PrivateInfo_{n,t}$	$PublicInfo_{n,t}$	$Noise_{n,t}$
Panel A: Full Specification.							
$Narrative\ Exposure_{n,t}$	0.776	-0.042	0.795	0.208	0.632	0.629	0.646
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2 (%)	87.75	77.96	87.96	48.81	64.19	74.78	66.05
Obs.	2,413	2,413	2,413	2,413	2,413	2,413	2,413
Factor betas	FF4	FF4	FF4	FF4	FF4	FF4	FF4
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: Reduced Specification.							
$Narrative\ Exposure_{n,t}$	0.923	0.052	0.928	0.359	0.764	0.845	0.777
	(0.001)	(0.208)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2 (%)	85.17	2.28	86.09	13.97	58.51	71.37	60.49
Obs.	2,413	2,413	2,413	2,413	2,413	2,413	2,413
Controls/ FE	No	No	No	No	No	No	No

- $1 \times SD$ change in $Narrative\ Exposure_{n,t} \rightarrow 0.8 \times SD$ change in *IdVar*!
- Narr. Exposure alone explains 86% variability in *IdVar*: mainly through *PublicInfo*
- **Narr. Exposure proxies the main source of non-systematic variance**

Information Channels and Price Informativeness I

- Use an approach similar to Bai, Philippon, and Savov (2016):
  - Regress future fundamentals ($EBIT/A$) on current market value (M/A)

$$\frac{E_{n,t+h}}{A_{n,t}} = a + b_{0,h}\frac{E_{n,t}}{A_{n,t}} + \left[b_{1,h} + b_{proxy,h}^{\top} proxy_{n,t}\right] \times \ln \frac{M_{n,t}}{A_{n,t}} + b_x^{\top} X_{n,t} + \varepsilon_{n,t+h}$$

  - Two-stage regression: CRS $\rightarrow$ TS
  - $b_{1,h}$ gives price informativeness for horizon $h = 1$ or 3 years
  - Interact information proxy $proxy_{n,t}$ with market value
  - $b_{proxy,h}$ is the effect of information proxy intensity on price informativeness
  - Control for 1-digit SIC, factor betas, multiple fundamentals: *Debt/Assets*, *Cash/Assets*, *Ppent/Assets*, *Capex/Assets*, *Sales/Assets*, *R&D/Assets*

Information Channels and Price Informativeness II

- *IdVar* reduces price informativeness by ≈ 60% of the base effect
- *PublicInfo* reduces price informativeness by ≈ 45% of the base effect

	One-year horizon				Three-year horizon			
	MM	FF4	FF5	BNPW	MM	FF4	FF5	BNPW
$\ln(M/A)_{n,t}$	0.019	0.019	0.020	0.021	0.035	0.038	0.038	0.040
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\ln(M/A)_{n,t} \times SysVar_{n,t}$	-0.000	-0.001	-0.002	–	0.000	-0.000	-0.000	–
	(0.521)	(0.070)	(0.028)		(0.992)	(0.977)	(0.892)	
$\ln(M/A)_{n,t} \times IdVar_{n,t}$	-0.014	-0.014	-0.014	–	-0.020	-0.024	-0.024	–
	(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)	
$\ln(M/A)_{n,t} \times MktInfo_{n,t}$	–	–	–	-0.003	–	–	–	0.001
				(0.001)				(0.797)
$\ln(M/A)_{n,t} \times PrivateInfo_{n,t}$	–	–	–	-0.003	–	–	–	0.008
				(0.001)				(0.556)
$\ln(M/A)_{n,t} \times PublicInfo_{n,t}$	–	–	–	-0.009	–	–	–	-0.014
				(0.001)				(0.001)
$\ln(M/A)_{n,t} \times Noise_{n,t}$	–	–	–	-0.003	–	–	–	-0.007
				(0.001)				(0.076)
R^2 (%)	79.68	79.69	79.69	80.41	60.75	60.86	60.86	62.56
Obs.	3,151	3,151	3,151	2,223	2,470	2,470	2,470	1,736
Factor betas	FF4	FF4	FF4	FF4	FF4	FF4	FF4	FF4
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Narrative Exposure and Price Informativeness I

- Use an approach similar to Bai, Philippon, and Savov (2016):
  - Regress future fundamentals ($EBIT/A$) on current market value (M/A)

$$\frac{E_{n,t+h}}{A_{n,t}} = a + b_{0,h}\frac{E_{n,t}}{A_{n,t}} + \ln\frac{M_{n,t}}{A_{n,t}} \cdot [b_{1,h} + b_{2,h} Nar\ Exposure_{n,t}] + b_{x,h}^{\top} X_{n,t} + \varepsilon_{n,t+h}$$

  - Two-stage regression: CRS $\rightarrow$ TS
  - $b_{1,h}$ gives price informativeness for horizon $h = 1$ or 3 years
  - $b_{2,h}$ captures how narrative exposure relates to price informativeness
  - Controls for 1-digit SIC, factor betas, multiple fundamentals: *Debt/Assets, Cash/Assets, Ppent/Assets, Capex/Assets, Sales/Assets, R&D/Assets*

Narrative Exposure and Price Informativeness II

	One-year horizon				*Three-year horizon*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(M/A)_{n,t}$	0.022	0.032	0.032	0.032	0.046	0.059	0.058	0.060
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\ln(M/A)_{n,t} \times \textit{Narr Exposure}_{n,t}$	-0.016	-0.015	-0.015	-0.009	-0.028	-0.025	-0.024	-0.016
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2 (%)	77.94	79.40	79.46	77.54	57.04	60.31	60.50	55.28
Obs.	3,151	3,151	3,151	946	2,470	2,470	2,470	859
Factor betas	–	FF4	FF4	FF4	–	FF4	FF4	FF4
Fundamentals	–	Yes	Yes	Yes	–	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High Average Exposure	-0.006	-0.006	-0.006	-0.003	-0.011	-0.004	-0.003	-0.001
	(0.013)	(0.015)	(0.014)	(0.038)	(0.306)	(0.443)	(0.472)	(0.853)

- Stock prices are informative on average
- But high narrative exposure significantly decreases price informativeness
- Periods of elevated average exposure incrementally decreases price informativeness

Narrative Exposure and Price Informativeness III

- **Get closer to causality:**

— *Narrative Exposure*$_{n,t}$ is reasonably persistent across adjacent years: 66% (61%) probability of remaining in bottom (top) quintile

Old \ New	1	2	3	4	5
1	0.662	0.241	0.069	0.020	0.008
2	0.248	0.383	0.238	0.100	0.031
3	0.072	0.253	0.348	0.237	0.090
4	0.015	0.103	0.257	0.367	0.258
5	0.003	0.020	0.089	0.275	0.613

— Use sizable increase (25 pp.) in *Narrative Exposure*$_{n,t}$ percentile rank as an indicator of treatment

— Identify comparable firms using propensity score matching (based on the following characteristics observed one year before treatment: *Narrative Exposure*, ln(*Market Cap.*), ln(*Market Cap./Assets*), ln(*BTM*), *EBIT/Asset*, *Capex/Assets*, *R&D/Assets*, *Market Beta*, and *Illiquidity*)

Narrative Exposure and Price Informativeness IV

— estimate panel regression:

$$\frac{E_{n,t+h}}{A_{n,t}} = a + b_{0,h}\frac{E_{n,t}}{A_{n,t}} + \ln\frac{M_{n,t}}{A_{n,t}} \cdot [b_{1,h} + b_{2,h}\,\mathit{Treated}_{n,t}] + b_{x,h}^{\top}X_{n,t} + \ldots$$

- **Treated firms**: $\geq$25 pp. **change** in Narrative Exposure percentile rank from t to $t+1$
- **Control firms**: Up to 5 firms matched on observables
- $X_{n,t}$ includes controls to account for residual differences in characteristics

Narrative Exposure and Price Informativeness V

	One-year horizon				*Three-year horizon*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(M/A)_{n,t}$	0.0112	0.0109	0.0109	0.0110	0.0192	0.0220	0.0222	0.0222
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\ln(M/A)_{n,t} \times$ *Treated*	-0.0045	-0.0048	-0.0046	-0.0046	-0.0103	-0.0097	-0.0095	-0.0094
	(0.046)	(0.022)	(0.032)	(0.035)	(0.000)	(0.000)	(0.000)	(0.000)
R^2 (%)	70.79	71.22	71.37	71.96	45.46	46.92	47.15	48.58
Obs.	34,350	34,350	34,350	34,350	25,722	25,722	25,722	25,722
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	No	Yes	No	Yes	No	Yes	No
Year FE	No	Yes	Yes	No	No	Yes	Yes	No
Sector x Year FE	No	No	No	Yes	No	No	No	Yes

- Price informativeness is significantly lower for firms with sizable increase in narr. exposure relative to their matched comparable firms

Narrative Exposure and Trading Activity

- Finding: higher narrative exposure → higher turnover

	$Turnover_{n,t}$				
	(1)	(2)	(3)	(4)	(5)
$Narr\ Exposure_{n,t}$	0.201	0.198	0.376	0.334	0.410
	(0.010)	(0.006)	(0.001)	(0.001)	(0.001)
$Illiquidity_{n,t}$	–	–	–	-0.202	-1.001
				(0.001)	(0.001)
$MAX_{n,t}$	–	–	–	0.108	0.354
				(0.001)	(0.001)
$DOB_{n,t}$	–	–	–	–	0.048
					(0.001)
$Inst.\ Ownership_{n,t}$, %	–	–	–	–	0.489
					(0.001)
R^2 (%)	11.10	30.32	39.31	42.24	48.28
Obs.	3,412	3,412	3,412	3,412	980
Fundamentals	No	No	Yes	Yes	Yes
Factor Betas	No	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes

Model Sketch I

A simple infinite-horizon economy

- ∞ periods, $N+1$ assets, continuum of investors of two types
- A riskfree asset ($\bar{r}$) and N risky assets paying regular dividends

$$D_{n,t} = \bar{D}_n + \beta_n' f_t + \varphi_{n,t},$$

driven by $K \times 1$ vector of common factors f_t

Model Sketch II

Media provides valuable but biased information

- At t, a media outlet publishes M articles with narratives z_t $(L \times 1)$:

$$z_t = Af_t + \eta_t, \quad \eta_t \sim N\left(0, \Sigma_\eta\right),$$

An article delivers narrative l with probability $\theta_{l,t}$
Note: $\theta_{l,t}$ closely maps attention extracted from news texts

- An article m gives a signal with a narrative-specific bias $\pi_{l,t}$

$$s_{m,t} = z_{l,t+1} + \pi_{l,t} + \zeta_{m,t} \quad \pi_{l,t} \sim N(\pi_l, \pi_l^2 \sigma^2)$$

- With $M \to \infty$, investors' information is equivalent to L signals

$$S_{l,t} = z_{l,t+1} + \pi_{l,t} + \hat{\zeta}_{l,t}, \quad \hat{\zeta}_{l,t} \sim N\left(0, \left(\omega \theta_{l,t}\right)^{-1}\right)$$

- Relative attention $\theta_{l,t}$ to narrative l increases precision of $S_{l,t}$

Model Sketch III

Investors: rational and unsophisticated

- Continuum of risk-neutral investors
- Born every period, trade, next period consume and exit...
- **R**ational investors know about the bias; **U**nsophisticated ignore it
- Thus, expected payoff of both types of investors are

$$
\begin{aligned}
\textbf{Rational}\ E_{R,t}\left(D_{n,t+1}\right) &= \beta_n' \Phi_t (S_t - \pi_t) \\
\textbf{Unsophisticated}\ E_{U,t}\left(D_{n,t+1}\right) &= E_{R,t}\left(D_{n,t+1}\right) + \beta_n' \Phi_t \pi_t \\
&= E_{R,t}\left(D_{n,t+1}\right) + \Pi_{n,t}
\end{aligned}
$$

  - Φ_t depends on attention level θ_t via precision matrix Θ_t
  - $\Pi_{n,t}$ gives the total effect of bias on **U**'s dividend expectation

Model Sketch IV

Asset prices and returns

- Asset returns are affected by both bias and narrative attention

$$r_{n,t} = \ldots + \gamma_n(\Pi_{n,t} - \Pi_{n,t-1})$$

with the **red** part being the bias-driven return $= f(\pi, \theta)$.

- Asset's exposure to narrative attention

$$\beta\left(n, l\right) := \frac{Cov\left(r_{n,t}, \theta_{l,t}\right)}{Var\left(\theta_{l,t}\right)}$$

- Bias-driven component $\rightarrow$ absolute exposure $|\beta\left(n, l\right)|$ **increases** with
  - Mass of U investors invested in n, i.e., γ_n
  - Bias magnitude π
- **If bias is zero, narrative exposure is also zero!**

Model Sketch V

Narrative exposures, price informativeness, and trading volume

- **Price Informativeness**

$$I_n = \frac{Cov\left(D_{n,t+1}, P_{n,t}\right)^2}{Var\left(P_{n,t}\right)} = \frac{Var\left[E_{R,t}\left(D_{n,t+1}\right)\right]^2}{Var\left[E_{R,t}\left(D_{n,t+1}\right)\right] + \gamma_n^2 Var(\Pi_{n,t})}$$

  - $\gamma_n^2 Var(\Pi_{n,t}) \propto IdVar_n =$ idiosyncratic return variance

- **Narrative Exposure is a proxy for $\gamma_n^2 Var(\Pi_{n,t})$**

$$\beta\left(n, l\right)^2 = \gamma_n^2 Var(\Pi_{n,t}) \frac{Corr\left(\Pi_{n,t}, \theta_{l,t}\right)^2}{Var\left(\theta_{l,t}\right)}$$

- **Trading Volume**

$$TV_{n,t} = \gamma_n(1-\gamma_n) \left| \left[\Pi_{n,t} - E(\Pi_{n,t})\right] \right|$$

ALL : f(bias $\pi_{n,t}$, mass of unsophisticated investors γ_n, media attention $\theta_{l,t}$)

Testable Predictions

A number of (cross-sectional) testable predictions

1. Narrative exposure reduces price informativeness
2. Higher media attention to a narrative reduces exposed stocks' price informativeness
3. Narrative exposure is positively related to non-systematic variance
   — Non-systematic variance in turn reduces price informativeness
4. Shocks to narrative attention or bias generates higher trading volume for exposed stocks

Bottom Line

Media narrative exposure proxies non-informative trading and investor disagreement that creates excess volatility and distorts the information content of stock prices

References I

Bai, J., T. Philippon, and A. Savov, 2016, “Have financial markets become more informative?,” *Journal of Financial Economics*, 122(3), 625 – 654.

Brogaard, J., T. H. Nguyen, T. J. Putnins, and E. Wu, 2022, “What Moves Stock Prices? The Roles of News, Noise, and Information,” *The Review of Financial Studies*, 35(9), 4341–4386.