Sentiment during recessions

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Shiller's view of the media

- Shiller (2000)'s account of the media: hyping, tagging-along, entertainment at best.
- "The history of speculative bubbles begins roughly with the advent of newspapers."
- "A downward movement in stock prices, for example, generates chatter and media response, and reminds people of longstanding pessimistic stories and theories. These stories, newly prominent in their minds, incline them toward gloomy intuitive assessments. As a result, the downward spiral can continue: declining prices cause the stories to spread, causing still more price declines and further reinforcement of the stories" (NYT, 2009).

Recent work on media and the stock market

- Tetlock(2007)'s study of "Abreast of the market" column, 1984–1999: negative word counts move stock returns by 5-8bps, most of the effect reverses over 5 days.
    - Small sample size.
    - Negative sentiment constructed using principal component analysis.
    - Positive words do not load.
- Barber and Odean (2008) show individual investors trade following news coverage, attention-driven buying.
- Causal evidence: Engelberg and Parsons (2011) and Dougal, Engelberg, García and Parsons (2011).
- Many more papers both in asset pricing and corporate finance.

Motivation I

- Evidence from psychology showing people react more to information when primed into negative mood states.
  - Different reliance in heuristics versus systematic processing (Tiedens and Linton, 2001).
  - Anxiety makes agents more receptive to advice, even if this advice is bad (Gino, Wood, and Schweitzer, 2009).
- Akerlof and Shiller (2009): "we conceive of the link between **changes in confidence** [...] as being especially **large and critical when economies are going into a downturn**, but not so important at other times."

Motivation II

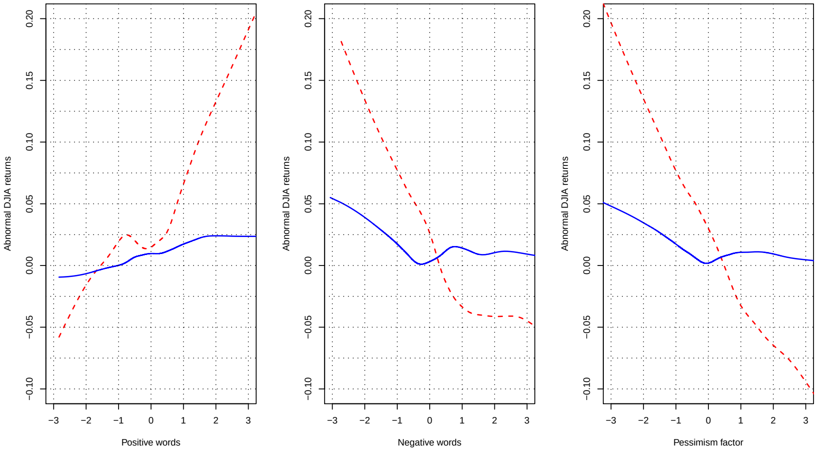
Our project essentially reproduces Tetlock (2007) by constructing measure of financial news content by counting positive and negative words from two columns in the NYT (1905–2005).

- Long–time series almost a must if we are to study business cycle variation.
  - First draft was concentrated on Great Depression.
- Independent time-series, significantly higher statistical power.
- Pre-1984 the media was much more concentrated, so we have an outlet that virtually every investor read.

Main results

- Media predicts stock returns at the daily frequency, particularly so **during recessions**.
  - Over a day, a one-SD increase in pessimism makes DJIA drop by 12 basis points in recessions.
  - Effect is 3.5 basis points in expansions.
  - Survives a battery of statistical tests.
- The predictability lasts into the afternoon, and the initial effect partially reverses over five days.
  - Rules out hypothesis based on information quickly getting impounded into prices.
  - Reversal points into sentiment interpretation.
- Ancillary results:
  - Both positive and negative words bite.
  - The effect is particularly pronounced Mondays.
  - Media reporting itself does not change along the business cycle.

Non-parametric estimates by business cycle



Economic variables

Study covers 1905–2005 time-period.

- Focus on the total return index for the Dow Jones Industrial average.
  - CRSP data not available for 20+ years in my sample.
- NBER recession data.
  - Twenty different recessions during these 101 years, including the Great Depression.
- Intraday DJIA data from Global Financial Data (1933–2005).

New York Times columns

- Focus on two columns from the New York Times: "Financial Markets" and "Topics in Wall Street" ("Sidelights of the day," eventually "Market Place").
  - Both ran virtually uninterrupted from 1905–2005.
  - The later is slightly longer, around 1000 words versus 700.
  - Discuss anything from the stock market to industry conditions to details on a specific company.
  - A total of over 55,000+ columns.
- Obtained copies of their pdf images via `ProQuest`, from the NYT Historical Archive.
  - Also available to any subscriber of the NYT.
- Convert the pdf images to text via "optical character recognition" (OCR).
  - Use a version of ABBYY available at the Carolina Digital Library and Archives (CDLA).

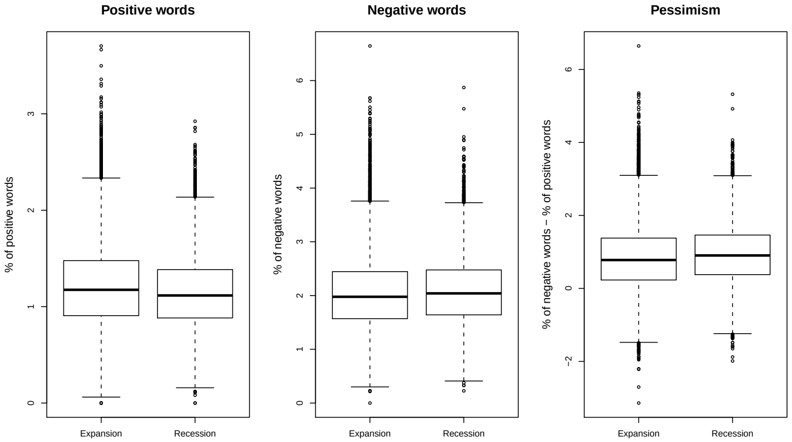
Media measures

- For each article I count the total number of positive words g_{it} and negative words b_{it}.
  - Using Loughran–McDonald's dictionaries for signing words.
- Normalize by the total number of words w_{it} to create a measure of positive/negative news.
- Aggregate all the news by taking the average of all articles written from market close to market open to create two time-series, G_t and B_t, that run on the same time domain as the DJIA.
  - Essentially grab the news written on the afternoon and published the next day.
  - Need the close-to-open to get some news published on Mondays that dealt with the stock market on Saturdays.

Sample statistics, media content

News	Mean	Median	25%-qu.	75%-qu.	SD
A. All dates					
Positive	1.20	1.16	0.90	1.46	0.42
Negative	2.06	1.99	1.59	2.45	0.67
Pessimism	0.86	0.81	0.26	1.40	0.88
B. Recessions					
Positive	1.15	1.12	0.88	1.38	0.39
Negative	2.09	2.04	1.64	2.48	0.64
Pessimism	0.94	0.90	0.38	1.46	0.84
C. Expansions					
Positive	1.21	1.17	0.91	1.48	0.43
Negative	2.05	1.98	1.57	2.45	0.68
Pessimism	0.84	0.78	0.23	1.38	0.89

Boxplot of media variables



DJIA returns, sample stats

A. Sample stats

	Mean	Median	25%-qu.	75%-qu.	SD
All dates	0.020	0.044	-0.450	0.526	1.071
Expansions	0.042	0.056	-0.410	0.517	0.943
Recessions	-0.053	-0.011	-0.637	0.565	1.408

Simple model of asset returns

$$R_t = (1 - D_t)\gamma_1 \mathcal{L}_s(R_t) + D_t \gamma_2 \mathcal{L}_s(R_t) + \boldsymbol{\eta} X_t + \epsilon_t;$$

where $\mathcal{L}_s(R_t) = \{R_{t-1}, \ldots, R_{t-s}\}$.

DJIA autocorrelations

B. Time-series regression

Expansions	γ_1	t-stat	Recessions	γ_2	t-stat
$(1 - D_t) \times R_{t-1}$	0.052	3.1	$D_t \times R_{t-1}$	0.024	0.8
$(1 - D_t) \times R_{t-2}$	-0.045	-2.7	$D_t \times R_{t-2}$	-0.019	-0.7
$(1 - D_t) \times R_{t-3}$	0.004	0.3	$D_t \times R_{t-3}$	0.004	0.2
$(1 - D_t) \times R_{t-4}$	0.005	0.5	$D_t \times R_{t-4}$	0.062	2.6
$(1 - D_t) \times R_{t-5}$	0.011	0.7	$D_t \times R_{t-5}$	0.022	0.9
	η	t-stat		η	t-stat
I_{Tue}	0.140	6.3	I_{Fri}	0.167	7.4
I_{Wed}	0.153	6.7	I_{Sat}	0.189	7.5
I_{Thu}	0.125	5.6	D_t	-0.091	-5.0

Econometric approach - news to returns

Estimate the following model of stock returns

$$R_t = \beta \mathcal{L}_s(M_t) + \rho \mathcal{L}_s(R_t) + \gamma \mathcal{L}_s(R_t^2) + \eta X_t + \epsilon_t;$$

where

- $\mathcal{L}_s$ denotes an s-lag operator.
- M_t denotes one of our media measures i.e. $M_t = G_t$ in the case of positive news, $M_t = B_t$ in the case of negative news, and $M_t = B_t - G_t$ in the case of our pessimism factor.
- X_t includes a constant term, day-of-the-week dummies, and a dummy for recessions or an expansion.
- Standard errors as in White (1980).

Feedback news to stock returns

	Positive		Negative		Pessimism	
	β	t-stat	β	t-stat	β	t-stat
A. All dates						
M_{t-1}	0.039	5.2	-0.043	-5.2	-0.055	-6.3
M_{t-2}	0.003	0.4	0.003	0.3	0.001	0.2
M_{t-3}	-0.008	-1.1	0.005	0.7	0.008	1.0
M_{t-4}	-0.013	-1.8	0.008	1.0	0.013	1.6
M_{t-5}	-0.005	-0.6	0.009	1.2	0.010	1.3
B. Tests	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_1 = 0$	26.9	0.000	26.8	0.000	40.0	0.000
$\sum_{j=2}^{5} \beta_j = 0$	3.1	0.077	3.6	0.059	5.6	0.018

Qualitative findings

- Statistically strong one–day effect, but small in magnitude (5.5 bps).
    - Similar to Tetlock (2007).
- More than half of the one–day effect dissipates over the following four trading days.
    - Suggests the pricing effect is temporary (favors sentiment vs information interpretations).
- Overall, corraborates Tetlock (2007), with the exception that positive words also have an effect.

Feedback news to stock returns along the business cycle

Same as before, but interacting variables with business cycle indicators:

$$
\begin{aligned}
R_t &= (1 - D_t)\left(\beta_1 \mathcal{L}_s(M_t) + \gamma_1 \mathcal{L}_s(R_t) + \psi_1 \mathcal{L}_s(R_t^2)\right) \\
&\quad + D_t\left(\beta_2 \mathcal{L}_s(M_t) + \gamma_2 \mathcal{L}_s(R_t) + \psi_2 \mathcal{L}_s(R_t^2)\right) \\
&\quad + \eta X_t + \epsilon_t.
\end{aligned}
$$

Basic test: differences in influence of media variables, β_1 versus β_2.

Feedback news to stock returns

	Positive		Negative		Pessimism	
	β	t-stat	β	t-stat	β	t-stat
A. Expansions (β_1)						
$(1 - D_t) \times M_{t-1}$	0.024	3.3	-0.028	-3.5	-0.035	-4.2
$(1 - D_t) \times M_{t-2}$	0.004	0.6	0.004	0.5	0.001	0.1
$(1 - D_t) \times M_{t-3}$	-0.004	-0.6	0.005	0.7	0.006	0.8
$(1 - D_t) \times M_{t-4}$	-0.012	-1.7	0.006	0.8	0.011	1.5
$(1 - D_t) \times M_{t-5}$	-0.004	-0.6	0.006	0.8	0.007	0.9
B. Recessions (β_2)						
$D_t \times M_{t-1}$	0.085	3.9	-0.087	-3.4	-0.117	-4.4
$D_t \times M_{t-2}$	0.004	0.2	-0.005	-0.2	-0.004	-0.2
$D_t \times M_{t-3}$	-0.021	-1.0	0.010	0.4	0.020	0.8
$D_t \times M_{t-4}$	-0.009	-0.4	0.016	0.7	0.019	0.8
$D_t \times M_{t-5}$	-0.005	-0.2	0.028	1.2	0.026	1.1

Feedback news to stock returns

C. Tests	Positive		Negative		Pessimism	
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11} = \beta_{21}$	7.2	0.007	5.0	0.025	8.6	0.003
$\sum_{j=2}^{5} \beta_{1j} = 0$	1.6	0.205	2.6	0.109	3.4	0.066
$\sum_{j=2}^{5} \beta_{2j} = 0$	0.7	0.403	1.6	0.212	2.3	0.132

- Leading coefficients much larger in recessions.
- Some evidence of reversals.

Some robustness checks

- Volatility is larger during recessions – could this partially drive our results?
  - Normalize return series by estimates from a first–stage GARCH(1,1) fit.
- News are probably related to R_{t-1} – perhaps picking up autocorrelation?
  - Fit $M_t = R_t + \mathcal{L}_s(R_t) + \epsilon_t$, then use $\hat{\epsilon}_t$ instead of M_t.
- Could outliers drive results?
  - Use Huber–type M–estimator.
- Significant time–series variation: perhaps autocorrelations/media/weather changed through sample.
  - Run specification for each business–cycle (fixed–effects interacted with all RHS variables).

GARCH(1,1) adjusted returns

	Positive		Negative		Pessimism	
A. GARCH-adjusted returns						
	β	t-stat	β	t-stat	β	t-stat
$(1 - D_t) \times M_{t-1}$	0.022	3.1	-0.025	-3.3	-0.033	-4.1
$D_t \times M_{t-1}$	0.051	3.5	-0.070	-4.3	-0.087	-5.1
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11} = \beta_{21}$	3.1	0.079	6.1	0.014	8.2	0.004
$\sum_{j=2}^{5} \beta_{1j} = 0$	1.3	0.254	1.9	0.170	3.0	0.085
$\sum_{j=2}^{5} \beta_{2j} = 0$	0.0	0.868	2.7	0.103	2.1	0.148

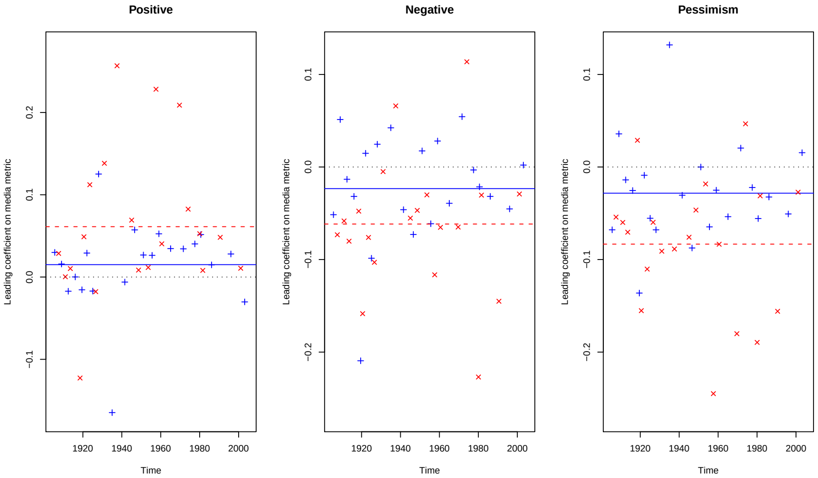
Using residuals of media regressions

	Positive		Negative		Pessimism	
B. Orthogonal media measures						
	β	t-stat	β	t-stat	β	t-stat
$(1-D_t) \times M_{t-1}$	0.022	3.3	-0.027	-3.8	-0.032	-4.4
$D_t \times M_{t-1}$	0.078	3.8	-0.068	-3.1	-0.094	-4.1
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11} = \beta_{21}$	6.9	0.008	3.1	0.080	6.6	0.010
$\sum_{j=2}^{5} \beta_{1j} = 0$	0.1	0.815	0.2	0.667	0.2	0.688
$\sum_{j=2}^{5} \beta_{2j} = 0$	0.0	0.898	0.0	0.867	0.0	0.917

Robust regressions

	Positive		Negative		Pessimism	
C. Robust regression						
	β	t-stat	β	t-stat	β	t-stat
$(1-D_t)\times M_{t-1}$	0.024	4.0	-0.025	-4.0	-0.034	-5.3
$D_t \times M_{t-1}$	0.055	4.6	-0.086	-7.0	-0.101	-7.9
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11}=\beta_{21}$	5.4	0.020	19.7	0.000	22.2	0.000
$\sum_{j=2}^{5}\beta_{1j}=0$	3.2	0.075	1.3	0.258	3.4	0.065
$\sum_{j=2}^{5}\beta_{2j}=0$	1.2	0.282	7.7	0.005	3.5	0.063

Estimates by business cycle



Information or sentiment

- Reversals point in sentiment direction.
  - But even with 100 years of data we have low power.
- First – is reporting different in recessions than in expansions?
  - Look at $M_t = (1 - D_t)R_t + D_t R_t + \ldots$.
- Second – any differences based on "facts" reported?
  - Use "numbers" as proxy for facts.
- Third – any differences on days–of–the–week?
  - Weekends are less likely to produce information, but more investors read news.
- Last – is the effect quickly incorporated into prices?
  - Study returns 11am–close.

Econometric approach - stock to news

Estimate the following model

$$
\begin{aligned}
M_t &= (1 - D_t)\left(\beta_1 \mathcal{L}_s(M_t) + \lambda_1 R_t + \gamma_1 \mathcal{L}_s(R_t) + \psi_1 \mathcal{L}_s(R_t^2)\right) \\
&\quad + D_t\left(\beta_2 \mathcal{L}_s(M_t) + \lambda_2 R_t + \gamma_2 \mathcal{L}_s(R_t) + \psi_2 \mathcal{L}_s(R_t^2)\right) \\
&\quad + \boldsymbol{\eta} X_t + \epsilon_t.
\end{aligned}
$$

- System of equations not strictly a VAR, since one should include contemporaneous returns.
  - Columns are finished after the market closed.
- If we pick up differences in reporting, perhaps that explains the differential effect of media on stock returns.

Feedback stock returns to news

	Positive		Negative		Pessimism	
	λ, β	t-stat	λ, β	t-stat	λ, β	t-stat
A. Using raw returns $(\lambda_1, \beta_1, \lambda_2, \beta_2)$						
$(1 - D_t) \times R_t$	0.335	32.3	-0.332	-30.7	-0.414	-34.2
$(1 - D_t) \times R_{t-1}$	0.046	6.1	-0.056	-7.6	-0.059	-7.8
$D_t \times R_t$	0.197	16.8	-0.221	-19.5	-0.263	-20.3
$D_t \times R_{t-1}$	0.048	5.4	-0.045	-5.4	-0.052	-5.7
	F-stat	p-value	F-stat	p-value	F-stat	p-value
Test $\lambda_1 = \lambda_2$	28.5	0.000	20.2	0.000	28.6	0.000

Feedback stock returns to news

	Positive		Negative		Pessimism	
	λ, β	t-stat	λ, β	t-stat	λ, β	t-stat
B. Returns normalized by GARCH(1,1) $(\lambda_1, \beta_1, \lambda_2, \beta_2)$						
$(1 - D_t) \times R_t$	0.345	48.7	-0.342	-50.2	-0.427	-61.7
$(1 - D_t) \times R_{t-1}$	0.040	5.6	-0.044	-6.4	-0.047	-6.8
$D_t \times R_t$	0.324	26.3	-0.338	-31.4	-0.413	-37.0
$D_t \times R_{t-1}$	0.065	5.5	-0.050	-4.7	-0.063	-5.6
	F-stat	p-value	F-stat	p-value	F-stat	p-value
Test $\lambda_1 = \lambda_2$	1.9	0.086	0.9	0.474	0.8	0.564

Hard news versus word counts

	Positive		Negative		Pessimism	
	β	t-stat	β	t-stat	β	t-stat
Exp, high-inf, β_{11}	0.020	1.9	-0.026	-2.1	-0.031	-2.6
Exp, low-inf, β_{21}	0.026	3.0	-0.029	-3.0	-0.038	-3.8
Rec, high-inf, β_{31}	0.098	3.1	-0.094	-2.6	-0.127	-3.4
Rec, low-inf, β_{41}	0.075	2.9	-0.082	-2.8	-0.109	-3.7
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11} = \beta_{21}$	0.3	0.611	0.1	0.819	0.2	0.644
$\beta_{31} = \beta_{41}$	0.4	0.532	0.1	0.779	0.2	0.662
$\beta_{11} = \beta_{31}$	5.7	0.017	3.1	0.076	6.1	0.014
$\beta_{21} = \beta_{41}$	3.2	0.075	2.9	0.086	5.2	0.022

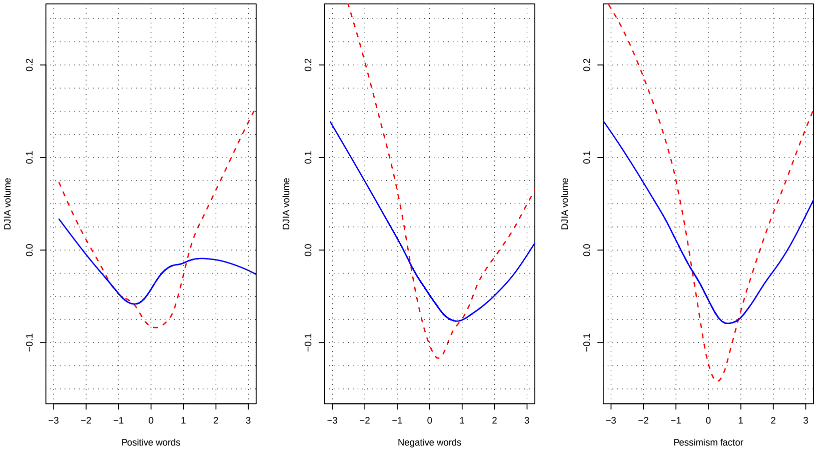
Mondays and holidays

	Positive		Negative		Pessimism	
	β	t-stat	β	t-stat	β	t-stat
Exp, Mon/holidays, β_{11}	0.056	3.3	-0.062	-3.5	-0.079	-4.1
Exp, weekday, β_{21}	0.015	1.9	-0.019	-2.1	-0.024	-2.6
Rec, Mon/holidays, β_{31}	0.188	4.0	-0.208	-3.8	-0.267	-4.9
Rec, weekdays, β_{41}	0.062	2.8	-0.061	-2.3	-0.085	-3.1
	F-stat	p-value	F-stat	p-value	F-stat	p-value
$\beta_{11} = \beta_{21}$	4.7	0.031	4.8	0.029	6.6	0.010
$\beta_{31} = \beta_{41}$	6.2	0.012	6.0	0.014	10.0	0.002
$\beta_{11} = \beta_{31}$	6.9	0.008	6.2	0.013	10.5	0.001
$\beta_{21} = \beta_{41}$	4.0	0.046	2.3	0.128	4.5	0.034

Returns from 11am to close

	Positive		Negative		Pessimism	
	β	t-stat	β	t-stat	β	t-stat
$(1 - D_t) \times M_{t-1}$	-0.001	-0.1	-0.015	-2.3	-0.012	-1.8
$D_t \times M_{t-1}$	0.057	3.1	-0.047	-2.6	-0.065	-3.5
	F-stat	p-value	F-stat	p-value	F-stat	p-value
Test $\beta_{11} = \beta_{21}$	8.9	0.003	2.9	0.088	7.3	0.007

Volume and the media



Conclusion

- Paper presents evidence of strong asymmetry in the **reaction of DJIA returns to news** across the business cycle.
  - Effect particularly strong in **recessions**.
- Evidence is consistent with **sentiment** playing a more important role during economic downturns.
  - Reversals, concentration on Monday, afternoon predictability.