Sentiment during recessions

Diego García
UNC at Chapel Hill

First International Moscow Finance Conference
November 18th, 2011
Shiller’s view of the media

- “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 5-8 bps, 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.
- 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.”
Our project essentially reproduces Tetlock (2007) by constructing a 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


- 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.
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

<table>
<thead>
<tr>
<th>News</th>
<th>Mean</th>
<th>Median</th>
<th>25%-qu.</th>
<th>75%-qu.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. All dates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>1.20</td>
<td>1.16</td>
<td>0.90</td>
<td>1.46</td>
<td>0.42</td>
</tr>
<tr>
<td>Negative</td>
<td>2.06</td>
<td>1.99</td>
<td>1.59</td>
<td>2.45</td>
<td>0.67</td>
</tr>
<tr>
<td>Pessimism</td>
<td>0.86</td>
<td>0.81</td>
<td>0.26</td>
<td>1.40</td>
<td>0.88</td>
</tr>
<tr>
<td><strong>B. Recessions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>1.15</td>
<td>1.12</td>
<td>0.88</td>
<td>1.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Negative</td>
<td>2.09</td>
<td>2.04</td>
<td>1.64</td>
<td>2.48</td>
<td>0.64</td>
</tr>
<tr>
<td>Pessimism</td>
<td>0.94</td>
<td>0.90</td>
<td>0.38</td>
<td>1.46</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>C. Expansions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>1.21</td>
<td>1.17</td>
<td>0.91</td>
<td>1.48</td>
<td>0.43</td>
</tr>
<tr>
<td>Negative</td>
<td>2.05</td>
<td>1.98</td>
<td>1.57</td>
<td>2.45</td>
<td>0.68</td>
</tr>
<tr>
<td>Pessimism</td>
<td>0.84</td>
<td>0.78</td>
<td>0.23</td>
<td>1.38</td>
<td>0.89</td>
</tr>
</tbody>
</table>
Boxplot of media variables
DJIA returns, sample stats

A. Sample stats

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>25%-qu.</th>
<th>75%-qu.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All dates</td>
<td>0.020</td>
<td>0.044</td>
<td>-0.450</td>
<td>0.526</td>
<td>1.071</td>
</tr>
<tr>
<td>Expansions</td>
<td>0.042</td>
<td>0.056</td>
<td>-0.410</td>
<td>0.517</td>
<td>0.943</td>
</tr>
<tr>
<td>Recessions</td>
<td>-0.053</td>
<td>-0.011</td>
<td>-0.637</td>
<td>0.565</td>
<td>1.408</td>
</tr>
</tbody>
</table>

Simple model of asset returns

\[ R_t = (1 - D_t)\gamma_1 L_s(R_t) + D_t\gamma_2 L_s(R_t) + \eta X_t + \epsilon_t; \]

where \( L_s(R_t) = \{R_{t-1}, \ldots, R_{t-s}\}. \)
## DJIA autocorrelations

### B. Time-series regression

<table>
<thead>
<tr>
<th>Expansions</th>
<th>$\gamma_1$</th>
<th>$t$-stat</th>
<th>Recessions</th>
<th>$\gamma_2$</th>
<th>$t$-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(1 - D_t) \times R_{t-1}$</td>
<td>0.052</td>
<td>3.1</td>
<td>$D_t \times R_{t-1}$</td>
<td>0.024</td>
<td>0.8</td>
</tr>
<tr>
<td>$(1 - D_t) \times R_{t-2}$</td>
<td>-0.045</td>
<td>-2.7</td>
<td>$D_t \times R_{t-2}$</td>
<td>-0.019</td>
<td>-0.7</td>
</tr>
<tr>
<td>$(1 - D_t) \times R_{t-3}$</td>
<td>0.004</td>
<td>0.3</td>
<td>$D_t \times R_{t-3}$</td>
<td>0.004</td>
<td>0.2</td>
</tr>
<tr>
<td>$(1 - D_t) \times R_{t-4}$</td>
<td>0.005</td>
<td>0.5</td>
<td>$D_t \times R_{t-4}$</td>
<td>0.062</td>
<td>2.6</td>
</tr>
<tr>
<td>$(1 - D_t) \times R_{t-5}$</td>
<td>0.011</td>
<td>0.7</td>
<td>$D_t \times R_{t-5}$</td>
<td>0.022</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\eta$</th>
<th>$t$-stat</th>
<th>$\eta$</th>
<th>$t$-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>$l_{\text{Tue}}$</td>
<td>0.140</td>
<td>6.3</td>
<td>0.167</td>
</tr>
<tr>
<td>$l_{\text{Wed}}$</td>
<td>0.153</td>
<td>6.7</td>
<td>0.189</td>
</tr>
<tr>
<td>$l_{\text{Thu}}$</td>
<td>0.125</td>
<td>5.6</td>
<td>$D_t$</td>
</tr>
<tr>
<td>$l_{\text{Fri}}$</td>
<td>0.167</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$l_{\text{Sat}}$</td>
<td>0.189</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diego García (UNC at Chapel Hill)
Econometric approach - news to returns

Estimate the following model of stock returns

\[ R_t = \beta L_s(M_t) + \rho L_s(R_t) + \gamma L_s(R_t^2) + \eta X_t + \epsilon_t; \]

where

- \( L_s \) 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

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>$M_{t-1}$</td>
<td>0.039</td>
<td>5.2</td>
</tr>
<tr>
<td>$M_{t-2}$</td>
<td>0.003</td>
<td>0.4</td>
</tr>
<tr>
<td>$M_{t-3}$</td>
<td>-0.008</td>
<td>-1.1</td>
</tr>
<tr>
<td>$M_{t-4}$</td>
<td>-0.013</td>
<td>-1.8</td>
</tr>
<tr>
<td>$M_{t-5}$</td>
<td>-0.005</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

B. Tests

<table>
<thead>
<tr>
<th>$\beta_1 = 0$</th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26.9</td>
<td>0.000</td>
<td>26.8</td>
<td>0.000</td>
<td>40.0</td>
<td>0.000</td>
</tr>
<tr>
<td>$\sum_{j=2}^5 \beta_j = 0$</td>
<td>3.1</td>
<td>0.077</td>
<td>3.6</td>
<td>0.059</td>
<td>5.6</td>
<td>0.018</td>
</tr>
</tbody>
</table>
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, corroborates 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:

\[ R_t = (1 - D_t) \left( \beta_1 L_s(M_t) + \gamma_1 L_s(R_t) + \psi_1 L_s(R^2_t) \right) + D_t \left( \beta_2 L_s(M_t) + \gamma_2 L_s(R_t) + \psi_2 L_s(R^2_t) \right) + \eta X_t + \epsilon_t. \]

Basic test: differences in influence of media variables, \( \beta_1 \) versus \( \beta_2 \).
Feedback news to stock returns

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Pessimism</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
</tr>
<tr>
<td><strong>A. Expansions ($\beta_1$)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-1}$</td>
<td>0.024</td>
<td>3.3</td>
<td>-0.028</td>
<td>-3.5</td>
<td>-0.035</td>
<td>-4.2</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-2}$</td>
<td>0.004</td>
<td>0.6</td>
<td>0.004</td>
<td>0.5</td>
<td>0.001</td>
<td>0.1</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-3}$</td>
<td>-0.004</td>
<td>-0.6</td>
<td>0.005</td>
<td>0.7</td>
<td>0.006</td>
<td>0.8</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-4}$</td>
<td>-0.012</td>
<td>-1.7</td>
<td>0.006</td>
<td>0.8</td>
<td>0.011</td>
<td>1.5</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-5}$</td>
<td>-0.004</td>
<td>-0.6</td>
<td>0.006</td>
<td>0.8</td>
<td>0.007</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>B. Recessions ($\beta_2$)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$D_t \times M_{t-1}$</td>
<td>0.085</td>
<td>3.9</td>
<td>-0.087</td>
<td>-3.4</td>
<td>-0.117</td>
<td>-4.4</td>
</tr>
<tr>
<td>$D_t \times M_{t-2}$</td>
<td>0.004</td>
<td>0.2</td>
<td>-0.005</td>
<td>-0.2</td>
<td>-0.004</td>
<td>-0.2</td>
</tr>
<tr>
<td>$D_t \times M_{t-3}$</td>
<td>-0.021</td>
<td>-1.0</td>
<td>0.010</td>
<td>0.4</td>
<td>0.020</td>
<td>0.8</td>
</tr>
<tr>
<td>$D_t \times M_{t-4}$</td>
<td>-0.009</td>
<td>-0.4</td>
<td>0.016</td>
<td>0.7</td>
<td>0.019</td>
<td>0.8</td>
</tr>
<tr>
<td>$D_t \times M_{t-5}$</td>
<td>-0.005</td>
<td>-0.2</td>
<td>0.028</td>
<td>1.2</td>
<td>0.026</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Feedback news to stock returns

<table>
<thead>
<tr>
<th>C. Tests</th>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{11} = \beta_{21}$</td>
<td>7.2</td>
<td>5.0</td>
<td>8.6</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{1j} = 0$</td>
<td>1.6</td>
<td>2.6</td>
<td>3.4</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{2j} = 0$</td>
<td>0.7</td>
<td>1.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

- 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 $M_t = R_t + L_s(R_t) + \epsilon_t$, 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).
### A. GARCH-adjusted returns

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Pessimism</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-1}$</td>
<td>0.022</td>
<td>3.1</td>
<td>-0.025</td>
<td>-3.3</td>
<td>-0.033</td>
<td>-4.1</td>
</tr>
<tr>
<td>$D_t \times M_{t-1}$</td>
<td>0.051</td>
<td>3.5</td>
<td>-0.070</td>
<td>-4.3</td>
<td>-0.087</td>
<td>-5.1</td>
</tr>
<tr>
<td>$\beta_{11} = \beta_{21}$</td>
<td>3.1</td>
<td>0.079</td>
<td>6.1</td>
<td>0.014</td>
<td>8.2</td>
<td>0.004</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{1j} = 0$</td>
<td>1.3</td>
<td>0.254</td>
<td>1.9</td>
<td>0.170</td>
<td>3.0</td>
<td>0.085</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{2j} = 0$</td>
<td>0.0</td>
<td>0.868</td>
<td>2.7</td>
<td>0.103</td>
<td>2.1</td>
<td>0.148</td>
</tr>
</tbody>
</table>
Using residuals of media regressions

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Pessimism</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. Orthogonal media measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((1 - D_t) \times M_{t-1})</td>
<td>(\beta)</td>
<td>(t)-stat</td>
<td>(\beta)</td>
<td>(t)-stat</td>
<td>(\beta)</td>
<td>(t)-stat</td>
</tr>
<tr>
<td></td>
<td>0.022</td>
<td>3.3</td>
<td>-0.027</td>
<td>-3.8</td>
<td>-0.032</td>
<td>-4.4</td>
</tr>
<tr>
<td>(D_t \times M_{t-1})</td>
<td>0.078</td>
<td>3.8</td>
<td>-0.068</td>
<td>-3.1</td>
<td>-0.094</td>
<td>-4.1</td>
</tr>
<tr>
<td><strong>F-stat</strong></td>
<td>(F)-stat</td>
<td>(p)-value</td>
<td><strong>F-stat</strong></td>
<td>(p)-value</td>
<td><strong>F-stat</strong></td>
<td>(p)-value</td>
</tr>
<tr>
<td>(\beta_{11} = \beta_{21})</td>
<td>6.9</td>
<td>0.008</td>
<td>3.1</td>
<td>0.080</td>
<td>6.6</td>
<td>0.010</td>
</tr>
<tr>
<td>(\sum_{j=2}^{5} \beta_{1j} = 0)</td>
<td>0.1</td>
<td>0.815</td>
<td>0.2</td>
<td>0.667</td>
<td>0.2</td>
<td>0.688</td>
</tr>
<tr>
<td>(\sum_{j=2}^{5} \beta_{2j} = 0)</td>
<td>0.0</td>
<td>0.898</td>
<td>0.0</td>
<td>0.867</td>
<td>0.0</td>
<td>0.917</td>
</tr>
</tbody>
</table>
### C. Robust regression

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
</tr>
<tr>
<td>$(1 - D_t) \times M_{t-1}$</td>
<td>0.024</td>
<td>4.0</td>
<td>-0.025</td>
</tr>
<tr>
<td>$D_t \times M_{t-1}$</td>
<td>0.055</td>
<td>4.6</td>
<td>-0.086</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{11} = \beta_{21}$</td>
<td>5.4</td>
<td>0.020</td>
<td>19.7</td>
<td>0.000</td>
<td>22.2</td>
<td>0.000</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{1j} = 0$</td>
<td>3.2</td>
<td>0.075</td>
<td>1.3</td>
<td>0.258</td>
<td>3.4</td>
<td>0.065</td>
</tr>
<tr>
<td>$\sum_{j=2}^{5} \beta_{2j} = 0$</td>
<td>1.2</td>
<td>0.282</td>
<td>7.7</td>
<td>0.005</td>
<td>3.5</td>
<td>0.063</td>
</tr>
</tbody>
</table>
Estimates by business cycle

### Positive

<table>
<thead>
<tr>
<th>Year</th>
<th>-0.2</th>
<th>-0.1</th>
<th>0.0</th>
<th>0.1</th>
<th>0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>x</td>
<td>+</td>
</tr>
<tr>
<td>1940</td>
<td>x</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1960</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1980</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2000</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

### Negative

<table>
<thead>
<tr>
<th>Year</th>
<th>-0.2</th>
<th>-0.1</th>
<th>0.0</th>
<th>0.1</th>
<th>0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>x</td>
<td>+</td>
</tr>
<tr>
<td>1940</td>
<td>x</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1960</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1980</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2000</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

### Pessimism

<table>
<thead>
<tr>
<th>Year</th>
<th>-0.2</th>
<th>-0.1</th>
<th>0.0</th>
<th>0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1940</td>
<td>x</td>
<td>x</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1960</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
</tr>
<tr>
<td>1980</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2000</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

---

Diego García (UNC at Chapel Hill)
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.
Estimate the following model

\[ M_t = (1 - D_t) (\beta_1 L_s(M_t) + \lambda_1 R_t + \gamma_1 L_s(R_t) + \psi_1 L_s(R_t^2)) \]

\[ + D_t (\beta_2 L_s(M_t) + \lambda_2 R_t + \gamma_2 L_s(R_t) + \psi_2 L_s(R_t^2)) \]

\[ + \eta X_t + \epsilon_t. \]

- 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

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda, \beta$</td>
<td>$\lambda, \beta$</td>
<td>$\lambda, \beta$</td>
</tr>
<tr>
<td>$t$-stat</td>
<td>$t$-stat</td>
<td>$t$-stat</td>
</tr>
</tbody>
</table>

### 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  |

<table>
<thead>
<tr>
<th>Test $\lambda_1 = \lambda_2$</th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
<th>$F$-stat</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.5</td>
<td>0.000</td>
<td>20.2</td>
<td>0.000</td>
<td>28.6</td>
<td>0.000</td>
</tr>
</tbody>
</table>
**Feedback stock returns to news**

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Pessimism</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\lambda, \beta$</td>
<td>$t$-stat</td>
<td>$\lambda, \beta$</td>
<td>$t$-stat</td>
<td>$\lambda, \beta$</td>
<td>$t$-stat</td>
</tr>
<tr>
<td>(1 - $D_t$) $\times R_t$</td>
<td>0.345</td>
<td>48.7</td>
<td>-0.342</td>
<td>-50.2</td>
<td>-0.427</td>
<td>-61.7</td>
</tr>
<tr>
<td>(1 - $D_t$) $\times R_{t-1}$</td>
<td>0.040</td>
<td>5.6</td>
<td>-0.044</td>
<td>-6.4</td>
<td>-0.047</td>
<td>-6.8</td>
</tr>
<tr>
<td>$D_t \times R_t$</td>
<td>0.324</td>
<td>26.3</td>
<td>-0.338</td>
<td>-31.4</td>
<td>-0.413</td>
<td>-37.0</td>
</tr>
<tr>
<td>$D_t \times R_{t-1}$</td>
<td>0.065</td>
<td>5.5</td>
<td>-0.050</td>
<td>-4.7</td>
<td>-0.063</td>
<td>-5.6</td>
</tr>
<tr>
<td>Test $\lambda_1 = \lambda_2$</td>
<td>1.9</td>
<td>0.086</td>
<td>0.9</td>
<td>0.474</td>
<td>0.8</td>
<td>0.564</td>
</tr>
</tbody>
</table>

B. Returns normalized by GARCH(1,1) ($\lambda_1, \beta_1, \lambda_2, \beta_2$)
## Hard news versus word counts

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Pessimism</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
<td>$\beta$</td>
<td>$t$-stat</td>
</tr>
<tr>
<td>Exp, high-inf, $\beta_{11}$</td>
<td>0.020</td>
<td>1.9</td>
<td>-0.026</td>
<td>-2.1</td>
<td>-0.031</td>
<td>-2.6</td>
</tr>
<tr>
<td>Exp, low-inf, $\beta_{21}$</td>
<td>0.026</td>
<td>3.0</td>
<td>-0.029</td>
<td>-3.0</td>
<td>-0.038</td>
<td>-3.8</td>
</tr>
<tr>
<td>Rec, high-inf, $\beta_{31}$</td>
<td>0.098</td>
<td>3.1</td>
<td>-0.094</td>
<td>-2.6</td>
<td>-0.127</td>
<td>-3.4</td>
</tr>
<tr>
<td>Rec, low-inf, $\beta_{41}$</td>
<td>0.075</td>
<td>2.9</td>
<td>-0.082</td>
<td>-2.8</td>
<td>-0.109</td>
<td>-3.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>F-stat</th>
<th>$p$-value</th>
<th>F-stat</th>
<th>$p$-value</th>
<th>F-stat</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{11} = \beta_{21}$</td>
<td>0.3</td>
<td>0.611</td>
<td>0.1</td>
<td>0.819</td>
<td>0.2</td>
<td>0.644</td>
</tr>
<tr>
<td>$\beta_{31} = \beta_{41}$</td>
<td>0.4</td>
<td>0.532</td>
<td>0.1</td>
<td>0.779</td>
<td>0.2</td>
<td>0.662</td>
</tr>
<tr>
<td>$\beta_{11} = \beta_{31}$</td>
<td>5.7</td>
<td>0.017</td>
<td>3.1</td>
<td>0.076</td>
<td>6.1</td>
<td>0.014</td>
</tr>
<tr>
<td>$\beta_{21} = \beta_{41}$</td>
<td>3.2</td>
<td>0.075</td>
<td>2.9</td>
<td>0.086</td>
<td>5.2</td>
<td>0.022</td>
</tr>
</tbody>
</table>
The data

Results

Information versus sentiment

Conclusion

Mondays and holidays

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>β</td>
<td>t-stat</td>
<td>β</td>
</tr>
<tr>
<td>Exp, Mon/holidays, $\beta_{11}$</td>
<td>0.056</td>
<td>3.3</td>
</tr>
<tr>
<td>Exp, weekday, $\beta_{21}$</td>
<td>0.015</td>
<td>1.9</td>
</tr>
<tr>
<td>Rec, Mon/holidays, $\beta_{31}$</td>
<td>0.188</td>
<td>4.0</td>
</tr>
<tr>
<td>Rec, weekdays, $\beta_{41}$</td>
<td>0.062</td>
<td>2.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$F$-stat</th>
<th>p-value</th>
<th>$F$-stat</th>
<th>p-value</th>
<th>$F$-stat</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{11} = \beta_{21}$</td>
<td>4.7</td>
<td>0.031</td>
<td>4.8</td>
<td>0.029</td>
<td>6.6</td>
</tr>
<tr>
<td>$\beta_{31} = \beta_{41}$</td>
<td>6.2</td>
<td>0.012</td>
<td>6.0</td>
<td>0.014</td>
<td>10.0</td>
</tr>
<tr>
<td>$\beta_{11} = \beta_{31}$</td>
<td>6.9</td>
<td>0.008</td>
<td>6.2</td>
<td>0.013</td>
<td>10.5</td>
</tr>
<tr>
<td>$\beta_{21} = \beta_{41}$</td>
<td>4.0</td>
<td>0.046</td>
<td>2.3</td>
<td>0.128</td>
<td>4.5</td>
</tr>
</tbody>
</table>
## Results

### Information versus sentiment

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
<th>Pessimism</th>
</tr>
</thead>
<tbody>
<tr>
<td>((1 - D_t) \times M_{t-1})</td>
<td>(\beta)</td>
<td>(t)-stat</td>
<td>(\beta)</td>
</tr>
<tr>
<td>(D_t \times M_{t-1})</td>
<td>-0.001</td>
<td>-0.1</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>0.057</td>
<td>3.1</td>
<td>-0.047</td>
</tr>
<tr>
<td><strong>Test</strong> (\beta_{11} = \beta_{21})</td>
<td><strong>8.9</strong></td>
<td><strong>0.003</strong></td>
<td><strong>2.9</strong></td>
</tr>
</tbody>
</table>
Volume and the media

Diego García (UNC at Chapel Hill)
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.