Macroeconomic News Announcements, Financial Market Volatility and Jumps

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Q: How does financial market response to macroeconomic news announcements?

- Financial economics – efficient market hypothesis.
- Macroeconomics – policy decision making.
- Practical implications for investors.

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Market responses are hard to detected using daily data:

Strong evidence of market responses based on high-frequency data:


Factors contributing to the weak evidence of response:

- Most responses are short-lived — need high-frequency data to detect.
- Response direction may change during different business cycles — effects may cancel out if aggregating across BCs.
- Only surprising news matter — responses seem weaker if considering all the announcements.
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This paper progresses in two directions:

- Separate market responses into continuous volatility and discontinuous jumps.
- Differentiate disagreement and uncertainty in measuring surprises.

Main findings of this paper:

- More large jumps in news announcement days than in no-news days.
- Fixed-income market is more responsive to news.
- Non-farm payroll employment is the most influential news.
- Surprises in forecasts impact volatility and jumps in the bond market more than the equity market.
- Disagreement and uncertainty influence both markets with different effects on volatility and jumps.
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Outline

• Theoretical background.
  • Volatility and jump definitions.
  • Jump detection test statistics.

• Empirical evidence.
  • Economic derivatives.
  • Impact of news surprises on volatility and jumps.
  • Impact of disagreement and uncertainty on volatility and jumps.

• Conclusions.
Notation

- Dynamics of the log price process

\[ dp(\tau) = \mu(\tau)d\tau + \sigma(\tau-)dw(\tau) + \kappa(\tau)dq(\tau), \quad (1) \]

where \( \tau \in \mathbb{R}^+ \).

- Within-day trading-time geometric returns

\[ r_{t,j} = p(t - 1 + j/M) - p(t - 1 + (j - 1)/M), \quad j = 1, 2, \ldots, M \]

(2)

where \( j = 1, 2, \ldots, M, \ t = 1, 2, \ldots \).
Trading-time Quadratic Variation:

\[ QV_t = \int_{t-1}^{t} \sigma^2(s) \, ds + \sum_{j=1}^{N_t} \kappa_{tj}^2 = IV_t + QVJ_t. \] (3)

Nonparametric measures of \( QV_t, IV_t \) and \( QVJ_t \):

- Realized Variance: \( RV_t = \sum_{j=1}^{M} r_{tj}^2 \xrightarrow{\mathbb{P}} QV_t \).
- Realized Bipower Variation:

\[ RBV_{i,t} = \mu_a^{-2} \left( \frac{M}{M - 1 - i} \right) \sum_{j=2+i}^{M} |r_{t,j-(1+i)}||r_{t,j}| \xrightarrow{\mathbb{P}} IV_t, \quad i \geq 0. \]

where \( \mu_a = E(|Z|^a) \), \( Z \sim N(0, 1) \), \( a > 0 \).

Jump Contribution: \( J_{i,t} = RV_t - RBV_{i,t} \xrightarrow{\mathbb{P}} QVJ_t \).
Trading-time Quadratic Variation:

\[ QV_t = \int_{t-1}^{t} \sigma^2(s) ds + \sum_{j=1}^{N_t} \kappa_j^2 = IV_t + QVJ_t. \]  

Nonparametric measures of \( QV_t, IV_t \) and \( QVJ_t \).

- Realized Variance: \( RV_t = \sum_{j=1}^{M} r_{tj}^2 \xrightarrow{P} QV_t \).
- Realized Bipower Variation:

\[ RBV_{i,t} = \mu_{-2}^{-1} \left( \frac{M}{M-1-i} \right) \sum_{j=2+i}^{M} |r_{t,j-(1+i)}| |r_{t,j}| \xrightarrow{P} IV_t, \quad i \geq 0. \]

where \( \mu_a = E(|Z|^a), \quad Z \sim N(0,1), \quad a > 0. \)

- Jump Contribution: \( J_{i,t} = RV_t - RBV_{i,t} \xrightarrow{P} QVJ_t. \)
Jump Detection Test Statistics

\[
Z_{RTQ, rm, t} = \frac{RV_t - RBV_{1,t}}{RV_t} \sqrt{((\frac{\pi}{2})^2 + \pi - 5) \frac{1}{M} \max(1, \frac{RTQ_t}{RBV_{1,t}^2})}
\]  

(4)

where

\[
RTQ_{1,t} = M \mu_{\frac{4}{3}} \left( \frac{M}{M - 6} \right) \sum_{j=1}^{M} |r_{t,j-4}|^{4/3} |r_{t,j-2}|^{4/3} |r_{t,j}|^{4/3}.
\]  

(5)

- \( Z_{RTQ, rm, t} \overset{a}{\sim} N(0, 1) \).
- \( Z_{RTQ, rm, t} > \Phi_\alpha \) signals a jump day at \( \alpha \) level of significance.

- Sample periods

- Trading time
  - US 30-year TB: 8:20 - 15:00 (EST).

Macroeconomic news announcements. Sample periods varies.

Market expectations:
- Survey forecasts: Money Market Services (MMS). Same periods as those of announcements.
Figure 1: Price plot on 6/7/1996. NFPAY (8:30am): announcement 340, expectation 170, std. dev. 56.5.
### Table 1: Proportion of Jump Days in Announcement Days (0.99)

<table>
<thead>
<tr>
<th>Announcement</th>
<th>SP</th>
<th>US</th>
<th>Cojump</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPAY</td>
<td>0.356&lt;132&gt;(5.482)[0.000]**</td>
<td>0.547&lt;192&gt;(8.705)[0.000]**</td>
<td>0.200&lt;130&gt;(4.978)[0.000]**</td>
</tr>
<tr>
<td>ICLM</td>
<td>0.179&lt;581&gt;(3.068)[0.001]**</td>
<td>0.258&lt;705&gt;(1.963)[0.025]**</td>
<td>0.064&lt;575&gt;(3.572)[0.000]**</td>
</tr>
<tr>
<td>CPI</td>
<td>0.232&lt;138&gt;(2.982)[0.001]**</td>
<td>0.307&lt;199&gt;(2.534)[0.006]**</td>
<td>0.080&lt;138&gt;(2.379)[0.009]**</td>
</tr>
<tr>
<td>PPI</td>
<td>0.228&lt;136&gt;(2.873)[0.002]**</td>
<td>0.411&lt;192&gt;(5.165)[0.000]**</td>
<td>0.137&lt;131&gt;(3.733)[0.000]**</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.244&lt;131&gt;(3.181)[0.001]**</td>
<td>0.326&lt;193&gt;(3.020)[0.001]**</td>
<td>0.107&lt;131&gt;(3.034)[0.001]**</td>
</tr>
<tr>
<td>RETLS</td>
<td>0.243&lt;136&gt;(3.200)[0.001]**</td>
<td>0.368&lt;193&gt;(4.080)[0.000]**</td>
<td>0.106&lt;132&gt;(3.025)[0.001]**</td>
</tr>
<tr>
<td>RSXAUT</td>
<td>0.250&lt;136&gt;(3.361)[0.000]**</td>
<td>0.364&lt;184&gt;(3.900)[0.000]**</td>
<td>0.114&lt;132&gt;(3.208)[0.001]**</td>
</tr>
<tr>
<td>BUSINV</td>
<td>0.181&lt;116&gt;(1.633)[0.051]*</td>
<td>0.339&lt;174&gt;(3.193)[0.001]**</td>
<td>0.061&lt;115&gt;(1.632)[0.051]*</td>
</tr>
<tr>
<td>News</td>
<td>0.169&lt;1949&gt;</td>
<td>0.290&lt;2783&gt;</td>
<td>0.063&lt;1924&gt;</td>
</tr>
<tr>
<td>No-news</td>
<td>0.120&lt;908&gt;</td>
<td>0.219&lt;1325&gt;</td>
<td>0.024&lt;892&gt;</td>
</tr>
<tr>
<td>Total</td>
<td>0.154&lt;2857&gt;</td>
<td>0.267&lt;4108&gt;</td>
<td>0.051&lt;2816&gt;</td>
</tr>
</tbody>
</table>
### Table 2: Proportion of Announcements Days in Jump Days

<table>
<thead>
<tr>
<th>Asset</th>
<th>0.99 Sig. Jumps</th>
<th>0.999 Sig. Jumps</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>0.752 &lt; 439 &gt; (3.106)[0.001]**</td>
<td>0.775 &lt; 231 &gt; (3.216)[0.001]**</td>
<td>0.682 &lt; 2857 &gt;</td>
</tr>
<tr>
<td>US</td>
<td>0.735 &lt; 1096 &gt; (3.815)[0.000]**</td>
<td>0.795 &lt; 575 &gt; (6.392)[0.000]**</td>
<td>0.677 &lt; 4108 &gt;</td>
</tr>
<tr>
<td>Cojump</td>
<td>0.853 &lt; 143 &gt; (5.504)[0.000]**</td>
<td>0.939 &lt; 49 &gt; (7.228)[0.000]**</td>
<td>0.683 &lt; 2816 &gt;</td>
</tr>
</tbody>
</table>
Goldman Sachs and Deutsche Bank launched Economic Derivatives in October 2002, now traded in CME and online markets.

- Digital options whose payoff depends on news announcements: The digital call (put) pays $1 if the announcement value is above (below) the strike.

- Most auctions take place on the announcement day before the data are released.

- Option prices can be used to construct a risk-neutral density for each release, so they provide richer information than MMS.
Economic Derivatives (conti.)

- Allow for measurement of uncertainty instead of disagreement.
- More accurate forecast than MMS survey. (Gürkaynak and Wolfers (2006))
- Options on four announcements are studied in this presentation:
  - NFPAY: Nonfarm Payrolls.
  - NAPM: National Association of Purchasing Managers.
  - ICLM: Initial Claims.
  - RSXAUT: Retail Sales excluding Auto.
Implied PDF for NFP, 6/3/2006
**Surprise, Volatility and Jumps**

- **Standardized News Surprise** (ABDV(2003, 2005)):
  \[ S_{kt} = \frac{A_{kt} - E_{kt}}{\hat{\sigma}_k} \]  
  - \( A_{kt} \): the released value for news \( k \) on day \( t \),
  - \( E_{kt} \): the mean of survey or market-based forecast,
  - \( \hat{\sigma}_k \): the sample standard deviation of surprise \( A_{kt} - E_{kt} \).

- **Realized Continuous Variance**:
  \[ C_t = I(z_{RTQ,rm,t} \leq \Phi_\alpha) \cdot RV_t + I(z_{RTQ,rm,t} > \Phi_\alpha) \cdot RBV_t \]  

- **Jumps**:
  \[ J_t = I(z_{RTQ,rm,t} > \Phi_\alpha) \cdot (RV_t - RBV_t) \]
Impact of News Surprises on Volatility and Jumps

- Individual news regressions:

\[
\log(C^h_t + 1) = \alpha^h_{C,k} + \beta^h_{C,k} S^{ED}_{kt} + \gamma^h_{C,k} S^S_{kt} + \epsilon^h_{C,t}
\]

\[
\log(J^h_t + 1) = \alpha^h_{J,k} + \beta^h_{J,k} S^{ED}_{kt} + \gamma^h_{J,k} S^S_{kt} + \epsilon^h_{J,t}
\]

- Joint news regressions:

\[
\log(C^h_t + 1) = \sum_{k \in \text{Economic series}} \alpha^h_{C,k} + \beta^h_{C,k} S^{ED}_{kt} + \gamma^h_{C,k} S^S_{kt} + \epsilon^h_{C,t}
\]

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\log(J^h_t + 1) = \sum_{k \in \text{Economic series}} \alpha^h_{J,k} + \beta^h_{J,k} S^{ED}_{kt} + \gamma^h_{J,k} S^S_{kt} + \epsilon^h_{J,t}
\]
Table 3: Economic Derivatives v.s. Survey Forecast Surprises

<table>
<thead>
<tr>
<th></th>
<th>NFPAY</th>
<th>NAPM</th>
<th>RSXAUT</th>
<th>ICLM</th>
<th>Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel 1: S&amp;P 500, C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>0.481</td>
<td>-0.078</td>
<td>0.554</td>
<td>-0.013</td>
<td>p=0.381</td>
</tr>
<tr>
<td></td>
<td>(0.307)</td>
<td>(0.245)</td>
<td>(0.272)</td>
<td>(0.134)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>-0.504</td>
<td>-0.073</td>
<td>-0.406</td>
<td>0.009</td>
<td>p=0.407</td>
</tr>
<tr>
<td></td>
<td>(0.301)</td>
<td>(0.189)</td>
<td>(0.224)</td>
<td>(0.124)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 2: S&amp;P 500, J</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-0.037</td>
<td>0.059</td>
<td>-0.120</td>
<td>0.014</td>
<td>p=0.448</td>
</tr>
<tr>
<td></td>
<td>(0.171)</td>
<td>(0.106)</td>
<td>(0.051)</td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>-0.032</td>
<td>-0.043</td>
<td>0.138</td>
<td>-0.017</td>
<td>p=0.268</td>
</tr>
<tr>
<td></td>
<td>(0.189)</td>
<td>(0.092)</td>
<td>(0.068)</td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 3: US 30-Year TB, C</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-0.199</td>
<td>-0.108</td>
<td>0.060</td>
<td>0.019</td>
<td>p=0.008**</td>
</tr>
<tr>
<td></td>
<td>(0.194)</td>
<td>(0.126)</td>
<td>(0.130)</td>
<td>(0.046)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>0.187</td>
<td>0.127</td>
<td>-0.046</td>
<td>-0.027</td>
<td>p=0.027**</td>
</tr>
<tr>
<td></td>
<td>(0.224)</td>
<td>(0.120)</td>
<td>(0.109)</td>
<td>(0.044)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 4: US 30-Year TB, J</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-0.614</td>
<td>0.006</td>
<td>-0.082</td>
<td>-0.015</td>
<td>p=0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.265)</td>
<td>(0.030)</td>
<td>(0.040)</td>
<td>(0.031)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>0.664</td>
<td>0.004</td>
<td>0.085</td>
<td>0.016</td>
<td>p=0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.270)</td>
<td>(0.027)</td>
<td>(0.036)</td>
<td>(0.029)</td>
<td></td>
</tr>
</tbody>
</table>
Disagreement v.s. Uncertainty

Disagreement v.s. Uncertainty:
- Survey standard deviations — disagreement,
- Economic derivatives standard deviations — uncertainty.

Individual news regressions:
\[
\log(C^h_t + 1) = \alpha^h_{C,k} + \beta^h_{C,k} SD_{kt}^{ED} + \gamma^h_{C,k} SD_{kt}^S + \epsilon^h_{C,t}
\]
\[
\log(J^h_t + 1) = \alpha^h_{J,k} + \beta^h_{J,k} SD_{kt}^{ED} + \gamma^h_{J,k} SD_{kt}^S + \epsilon^h_{J,t}
\]

Joint news regressions:
\[
\log(C^h_t + 1) = \sum_{k \in \text{Economic series}} \alpha^h_{C,k} + \beta^h_{C,k} SD_{kt}^{ED} + \gamma^h_{C,k} SD_{kt}^S + \epsilon^h_{C,t}
\]
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\log(J^h_t + 1) = \sum_{k \in \text{Economic series}} \alpha^h_{J,k} + \beta^h_{J,k} SD_{kt}^{ED} + \gamma^h_{J,k} SD_{kt}^S + \epsilon^h_{J,t}
\]

where \(SD\) is the standard deviation from economic derivatives and survey.
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Individual news regressions:
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\log(C^h_t + 1) = \alpha^{h}_{C,k} + \beta^{h}_{C,k} SD^{ED}_{kt} + \gamma^{h}_{C,k} SD^{S}_{kt} + \epsilon^{h}_{C,t}
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\[
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\]
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\]

where \(SD\) is the standard deviation from economic derivatives and survey.
### Table 4: Disagreement v.s. Uncertainty

<table>
<thead>
<tr>
<th></th>
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<th>NAPM</th>
<th>RSXAUT</th>
<th>ICLM</th>
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</tr>
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<tbody>
<tr>
<td><strong>Panel 1: S&amp;P 500, C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-1.126</td>
<td>0.639</td>
<td>-0.025</td>
<td>0.324</td>
<td>p=0.035**</td>
</tr>
<tr>
<td></td>
<td>(0.395)</td>
<td>(0.707)</td>
<td>(0.539)</td>
<td>(0.251)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>0.744</td>
<td>-0.746</td>
<td>0.145</td>
<td>-0.108</td>
<td>p=0.238</td>
</tr>
<tr>
<td></td>
<td>(0.524)</td>
<td>(0.348)</td>
<td>(0.349)</td>
<td>(0.145)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 2: S&amp;P 500, J</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-0.454</td>
<td>0.358</td>
<td>0.132</td>
<td>0.002</td>
<td>p=0.001**</td>
</tr>
<tr>
<td></td>
<td>(0.293)</td>
<td>(0.269)</td>
<td>(0.222)</td>
<td>(0.076)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>0.350</td>
<td>0.051</td>
<td>-0.152</td>
<td>-0.009</td>
<td>p=0.057*</td>
</tr>
<tr>
<td></td>
<td>(0.453)</td>
<td>(0.088*)</td>
<td>(0.145)</td>
<td>(0.043)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 3: US 30-Year TB, C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Econ. Deriv.</td>
<td>-0.616</td>
<td>0.284</td>
<td>-0.239</td>
<td>-0.108</td>
<td>p=0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.370)</td>
<td>(0.399)</td>
<td>(0.145)</td>
<td>(0.116)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>-0.455</td>
<td>-0.604</td>
<td>-0.012</td>
<td>-0.031</td>
<td>p=0.166</td>
</tr>
<tr>
<td></td>
<td>(0.512)</td>
<td>(0.383)</td>
<td>(0.211)</td>
<td>(0.060)</td>
<td></td>
</tr>
<tr>
<td><strong>Panel 4: US 30-Year TB, J</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Econ. Deriv.</td>
<td>0.773</td>
<td>0.086</td>
<td>-0.115</td>
<td>0.104</td>
<td>p=0.727</td>
</tr>
<tr>
<td></td>
<td>(0.466)</td>
<td>(0.148)</td>
<td>(0.133)</td>
<td>(0.077)</td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>-0.434</td>
<td>-0.006</td>
<td>0.014</td>
<td>0.025</td>
<td>p=0.003**</td>
</tr>
<tr>
<td></td>
<td>(0.793)</td>
<td>(0.113)</td>
<td>(0.117)</td>
<td>(0.042)</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- This paper extends the recent literature on macroeconomic news announcements and financial market response by separating market responses into continuous variance and discontinuous jump, and differentiating market’s uncertainty and disagreement.

- Financial markets are found to response to surprise in news announcements. Fixed-income market is more responsive to news, and surprises in non-farm payroll employment affects the markets most.

- Surprises in news releases affect the fixed-income market more.

- Disagreement and uncertainty affect volatility and jumps differently: disagreement affects jumps in the fixed-income market, while uncertainty affects volatility in both markets, and jumps in the equity market.