THE IMPACT OF MONETARY POLICY SURPRISES ON ENERGY PRICES

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George Washington University, 4/18/2013
FOCUS OF THE STUDY

- Do oil prices respond to monetary shocks in the high-frequency data?
- Do the high-frequency results persist in longer horizon data?
The estimates of federal funds rate shock on oil prices are negative, quite large and significant using intra-day data.

We find no evidence, using daily and monthly data, that the above reactions persist beyond the event day.

Practitioners should be careful about using high-frequency results for VAR identifications.
OUTLINE

- Background literature
- Data and variables description
- Empirical results: intra-day, event study
- Empirical results: daily, intervention analysis
- Empirical results: monthly VAR
- Conclusion
Monetary Policy Goals: Stabilizing inflation and business cycle (full employment)

- On GDP (Hamilton, 1983)
- On Inflation (Hooker, 2002; Harris, Kasman, Shapiro and West, 2009)

Monetary Policy Link:
- Bohi (1989)
- Bernanke, Gertler and Watson (1997)
- Hamilton and Herrera (2004), Kilian and Lewis (2011)
EFFECT OF MONETARY POLICY ON OIL PRICES

- Theory: Frankel (1986, 2008), Hotelling (1931)

- Empirics:
  - Frankel (2008): no association between crude oil and real interest rate.
EFFECT OF MACRO NEWS ON OIL PRICES

- Kilian and Vega (2011)
  Event study with daily spot returns. No response to news, including monetary policy. Weak fit. MMS data.

- Chatrath, Miao and Ramchander (2011)
  Supports Kilian and Vega (2011) even after accounting for inventory changes.
Use of Event Study Results

- D’Amico and Farka (2011) use to identify structural VARs in the context of interaction between stock market and Fed actions.

- Kilian and Lewis (2011) use Kilian and Vega (2011) to justify short-run restrictions in monthly structural VARs.
MONETARY NEWS AND OIL PRICES

Our initial framework:

- Intra day target rate shocks using federal funds futures data (Kuttner, 2001)

\[ \Delta i_t^u = \frac{D}{D - d} \left( f_t^0 - f_{t-1}^0 \right) \]

- Path shocks using changes in 1-year ahead Eurodollar futures rate
- Intra day WTI crude oil futures returns
DATA AND MODELS

Sample: January 1994 to December 2008, 129 events.
Event window: 30 minutes for scheduled meetings and three hours for unscheduled meetings.

The first model (includes a constant term):

\[ R_t = \gamma_1 TS_t + \gamma_2 PS_t + \epsilon_t \]
TARGET SURPRISES
# Empirical Results on Oil Futures

<table>
<thead>
<tr>
<th></th>
<th>Target Surprise</th>
<th>Target and Path Surprises</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target</td>
<td>Target</td>
</tr>
<tr>
<td>Crude Oil</td>
<td>-3.26 (1.0)*</td>
<td>-3.94 (1.1)*</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-3.05 (0.8)*</td>
<td>-3.82 (0.8)*</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>-7.19 (1.1)*</td>
<td>-6.69 (1.4)*</td>
</tr>
</tbody>
</table>
### Intraday Scheduled/Unscheduled Meetings

<table>
<thead>
<tr>
<th></th>
<th>Target*Scheduled</th>
<th>Target*Unscheduled</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>-0.88 (0.8)</td>
<td>-5.61 (0.9)*</td>
<td>0.3</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-0.93 (0.9)</td>
<td>-5.40 (0.6)*</td>
<td>0.3</td>
</tr>
</tbody>
</table>
**Daily Data/Intervention Analysis**

\[ R_t = \alpha + \sum_{i=0}^{T} \gamma_{1i} TS_{t-i}^{Sched} + \sum_{j=0}^{T} \gamma_{2j} TS_{t-j}^{Unsched} + \gamma_{3} PS_{t} + \sum_{k} \gamma_{4k} X_{k,t} + \epsilon_{t} \]

Four non-monetary surprises: PPI, industrial production, employment, unemployment.

Control for daily natural gas return.

January 1994 to December 2008, 3759 observations.

Distributed lagged responses to target shocks.
## Daily Data Scheduled/Unscheduled Meetings

<table>
<thead>
<tr>
<th></th>
<th>Target*Scheduled</th>
<th>Target*Unscheduled</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>-2.88 (3.2)</td>
<td>-3.82 (1.4)*</td>
<td>0.08</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-1.46 (3.5)</td>
<td>-3.07 (1.1)*</td>
<td>0.08</td>
</tr>
</tbody>
</table>
# Impact and 5-day Accumulated Responses

<table>
<thead>
<tr>
<th></th>
<th>Target*Scheduled</th>
<th>Target*Unscheduled</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crude Oil</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>-2.83 (3.2)</td>
<td>-3.83 (1.4)*</td>
<td>0.09</td>
</tr>
<tr>
<td>A</td>
<td>2.33 (7.9)</td>
<td>0.80 (6.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Gasoline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>-1.43 (3.6)</td>
<td>-3.07 (1.1)*</td>
<td>0.08</td>
</tr>
<tr>
<td>A</td>
<td>4.63 (8.8)</td>
<td>-1.04 (6.5)</td>
<td></td>
</tr>
</tbody>
</table>
# Impact and 20-Day Accumulated Responses

<table>
<thead>
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<th>Target*Scheduled</th>
<th>Target* Unscheduled</th>
<th>( R^2 )</th>
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<tr>
<td>Crude Oil</td>
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</tr>
<tr>
<td>I</td>
<td>-2.33 (3.3)</td>
<td>-3.63 (1.4)*</td>
<td>0.09</td>
</tr>
<tr>
<td>A</td>
<td>0.59 (15.0)</td>
<td>-9.18 (10.6)</td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>-1.16 (3.6)</td>
<td>-2.87 (1.1)*</td>
<td>0.09</td>
</tr>
<tr>
<td>A</td>
<td>-10.93 (16.5)</td>
<td>-2.09 (11.1)</td>
<td></td>
</tr>
</tbody>
</table>
Crude Oil Accumulated Dynamic Response, Scheduled Meeting

Crude Oil Accumulated Dynamic Response, Unscheduled Meeting

Gasoline Accumulated Dynamic Response, Scheduled Meeting

Gasoline Accumulated Dynamic Response, Unscheduled Meeting
MONTHLY STRUCTURAL VAR

- Based on Kilian and Lewis (2011)

- 5 variables; CRB Spot index, US composite refiner’s acquisition of crude oil, CFNAI, CPI/Core PCE, Federal Funds Rate, in this order.

- 12 lags

- Kilian and Lewis assumed federal funds rate shocks do not affect any other variables on impact. Recursive identification.
Our identification

- Federal funds futures data shows there are at least 112 months between January 1990 and December 2008 with no surprises.
- 145 months if you count surprises up to 2 basis points as no surprises.
- We assume those months as ‘no FFR shock’ months. This allows us to identify the contemporaneous impact of FFR shocks on the remaining four variables.
**Impact Matrix Parameters to Identify**

\[
\begin{bmatrix}
    a_{11} & 0 & 0 & 0 & D_t a_{15} \\
    a_{21} & a_{22} & 0 & 0 & D_t a_{25} \\
    a_{31} & a_{32} & a_{33} & 0 & D_t a_{35} \\
    a_{41} & a_{42} & a_{43} & a_{44} & D_t a_{45} \\
    a_{51} & a_{52} & a_{53} & a_{54} & D_t a_{55} \\
\end{bmatrix}
\]

\[D_t = 0, 1.\]
PROCEDURE

- Equally weighted GMM
- 30 moments, 19 parameters, 228 months
- 1000 regime specific bootstrapped replications to compute standard errors.
## Results of VAR, 112 No FFR Shocks

<table>
<thead>
<tr>
<th></th>
<th>CRB</th>
<th>Oil</th>
<th>CFNAI</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>0.67 (0.8)</td>
<td>-0.04 (0.7)</td>
<td>0.00 (0.1)</td>
<td>0.10 (0.1)</td>
</tr>
<tr>
<td>Core PCE</td>
<td>0.92 (1.0)</td>
<td>-0.13 (0.8)</td>
<td>-0.00 (0.1)</td>
<td>0.02 (0.0)</td>
</tr>
</tbody>
</table>
## Results of VAR, 145 No FFR Shocks

<table>
<thead>
<tr>
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<th>Oil</th>
<th>CFNAI</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>0.36 (0.7)</td>
<td>0.01 (0.6)</td>
<td>0.14 (0.1)*</td>
<td>0.04 (0.1)</td>
</tr>
<tr>
<td>Core PCE</td>
<td>0.65 (0.9)</td>
<td>-0.04 (0.8)</td>
<td>0.07 (0.1)</td>
<td>0.04 (0.0)</td>
</tr>
</tbody>
</table>
## Results of VAR, 112 No FFR Shocks

<table>
<thead>
<tr>
<th></th>
<th>CRB-N</th>
<th>WTI</th>
<th>CFNAI</th>
<th>Inflation</th>
</tr>
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<tbody>
<tr>
<td>CPI</td>
<td>0.67 (0.9)</td>
<td>-0.06 (1.0)</td>
<td>0.01 (0.1)</td>
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</tr>
</tbody>
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VAR RESULTS SUMMARY

- The estimated effects of FFR shocks on oil price are quantitatively small and statistically imprecise in the monthly data.

- These results do not match the high frequency event study results.

- Supports Kilian and Lewis (2011) VAR identification assumptions directly.
CONCLUSIONS

- Energy prices do respond to US monetary news in the intra-day event studies.

- These results do not carry over to monthly data. The monthly impacts are small.

- Further examination of the link between intra-day results and monthly results needed.