The Impact of Monetary Policy Surprises on Energy Prices

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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?

Summary

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

Oil Prices and Monetary Policy

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.
- Barsky and Kilian (2002, 2004): Monetary conditions for oil price rise in the 1970s.
- Anzuini, Lombardi and Pagano (2010): 2% rise after 100 basis point cut. Low and imprecise.

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

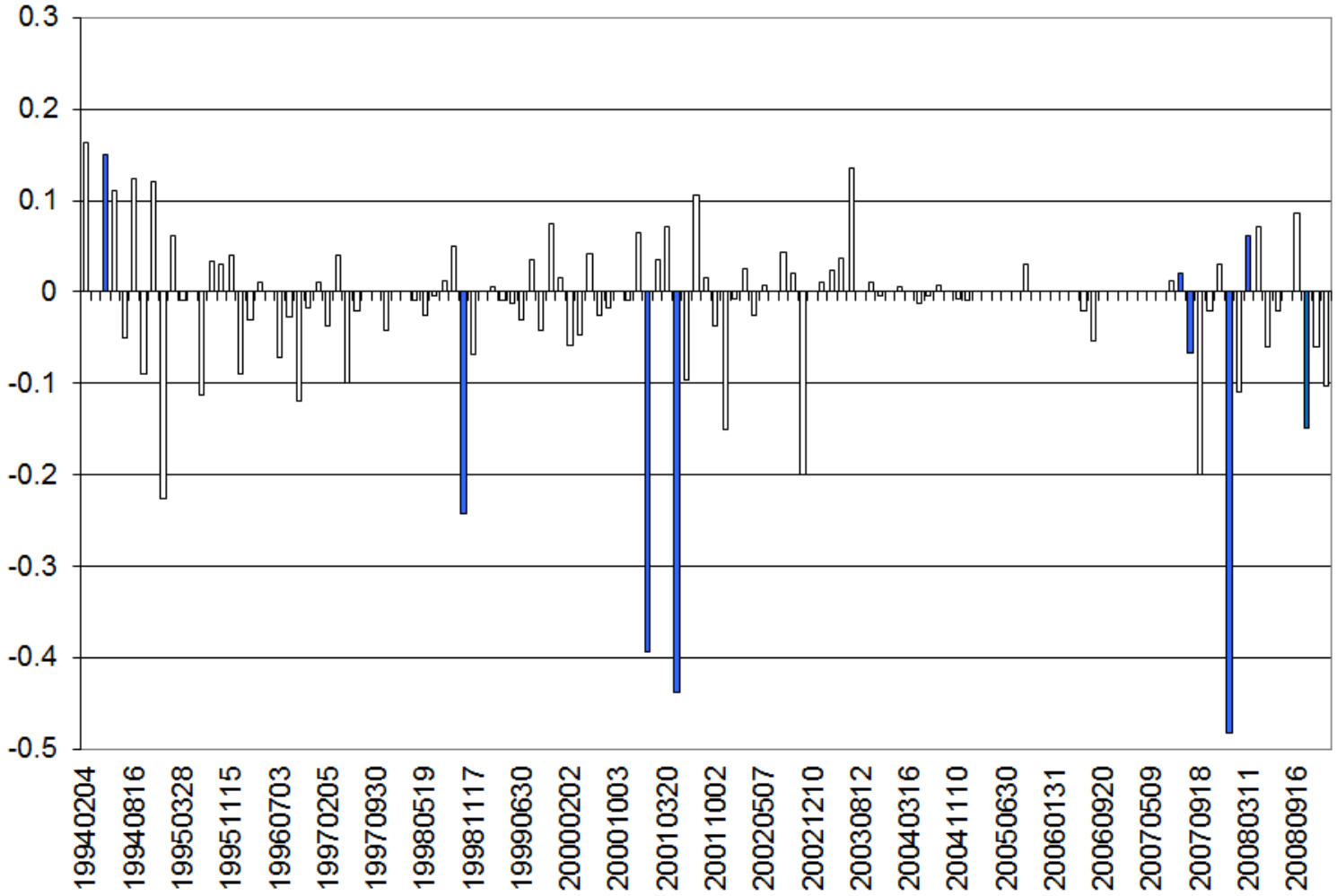
Sample: January 1994 to December 2008, 129 events.

Event window: 30 minutes for scheduled meetings and three hours for unscheduled meetings.

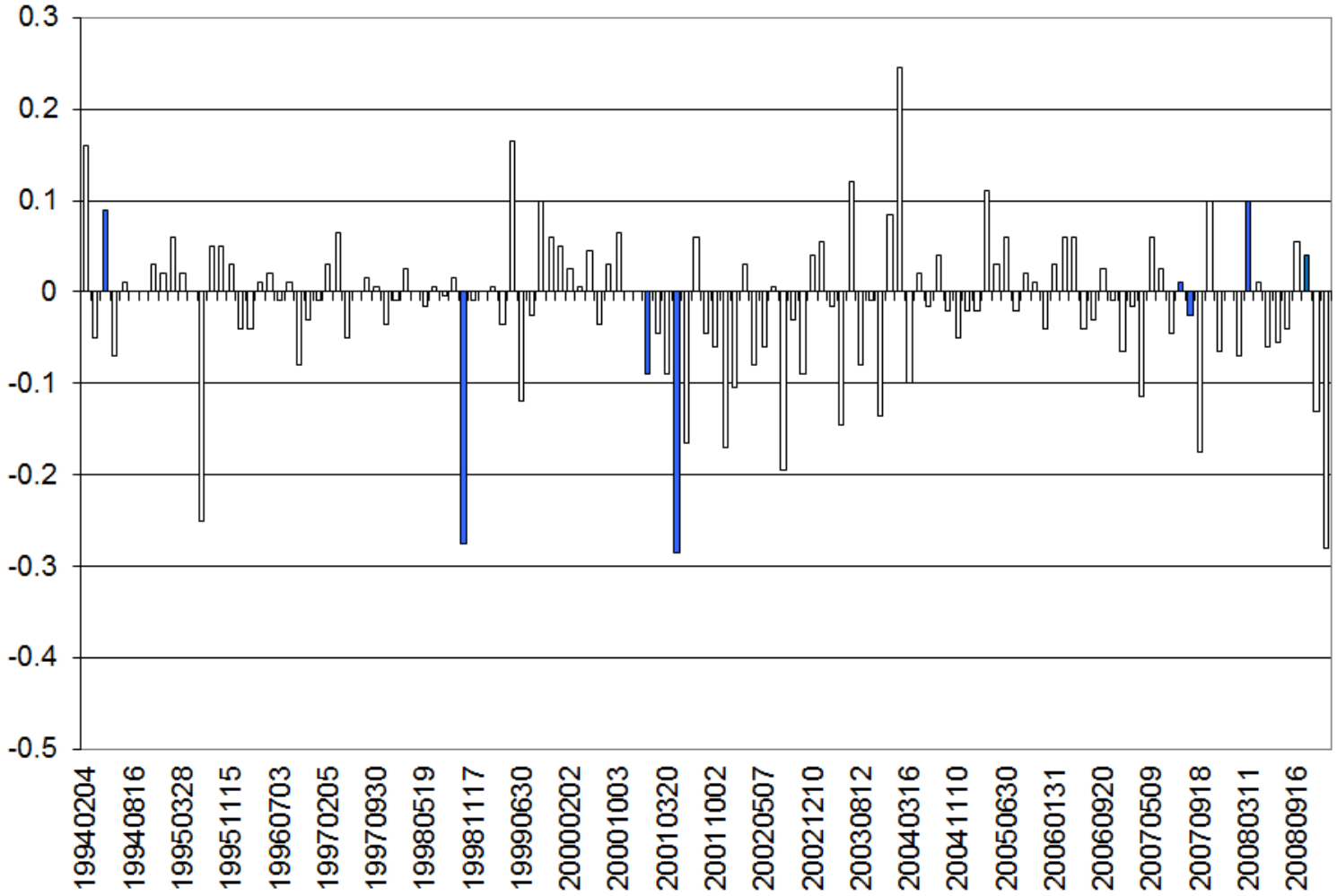
The first model (includes a constant term):

$$R_t = \gamma_1 TS_t + \gamma_2 PS_t + \varepsilon_t$$

Target Surprises



Path Surprises



Empirical results on Oil Futures

	Target Surprise	Target and Path Surprises		
	Target	Target	Path	R^2
Crude Oil	-3.26 (1.0)*	-3.94 (1.1)*	1.64 (1.1)	0.2
Gasoline	-3.05 (0.8)*	-3.82 (0.8)*	1.88 (0.9)*	0.2
S&P 500	-7.19 (1.1)*	-6.69 (1.4)*	-1.20 (1.1)	0.5

Intraday Scheduled/unscheduled meetings

	Target*Scheduled	Target*Unscheduled	R^2
Crude Oil	-0.88 (0.8)	-5.61 (0.9)*	0.3
Gasoline	-0.93 (0.9)	-5.40 (0.6)*	0.3

Daily Data/Intervention analysis

$$R_t = \alpha + \sum_{i=0}^{T} \gamma_{1i} TS_{t-i} Sched_{t-i} + \sum_{j=0}^{T} \gamma_{2j} TS_{t-j} Unsched_{t-j} + \gamma_3 PS_t + \sum_k \gamma_{4k} X_{k,t} + \varepsilon_t$$

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

Control for daily natural gas return.

January 1994 to December 2008, 3759 observations.

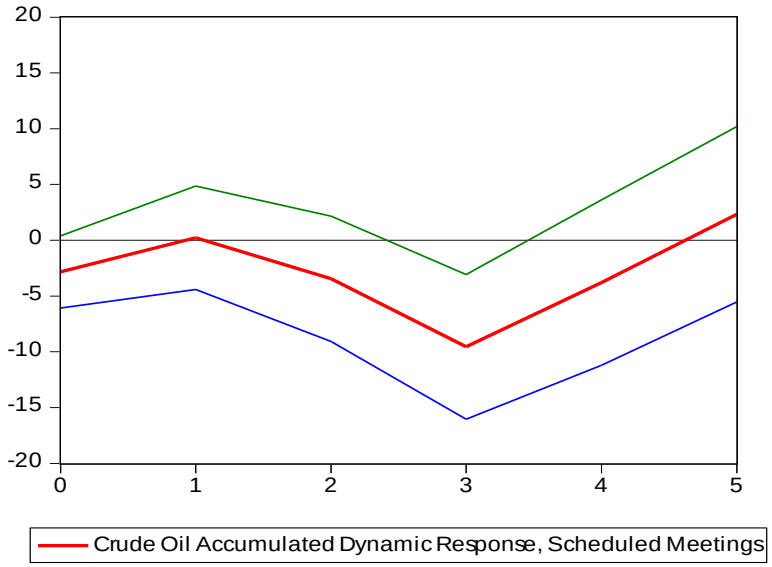
Distributed lagged responses to target shocks.

Daily data Scheduled/unscheduled meetings

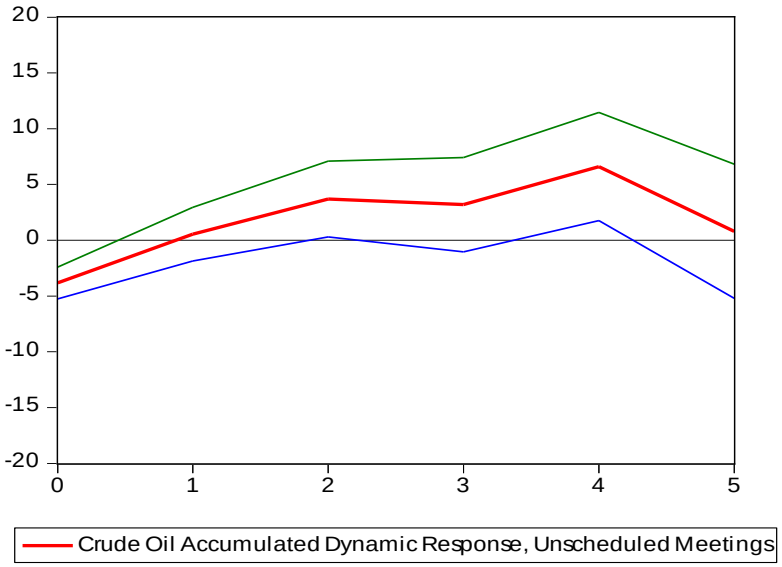
	Target*Scheduled	Target*Unscheduled	R^2
Crude Oil	-2.88 (3.2)	-3.82 (1.4)*	0.08
Gasoline	-1.46 (3.5)	-3.07 (1.1)*	0.08

Impact and 5-day Accumulated Responses

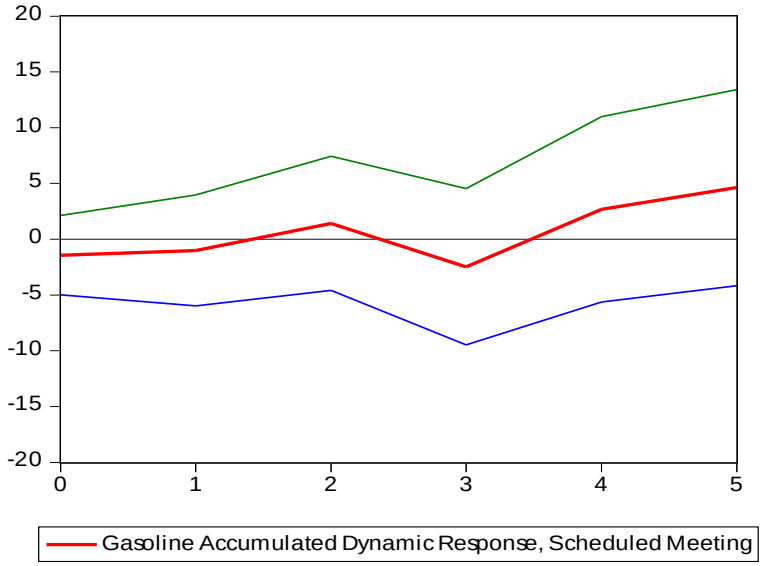
		Target*Scheduled	Target*Unscheduled	R^2
Crude Oil	I	-2.83 (3.2)	-3.83 (1.4)*	0.09
	A	2.33 (7.9)	0.80 (6.0)	
Gasoline	I	-1.43 (3.6)	-3.07 (1.1)*	0.08
	A	4.63 (8.8)	-1.04 (6.5)	



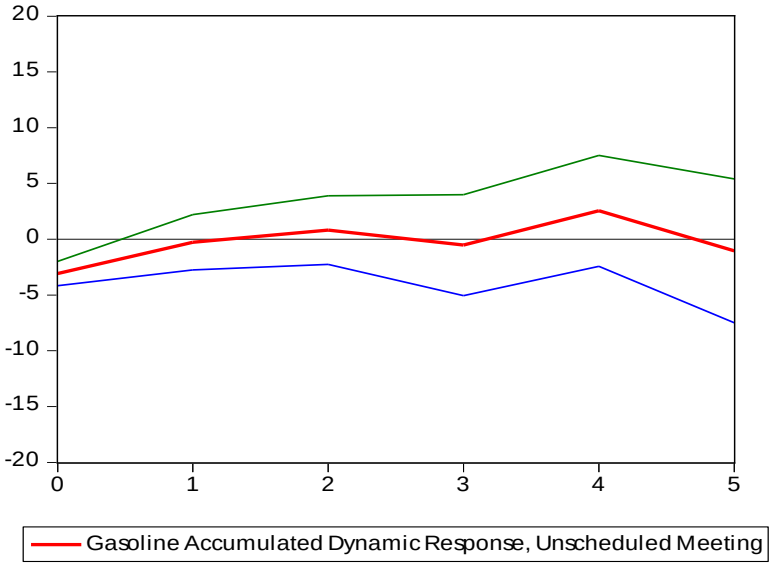
Crude Oil Accumulated Dynamic Response, Scheduled Meetings



Crude Oil Accumulated Dynamic Response, Unscheduled Meetings



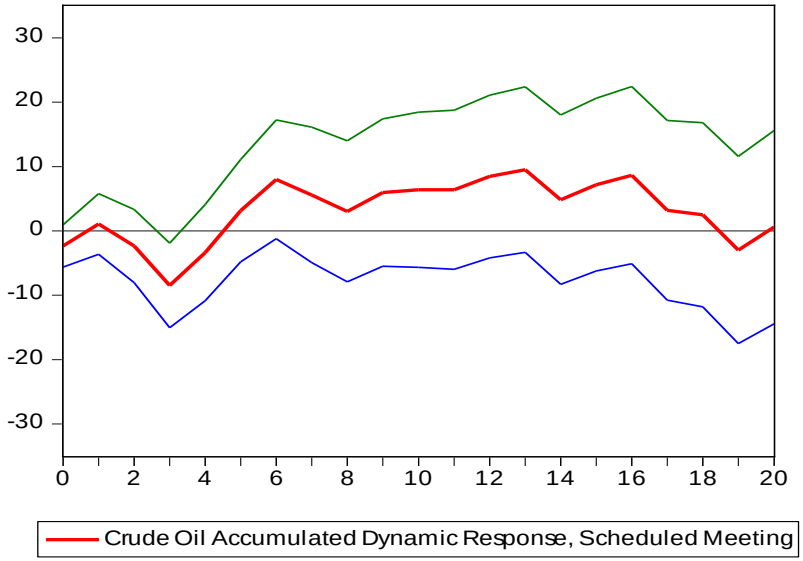
Gasoline Accumulated Dynamic Response, Scheduled Meeting



Gasoline Accumulated Dynamic Response, Unscheduled Meeting

Impact and 20-day Accumulated Responses

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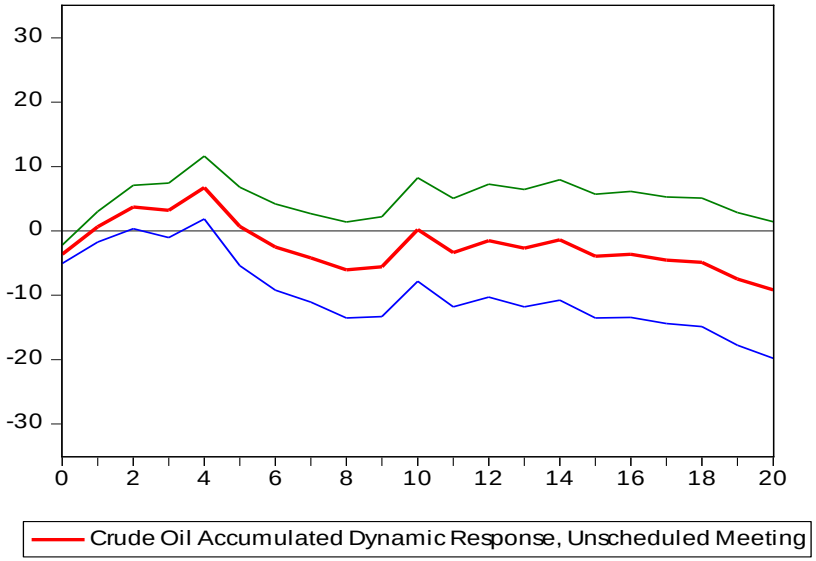
Crude Oil Accumulated Dynamic Response, Scheduled Meeting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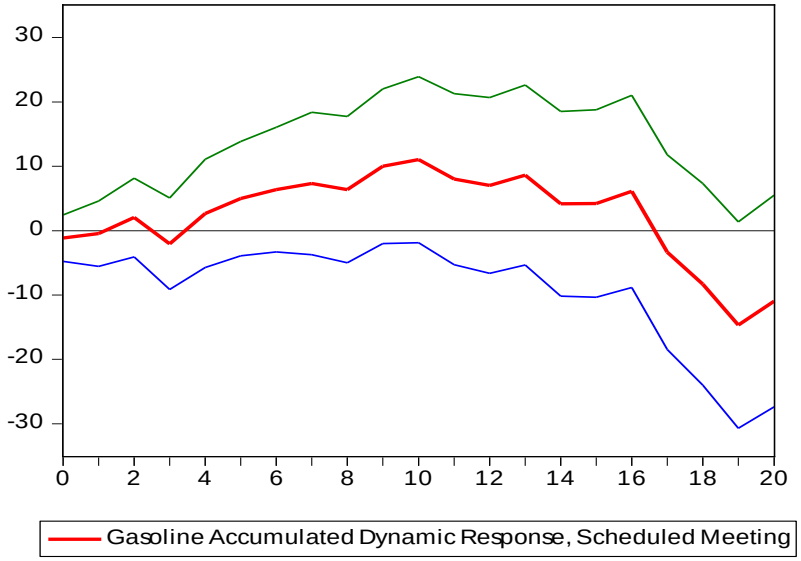
Crude Oil Accumulated Dynamic Response, Unscheduled Meeting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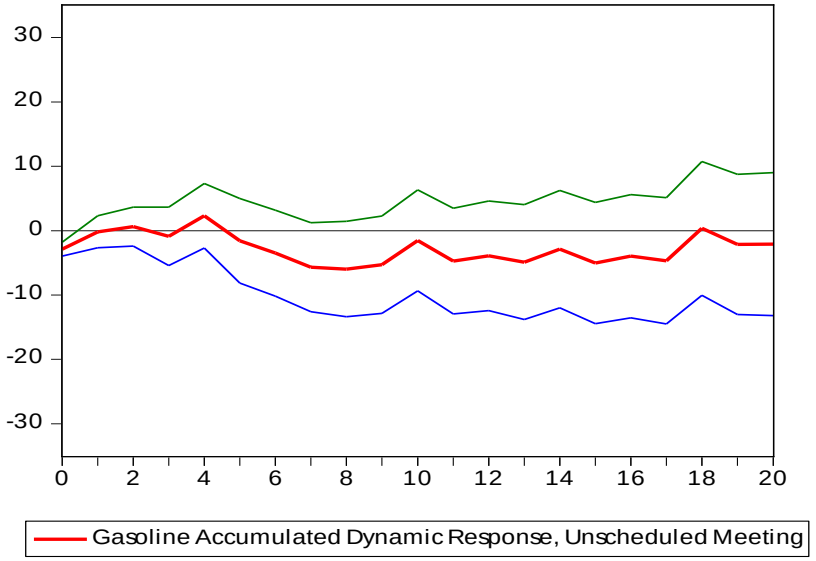
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Gasoline Accumulated Dynamic Response, Unscheduled Meeting

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 upto 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
- Rigobon (2003) identification through heteroskedasticity procedure.
- 1000 regime specific bootstrapped replications to compute standard errors.

Results of VAR, 112 No FFR Shocks

	CRB	Oil	CFNAI	Inflation
CPI	0.67 (0.8)	-0.04 (0.7)	0.00 (0.1)	0.10 (0.1)
Core PCE	0.92 (1.0)	-0.13 (0.8)	-0.00 (0.1)	0.02 (0.0)

Results of VAR, 145 No FFR Shocks

	CRB	Oil	CFNAI	Inflation
CPI	0.36 (0.7)	0.01 (0.6)	0.14 (0.1)*	0.04 (0.1)
Core PCE	0.65 (0.9)	-0.04 (0.8)	0.07 (0.1)	0.04 (0.0)

Results of VAR, 112 No FFR Shocks

	CRB-N	WTI	CFNAI	Inflation
CPI	0.67 (0.9)	-0.06 (1.0)	0.01 (0.1)	0.10 (0.1)

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.