State-Dependent Effects of Monetary Policy: the Central Bank Information Channel

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Motivation

Large body of evidence that the central bank and private agents have different information sets

When private agents observe a policy decision, they cannot infer whether it stems from:

- a change in policymakers' assessment of the macroeconomic outlook (the endogenous policy response)

- an exogenous policy innovation (either a pure policy shock or a change in policymakers' preferences)

Motivation

Policy decisions can convey information about the CB view of macro outlook, so policy announcements would influence private beliefs about the state of the economy Illustration

- ▶ Romer-Romer (2000) and Ellingson-Söderström (2001, 2005) find evidence of this revelation of Fed private information

- ▶ Burgeoning literature about this signaling / information channel of monetary policy

Motivation

- When information sets differ, a policy announcement creates a signal extraction issue for private agents

- However, the publication of the central bank macroeconomic information set may help reduce the dimensionality of this signal extraction issue

- Private agents now observe the CB view of the state of the economy and may be able to appreciate the endogenous policy response

- So they can update their decomposition of the initial policy announcement and may revise their beliefs about policy

This paper

What we do:

- ▸ We investigate whether the transmission of monetary policy depends on the publication by a central bank of its own assessment of the macroeconomic outlook

Why it matters:

- ▸ Private agents' interpretation of policy changes is crucial for determining the sign and magnitude of the effects of monetary policy decisions
- ▸ By aligning private agents' and policymakers' information sets, CB communication policies may take on a particular importance for the transmission of monetary policy

This paper

Figure 1: Financial Times (10 May 2017)

This paper

We focus on UK daily data for 3 reasons:

- ▶ MPC decisions and the IR were released on different days until August 2015. So we can measure the surprise component of the two events using an event-study analysis

- ▶ For monetary & CB info surprises to be separately identified, the published CB information cannot be a function of the current policy decision
  We exploit the fact that the IR is conditioned on a policy path implied by market interest rates prior to the policy meeting

- ▶ Monthly MPC decisions but IR is published quarterly, so private agents observe CB info for only 1/3 of policy decisions

Related literature

At the crossroads of 3 strands of the literature:

- ▶ the central bank information channel

  Campbell et al. (2012, 2017), Hanson-Stein (2015), Tang (2015), Melosi (2017), MirandaAgrippino-Ricco (2017), Lakdawala-Schaffer (2017), Nakamura-Steinsson (2018), Andrade-Ferroni (2018), Cieslak-Schrimpf (2018), Jarocinski-Karadi (2019) and Kerssenfischer (2019)

- ▶ the identification and transmission of monetary policy

  Sims (1972), Bernanke-Blinder (1992), Romer-Romer (2004), Coibion (2012), Gertler-Karadi (2015), MirandaAgrippino (2016), Ramey (2016) and MirandaAgrippino-Ricco (2017)

- ▶ the state-dependent effects of monetary policy

  Weise (1999), Garcia (2002), Lo-Piger (2005), Angrist et al. (2013), Santoro et al. (2014), Barnichon-Matthes (2015), Hubrich-Tetlow (2015), Tenreyro-Thwaites (2016), Aikman et al. (2017), Beraja et al. (2017), Ottonello-Windberry (2017), Alpanda-Zubairy (2018), Cloyne et al. (2018)

Contribution

So far, the attention has focused on the quantification of CB information shocks and on the measure of their direct effect on financial and macro variables

We bridge the CB information literature with the literature about the non-linear effects of monetary policy:

- ▶ This paper provides original empirical evidence about whether CB information matters for the effect of monetary policy

What this paper is not about

▶ We do not focus on the content of policy announcements, the communication about the future path of policy (i.e. Gürkaynak et al, 2005), or the debate about Delphic and Odyssean Forward Guidance (Campbell et al, 2012)

▶ We abstract from quantification issues of qualitative communication like statements, minutes and speeches (i.e. Lucca-Trebbi, 2011, or Hansen-McMahon, 2017)

▶ We do not attempt to measure policy preferences

Estimation

Daily-frequency event-study analysis
Sample: 01 october 2004 to 31 July 2015
130 policy decisions

$$\Delta y_t = \alpha + \beta_1 \Delta x_t + \epsilon_t$$

$$\Delta_w y_t = \alpha + \beta_1 \Delta x_t + \beta_2 \Delta z_{t+i} + \beta_3 \Delta x_t \Delta z_{t+i} + \epsilon_t$$

- ▶ $\Delta_w y_t$: asset prices (inflation swaps or stock prices)
- ▶ w : window size
- ▶ Δx_t : monetary surprises
- ▶ Δz_{t+i} : Inflation Report (IR) surprises
- ▶ i : number of days btw. MPC decision and IR publication

Monetary and IR surprises

▶ Both measured as the daily change in 1-year spot nominal
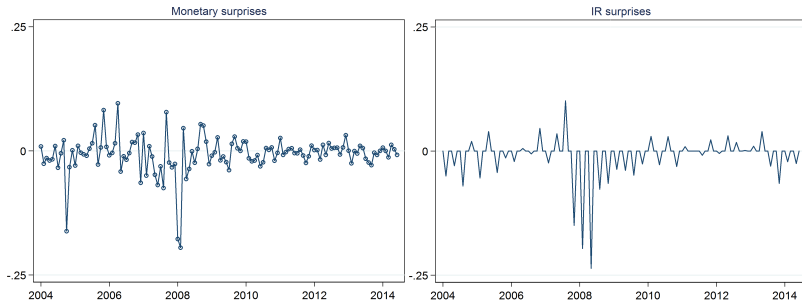 yields, following GSS (2005) and Hanson-Stein (2015)

Figure 2: MPC and IR surprises

Similar results with 2-year or 5-year maturities, or
futures over a 30-min window (Cesa-Bianchi et al, 2017)

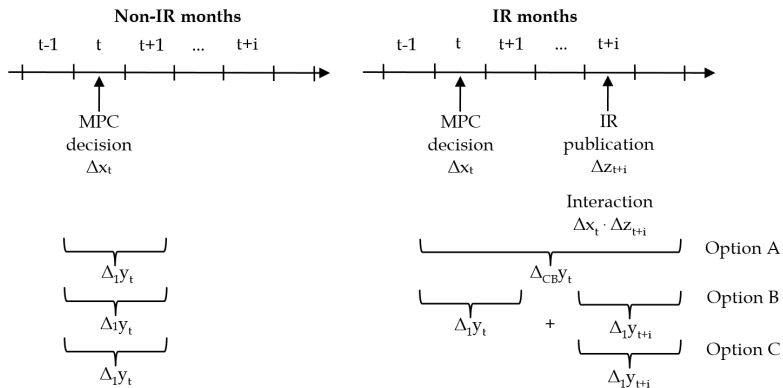# The issue of interacting events on different days

Figure 3: Different windows for the response of asset prices

The state-dependent effect of monetary policy

Table 1: Interaction of MPC and IR surprises

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
	CB-announcement-period window				
β_1	0.748*	0.603**	0.366*	0.161	-0.011
	[0.45]	[0.28]	[0.21]	[0.17]	[0.16]
β_2	1.004	0.575*	0.395	0.319	0.259
	[1.12]	[0.35]	[0.25]	[0.21]	[0.16]
β_3	5.755	-8.176***	-8.677***	-4.479**	-0.796
	[7.15]	[2.68]	[1.96]	[1.84]	[1.65]
R2	0.04	0.27	0.33	0.17	0.04
	Smallest window (on IR days only)				
β_1	0.556	0.574**	0.387**	0.181	0.006
	[0.40]	[0.28]	[0.19]	[0.14]	[0.14]
β_2	0.716	0.512	0.287***	0.118	0.02
	[0.94]	[0.32]	[0.10]	[0.11]	[0.18]
β_3	7.195	-6.292**	-6.152***	-2.916***	-0.487
	[6.07]	[2.65]	[1.18]	[1.01]	[1.18]
R2	0.03	0.27	0.30	0.09	0.00
N	130	130	130	130	130

Note: Robust SE. *p<0.1; **p<0.05; ***p<0.01.

▶ In non-IR months, a positive 25bp MPC surprise increases swap3y by 9bp, but the same 25bp monetary surprise yields a 78bp decrease if associated with a positive 10bp IR surprise

Extensions

Stock returns and 10y yields `Estimates`

▶ Similar state-dep. result for FTSE returns, but not for 10y yields

▶ The expectation hypothesis of the term structure of interest rates dominates the information effect

Measurement errors `Estimates`

▶ Zeros in non-IR months are different from zeros in IR months

▶ Policymakers' speeches in non-IR months may reveal part of the central bank information set

▶ Subsample estimation on IR months only

ECB decisions & Macroeconomic releases `Estimates`

▶ Potential concern that the non-linearity may reflect other news published around the MPC decision and the IR publication

▶ ECB decisions (MPC) Industrial production (MPC), weekly earnings and unemployment (IR) and PPI inflation (in-btw)

Robustness

Removing outliers

▶ 3 largest MPC and 3 largest IR surprises

Controlling for differences in IR and non-IR months

▶ Conditional volatility, IR dummy and actual changes in policy rate

Risk-premia correction

▶ Regression-based approach using VIX & average UK banks CDS premia

Removing the GFC subsample

▶ Drop the 12 months after the bankrupcy of Lehman Brothers

Heteroskedasticity-based identification

▶ "Control" days: Monday, Tuesday and Wednesday (not MPC or IR days)

Euro area data (Eurostoxx50)

▶ Intraday data: 30min window around policy statement and
90min window around Press Conference

Estimates

Timeline of private beliefs' revisions

- ▶ Measure the dynamic effect of MPC surprises, and how the IR publication modifies the response of asset prices

- ▶ Jordà (2005)'s local projections with our externally identified instruments for monetary and IR surprises

$$\Delta y_{t+k} = \alpha_k + \beta_{1,k}\Delta x_t + \beta_{2,k}\Delta z_t + \beta_{3,k}\Delta x_t \, \Delta z_t + \epsilon_{t+k}$$

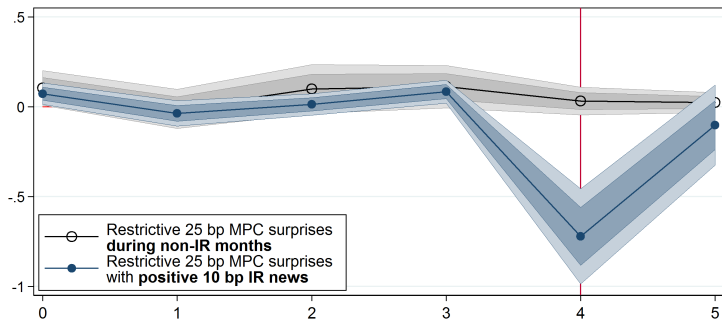- ▶ with $k = 0,...,5$

Timeline of private beliefs' revisions

Figure 4: Response of 3y inflation swaps to MPC surprises over 6 business days

The state-dependent effect over different dimensions

Central bank projection surprises
- ▶ What enters the policy reaction function
- ▶ Surprises   Estimates

Monthly frequency
- ▶ No assumption on the window size
- ▶ Model   Estimates

Monetary shocks
- ▶ Exogenous innovations to the policy instrument, in contrast with shocks to private information sets
- ▶ Shocks   Estimates

Dynamic macro effects
- ▶ Expected inflation, stock prices, inflation and industrial production
- ▶ Model   Estimates

Exploring the mechanism

▶ One plausible explanation relates to the resolution of the signal extraction issue

$$\text{MPS}_{t|k} = (1 - \gamma_k)\,\epsilon_t^i + \gamma_k\,s_t^Y$$
$$\text{CBIS}_{t+i} = E^{CB}[Y] - E^{PA}[Y] = \epsilon_{t+i}^Y$$

▶ State-dependence driven by the combination of the inferred macro signal s_t^Y and the observed macro news ϵ_{t+i}^Y :

  ▶ When s_t^Y is reflected in ϵ_{t+i}^Y some days later, the information content of the initial economic signal s_t^Y is weak: the same information content can be observed in the IR published

  ▶ In $k = t + i$, private agents revise their initial decomposition of the policy announcement such that the information effect disappears: $\gamma_{t+i} = 0$

Main messages

- The sign and magnitude of the effect of monetary policy depends on the publication of CB macro information

    - Restrictive monetary policy has positive effects on inflation swaps/stock prices when conditioned on negative economic news (the signalling channel is at work),

    - whereas it has strong negative effects when associated with positive economic news (policy signals dominate)

- Publishing the CB macro information set helps private agents solve the signal extraction issue of policy announcements

Thank you for your attention

Unexpected asset price responses

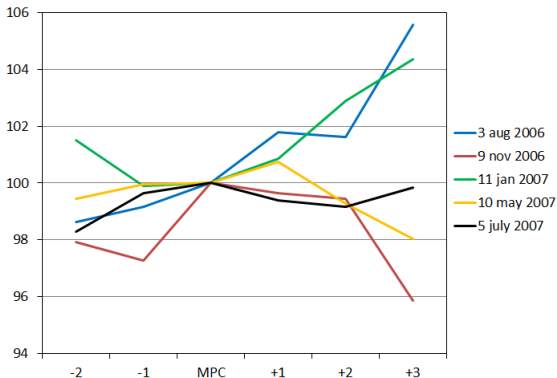▶ An illustrative example of CB policy announcements generating unexpected asset price responses

Figure 5: 2-year inflation swaps responses to 25bp increases in the UK policy rate (basis 100 on MPC day)

Measurement errors

- A limitation of this set-up is that the interaction term is equal to zero for 2/3 of the observations by construction
- Zeros in non-IR months are different from zeros in IR months
- The former relates to the absence of CB macro information published, whereas the latter relates to IR for which the informational content was expected
- Yet, zeros in non-IR months can be seen as measurement errors: policymakers' speeches in these months may reveal part of the central bank information set

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Separate estimations for non-IR and IR months

Table 2: Two subsamples

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
		Non-IR months			
β_1	0.735	0.584*	0.426*	0.277*	0.133
	[0.48]	[0.33]	[0.24]	[0.15]	[0.15]
R2	0.04	0.07	0.05	0.03	0.01
N	87	87	87	87	87
		IR months (smallest window)			
β_1	-0.209	0.473	0.224	-0.175	-0.460*
	[0.76]	[0.41]	[0.17]	[0.18]	[0.26]
β_2	0.434	0.387	0.232**	0.068	-0.038
	[0.89]	[0.29]	[0.09]	[0.10]	[0.18]
β_3	2.586	-7.153**	-7.120***	-4.822***	-2.964
	[5.69]	[2.78]	[1.01]	[1.14]	[1.78]
R2	0.01	0.43	0.71	0.38	0.09
N	43	43	43	43	43

Note: Robust SE. *p<0.1; **p<0.05; ***p<0.01.

Stock returns and 10y yields

Table 3: Alternative dependent variables

	FTSE	10y yields	FTSE	10y yields	FTSE	10y yields
	All months		Non-IR months		IR months	
β_1	0.152**	0.669**	0.184**	0.677*	0.039	0.702*
	[0.06]	[0.31]	[0.07]	[0.39]	[0.10]	[0.37]
β_2	-0.010	1.515***	.	.	-0.019	1.623***
	[0.04]	[0.33]			[0.04]	[0.34]
β_3	-1.378***	2.722	.	.	-1.967***	3.196
	[0.43]	[2.44]			[0.62]	[2.83]
R2	0.22	0.26	0.16	0.05	0.31	0.52
N	130	130	87	87	43	43

Note: Robust SE. *p<0.1; **p<0.05; ***p<0.01.

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ECB decisions & Macroeconomic releases

- ▶ Potential concern that the non-linearity may reflect other news published around the MPC decision and the IR publication
- ▶ Control for ECB policy decisions and monetary surprises
- ▶ Control for the news surprises in 9 of the most important macro data releases:
  - Employment changes
  - ILO unemployment rate
  - Industrial production
  - PMI Services
  - PMI Manufacturing
  - GDP growth
  - Average weekly earnings
  - Producer price index (PPI) for output
  - CPI inflation

ECB decisions & Macroeconomic releases

- ECB decisions happened 89 times on the same day than the MPC.
- While some series (i.e. GDP) were never released on MPC and IR dates or in-between, some have been and regularly
- For instance, industrial production has been released 30 times on MPC dates over our sample
- Weekly earnings and unemployment have been published 27 times on IR dates
- PPI inflation figures have been released 32 times during the days between the MPC and IR dates

ECB decisions & Macroeconomic releases

Table 4: The influence of other news

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Controlling for ECB surprises					
β_3	7.256	-6.233**	-6.142***	-2.921***	-0.484
	[6.07]	[2.66]	[1.19]	[0.99]	[1.17]
ECB surprises	Yes	Yes	Yes	Yes	Yes
R2	0.03	0.27	0.30	0.09	0.01
N	130	130	130	130	130
Controlling for macro news surprises					
β_3	4.247	-6.993***	-5.856***	-2.658**	-0.440
	[4.69]	[2.23]	[1.21]	[1.02]	[1.20]
Macro news	Yes	Yes	Yes	Yes	Yes
R2	0.36	0.40	0.32	0.11	0.01
N	130	130	130	130	130

Note: Robust SE. *p<0.1; **p<0.05; ***p<0.01.

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Robustness

Table 5: Robustness tests

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
			Removing outliers		
β_3	22.377	-7.977	-25.548***	-26.500***	-22.500***
	[28.9]	[11.5]	[5.15]	[3.88]	[3.51]
			Diff. in IR and non-IR months		
β_3	0.419	-8.575***	-9.295***	-4.376**	-0.366
	[6.67]	[2.61]	[2.04]	[1.91]	[1.88]
			Risk premia correction		
β_3	5.361	-8.305***	-8.959***	-5.013***	-1.581
	[6.99]	[2.49]	[1.80]	[1.76]	[1.77]
			Removing the GFC subsample		
β_3	27.988	-2.367	-18.605***	-19.868***	-16.891***
	[30.1]	[11.4]	[6.81]	[6.82]	[6.34]
			Heteroskedasticity based Identification		
β_3	-6.650	-10.401***	-8.079***	-5.448*	-3.394
	[4.90]	[2.75]	[2.99]	[2.99]	[2.96]
			Euro area data		
	EuroStoxx50	EURUSD	DE-10y	FR-10y	
β_3	-0.123***	0.038***	0.235***	0.268***	
	[0.02]	[0.01]	[0.09]	[0.10]	

Note: Robust SE. $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

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Central bank projection surprises

- CB inflation and output projection surprises are identified as the unpredictable component of CB projections, conditional on the information available to private agents at the date when they are published

- Similar to Romer-Romer (2004) for the policy instrument

- A key requirement to ensure identification is that CB projections do not contain the effect of the contemporaneous policy decision

Central bank projection surprises

CB inflation and output projections are regressed on:

- the market interest rate curve used as conditioning path
- the lagged policy rate
- lagged CB inflation and output projections
- lagged private inflation and output expectations (Miranda-Aggripino, 2016)
- lagged macro variables likely to determine future inflation: CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, and housing prices

The error term reflects the CB projection surprises
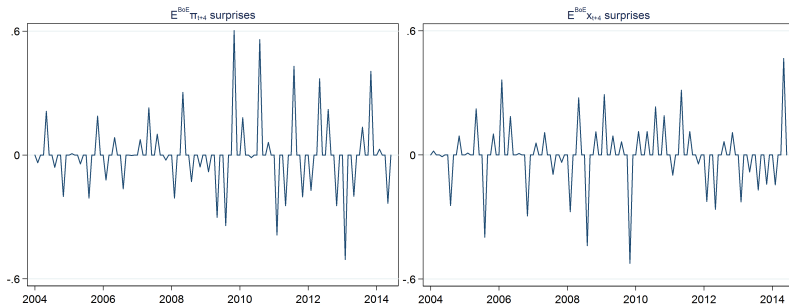
Central bank projection surprises

Figure 6: 4-quarter ahead inflation and output projection surprises

The state-dependent effect of monetary policy

Table 6: Interaction of MPC and CB inflation projection surprises

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
	Smallest window (on IR days only)				
β_1	0.493	0.770***	0.537***	0.227*	-0.020
	[0.36]	[0.25]	[0.18]	[0.12]	[0.12]
β_2	0.191	0.035	-0.005	0.016	0.035*
	[0.20]	[0.08]	[0.02]	[0.02]	[0.02]
β_3	3.220	-4.900*	-4.889***	-2.922***	-1.440*
	[3.92]	[2.55]	[1.31]	[0.57]	[0.84]
R^2	0.04	0.20	0.24	0.10	0.03
N	130	130	130	130	130

Note: Robust SE. $^*p{<}0.1$; $^{**}p{<}0.05$; $^{***}p{<}0.01$.

State-dependent MP at a lower frequency

- We use a simple empirical model derived from the information friction literature

- Since policy decisions and the IR are released on different days in a given month, working at the monthly frequency enables us to interact monetary and IR surprises at the same date

The empirical model

Following sticky and noisy information models, and assuming homogeneous private beliefs :

- ▶ Inflation swaps can be modelled as a linear combination of an initial belief about future inflation (lagged inflation swaps) and new information:

$$E_t \pi_{t+h} = \alpha + \beta_L E_{t-1} \pi_{t+h} + \beta_X X_t + \epsilon_t$$

X_t includes :

- ▶ MPC surprises, IR surprises (or CB projection surprises) and their interaction
- ▶ News shocks (Andersen et al, 2003), macro and uncertainty surprises (Scotti, 2016), UK move and FTSE indices
- ▶ Macro variables (inflation, industrial production, oil prices, net lending, the sterling exchange rate, housing prices)

The state-dependent effect at a lower frequency

Table 7: A monthly model of expectations updating

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
	Conditional on IR surprises				
β_1	0.020	0.042*	0.039**	0.027	0.013
	[0.03]	[0.02]	[0.02]	[0.02]	[0.01]
β_2	-0.079	-0.035	-0.014	-0.005	0.001
	[0.07]	[0.05]	[0.04]	[0.03]	[0.03]
β_3	-0.061***	-0.041***	-0.030***	-0.022**	-0.016*
	[0.02]	[0.01]	[0.01]	[0.01]	[0.01]
β_L	0.694***	0.683***	0.742***	0.814***	0.875***
	[0.10]	[0.09]	[0.08]	[0.08]	[0.07]
R2	0.83	0.78	0.77	0.79	0.84
	Conditional on CB inflation projection surprises				
β_1	0.022	0.044*	0.041**	0.027*	0.013
	[0.04]	[0.02]	[0.02]	[0.02]	[0.01]
β_2	0.316*	0.201*	0.146	0.113	0.087
	[0.18]	[0.12]	[0.10]	[0.08]	[0.07]
β_3	-0.912***	-0.660***	-0.522***	-0.411***	-0.312***
	[0.29]	[0.19]	[0.14]	[0.12]	[0.10]
β_L	0.704***	0.697***	0.751***	0.816***	0.872***
	[0.09]	[0.08]	[0.07]	[0.06]	[0.06]
R2	0.84	0.80	0.78	0.80	0.85
N	125	125	125	125	125

Note: Robust SE. $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

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The state-dependent effect of monetary shocks

- ▶ Romer & Romer (2004) approach applied to UK data by Cloyne & Huertgen (2016)

- ▶ Augmented with private inflation, output and interest rate forecasts because of potential non-nested information sets (Miranda-Agrippino & Ricco, 2017)

- ▶ The policy stance is proxied by a BoE in-house shadow rate
  - because the policy rate is at the ZLB during most of our sample
  - and monetary policy has taken various dimensions in the meantime
  - alternative estimates with Wu and Xia (2016) and Krippner (2014)

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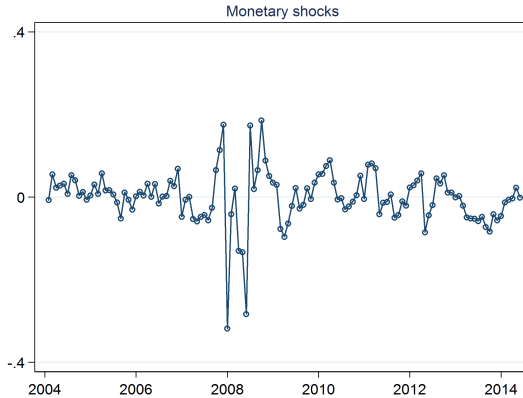
Time series of monetary shocks

Figure 7: Monetary shocks

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The state-dependent effect of monetary shocks

Table 8: Interaction of monetary shocks and CB inflation projection surprises at the monthly frequency

	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
β_1	-0.003	0.004	0.005	0.001	-0.003
	[0.03]	[0.02]	[0.02]	[0.01]	[0.01]
β_2	0.111	0.07	0.056	0.041	0.026
	[0.15]	[0.10]	[0.09]	[0.07]	[0.06]
β_3	-0.992***	-0.675***	-0.481***	-0.372***	-0.288***
	[0.34]	[0.22]	[0.16]	[0.13]	[0.10]
β_L	0.685***	0.679***	0.737***	0.809***	0.869***
	[0.10]	[0.10]	[0.10]	[0.09]	[0.07]
R2	0.83	0.77	0.74	0.77	0.84
N	125	125	125	125	125

Note: Robust SE. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

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Dynamic macro effects

- We investigate the dynamic effect of monetary shocks conditional on CB inflation projection surprises over 6 months

- Jordà (2005)'s local projections with our externally identified instruments for monetary shocks and CB projection surprises

$$E_{t+k}\pi_{t+h} = \alpha_k + \beta_{L,k}E_{t-1}\pi_{t+h} + \beta_X X_t + \epsilon_{t+k}$$
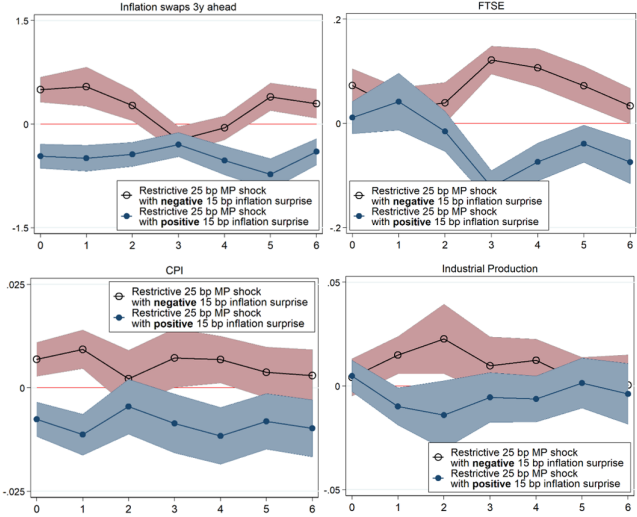
Dynamic macro effects

Figure 8: State-dependent response to monetary shocks