Monetary policy surprises: a local investigation

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Unconventional Monetary Policy: effectiveness and risks
Rome, October 21, 2016

This paper

- of the Federal Reserve
- and the European Central Bank,
- both across **"conventional"** years
- as well as **"unconventional"** years

our twist

- focus on financial markets response
- short-run impact: daily frequency
- flesh-out *forward looking component* of the surprise
- **so to make it comparable across ZLB and pre-ZLB years**

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Outline

- Monetary policy: the surprise component
- Approach
- Results

Motivation

Questions:

1. How effective is monetary policy across time?
2. Has its impact changed?
3. Have cross-country spillovers increased?

Problems

1. Defining the surprise component of monetary policy
2. Comparing it across time: "sizing" it
3. Measuring persistence

nor the first, nor the last to address these problems

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The surprise component of monetary policy

In **Unconventional** times

- daily event study: use only Δ in 2y yields
  (Hanson and Stein, 2015)
- daily VAR with heteroskedasticity identification
  (Wright, 2012)
- high-freq identification
  (Rogers, Scotti and Wright, 2015; Glick and Leduc, 2013)
- high-freq identification + disentangle Forward Guidance from LSAP
  (Swanson,2016)

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- event-study approach: jump in fed-fund futures around MPC
  (Kuttner, 2001; Bernanke and Kuttner, 2005)
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A soccer metaphor

Outcome of a penalty kick

A soccer metaphor

Outcome of a penalty kick

Depends on: the kicker and the goalie

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Outcome of a penalty kick

as well on the: strength of the kick, ball weight, field conditions...

A soccer metaphor

Different players...different shocks

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Different players...different shocks

Examine monetary policy surprise (MPS) with a given effect across period and areas:

1. a 25 bp tightening (*the kick*), not of short rates,
2. but of the **long-end** of the yield curve (10y rate),
3. so to compare pre-ZLB to post-ZLB periods *(different players/fields)*
4. what changes is the response of other assets (*outcome of penalty*)

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Our approach: event-study approach

focus on transmission beyond short term yields

To **compare** efficacy across periods we need to ignore movements due to short-term "target" changes

- follow GSS to extract a "path-factor" before the crisis
- compute asset-price responses
- for ZLB years, like in Swanson (2016) look at long-end of the curve to extract the monetary policy surprise

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Factor extraction from the yield curve

The GSS approach

On mon-policy days, Gürkanyak et al. (2005) assume a 2 factor model for N yields' changes

$$\begin{aligned} X_{T\times N} &= F_{T\times 2}\,\Lambda_{2\times N} + \upsilon_{T\times N} \\ \tilde{F}_{T\times 2} &= F_{T\times 2}\,U_{2\times 2} \end{aligned}$$

The rotation matrix U:

- suitably chosen to satisfy an identification condition,
- namely that the second factor is orthogonal wrt to the
- "target" variable (change in nearby fed-funds futures rate)

Note: GSS look at term structure up to 12 months

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Factor extraction from the yield curve

We slightly modify the GSS method

We extract a path-factor by "orthogonalizing ex-post" the 1*st* PC factor:

$$\begin{aligned} X_{T\times N} &= F_{T\times 2}\,\Lambda_{2\times N} + \epsilon_{T\times N} \\ \bar{F}_{T\times 1} &= M_r\,F_{T\times 1} \end{aligned}$$

where M_r is the residual projection matrix on changes in the nearby future contract for the central bank reference rate (r_t)

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1. Corr between the GSS path factor $\tilde{F}_t$ and this orthogonalized factor $\bar{F}_t$ is >0.9 (for the US in pre-financial crisis period)
2. We will use this definition from now on

Pre financial crisis

Our benchmark period

To calibrate our method, replicate the results of GSS (2005) for the United States, using daily data, and run 2 regressions :

$$\Delta y_t = \gamma + \alpha_{target}\, r_t + u_t \quad (1)$$

$$\Delta y_t = \gamma + \alpha_{target}\, r_t + \alpha_{path} \bar{F}_{1,t} + u_t \quad (2)$$

$\bar{F}_{1,t}$ is orthogonal to changes in the nearby fed-funds futures rate r_t

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Pre financial crisis

Results for GSS target factor

We replicate with *daily* data the results of GSS (2005) for the US:

$$\Delta y_t = \gamma + \alpha_{target} \tilde{F}_{1,t} + u_t$$

	α_{target}	pval	R^2
06m	25.00	0.00	0.82
12m	29.03	0.00	0.43
02y	21.64	0.00	0.63
05y	17.39	0.00	0.45
10y	12.01	0.00	0.31

Regressions on Fed announcement days only, using the GSS target and path factors

Pre financial crisis

Results for GSS target and path factor

We replicate with *daily* data the results of GSS (2005) for the US:

$$\Delta y_t = \gamma + \alpha_{target}\tilde{F}_{1,t} + \alpha_{path}\tilde{F}_{2,t} + u_t$$

	α_{target}	pval	R^2	α_{target}	pval	α_{path}	pval	R^2
06m	25.00	0.00	0.82	25.00	0.00	25.00	0.00	0.90
12m	29.03	0.00	0.43	29.03	0.00	98.40	0.00	0.91
02y	21.64	0.00	0.63	21.64	0.00	26.25	0.00	0.72
05y	17.39	0.00	0.45	17.39	0.00	32.25	0.00	0.60
10y	12.01	0.00	0.31	12.01	0.00	28.35	0.00	0.48

Regressions on Fed announcement days only, using the GSS target and path factors

Now using orthogonalized factors for the US

only target

$$\Delta y_t = \gamma + \alpha_{target} r_t + u_t$$

	α_{target}	pval	R^2	pval
6m	18.45	0.00	0.26	
12m	10.27	0.05	0.03	
2y	11.41	0.00	0.09	
5y	5.27	0.12	0.02	
10y	1.37	0.61	0.00	

Regressions on Fed announcement days only; orthogonalized factors

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Regressions on Fed announcement days only; orthogonalized factors

Now using orthogonalized factors for the US

target and path

$$\Delta y_t = \gamma + \alpha_{target} r_t + \alpha_{path} \bar{F}_{1,t} + u_t$$

	α_{target}	pval	R^2	α_{target}	*pval*	α_{path}	pval	R^2
6m	18.45	0.00	0.26	25.00	0.00	25.00	0.00	0.72
12m	10.27	0.05	0.03	23.00	0.00	54.25	0.00	0.91
2y	11.41	0.00	0.09	19.36	0.00	23.84	0.00	0.59
5y	5.27	0.12	0.02	12.29	0.00	23.67	0.00	0.53
10y	1.37	0.61	0.00	7.01	0.02	18.74	0.00	0.45

Regressions on Fed announcement days only; orthogonalized factors

Euro area

additional difficulties?

- before 2008: what yield curve should we use, many countries/rates
- Brand (2010): follows same approach as GSS, choosing the euro area OIS curve
- before the crisis ok, but afterwards?

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Euro area monetary policy

Before the financial crisis

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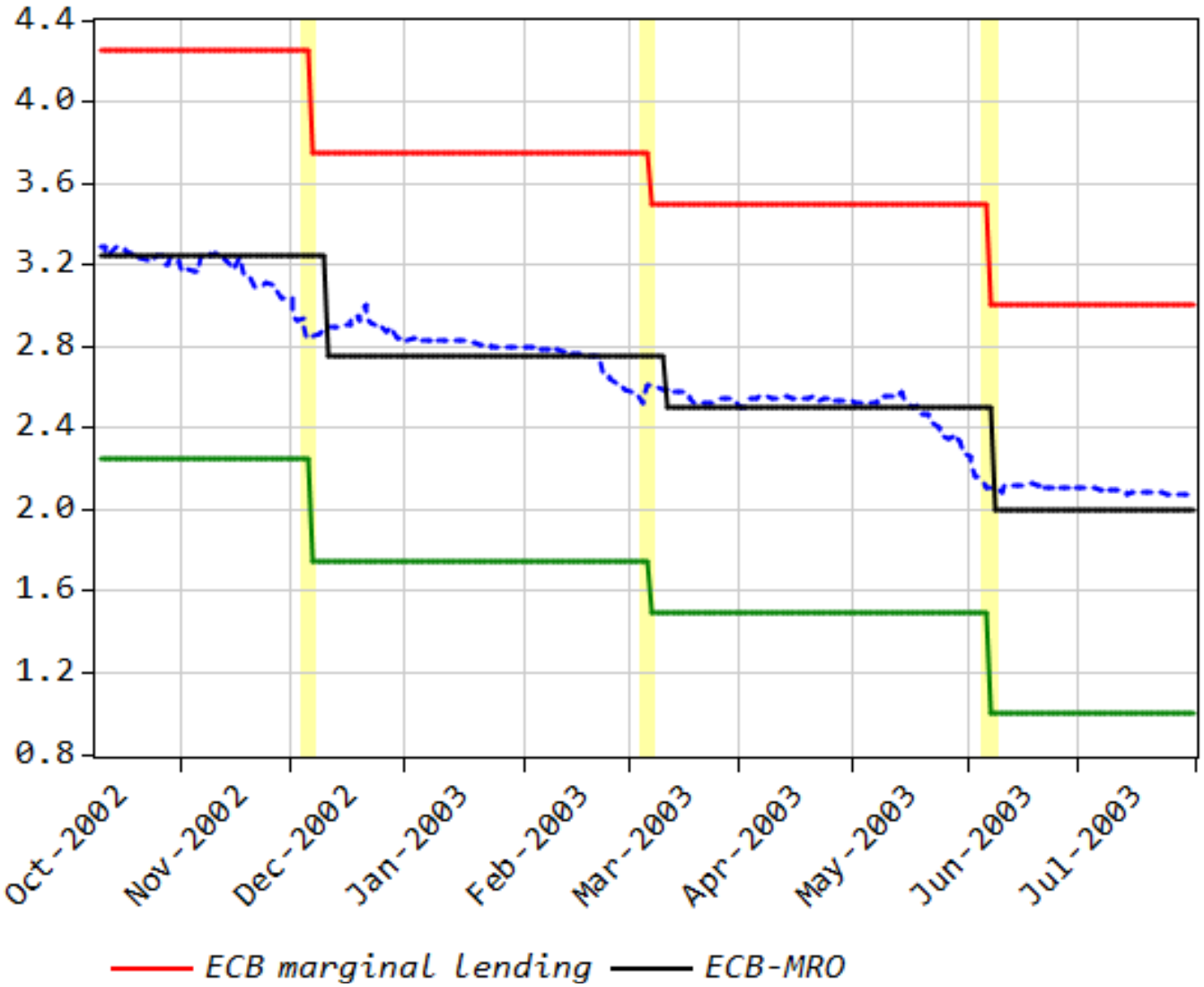

Euro area results

Before the financial crisis: only target

$$\Delta y_t = \gamma + \alpha_{target} r_t \qquad + u_t$$

	α_{target}	pval	R^2	pval
6m	25.00	0.00	0.35	
12m	22.59	0.00	0.20	
2y	17.73	0.00	0.13	
5y	10.13	0.01	0.05	
10y	2.68	0.39	0.01	

Regressions on ECB announcement days only; orthogonalized factors

Euro area results

Before the financial crisis: target and path

$$\Delta y_t = \gamma + \alpha_{target} r_t + \alpha_{path} \bar{F}_{1,t} + u_t$$

	α_{target}	pval	R^2	α_{target}	*pval*	α_{path}	pval	R^2
6m	25.00	0.00	0.35	25.00	0.00	25.00	0.00	0.96
12m	22.59	0.00	0.20	22.59	0.00	33.07	0.00	0.96
2y	17.73	0.00	0.13	17.73	0.00	25.35	0.00	0.62
5y	10.13	0.01	0.05	10.13	0.00	19.97	0.00	0.43
10y	2.68	0.39	0.01	2.68	0.33	11.36	0.00	0.23

Regressions on ECB announcement days only; orthogonalized factors

Factor extraction

How to compare results across regimes?

Exploit rates from the entire term structure of interest rates:

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		horizon	instruments
GSS (2005)	US	1-,3- ,6- ,9- ,12-mo	fed-fund and eurodollar futures
Brand et al. (2010)	euro area	10-,30-, 160-, 240-, 360-d	euro area OIS and swap rates

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our paper			
	US	add 2-, 5-,10-year	US treasuries
	euro area: DE, FR, IT, ES	add 2-, 5-,10-year	benchmark sovereign rates

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Define 3 subperiods:

- **Pre-crisis**: 1999 to Nov 2008 (beginning of US QE)
- **Crisis**: global financial crisis + euro area sovereign, Dec 2008 -Dec 2012
- **Post-crisis**: Jan 2013 - Sep 2016

Estimate regressions over separate subperiods

Method: run regressions on factors

...only on days with ECB or FED announcement

For each asset (i), examine its *daily* change $\Delta y_t^{(i)}$:

$$\Delta y_t^{(i)} = \alpha + \beta_1 \, r_t^{Fed} + \gamma_1 \, \bar{F}_{1,t}^{Fed} + \beta_2 \, r_{1,t}^{ECB} + \gamma_2 \, \bar{F}_{1,t}^{ECB} + u_t$$

- all regression include additional controls: macro-surprise indices, VIX
- we will report estimates for γ_1 and γ_2 only, along with R^2

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Results: pre-crisis

Impact on sovereign bond yields

	Fed	(γ_1)	s.e.	ECB	(γ_2)	s.e.	R^2	obs

Results: pre-crisis

Impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 10-Year Treasury	25.00 * **	[1.52]	21.31 * **	[3.11]	0.40	175
Ger 10-Year Bund	7.04 * **	[1.13]	25.00 * **	[2.31]	0.38	175

- normalize US and Ger 10-y response to 25bp

Results: pre-crisis

Impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	26.74 $*$ $**$	[1.41]	20.18 $*$ $**$	[2.88]	0.53	175
US 5-Year Treasury	30.40 $*$ $**$	[1.33]	30.86 $*$ $**$	[2.71]	0.50	175
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Ger 2-Year Bund	1.25$*$	[0.74]	42.90 $*$ $**$	[1.51]	0.50	175
Ger 5-Year Bund	1.44$*$	[0.83]	40.67 $*$ $**$	[1.70]	0.48	175
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- normalize US and Ger 10-y response to 25bp
- Hump-shaped response across term structure, in both euro area and US
- Spillovers across the Atlantic are substantial

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US 2-Year Treasury	26.74 $***$	[1.41]	20.18 $***$	[2.88]	0.53	175
US 5-Year Treasury	30.40 $***$	[1.33]	30.86 $***$	[2.71]	0.50	175
US 10-Year Treasury	25.00 $***$	[1.52]	21.31 $***$	[3.11]	0.40	175
Ger 2-Year Bund	1.25$*$	[0.74]	42.90 $***$	[1.51]	0.50	175
Ger 5-Year Bund	1.44$*$	[0.83]	40.67 $***$	[1.70]	0.48	175
Ger 10-Year Bund	7.04 $***$	[1.13]	25.00 $***$	[2.31]	0.38	175
Ita 2-Year BTP	1.37 $**$	[0.63]	43.06 $***$	[1.28]	0.52	175
Ita 5-Year BTP	5.68 $***$	[0.87]	38.48 $***$	[1.78]	0.50	175
Ita 10-Year BTP	4.26 $***$	[0.99]	26.98 $***$	[2.03]	0.41	175
Fra 2-Year OAT	2.11 $***$	[0.69]	44.64 $***$	[1.41]	0.53	175
Fra 5-Year OAT	3.14 $***$	[0.77]	39.14 $***$	[1.58]	0.52	175
Fra 10-Year OAT	9.49 $***$	[1.08]	26.47 $***$	[2.21]	0.43	175
Spa 2-Year Bonos	3.19 $***$	[0.68]	44.87 $***$	[1.38]	0.54	175
Spa 5-Year Bonos	6.08 $***$	[0.94]	42.43 $***$	[1.91]	0.50	175
Spa 10-Year Bonos	6.40 $***$	[1.09]	29.78 $***$	[2.23]	0.46	175

- normalize US and Ger 10-y response to 25bp
- Hump-shaped response across term structure, in both euro area and US
- Spillovers across the Atlantic are substantial
- Homogeneous pricing of sovereign risk in euro area

Results: pre-crisis

Impact on exchange rates, equities and term-premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-1.14**$	[0.34]	$2.32**$	[0.69]	0.10	175
USD/GBP	-0.11	[0.34]	$1.25*$	[0.69]	0.14	175
USD/YEN	$-1.63**$	[0.38]	-0.80	[0.78]	0.12	175

- Surprise tightening leads to currency appreciation

Results: pre-crisis

Impact on exchange rates, equities and term-premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-1.14**$	[0.34]	$2.32**$	[0.69]	0.10	175
USD/GBP	-0.11	[0.34]	$1.25*$	[0.69]	0.14	175
USD/YEN	$-1.63**$	[0.38]	-0.80	[0.78]	0.12	175
US stock	$1.08**$	[0.23]	$5.16**$	[0.47]	0.50	175
€ stock	0.48	[0.40]	$3.61**$	[0.82]	0.27	175
Jap stock	-0.19	[0.46]	-0.04	[0.94]	0.07	175
Ger stock	0.66	[0.48]	$3.73**$	[0.98]	0.24	175
Fra stock	0.35	[0.44]	$3.98**$	[0.90]	0.31	175
Italy stock	-0.05	[0.39]	$2.87**$	[0.80]	0.28	175

- Surprise tightening leads to currency appreciation
- Stock market indices respond *positively* to a path-surprise

Results: pre-crisis

Impact on exchange rates, equities and term-premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	−1.14 ∗ ∗∗	[0.34]	2.32 ∗ ∗∗	[0.69]	0.10	175
USD/GBP	−0.11	[0.34]	1.25∗	[0.69]	0.14	175
USD/YEN	−1.63 ∗ ∗∗	[0.38]	−0.80	[0.78]	0.12	175
US stock	1.08 ∗ ∗∗	[0.23]	5.16 ∗ ∗∗	[0.47]	0.50	175
€ stock	0.48	[0.40]	3.61 ∗ ∗∗	[0.82]	0.27	175
Jap stock	−0.19	[0.46]	−0.04	[0.94]	0.07	175
Ger stock	0.66	[0.48]	3.73 ∗ ∗∗	[0.98]	0.24	175
Fra stock	0.35	[0.44]	3.98 ∗ ∗∗	[0.90]	0.31	175
Italy stock	−0.05	[0.39]	2.87 ∗ ∗∗	[0.80]	0.28	175
US 2-Year term-premia	5.85 ∗ ∗∗	[1.08]	4.37 ∗ ∗	[2.23]	0.18	172
US 5-Year term-premia	6.01 ∗ ∗∗	[1.33]	6.10 ∗ ∗	[2.73]	0.16	172
US 10-Year term-premia	4.70 ∗ ∗∗	[1.67]	4.24	[3.43]	0.14	172
€ 2-Year term-premia	0.94	[1.21]	29.01 ∗ ∗∗	[2.47]	0.24	175
€ 5-Year term-premia	3.33∗	[1.71]	26.59 ∗ ∗∗	[3.49]	0.23	175
€ 10-Year term-premia	4.72 ∗ ∗∗	[1.73]	16.62 ∗ ∗∗	[3.53]	0.15	175
US 5y Inflation-swap	−0.84	[2.96]	21.14 ∗ ∗∗	[5.20]	0.06	127
US 5y-5y Inflation-swap	−0.52	[2.53]	7.51∗	[4.45]	0.09	128
€ 5y Inflation-swap	−1.04	[2.44]	14.64 ∗ ∗∗	[4.48]	0.14	138
€ 5y-5y Inflation-swap	1.74	[1.35]	7.75 ∗ ∗∗	[2.47]	0.13	138

- Surprise tightening leads to currency appreciation
- Stock market indices respond *positively* to a path-surprise
- Term-premia respond (much more so in the euro area), and spill-over both ways

Results: pre-crisis

Impact on exchange rates, equities and term-premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
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US stock	1.08 ∗ ∗∗	[0.23]	5.16 ∗ ∗∗	[0.47]	0.50	175
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Jap stock	−0.19	[0.46]	−0.04	[0.94]	0.07	175
Ger stock	0.66	[0.48]	3.73 ∗ ∗∗	[0.98]	0.24	175
Fra stock	0.35	[0.44]	3.98 ∗ ∗∗	[0.90]	0.31	175
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€ 5y-5y Inflation-swap	1.74	[1.35]	7.75 ∗ ∗∗	[2.47]	0.13	138

- Surprise tightening leads to currency appreciation
- Stock market indices respond *positively* to a path-surprise
- Term-premia respond (much more so in the euro area), and spill-over both ways
- In the US: most of the response is via real-rates (Hanson and Stein, 2015)

Results: pre-crisis

CDS, credit spreads and vols

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
France CDS	0.31	[0.36]	0.19	[0.63]	0.02	111
Italy CDS	−0.05	[0.21]	−0.13	[0.40]	0.03	147
€ OAS Inv. grade	−0.00	[0.05]	−0.76 ∗ ∗	[0.10]	0.20	175
€ OAS HY	−0.34	[0.28]	−3.16 ∗ ∗	[0.58]	0.13	175
US OAS Inv. grade	−0.13 ∗ ∗	[0.04]	−0.11	[0.08]	0.05	175
US OAS HY	−2.15 ∗ ∗	[0.26]	−2.99 ∗ ∗	[0.54]	0.26	175

- surprise tightening leads to compression of corporate spreads, both in US and euro area

Results: pre-crisis

CDS, credit spreads and vols

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
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€ OAS HY	−0.34	[0.28]	−3.16 ∗ ∗	[0.58]	0.13	175
US OAS Inv. grade	−0.13 ∗ ∗	[0.04]	−0.11	[0.08]	0.05	175
US OAS HY	−2.15 ∗ ∗	[0.26]	−2.99 ∗ ∗	[0.54]	0.26	175
US rates vol	−1.48	[1.34]	−0.09	[2.73]	0.10	175
Ger rates vol	0.29 ∗ ∗	[0.09]	0.75 ∗ ∗	[0.19]	0.08	175
EUR 1-mo implied vol	−0.05	[0.14]	0.11	[0.29]	0.05	175
GBP 1-mo implied vol	0.07	[0.13]	−0.35	[0.26]	0.03	175
JPY 1-mo implied vol	−0.49 ∗	[0.24]	−1.10 ∗	[0.49]	0.11	175
USD/EUR 25δ risk-rev.	0.04	[0.03]	0.16 ∗ ∗	[0.06]	0.06	148
USD/EUR 1y crosscurr basis	−0.83	[3.68]	0.02	[7.09]	0.18	41
Brent	0.72	[0.90]	−0.06	[1.83]	0.07	175

- surprise tightening leads to compression of corporate spreads, both in US and euro area
- no impact on implied-volatility of interest rates

Results: pre-crisis

CDS, credit spreads and vols

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
France CDS	0.31	[0.36]	0.19	[0.63]	0.02	111
Italy CDS	−0.05	[0.21]	−0.13	[0.40]	0.03	147
€ OAS Inv. grade	−0.00	[0.05]	−0.76 ∗ ∗	[0.10]	0.20	175
€ OAS HY	−0.34	[0.28]	−3.16 ∗ ∗	[0.58]	0.13	175
US OAS Inv. grade	−0.13 ∗ ∗	[0.04]	−0.11	[0.08]	0.05	175
US OAS HY	−2.15 ∗ ∗	[0.26]	−2.99 ∗ ∗	[0.54]	0.26	175
US rates vol	−1.48	[1.34]	−0.09	[2.73]	0.10	175
Ger rates vol	0.29 ∗ ∗	[0.09]	0.75 ∗ ∗	[0.19]	0.08	175
EUR 1-mo implied vol	−0.05	[0.14]	0.11	[0.29]	0.05	175
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Brent	0.72	[0.90]	−0.06	[1.83]	0.07	175

- surprise tightening leads to compression of corporate spreads, both in US and euro area
- no impact on implied-volatility of interest rates
- no impact on commodity prices either

Euro area

additional difficulties?

- before 2008: not too dissimilar from US case, but many countries/rates
- in crisis years task to define monetary policy is daunting [RSW (2014) consider the "spread" as the ECB "target"]
- but in the most recent years?

Euro area

additional difficulties?

- before 2008: not too dissimilar from US case, but many countries/rates
- in crisis years task to define monetary policy is daunting [RSW (2014) consider the "spread" as the ECB "target"]
- but in the most recent years?

Euro area monetary policy

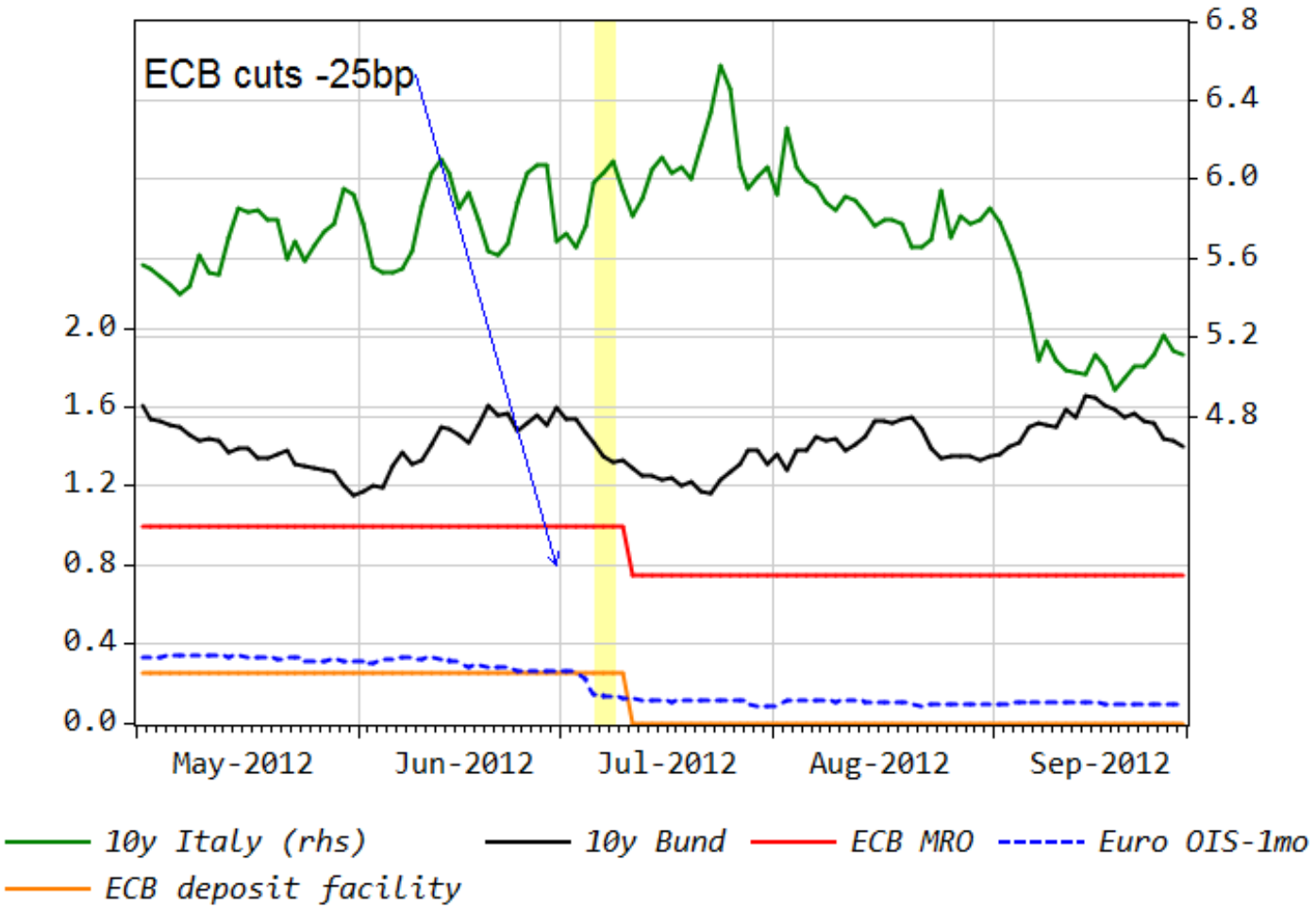
during the sovereign crisis

Official rates approach ZLB, long term yields diverge across the area

Euro area monetary policy

during the sovereign crisis

July 2012: ECB cuts reference rates by 25bp, deposit rate reaches 0

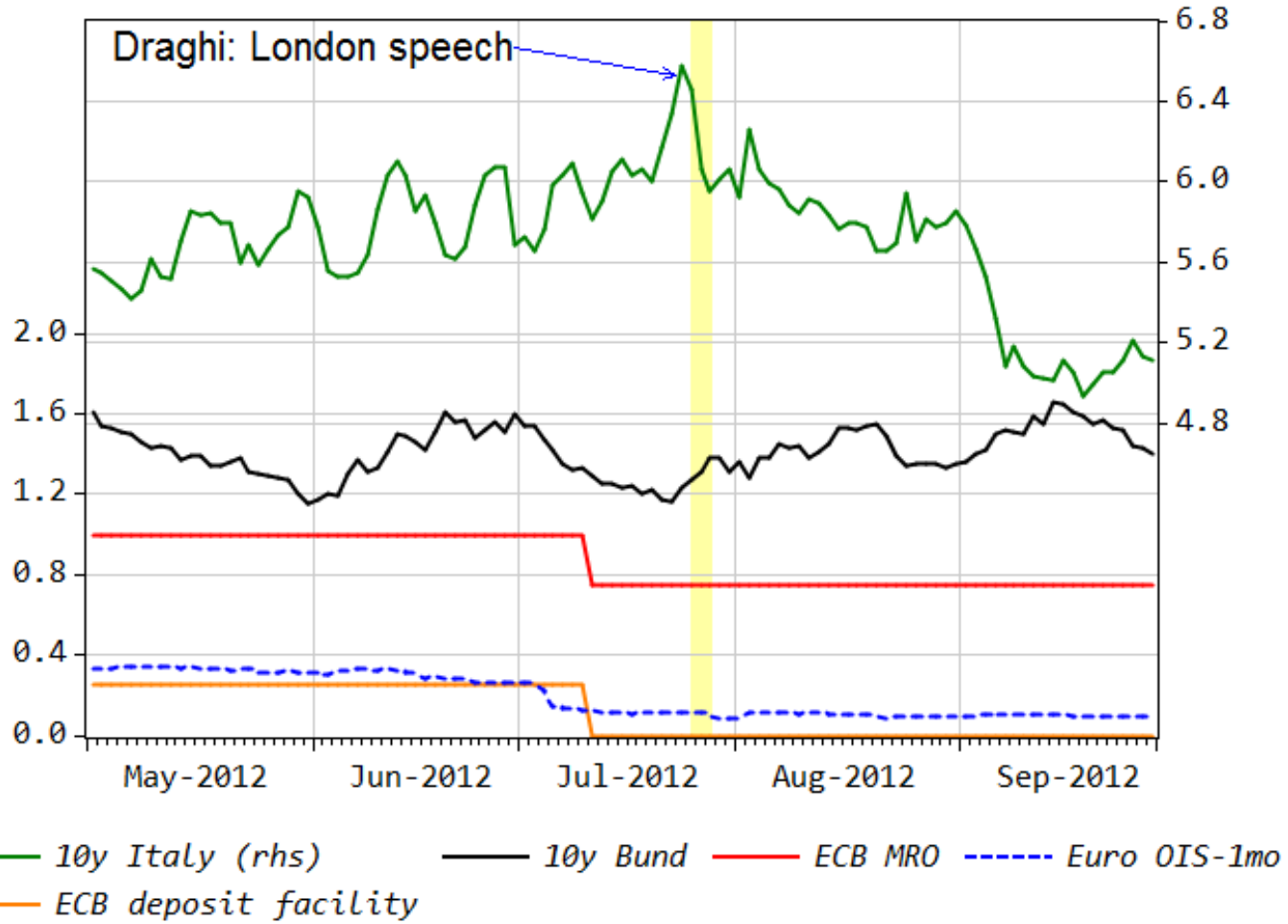


"easing" leads to *lower* DE, but *higher* IT rates

Euro area monetary policy

during the sovereign crisis

26 July 2012: Draghi "whatever it takes" speech in London

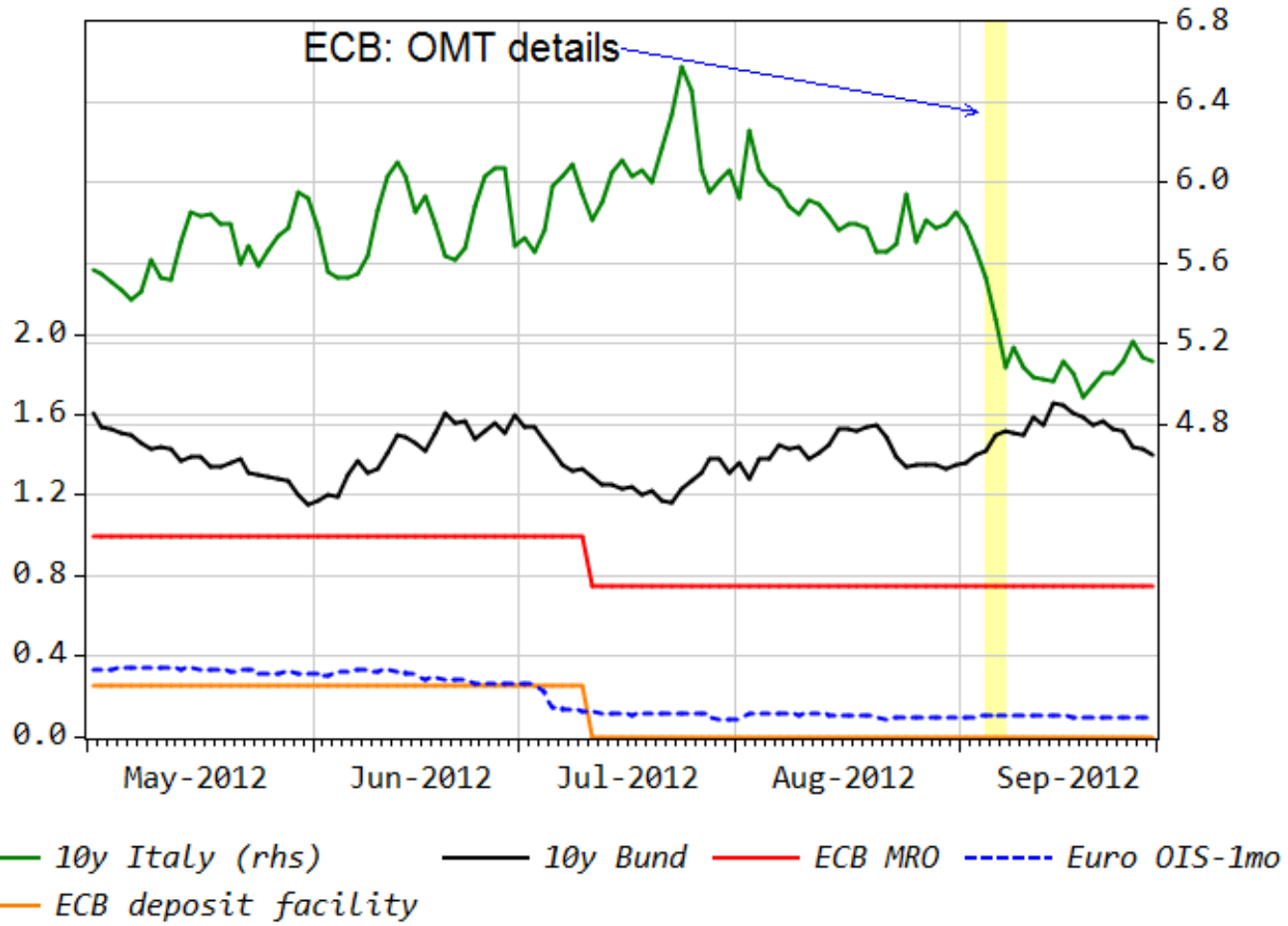


large drop in IT-DE spread

Euro area monetary policy

during the sovereign crisis

Sep 2012: ECB announces OMT details

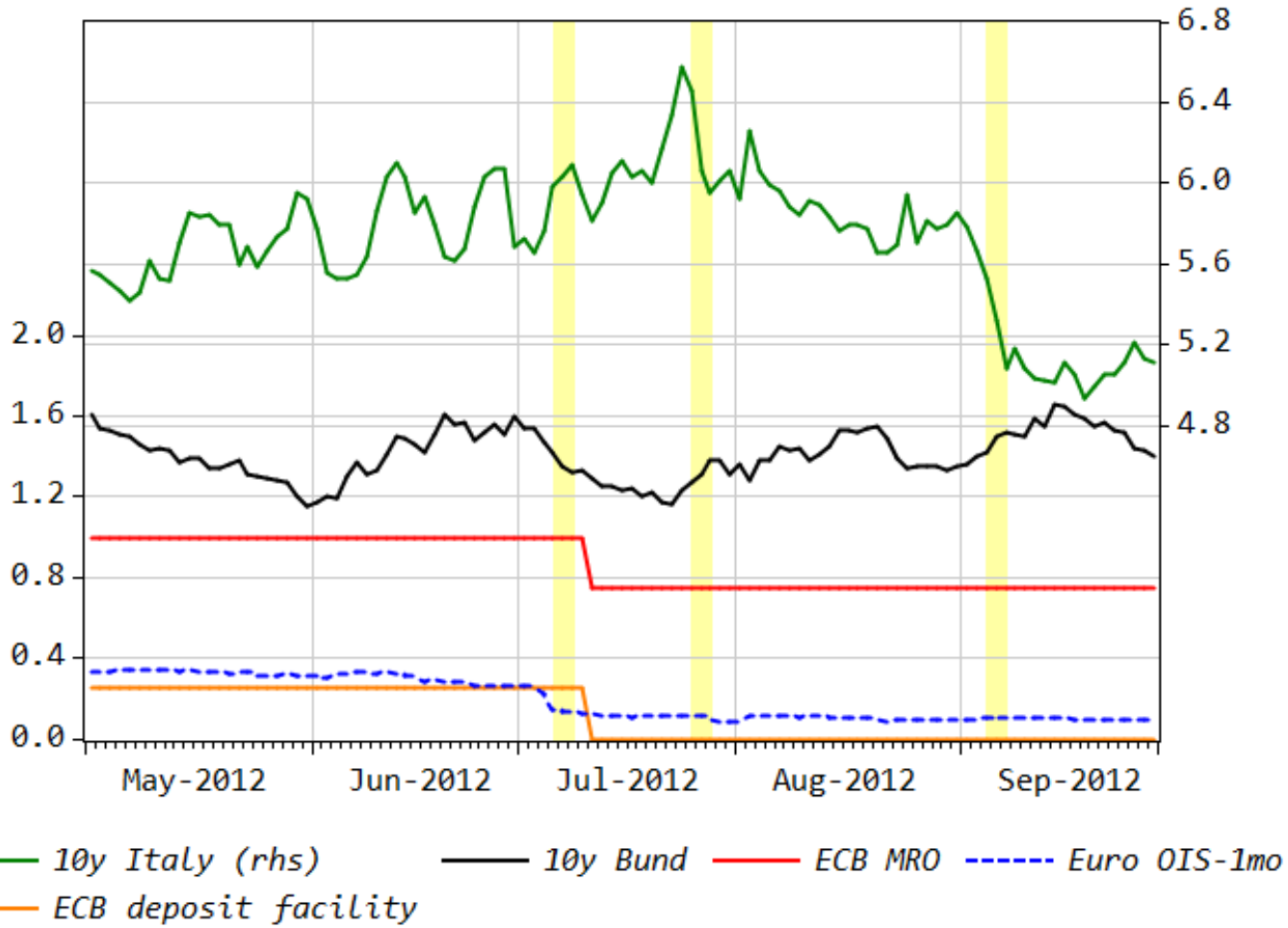


further drop in IT-DE spread, ridenomination risk abates

Euro area monetary policy

during the sovereign crisis

Different kind of surprises,



different propagation across euro area rates

Results: crisis years

Altered impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury						
US 5-Year Treasury						
US 10-Year Treasury	25.00 $***$	[1.54]				
Ger 2-Year Bund						
Ger 5-Year Bund						
Ger 10-Year Bund						
Ita 2-Year BTP						
Ita 5-Year BTP						
Ita 10-Year BTP						
Fra 2-Year OAT						
Fra 5-Year OAT						
Fra 10-Year OAT						
Spa 2-Year Bonos						
Spa 5-Year Bonos						
Spa 10-Year Bonos						

Results: crisis years

Altered impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.07 ***	[0.85]				
US 5-Year Treasury	22.03 ***	[1.44]				
US 10-Year Treasury	25.00 ***	[1.54]				
Ger 2-Year Bund						
Ger 5-Year Bund						
Ger 10-Year Bund						
Ita 2-Year BTP						
Ita 5-Year BTP						
Ita 10-Year BTP						
Fra 2-Year OAT						
Fra 5-Year OAT						
Fra 10-Year OAT						
Spa 2-Year Bonos						
Spa 5-Year Bonos						
Spa 10-Year Bonos						

- US curve response now slopes upwards

Results: crisis years

Altered impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.07 ***	[0.85]				
US 5-Year Treasury	22.03 ***	[1.44]				
US 10-Year Treasury	25.00 ***	[1.54]				
Ger 2-Year Bund	1.64	[1.16]				
Ger 5-Year Bund	3.77 **	[1.49]				
Ger 10-Year Bund	4.64 ***	[1.41]				
Ita 2-Year BTP	0.46	[1.98]				
Ita 5-Year BTP	3.76 ***	[1.33]				
Ita 10-Year BTP	− 0.88	[1.70]				
Fra 2-Year OAT	1.64	[1.18]				
Fra 5-Year OAT	1.69	[1.65]				
Fra 10-Year OAT	1.41	[1.61]				
Spa 2-Year Bonos	1.32	[2.33]				
Spa 5-Year Bonos	2.00	[2.02]				
Spa 10-Year Bonos	0.92	[1.77]				

- US curve response now slopes upwards
- *contractionary* surprise = ↓ Ger yields and ↑ Ita and Spa yields
- substantial *westward* spillovers: flight to the safety of US Treasuries

Results: crisis years

Altered impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.07 ***	[0.85]				
US 5-Year Treasury	22.03 ***	[1.44]				
US 10-Year Treasury	25.00 ***	[1.54]				
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Ger 5-Year Bund	3.77 **	[1.49]				
Ger 10-Year Bund	4.64 ***	[1.41]				
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Fra 5-Year OAT	1.69	[1.65]				
Fra 10-Year OAT	1.41	[1.61]				
Spa 2-Year Bonos	1.32	[2.33]				
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- US curve response now slopes upwards
- *contractionary* surprise = ↓ Ger yields and ↑ Ita and Spa yields
- substantial *westward* spillovers: flight to the safety of US Treasuries
- Flaring up of sovereign crisis: exorbitant responses, vulnerable vs non vulnerable economies

Results: crisis years

Altered impact on sovereign bond yields

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.07 ***	[0.85]	− 6.03	[6.55]	0.38	104
US 5-Year Treasury	22.03 ***	[1.44]	− 21.52 *	[11.13]	0.51	104
US 10-Year Treasury	25.00 ***	[1.54]	− 27.10 **	[11.90]	0.50	104
Ger 2-Year Bund	1.64	[1.16]	− 10.51	[8.96]	0.18	104
Ger 5-Year Bund	3.77 **	[1.49]	−30.68 ***	[11.46]	0.22	104
Ger 10-Year Bund	4.64 ***	[1.41]	− 25.00 **	[10.89]	0.21	104
Ita 2-Year BTP	0.46	[1.98]				
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US 10-Year Treasury	25.00 ***	[1.54]	− 27.10 **	[11.90]	0.50	104
Ger 2-Year Bund	1.64	[1.16]	− 10.51	[8.96]	0.18	104
Ger 5-Year Bund	3.77 **	[1.49]	−30.68 ***	[11.46]	0.22	104
Ger 10-Year Bund	4.64 ***	[1.41]	− 25.00 **	[10.89]	0.21	104
Ita 2-Year BTP	0.46	[1.98]	335.01 ***	[15.25]	0.43	104
Ita 5-Year BTP	3.76 ***	[1.33]	279.40 ***	[10.27]	0.49	104
Ita 10-Year BTP	− 0.88	[1.70]	218.31 ***	[13.13]	0.44	104
Fra 2-Year OAT	1.64	[1.18]	32.70 ***	[9.10]	0.22	104
Fra 5-Year OAT	1.69	[1.65]	29.97 **	[12.72]	0.17	104
Fra 10-Year OAT	1.41	[1.61]	42.24 ***	[12.42]	0.19	104
Spa 2-Year Bonos	1.32	[2.33]	325.44 ***	[18.00]	0.31	104
Spa 5-Year Bonos	2.00	[2.02]	245.02 ***	[15.57]	0.45	104
Spa 10-Year Bonos	0.92	[1.77]	198.36 ***	[13.66]	0.41	104

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Results: crisis years

as well as on currencies and term premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-0.54**$	[0.17]				
USD/GBP	$-0.79**$	[0.34]				
USD/YEN	$-2.06***$	[0.30]				

- Lessened impact of Fed on USD/EUR; greater impact on stocks; rates vol impacted

Results: crisis years

as well as on currencies and term premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-0.54**$	[0.17]				
USD/GBP	$-0.79**$	[0.34]				
USD/YEN	$-2.06***$	[0.30]				
US stock	$1.65***$	[0.28]				
€ stock	$0.95**$	[0.42]				
Jap stock	0.44	[0.47]				
Ger stock	$0.72*$	[0.41]				
Fra stock	$1.08**$	[0.44]				
Italy stock	0.35	[0.48]				

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USD/EUR	$-0.54**$	[0.17]				
USD/GBP	$-0.79**$	[0.34]				
USD/YEN	$-2.06***$	[0.30]				
US stock	$1.65***$	[0.28]				
€ stock	$0.95**$	[0.42]				
Jap stock	0.44	[0.47]				
Ger stock	$0.72*$	[0.41]				
Fra stock	$1.08**$	[0.44]				
Italy stock	0.35	[0.48]				
US 2-Year term-premia	$11.15***$	[1.08]				
US 5-Year term-premia	$19.50***$	[1.70]				
US 10-Year term-premia	$23.23***$	[2.20]				
€ 2-Year term-premia	-0.25	[1.24]				
€ 5-Year term-premia	1.90	[2.19]				
€ 10-Year term-premia	2.32	[1.79]				
US 5y Inflation-swap	0.80	[2.34]				
US 5y-5y Inflation-swap	-1.94	[1.61]				
€ 5y Inflation-swap	$-6.00**$	[2.94]				
€ 5y-5y Inflation-swap	$3.11**$	[1.45]				
US rates vol	$6.67***$	[1.10]				

- Lessened impact of Fed on USD/EUR; greater impact on stocks; rates vol impacted
- US term-premia move almost in tandem with US yields response

Results: crisis years

as well as on currencies and term premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-0.54**$	[0.17]	$-8.57***$	[2.84]	0.21	104
USD/GBP	$-0.79**$	[0.34]	$-6.43**$	[2.65]	0.17	104
USD/YEN	$-2.06***$	[0.30]	0.47	[2.33]	0.22	104
US stock	$1.65***$	[0.28]				
€ stock	$0.95**$	[0.42]				
Jap stock	0.44	[0.47]				
Ger stock	$0.72*$	[0.41]				
Fra stock	$1.08**$	[0.44]				
Italy stock	0.35	[0.48]				
US 2-Year term-premia	$11.15***$	[1.08]				
US 5-Year term-premia	$19.50***$	[1.70]				
US 10-Year term-premia	$23.23***$	[2.20]				
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€ 5-Year term-premia	1.90	[2.19]				
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US 5y Inflation-swap	0.80	[2.34]				
US 5y-5y Inflation-swap	-1.94	[1.61]				
€ 5y Inflation-swap	$-6.00**$	[2.94]				
€ 5y-5y Inflation-swap	$3.11**$	[1.45]				
US rates vol	$6.67***$	[1.10]				

- Lessened impact of Fed on USD/EUR; greater impact on stocks; rates vol impacted
- US term-premia move almost in tandem with US yields response
- ECB surprises affect (sovereign) credit risk: forceful impact on FX and equities

Results: crisis years

as well as on currencies and term premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	−0.54 ∗∗	[0.17]	−8.57 ∗∗∗	[2.84]	0.21	104
USD/GBP	−0.79 ∗∗	[0.34]	−6.43 ∗∗	[2.65]	0.17	104
USD/YEN	−2.06 ∗∗∗	[0.30]	0.47	[2.33]	0.22	104
US stock	1.65 ∗∗∗	[0.28]	−9.47 ∗∗∗	[2.17]	0.55	104
€ stock	0.95 ∗∗	[0.42]	−16.47 ∗∗∗	[3.20]	0.30	104
Jap stock	0.44	[0.47]	−5.61	[3.61]	0.05	104
Ger stock	0.72 ∗	[0.41]	−13.11 ∗∗∗	[3.19]	0.21	104
Fra stock	1.08 ∗∗	[0.44]	−16.94 ∗∗∗	[3.36]	0.31	104
Italy stock	0.35	[0.48]	−26.07 ∗∗∗	[3.72]	0.35	104
US 2-Year term-premia	11.15 ∗∗∗	[1.08]				
US 5-Year term-premia	19.50 ∗∗∗	[1.70]				
US 10-Year term-premia	23.23 ∗∗∗	[2.20]				
€ 2-Year term-premia	−0.25	[1.24]				
€ 5-Year term-premia	1.90	[2.19]				
€ 10-Year term-premia	2.32	[1.79]				
US 5y Inflation-swap	0.80	[2.34]				
US 5y-5y Inflation-swap	−1.94	[1.61]				
€ 5y Inflation-swap	−6.00 ∗∗	[2.94]				
€ 5y-5y Inflation-swap	3.11 ∗∗	[1.45]				
US rates vol	6.67 ∗∗∗	[1.10]				

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Results: crisis years

as well as on currencies and term premia

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	−0.54 ∗∗	[0.17]	−8.57 ∗∗∗	[2.84]	0.21	104
USD/GBP	−0.79 ∗∗	[0.34]	−6.43 ∗∗	[2.65]	0.17	104
USD/YEN	−2.06 ∗∗∗	[0.30]	0.47	[2.33]	0.22	104
US stock	1.65 ∗∗∗	[0.28]	−9.47 ∗∗∗	[2.17]	0.55	104
€ stock	0.95 ∗∗	[0.42]	−16.47 ∗∗∗	[3.20]	0.30	104
Jap stock	0.44	[0.47]	−5.61	[3.61]	0.05	104
Ger stock	0.72 ∗	[0.41]	−13.11 ∗∗∗	[3.19]	0.21	104
Fra stock	1.08 ∗∗	[0.44]	−16.94 ∗∗∗	[3.36]	0.31	104
Italy stock	0.35	[0.48]	−26.07 ∗∗∗	[3.72]	0.35	104
US 2-Year term-premia	11.15 ∗∗∗	[1.08]	−14.61 ∗	[8.67]	0.37	103
US 5-Year term-premia	19.50 ∗∗∗	[1.70]	−25.68 ∗	[13.64]	0.44	103
US 10-Year term-premia	23.23 ∗∗∗	[2.20]	−33.98 ∗	[17.60]	0.37	103
€ 2-Year term-premia	−0.25	[1.24]	101.55 ∗∗∗	[9.54]	0.23	104
€ 5-Year term-premia	1.90	[2.19]	115.66 ∗∗∗	[16.87]	0.17	104
€ 10-Year term-premia	2.32	[1.79]	95.07 ∗∗∗	[13.77]	0.29	104
US 5y Inflation-swap	0.80	[2.34]	−21.65	[18.02]	0.08	104
US 5y-5y Inflation-swap	−1.94	[1.61]	−25.35 ∗∗	[12.41]	0.14	104
€ 5y Inflation-swap	−6.00 ∗∗	[2.94]	40.65 ∗	[22.66]	0.09	101
€ 5y-5y Inflation-swap	3.11 ∗∗	[1.45]	−31.50 ∗∗∗	[11.20]	0.12	103
US rates vol	6.67 ∗∗∗	[1.10]	6.68	[8.49]	0.16	104

- Lessened impact of Fed on USD/EUR; greater impact on stocks; rates vol impacted
- US term-premia move almost in tandem with US yields response
- ECB surprises affect (sovereign) credit risk: forceful impact on FX and equities

Results: from 2013

yield curve response morphing back to more *standard* shape?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury						
US 5-Year Treasury						
US 10-Year Treasury	25.00 $***$	[2.22]				
Ger 2-Year Bund						
Ger 5-Year Bund						
Ger 10-Year Bund						
Ita 2-Year BTP						
Ita 5-Year BTP						
Ita 10-Year BTP						
Fra 2-Year OAT						
Fra 5-Year OAT						
Fra 10-Year OAT						
Spa 2-Year Bonos						
Spa 5-Year Bonos						
Spa 10-Year Bonos						

Results: from 2013

yield curve response morphing back to more *standard* shape?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.13 ***	[1.18]				
US 5-Year Treasury	31.82 ***	[1.47]				
US 10-Year Treasury	25.00 ***	[2.22]				
Ger 2-Year Bund						
Ger 5-Year Bund						
Ger 10-Year Bund						
Ita 2-Year BTP						
Ita 5-Year BTP						
Ita 10-Year BTP						
Fra 2-Year OAT						
Fra 5-Year OAT						
Fra 10-Year OAT						
Spa 2-Year Bonos						
Spa 5-Year Bonos						
Spa 10-Year Bonos						

- US rates response returns to be hump-shaped

Results: from 2013

yield curve response morphing back to more *standard* shape?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.13 ***	[1.18]				
US 5-Year Treasury	31.82 ***	[1.47]				
US 10-Year Treasury	25.00 ***	[2.22]				
Ger 2-Year Bund	0.49	[0.98]				
Ger 5-Year Bund	2.64	[1.65]				
Ger 10-Year Bund	3.94 *	[2.22]				
Ita 2-Year BTP	− 0.92	[2.56]				
Ita 5-Year BTP	1.04	[2.09]				
Ita 10-Year BTP	0.34	[2.31]				
Fra 2-Year OAT	1.17	[0.94]				
Fra 5-Year OAT	0.54	[1.58]				
Fra 10-Year OAT	3.03	[2.16]				
Spa 2-Year Bonos	− 0.45	[2.11]				
Spa 5-Year Bonos	5.77 ***	[2.01]				
Spa 10-Year Bonos	− 0.61	[2.55]				

- US rates response returns to be hump-shaped
- little spillovers from US to euro area rates

Results: from 2013

yield curve response morphing back to more *standard* shape?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.13 ***	[1.18]	1.92	[1.52]	0.47	
US 5-Year Treasury	31.82 ***	[1.47]	0.94	[1.89]	0.61	
US 10-Year Treasury	25.00 ***	[2.22]	2.36	[2.86]	0.50	
Ger 2-Year Bund	0.49	[0.98]	14.67 ***	[1.26]	0.29	
Ger 5-Year Bund	2.64	[1.65]	27.44 ***	[2.12]	0.40	
Ger 10-Year Bund	3.94 *	[2.22]	25.00 ***	[2.86]	0.21	
Ita 2-Year BTP	− 0.92	[2.56]				
Ita 5-Year BTP	1.04	[2.09]				
Ita 10-Year BTP	0.34	[2.31]				
Fra 2-Year OAT	1.17	[0.94]				
Fra 5-Year OAT	0.54	[1.58]				
Fra 10-Year OAT	3.03	[2.16]				
Spa 2-Year Bonos	− 0.45	[2.11]				
Spa 5-Year Bonos	5.77 ***	[2.01]				
Spa 10-Year Bonos	− 0.61	[2.55]				

- US rates response returns to be hump-shaped
- little spillovers from US to euro area rates
- when German rates move up, no flight to quality, and ...

Results: from 2013

yield curve response morphing back to more *standard* shape?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.13 ***	[1.18]	1.92	[1.52]	0.47	
US 5-Year Treasury	31.82 ***	[1.47]	0.94	[1.89]	0.61	
US 10-Year Treasury	25.00 ***	[2.22]	2.36	[2.86]	0.50	
Ger 2-Year Bund	0.49	[0.98]	14.67 ***	[1.26]	0.29	
Ger 5-Year Bund	2.64	[1.65]	27.44 ***	[2.12]	0.40	
Ger 10-Year Bund	3.94 *	[2.22]	25.00 ***	[2.86]	0.21	
Ita 2-Year BTP	− 0.92	[2.56]	32.01 ***	[3.29]	0.33	
Ita 5-Year BTP	1.04	[2.09]	44.07 ***	[2.69]	0.52	
Ita 10-Year BTP	0.34	[2.31]	41.10 ***	[2.98]	0.56	
Fra 2-Year OAT	1.17	[0.94]	16.72 ***	[1.21]	0.38	
Fra 5-Year OAT	0.54	[1.58]	27.63 ***	[2.04]	0.39	
Fra 10-Year OAT	3.03	[2.16]	24.34 ***	[2.78]	0.31	
Spa 2-Year Bonos	− 0.45	[2.11]	28.20 ***	[2.72]	0.41	
Spa 5-Year Bonos	5.77 ***	[2.01]	34.87 ***	[2.59]	0.48	
Spa 10-Year Bonos	− 0.61	[2.55]	40.66 ***	[3.28]	0.47	

- US rates response returns to be hump-shaped
- little spillovers from US to euro area rates
- when German rates move up, no flight to quality, and ...
- also rates in the rest of euro area move in tandem, albeit some heterogeneity remains

Results: from 2013

morph back to more *standard* responses?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR						
USD/GBP						
USD/YEN						
US stock						
€ stock						
Jap stock						
Ger stock						
Fra stock						
Italy stock						
US 2-Year term-premia						
US 5-Year term-premia						
US 10-Year term-premia						
€ 2-Year term-premia						
€ 5-Year term-premia						
€ 10-Year term-premia						
US 5y Inflation-swap						
US 5y-5y Inflation-swap						
€ 5y Inflation-swap						
€ 5y-5y Inflation-swap						
US rates vol						

Results: from 2013

morph back to more *standard* responses?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-1.67***$	[0.58]	$4.28***$	[0.75]	0.35	
USD/GBP	-0.52	[0.47]	$1.71***$	[0.61]	0.23	
USD/YEN	$-1.33**$	[0.66]	$1.87**$	[0.85]	0.17	
US stock						
€ stock						
Jap stock						
Ger stock						
Fra stock						
Italy stock						
US 2-Year term-premia						
US 5-Year term-premia						
US 10-Year term-premia						
€ 2-Year term-premia						
€ 5-Year term-premia						
€ 10-Year term-premia						
US 5y Inflation-swap						
US 5y-5y Inflation-swap						
€ 5y Inflation-swap						
€ 5y-5y Inflation-swap						
US rates vol						

- USD/EUR marked response, both to Fed as well as to ECB surprises (albeit smaller than in crisis years)

Results: from 2013

morph back to more *standard* responses?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-1.67***$	[0.58]	$4.28***$	[0.75]	0.35	
USD/GBP	-0.52	[0.47]	$1.71***$	[0.61]	0.23	
USD/YEN	$-1.33**$	[0.66]	$1.87**$	[0.85]	0.17	
US stock	-0.18	[0.25]	$-0.56*$	[0.32]	0.61	
€ stock	-0.36	[0.63]	$-3.77***$	[0.82]	0.25	
Jap stock	0.63	[0.92]	0.03	[1.19]	0.08	
Ger stock	-0.21	[0.65]	$-4.04***$	[0.83]	0.20	
Fra stock	-0.41	[0.72]	$-4.07***$	[0.92]	0.25	
Italy stock	-0.56	[1.00]	$-4.99***$	[1.28]	0.22	
US 2-Year term-premia						
US 5-Year term-premia						
US 10-Year term-premia						
€ 2-Year term-premia						
€ 5-Year term-premia						
€ 10-Year term-premia						
US 5y Inflation-swap						
US 5y-5y Inflation-swap						
€ 5y Inflation-swap						
€ 5y-5y Inflation-swap						
US rates vol						

- USD/EUR marked response, both to Fed as well as to ECB surprises (albeit smaller than in crisis years)
- Stock market indices respond mainly to ECB surprises (negatively)

Results: from 2013

morph back to more *standard* responses?

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	$-1.67***$	[0.58]	$4.28***$	[0.75]	0.35	
USD/GBP	-0.52	[0.47]	$1.71***$	[0.61]	0.23	
USD/YEN	$-1.33**$	[0.66]	$1.87**$	[0.85]	0.17	
US stock	-0.18	[0.25]	$-0.56*$	[0.32]	0.61	
€ stock	-0.36	[0.63]	$-3.77***$	[0.82]	0.25	
Jap stock	0.63	[0.92]	0.03	[1.19]	0.08	
Ger stock	-0.21	[0.65]	$-4.04***$	[0.83]	0.20	
Fra stock	-0.41	[0.72]	$-4.07***$	[0.92]	0.25	
Italy stock	-0.56	[1.00]	$-4.99***$	[1.28]	0.22	
US 2-Year term-premia	1.06	[1.97]	2.49	[2.58]	0.16	
US 5-Year term-premia	$10.47***$	[2.59]	4.42	[3.40]	0.29	
US 10-Year term-premia	$5.95*$	[3.56]	2.37	[4.66]	0.14	
€ 2-Year term-premia	$-2.35*$	[1.42]	$18.52***$	[1.83]	0.43	
€ 5-Year term-premia	-4.05	[2.75]	$30.24***$	[3.54]	0.34	
€ 10-Year term-premia	-4.55	[2.86]	$27.63***$	[3.68]	0.28	
US 5y Inflation-swap						
US 5y-5y Inflation-swap						
€ 5y Inflation-swap						
€ 5y-5y Inflation-swap						
US rates vol						

- USD/EUR marked response, both to Fed as well as to ECB surprises (albeit smaller than in crisis years)
- Stock market indices respond mainly to ECB surprises (negatively)
- US term premia still respond to Fed surprises, US rates vol too
- euro area term premia move a lot: now affected by ECB forward guidance and APP

Results: from 2013

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	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
USD/EUR	−1.67 ***	[0.58]	4.28 ***	[0.75]	0.35	
USD/GBP	− 0.52	[0.47]	1.71 ***	[0.61]	0.23	
USD/YEN	− 1.33 **	[0.66]	1.87 **	[0.85]	0.17	
US stock	− 0.18	[0.25]	− 0.56 *	[0.32]	0.61	
€ stock	− 0.36	[0.63]	−3.77 ***	[0.82]	0.25	
Jap stock	0.63	[0.92]	0.03	[1.19]	0.08	
Ger stock	− 0.21	[0.65]	−4.04 ***	[0.83]	0.20	
Fra stock	− 0.41	[0.72]	−4.07 ***	[0.92]	0.25	
Italy stock	− 0.56	[1.00]	−4.99 ***	[1.28]	0.22	
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US 5-Year term-premia	10.47 ***	[2.59]	4.42	[3.40]	0.29	
US 10-Year term-premia	5.95 *	[3.56]	2.37	[4.66]	0.14	
€ 2-Year term-premia	− 2.35 *	[1.42]	18.52 ***	[1.83]	0.43	
€ 5-Year term-premia	− 4.05	[2.75]	30.24 ***	[3.54]	0.34	
€ 10-Year term-premia	− 4.55	[2.86]	27.63 ***	[3.68]	0.28	
US 5y Inflation-swap	− 5.09 **	[2.16]	− 0.28	[2.78]	0.07	
US 5y-5y Inflation-swap	0.16	[2.18]	− 0.26	[2.80]	0.03	
€ 5y Inflation-swap	2.44 **	[0.95]	− 2.91 **	[1.23]	0.17	
€ 5y-5y Inflation-swap	0.32	[1.21]	− 4.00 **	[1.56]	0.07	
US rates vol	5.75 ***	[1.76]	2.29	[2.27]	0.20	

- USD/EUR marked response, both to Fed as well as to ECB surprises (albeit smaller than in crisis years)
- Stock market indices respond mainly to ECB surprises (negatively)
- US term premia still respond to Fed surprises, US rates vol too
- euro area term premia move a lot: now affected by ECB forward guidance and APP

Conclusions

Propose a method to measure monetary policy surprises:

- isolate path-component
- compare across space and time

Policy implications:

- unconventional policies are effective to steer interest rates
- have a potent effect on several assets
- risk-premia component matters
- spillovers across areas
- financial distress alters the responses

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- risk-premia component matters
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THANKS!

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Robustness...

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Robustness...
leave for the discussant !