Asset market responses to conventional and unconventional monetary policy shocks in the United States

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Outline of presentation

- **Overview**
- **Model and data**
- **Results**
- **Shadow Short Rate tests**
- **Conclusion**

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1. Overview

- **Overview**
- **Model and data**
- **Results**
- **Shadow Short Rate tests**
- **Conclusion**

First and main part of paper and presentation

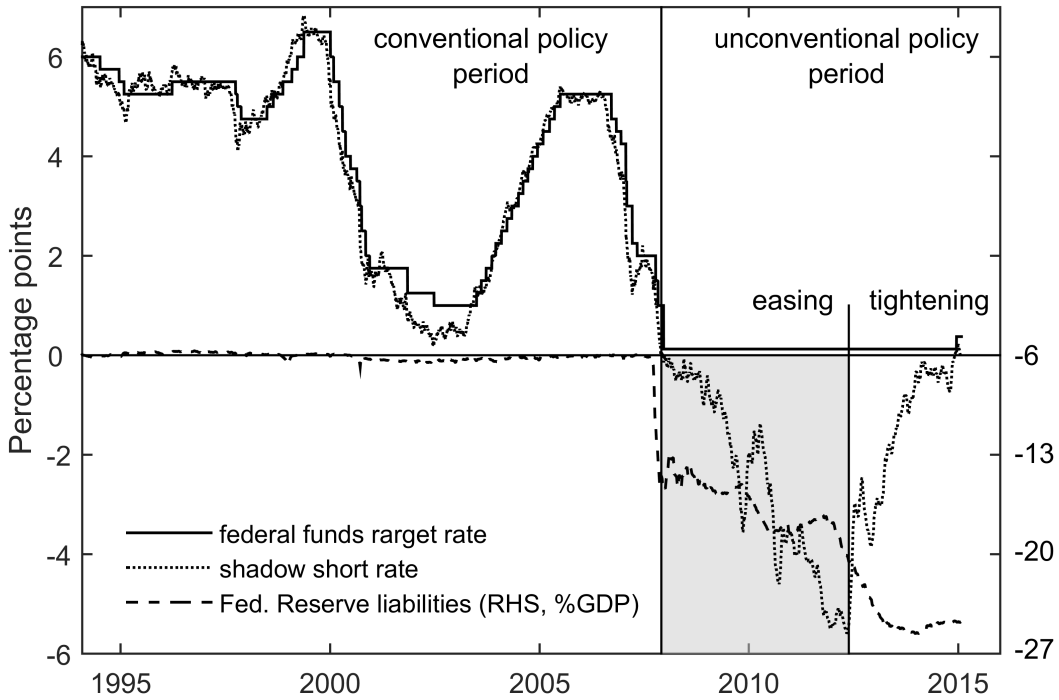
- We investigate the responses of asset markets to **conventional** and **unconventional** monetary policy (MP) shocks
- Important for understanding MP transmission:
  - MP shocks influence asset markets $\Rightarrow$ financial conditions $\Rightarrow$ decisions of agents $\Rightarrow$ macroeconomic outcomes
  - many central banks moved from CMP to UMP following the Global Financial Crisis when policy/short-maturity interest rates reached their lower-bound constraint
- If responses to MP shocks have changed, central banks should be aware and consider their processes appropriately

Literature on UMP shocks and asset markets

- 2011: Gagnon, Raskin, Remache, and Sack; Joyce, Lasaosa, Stevens, and Tong; Krishnamurthy and Vissing-Jorgensen; 2012: Swanson; Rosa; Wright; Glick and Leduc (2013), Kiley (2014), Rogers, Scotti and Wright (2014, 2016), Neely (2015), Swanson (2016), Arai (2017), Cieslak and Schrimpf (2018), [Gertler and Karadi (2015) credit/macro]
- Main themes:
  - event studies: e.g. 10-y movement on MP event days
  - high-frequency MP shock identification
    - infer MP shocks from interest rate responses on MP days
    - then assess asset price responses to MP shocks
- Our contribution:
  - one-step estimation of MP shocks and responses **using many asset classes**
  - diverse information set $\Leftrightarrow$ better MP shock identification

Second part of paper and presentation

- Testing estimated Shadow Short Rate (SSR) series



- Negative SSRs proposed as proxy for SM rates in UMP periods
- Krippner (2011-15), Bullard (2012, 2013), Wu and Xia (2015)
- **But are SSR estimates actually a good proxy?**

2. Model and data

- Overview
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Latent factor model (Rigobon and Sack 2004)

$$\begin{bmatrix} y_{1,t} \\ \vdots \\ y_{N,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \vdots \\ \alpha_N \end{bmatrix} a_t + \begin{bmatrix} \beta_1 \\ \vdots \\ \beta_N \end{bmatrix} m_t + \begin{bmatrix} \delta_1 & & \mathbf{0} \\ & \ddots & \\ \mathbf{0} & & \delta_N \end{bmatrix} \begin{bmatrix} d_{1,t} \\ \vdots \\ d_{N,t} \end{bmatrix}$$

$$Y_t = \alpha a_t + \beta m_t + \delta d_t$$

- Y_t contains changes in interest rates or asset prices on day t
- α contains responses (factor loadings) to common shocks a_t that can occur on any day
- β contains factor loadings for MP shocks m_t that can occur on MP event days T^{MP}
- δd_t accounts for idiosyncratic shocks on any day
- $\text{var}(\alpha a_t + \beta m_t + \delta d_t) > \text{var}(\alpha a_t + \delta d_t)$, allows the **identification by heteroskedasiticity**

Estimation

GMM often use to obtain just response factor loadings, α and β

We use Kalman filter for maximum likelihood estimation

– Measurement and State equations:

$$Y_t = [\alpha, \beta] \begin{bmatrix} a_t \\ m_t \end{bmatrix} + d_t \ , \ d_t \sim N\left(0, \begin{bmatrix} \delta_1 & & \mathbf{0} \\ & \ddots & \\ \mathbf{0} & & \delta_N \end{bmatrix}\right)$$

$$\begin{bmatrix} a_t \\ m_t \end{bmatrix} = \begin{bmatrix} \varepsilon_{a,t} \\ \varepsilon_{m,t} \end{bmatrix} \ , \ \begin{bmatrix} \varepsilon_{a,t} \\ \varepsilon_{m,t} \end{bmatrix} \sim N\left(0, \begin{bmatrix} 1 & & 0 \\ & \begin{cases} 1 & t \in T^{MP} \\ 0 & t \notin T^{MP} \end{cases} & \end{bmatrix}\right)$$

– variances normalized to 1, as with GMM estimation

Gives factor loading β plus time series of MP shocks m_t

Data: monetary policy event days

- FOMC announcement days (scheduled and unscheduled)
- Other days:
  - Humphrey-Hawkins testimony, Jackson Hole days, 25-Nov-2008 (QE1), 1-Dec-2008 (Bernanke speech), 22-May-2013 ("taper tantrum") from Bernanke testimony
- MP event days 221, and all other days 4,995
- Divide sample into CMP and UMP periods:
  - conventional period: 1-Feb-1996 to 12-Sep-2008
    - MP event days 135, and all other days 3,157
  - unconventional period: 15-Sep-2008 to 28-Jan-2016
    - MP event days 86, and all other days 1,838

Data: financial market variables

Broad range to reflect economy-wide monetary/financial conditions:

1. 10-year Treasury rate
2. Aaa corporate bond rate
3. Gold price (London 10:30 AM fixing, adjusted for time zone)
4. Standard & Poor's 500 equity price index
5. Wilshire US real estate securities total market index (REITs)
6. US dollar / UK pound, New York close mid-rate

Short-maturity rates/futures NOT INCLUDED:

- movements constrained by lower bound in UMP period
- responses will differ between CMP and UMP periods
- need data that can move freely in both periods

3. Results

- Overview
- Model and data
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- Shadow Short Rate tests
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Responses to 1 stdev (tightening) MP shock

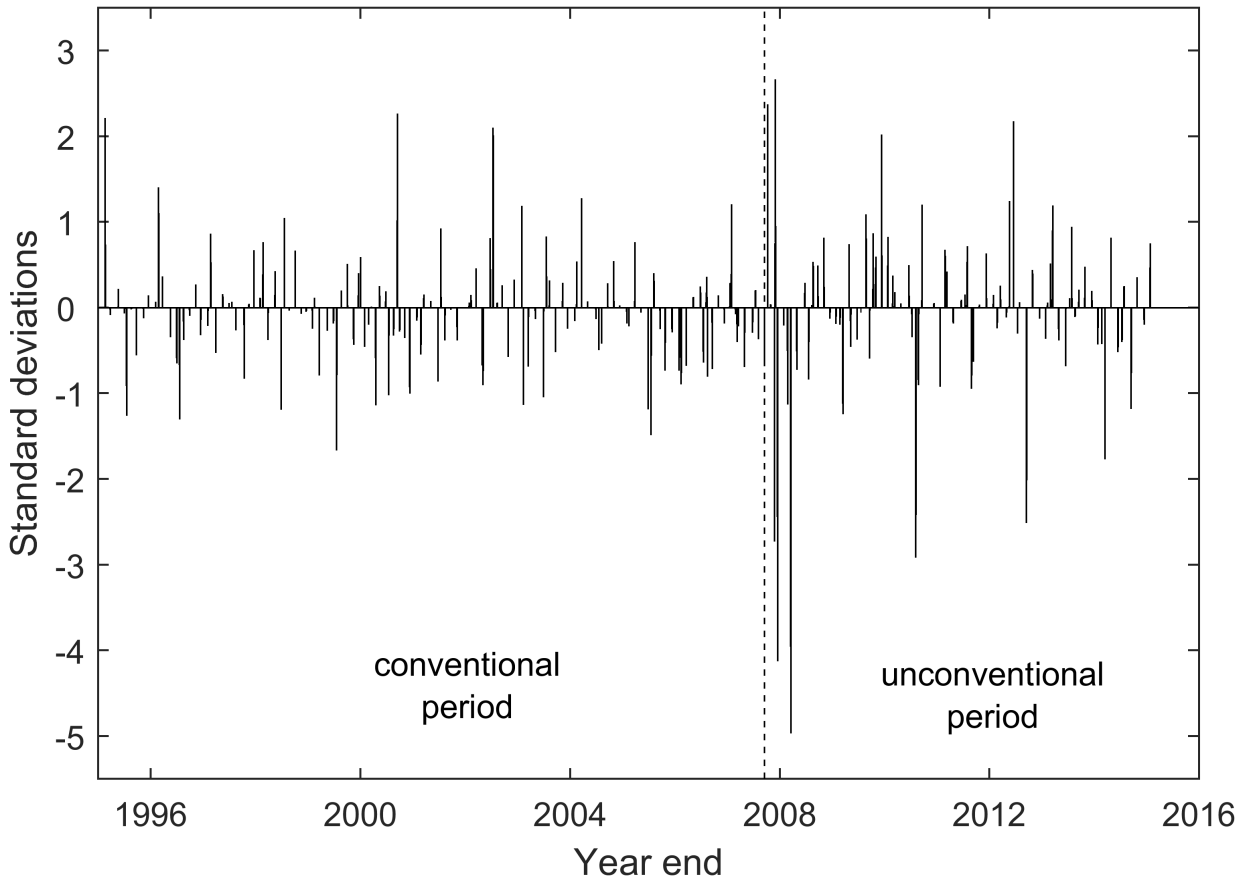
Table 1: MP response estimates (β)

	Full period	Conv. period	Uncov. period	Uncov. less Con
10-year rate	5.59[i]	0.61[v]	7.78[i]	7.17[i]
Corp. rate	3.78[i]	1.48	4.90[i]	3.42[x]
Gold	-0.55[i]	-0.20[i]	-0.82[i]	-0.62[i]
Equities	-0.71[i]	-0.95[v]	-0.70[i]	0.25
REITs	-1.26[i]	-0.85[i]	-1.72[i]	-0.87[i]
Exchange rate	-0.32[i]	-0.06	-0.43	-0.37

Note: i, v and x are 1, 5 and 10% levels of significance

- All have expected signs (rates $\uparrow$, prices $\downarrow$)
- Most significant in UMP period, and larger than CMP period

Estimated time series of MP shocks for full sample



- Occular: MP shocks larger in UMP than CMP period

Some notable UMP shocks

Largest easing shocks:

- 25 November 2008: QE1 announced
- 16 December 2008: rate cut to 0-0.25% range
- 18 March 2009: additional QE1 purchases announced
- 9 August 2011: first calendar forward guidance announced
- 18 September 2013: FOMC delays onset of QE3 tapering

Largest tightening shocks:

- 8 October 2008: unscheduled 50 bp cut
- 1 December 2008: Bernanke speech
- 14 December 2010: FOMC meeting (?)
- 19 June 2013: 14 of 19 FOMC members expect 2015 lift-off
  - also followed 22 May 2013 "taper tantrum"

Bernanke 1 December 2008 speech in more detail

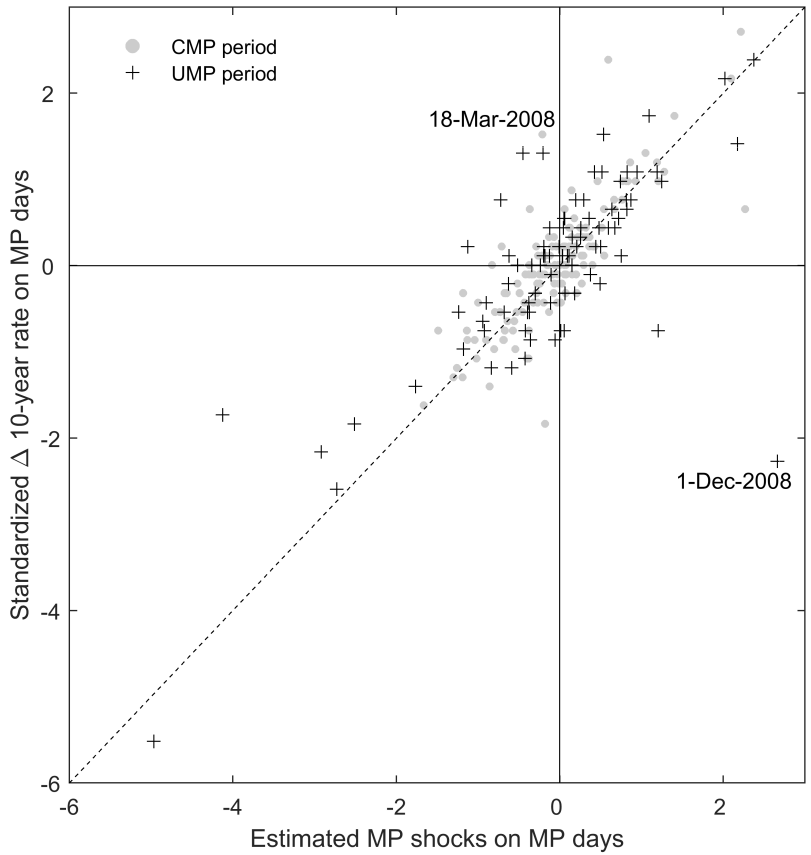
- Bernanke speech: "the Fed could purchase longer-term Treasury or agency securities on the open market in substantial quantities"
- That's an easing !!

- 10-year rate $\downarrow$ 21 bps and corporate bond rate $\downarrow$ 25 bps
- That's an easing shock !!

- But what about wider financial markets?
- gold $\downarrow$ 3%, S&P500 $\downarrow$ 9%, REITs $\downarrow$ 20%, FX $\downarrow$ 3.2%
- That's a tightening shock !!

- **Net result $\Longrightarrow$ tightening shock**
  - markets disappointed (and safe-haven bond buying)
- (Or news? $\Longrightarrow$ "it must be really bad")

10-year rates & MP shocks generally consistent



- correlations: full 77%, CMP 82%, UMP 74%
- but wider data set should provide more/better information

UMP shocks > CMP shocks

- Bootstrapping test (including estimation allowance) on full-sample MP shock time series:
  - var[UMP period] less var[CMP period) $= 0.876^{i=1\%}$
- And recall: earlier factor estimates show larger asset market responses in the UMP than CMP period

Natural questions:

- **larger shocks $\Leftrightarrow$ larger UMP factor responses?**
- **and/or a change in transmission?**

- Bootstrapping test (including estimation allowance):
  - {UMP responses / [MP shocks in UMP period]}
    less {CMP responses / [MP shocks in CMP period]}

Standardized responses to MP shocks

Table 2: Standardized MP responses

	Conv. period	Uncov. period	Uncov. less Con
10-year rate	0.77^{v}	6.49^{i}	5.72^{i}
Corp. rate	1.86	4.08^{i}	2.22
Gold	-0.26^{i}	-0.69^{i}	-0.43^{i}
Equities	-1.19^{v}	-0.58^{i}	0.61
REITs	-1.07^{i}	-1.43^{i}	-0.37
Exchange rate	-0.08	-0.36	-0.27

i, v and x are 1, 5 and 10% levels of significance

- 10-year rate still significant $\Leftrightarrow$ QE security
- Gold still significant $\Leftrightarrow$ safe haven and inflation-hedge asset
- Others can't reject: larger shocks $\Leftrightarrow$ larger responses

4. Shadow Short Rate tests

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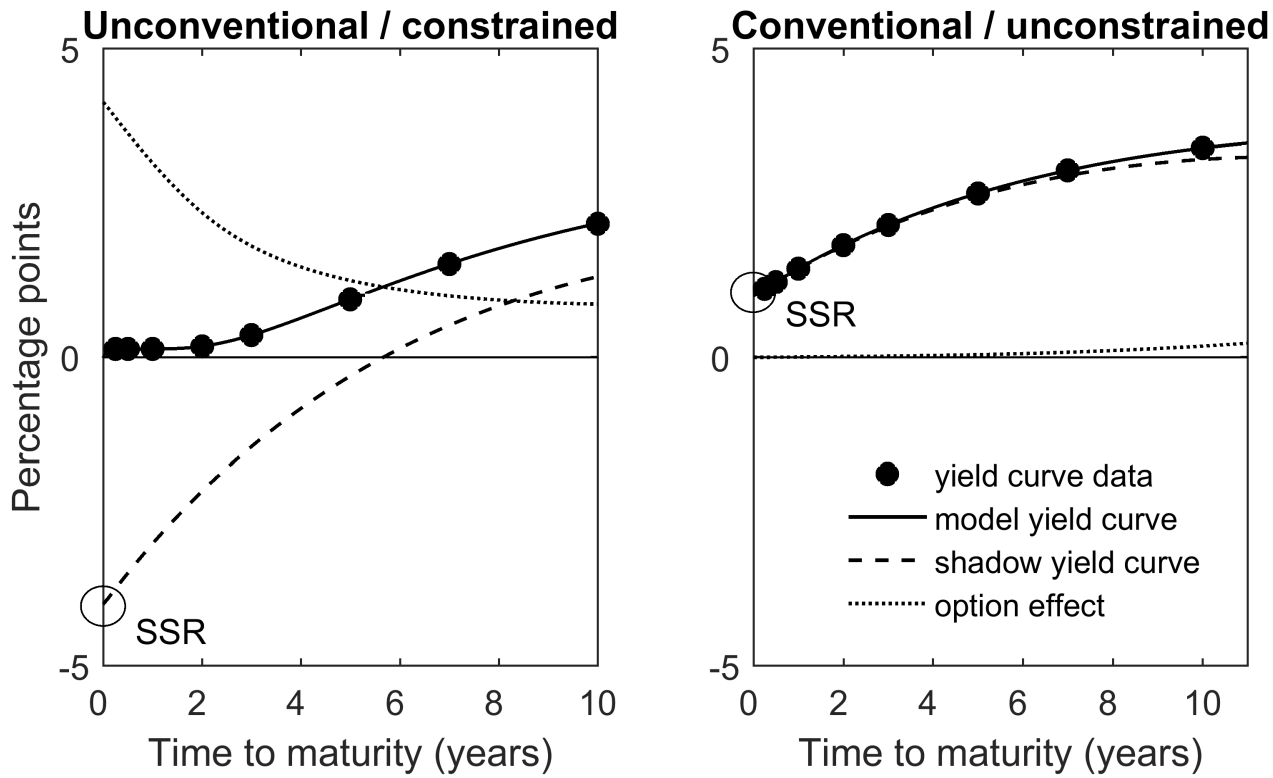
Shadow/ZLB term structure framework overview

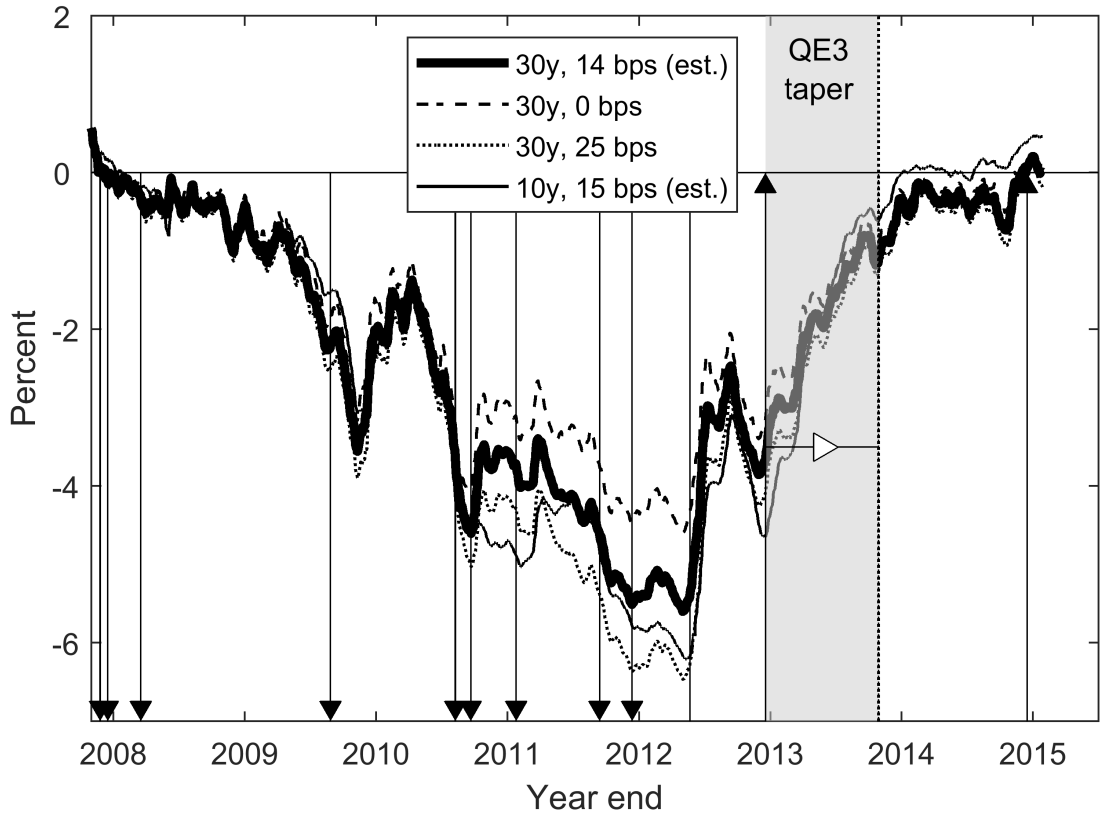
- ZLB short rate = shadow short rate + currency option
  - $\underline{r}(t) = r(t) + \max\left[-r\left(t\right), 0\right]$, (re-arranged from Black 1995)
- $\Rightarrow$ **ZLB yields = shadow yields + option effect**



Use SSRs as proxy for short-maturity rates in UMP period?

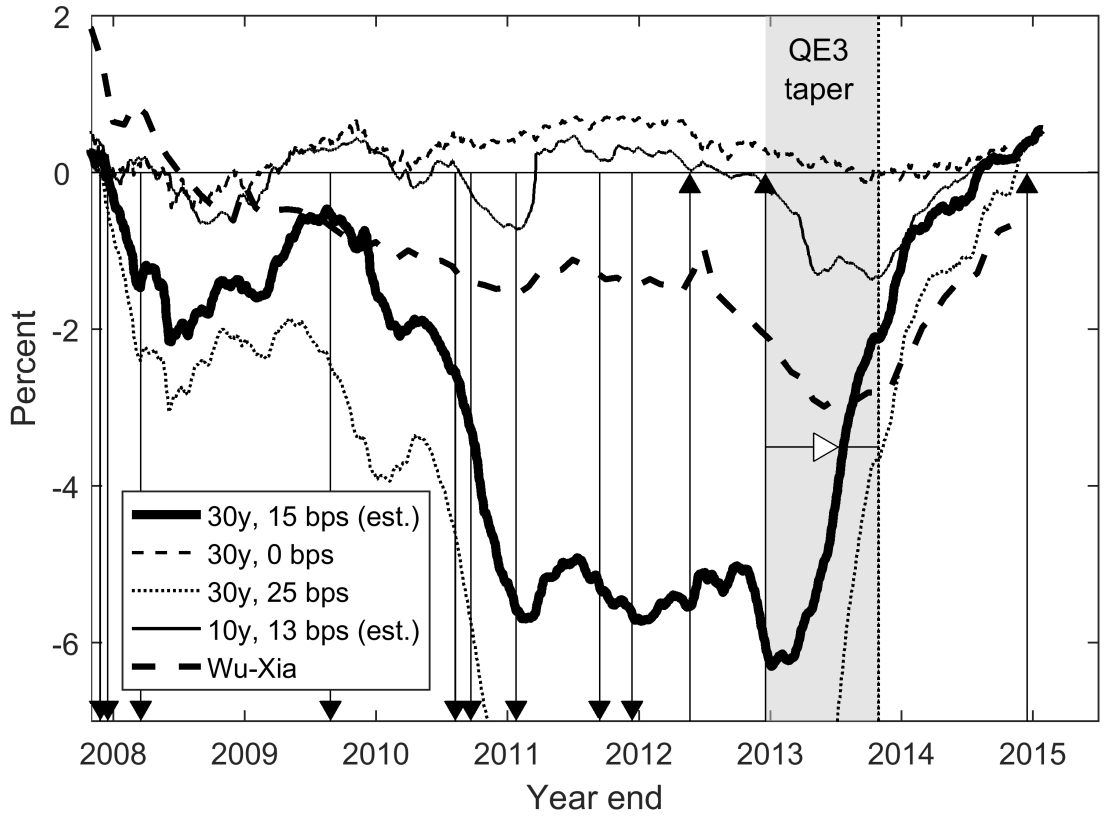
- Maybe, but SSRs are estimated ...
- ... so **subject to model and estimation variability**
- important to check robustness and consistency ("sensibility")
- We estimate a range of daily SSR series:
  - two- and three-factor shadow/lower-bound models
  - lower bound parameters 0 bps, 25 bps, or estimated
  - yield curve data from 0.25 to 10 years, and 0.25 to 30 years
- Then test each estimated SSR series in our latent-factor model
- **Do they behave like 90-day rates in CMP period?**

Informally: two-factor SSRs relatively robust



- Similar results for different specifications/data
- Consistent with major UMP events
- Could be a good proxy for short-maturity rates in UMP period

Informally: three-factor SSRs very sensitive



- Large differences with small specification/data changes
- Often inconsistent with major UMP events
- Might not be a good proxy for short-maturity rates in UMP period

Formally: test in latent factor framework

Table 4: MP response estimates, including 90-day or SSR series

		Shadow/LB model specification and estimation data							
Factors	n/a	2	2	2	2	3	3	3	3
L. bound	n/a	14e	0	25	15e	15e	0	25	13e
Data	90d	30y	30y	30y	10y	30y	30y	30y	10y
Responses to CMP shocks									
90d/SSR	2.5[i]	1.1[i]	1.5[i]	0.9	0.9[i]	0.2[i]	-0.3[i]	0.1[v]	0.6[i]
(plus other responses all similar to before)									
Responses to UMP shocks									
90d/SSR	0.2	2.6[i]	2.9[i]	2.4[i]	0.5[i]	-1.2[i]	-2.1[i]	-0.8	-0.2
(plus other responses all similar to before)									

- two-factor SSRs always respond like 90-day rates in CMP
- **three-factor SSRs don't (and sometime opposite)**

5. Conclusion

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Conclusion

- We quantify MP shocks and the response of asset prices to MP shocks in CMP and UMP periods using a latent factor model with identification by heteroskedasticity, and a diverse data set of interest rates, asset prices, and an exchange rate
- We find:
  - larger responses in the UMP than CMP period
  - larger MP shocks in the UMP than CMP period
  - larger MP shock transmission for 10-y rate and gold
- Policy take-out:
  - suitable caution required with UMP actions / communication
- Two-factor SSRs relatively robust and maintain expected response to MP shocks in UMP periods