BANK FOR INTERNATIONAL SETTLEMENTS

Discussion of "A survey-based Shadow Rate and Unconvetional Monetaray Policy Effects" by Hibiki Ichiue and Yoichi Ueno

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The views expressed in this presentation are my own and do not necessarily reflect those of the BIS.

Outline

- A new approach to estimate shadow rates
- Two shades of shadow rates
- Multidimensionality of monetary policies

Assumptions

Consistent linear relationship with growth and inflation throughout the sample

- y_t: log of real GDP; p_t: log of the GDP deflator; s_t: shadow rate

$$
\begin{aligned}
x_t &= \begin{bmatrix} y_t & p_t & s_t \end{bmatrix}' \\
x_t &= c + A_1 x_{t-1} + ... + A_4 x_{t-4} + \varepsilon_t, \varepsilon_t \sim i.i.d\ N(0, \Omega) \\
\xi_t &= \begin{bmatrix} x_t' & \ldots & x_{t-3}' \end{bmatrix}' \\
\xi_{t+1} &= d + F\xi_t + \nu_{t+1}
\end{aligned}
$$

Identical to short rate before the ZLB

- $s_t = i_t^0$ if before the ZLB, where i_t is the 3M T-bill rate

Relating to observables

- VAR-implied forecasts

$$\xi_{t+h|t} = (I + ... + F^{h-1})d + F^h \xi_t$$

- Survey-implied forecasts

$$\begin{aligned} \tilde{o}_t &= \begin{bmatrix} \Delta y^o_{t+1|t} & \cdots & \Delta y^o_{t+7|t} & \Delta p^o_{t+1|t} & \cdots & \Delta p^o_{t+7|t} \end{bmatrix} \\ \tilde{o}_t &= \tilde{a} + \tilde{H}' \xi_t + \tilde{w}_t, \tilde{w}_t \sim N(0, \tilde{R}) \end{aligned}$$

Estimation

- State space model

$$
\begin{aligned}
\text{Transistion equation: } \xi_{t+1} &= d + F\xi_t + \nu_{t+1} \\
\text{Observation equation: } \tilde{o}_t &= \tilde{a} + \tilde{H}'\xi_t + \tilde{w}_t \\
i_t^o &= s_t \text{ if } t \leq \text{2008Q3}
\end{aligned}
$$

- Estimating transition equation using data up to 2008Q3

- Applying Kalman filter to obtain $\hat{s}_{t|t}$

Comments

New aspects

- making use of survey data
- s_t beyond i_t^o post-ZLB

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Information in survey data

- Kalman gain
- "factor loading"

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Full model estimation

- Especially important for models without restricting $i_t^o = s_t$ if $t \leq$ 2008Q3 .
- Convergence challenge: good/a large number of initial values

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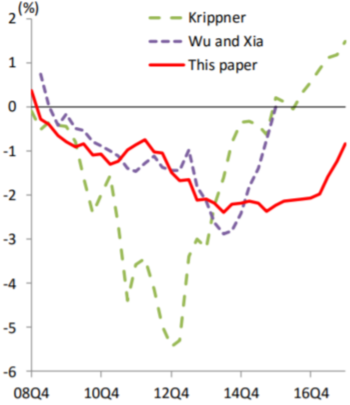
Robustness

- logarithm vs first difference of logarithm
- BCEI forecasts vs CE forecasts/SPF

Two shades of shadow rates



shadow rate term structure model

- Assumption

$$
\begin{aligned}
r_t &= max(s_t, 0) \\
s_t &= \mu + \rho s_{t-1} + \varepsilon_t
\end{aligned}
$$

- Relating to observables

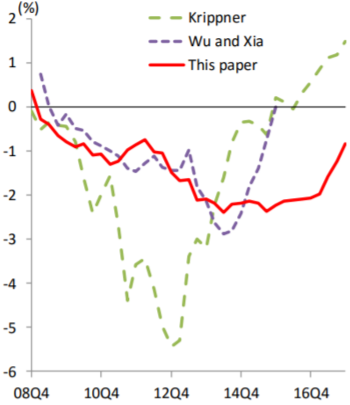
$$
\begin{aligned}
y_t^n &= -\frac{1}{n} log(\mathbb{E}^{\mathbb{Q}}[e^{-r_t - r_{t+1} - \ldots - r_{t+n}}]) \\
&= -\frac{1}{n} log(\mathbb{E}_t^{\mathbb{Q}}[e^{-max(s_t,0) - max(s_{t+1},0) - \ldots - max(s_{t+n},0)}]) \\
&= g(s_t; \theta)
\end{aligned}
$$

- Full model estimation

$$
\begin{aligned}
\text{Transition equation: } s_t &= \mu + \rho s_{t-1} + \varepsilon_t \\
\text{Observation equation: } Y_t^o &= G(s_t; \theta) + w_t
\end{aligned}
$$

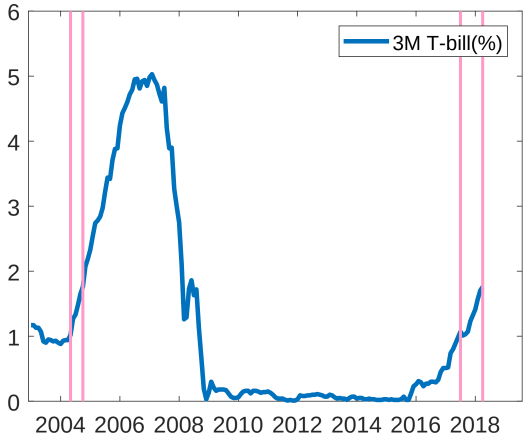
- Applications
  - Yield curve fitting Go
  - Fed funds rate equivalent at ZLB
    - Capturing unconvetional monetary policy tools Go
    - Preserving relation between Fed funds rate and macro variables Go

Two shades of shadow rates



Multidimensionality of monetary policies

- Real problem: short rate may not be adequate to capture monetary policies.



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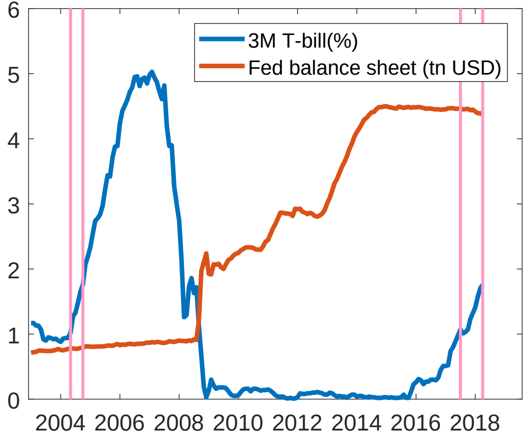
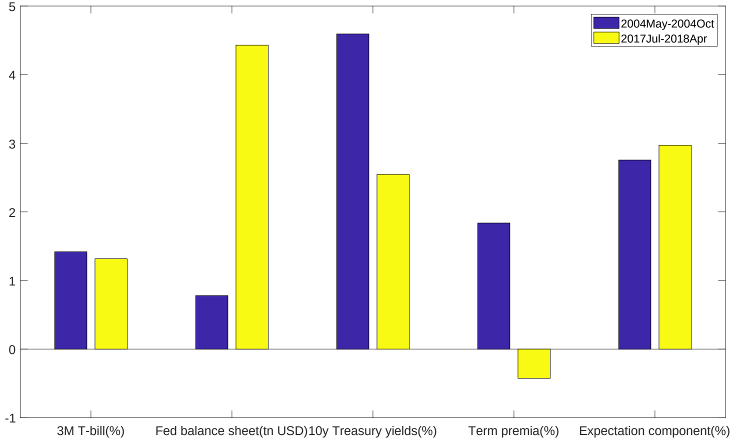


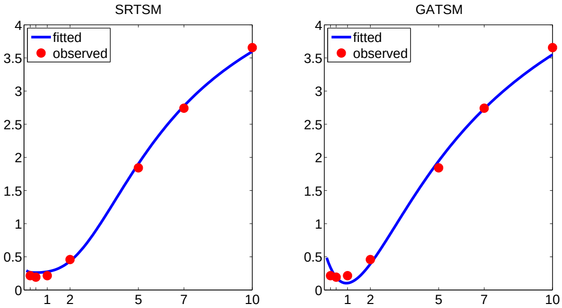

2004May-2004Oct
2017Jul-2018Apr
5
4
3
2
1
0
-1
3M T-bill(%)
Fed balance sheet(tn USD)
10y Treasury yields(%)
Term premia(%)
Expectation component(%)

- A new approach to estimate shadow rates

- The importance of modeling monetary policies with a multidimensional object

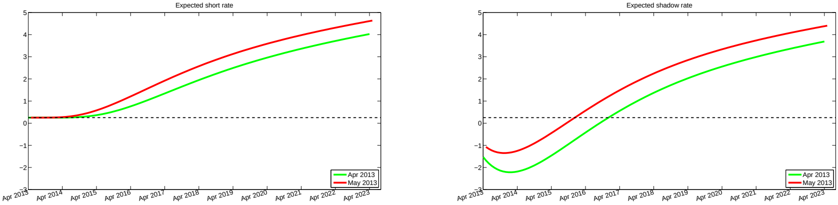
- Different facets of monetary policy shocks: target, path and term premia, Gurkaynak et. al.(2005), Swanson (2017), Inoue and Rossi (2018).

Figure: Average US Treasuries forward curve in 2012



Back

Figure: Impact of taper tantrum



Back

- Replace the fed funds rate with s_t in FAVAR

$$\begin{aligned} x_t^m &= \mu^x + \rho^{xx} X_{t-1}^m + u_t^x \\ &+ \mathbb{1}_{(t<\text{December 2007})}\rho_1^{xs} S_{t-1} \\ &+ \mathbb{1}_{(\text{December 2007}\leq t \leq \text{June 2009})}\rho_2^{xs} S_{t-1} \\ &+ \mathbb{1}_{(t>\text{June 2009})}\rho_3^{xs} S_{t-1} \end{aligned}$$

- Null hypothesis

$$H_0 : \rho_1^{xs} = \rho_3^{xs}$$

- Likelihood ratio test $\chi^2(39)$:

$$p = 0.29$$

Back