What do Data Say About Time-Variation in Monetary Policy Shock Identification?

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contributions

- mp shock identification changes over time:
- regime 1 dominates the sample:
  Taylor rule with term spread
- regime 2 sporadical, likely to occur after 2004:
  Taylor rule with money
- time-varying identification (TVI) crucial for TVP

contributions

- A new model: TVI-Structural VAR with:
  - Markov-switching structural matrix
  - TVI for data-driven selection of identifying restrictions
  - identification via heteroskedasticity within regimes
- Bayesian inference:
  - joint sampler of structural matrix and TVI indicator
  - within-regime identification via volatility verification

time-varying identification of US monetary policy shocks

TVI: time-varying identification

Data.

- January 1959 to June 2023
- y, π, R, TS, m, sp

Exclusion restrictions.

- lower-triangular structure on structural matrix
- but expanded Taylor rule settings
- zero on R in TS equation
  as in Baumeister and Benati (2013)

TVI: identifying mp shock

	y_t	π_t	R_t	TS_t	m_t	sp_t
TR	$*$	$*$	$*$	0	0	0
TR with TS	$*$	$*$	$*$	$*$	0	0
TR with m	$*$	$*$	$*$	0	$*$	0
MIR	0	0	$*$	0	$*$	0

TR stands for Taylor's Rule

TVI-SVAR

TVI-SVAR

Structural VAR.

reduced form: $\mathbf{y}_t = \mathbf{A}\mathbf{x}_t + \boldsymbol{\varepsilon}_t$

structural form: $\mathbf{B}(s_t, \boldsymbol{\kappa}(s_t))\boldsymbol{\varepsilon}_t = \mathbf{u}_t$

structural shocks: $\mathbf{u}_t \sim \mathcal{N}_N\left(\mathbf{0}_N, \text{diag}\left(\boldsymbol{\sigma}_t^2\right)\right)$

variances: $\sigma_{n.t}^2 = \exp\left\{\omega_n(s_t)h_{n.t}\right\}$

TVI-SVAR

Stochastic Volatility.

$$\begin{aligned}
\text{structural shocks:} \quad & \mathbf{u}_t \sim \mathcal{N}_N\left(\mathbf{0}_N, \operatorname{diag}\left(\boldsymbol{\sigma}_t^2\right)\right) \\
\text{variances:} \quad & \sigma_{n.t}^2 = \exp\left\{\omega_n(s_t) h_{n.t}\right\} \\
\text{log-volatilities:} \quad & h_{n.t} = \rho_n h_{n.t-1} + v_{n.t} \\
\text{shocks:} \quad & v_{n.t} \sim \mathcal{N}(0,1)
\end{aligned}$$

Homoskedasticity condition.

$$\omega_n(s_t = m) = 0$$

TVI

TVI

time-varying identification

structural form: $\mathbf{B}(s_t, \boldsymbol{\kappa}(s_t))\boldsymbol{\varepsilon}_t = \mathbf{u}_t$

TVI indicator: $\boldsymbol{\kappa}(s_t) = (\kappa_1(s_t), \ldots, \kappa_N(s_t))$

TVI : $\kappa_n(s_t) = k_n \in \{1, \ldots, K_n\}$

a row: $[\mathbf{B}(m, k_n)]_{n\cdot} = \mathbf{B}_{n.m.k_n}$

restrictions: $\mathbf{B}_{n.m.k_n} = \mathbf{b}_{n.m.k_n}\mathbf{V}_{n.m.k_n}$

$$\begin{bmatrix} b_{n.1} & b_{n.2} & 0 \end{bmatrix} = \begin{bmatrix} b_{n.1} & b_{n.2} \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

TVI

time-varying identification

structural: $\mathbf{b}'_{n.m.k_n} \mid \gamma_B, k_n \sim \mathcal{N}_{r_{n.m.k_n}}\left(\mathbf{0}_{r_{n.m.k_n}}, \gamma_B \mathbf{I}_{r_{n.m.k_n}}\right)$

TVI indicator: $\kappa_n(m) \sim \mathcal{M}ultinomial\left(K_n^{-1} \boldsymbol{\iota}_{K_n}\right)$

shrinkage: $\gamma_B \sim \mathcal{IG}2\left(\underline{s}_B, \underline{\nu}_B\right)$

TVI

inference on TVI components.

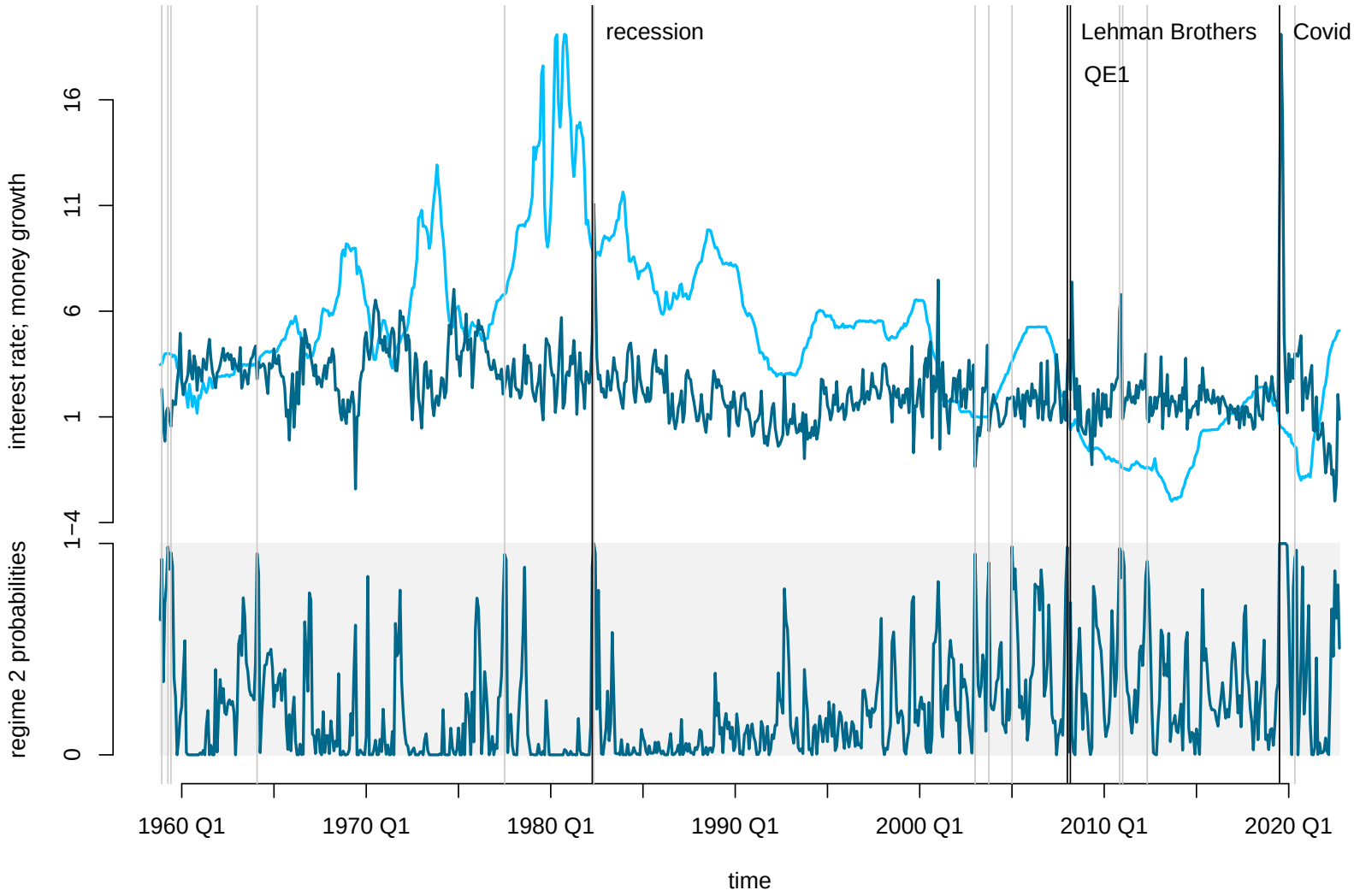
Given the S posterior draws $\left\{\kappa_n(m)^{(s)}\right\}_{s=1}^{S}$ compute the posterior probability of regime-specific TVI component by:

$$\widehat{\Pr}\left[\kappa_n(m) = k_n \mid \mathbf{Y}_T\right] = S^{-1} \sum_{s=1}^{S} \mathcal{I}(\kappa_n(m)^{(s)} = k_n) \qquad (1)$$

empirical evidence

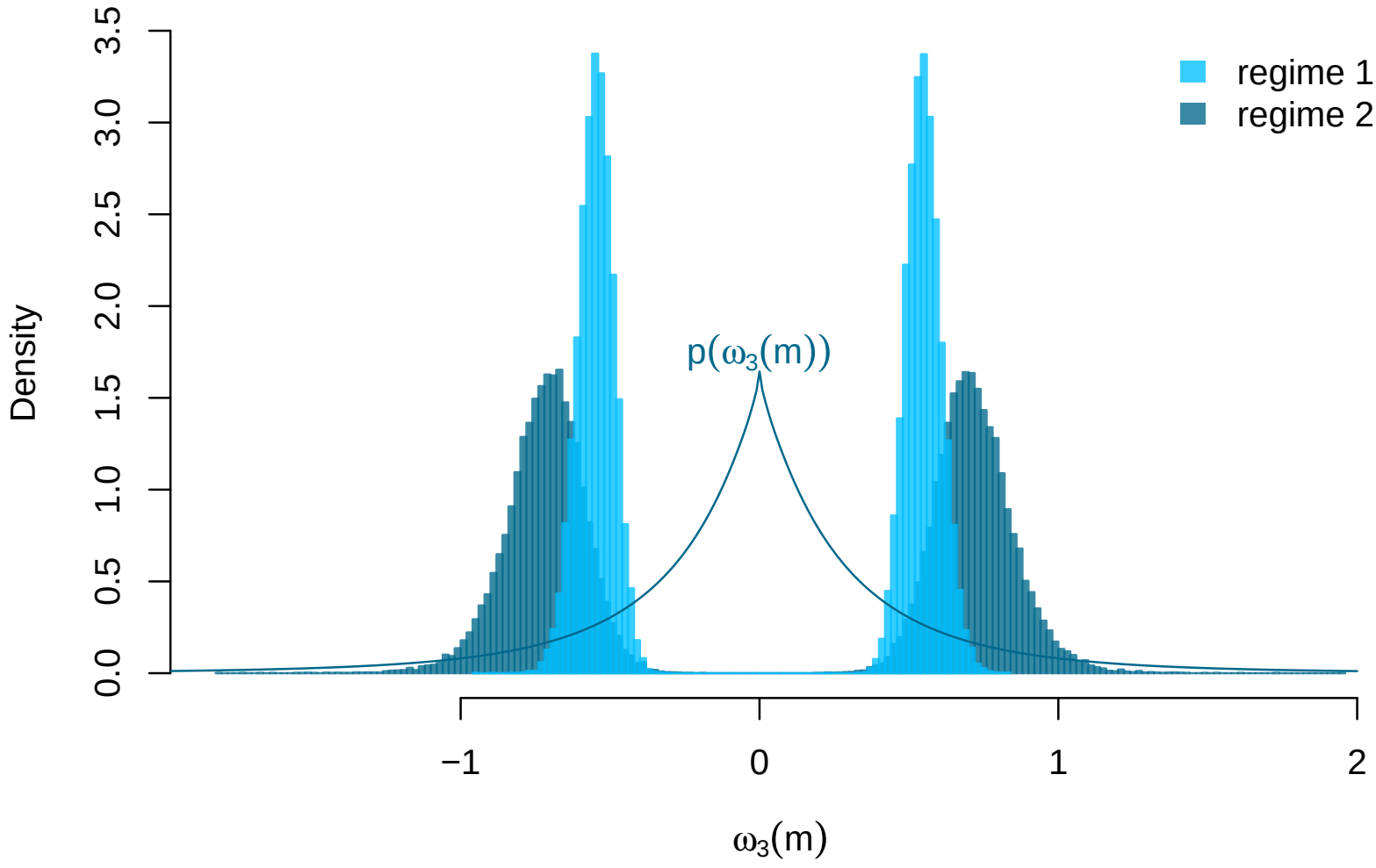
two regimes

regime probabilities, interest rate and money growth



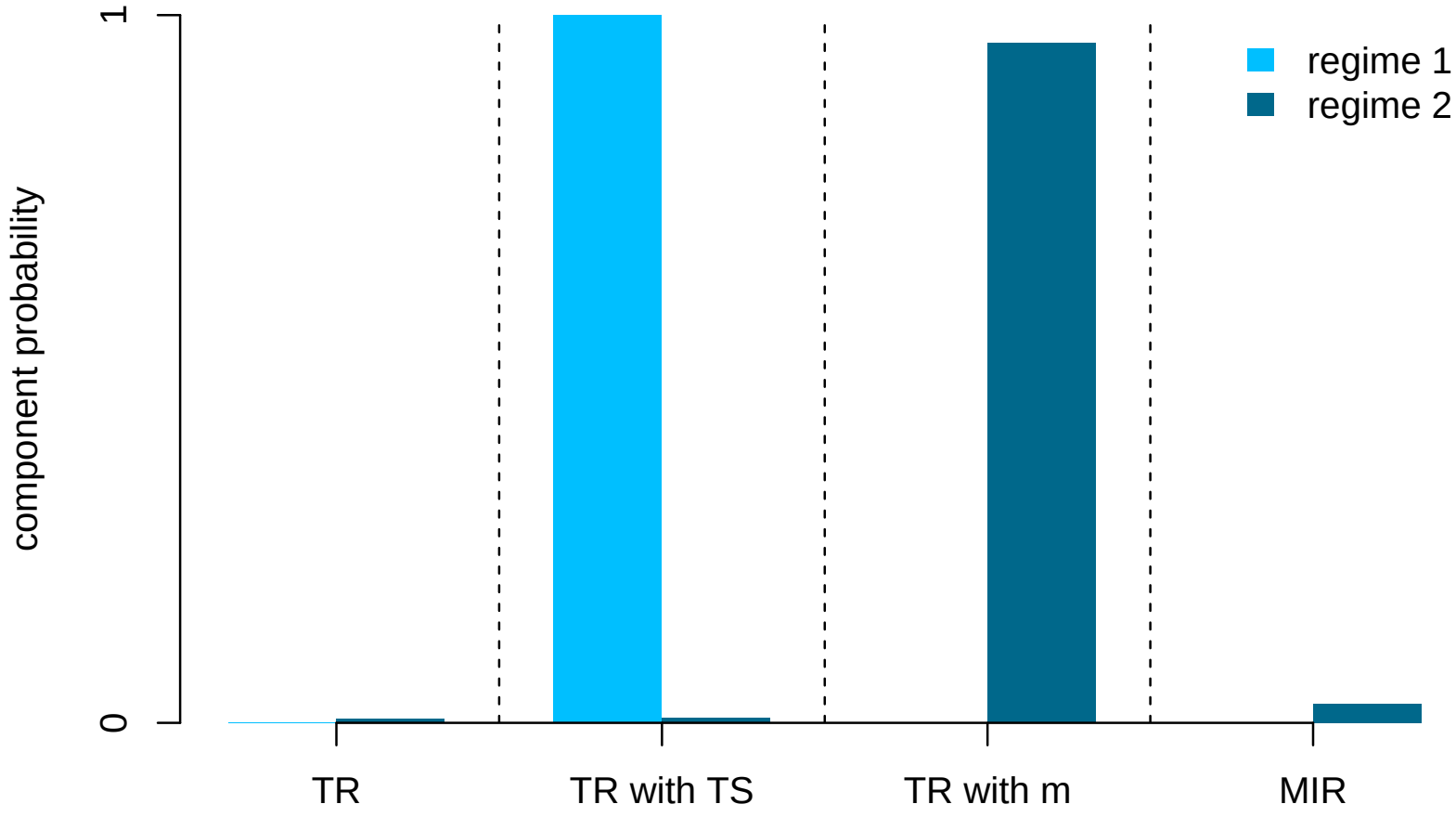
identified via heteroskedasticity

regime-specific volatility of the volatility $\omega_3(m)$



posterior probabilities of TVI

regime-specific component probabilities

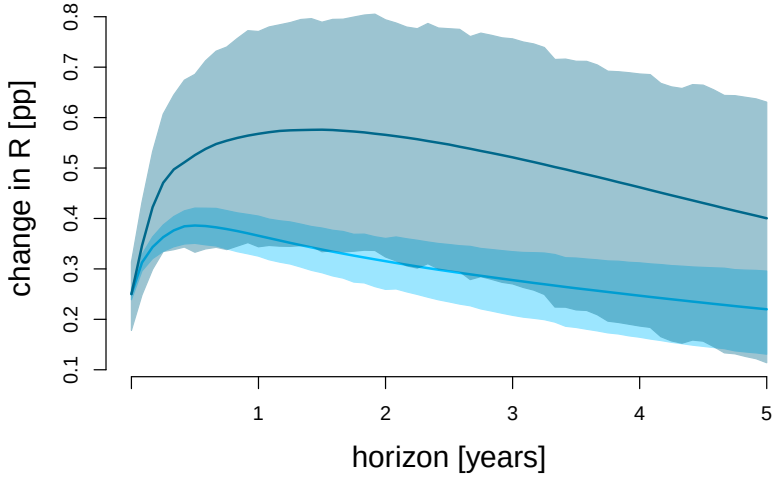


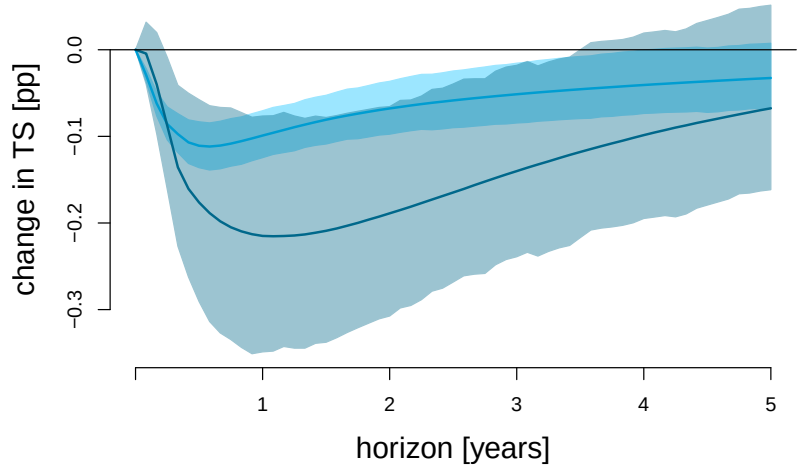
monetary policy reaction function

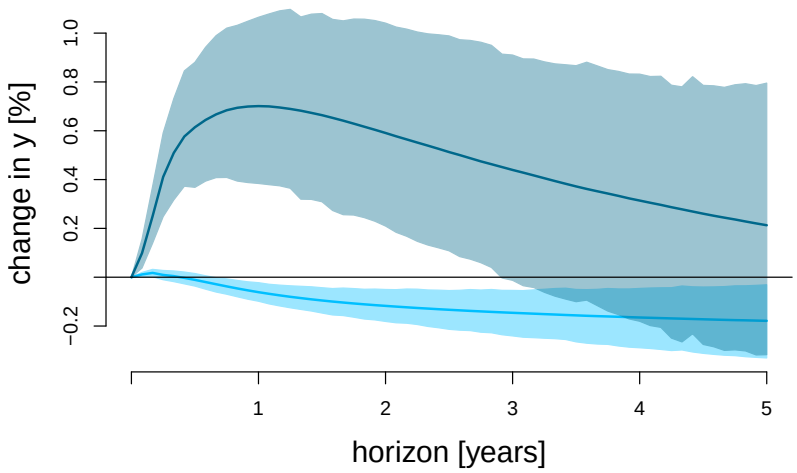
	y	π	R	TS	m	sp
Regime 1						
TR with TS	0.05	-0.06	3.93	3.15		
lower	-0.10	-0.10	3.65	2.88		
upper	0.20	-0.02	4.21	3.42		
Regime 2						
TR with m	-0.09	-0.02	7.02		1.95	
lower	-0.33	-0.10	5.15		1.59	
upper	0.13	0.05	9.25		2.77	

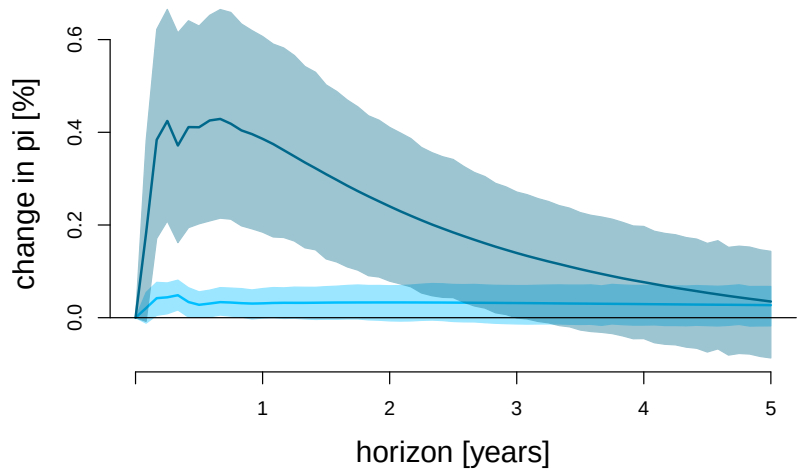
Posterior estimates for elements of $\mathbf{B}(s_t, \kappa(s_t))$

responses to mp shock

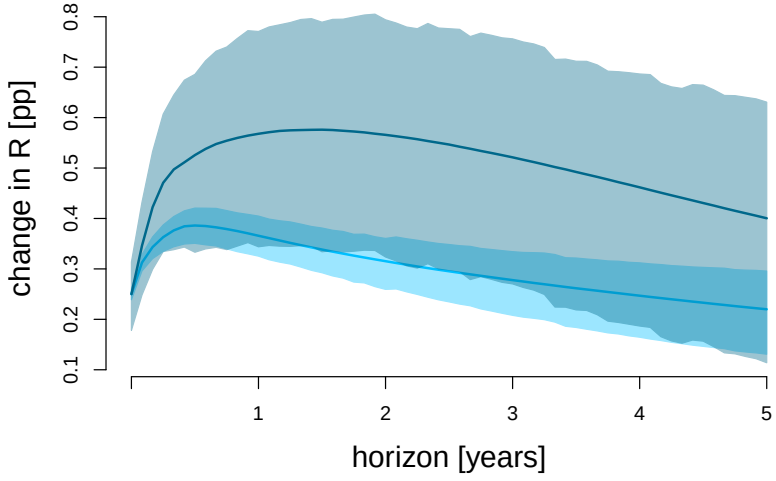


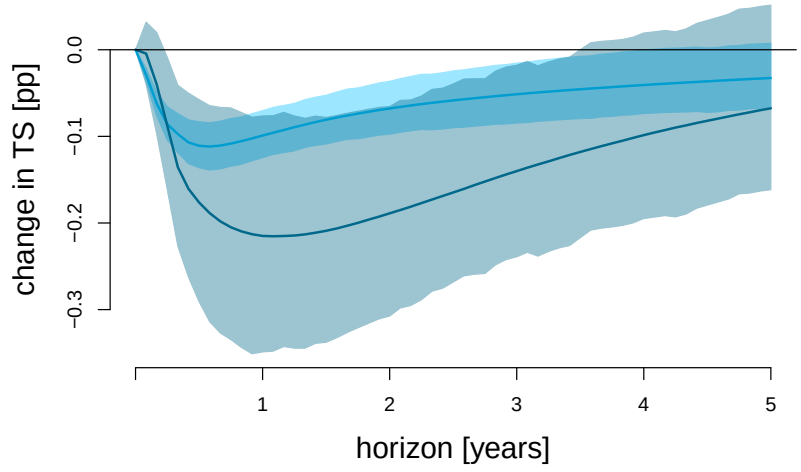


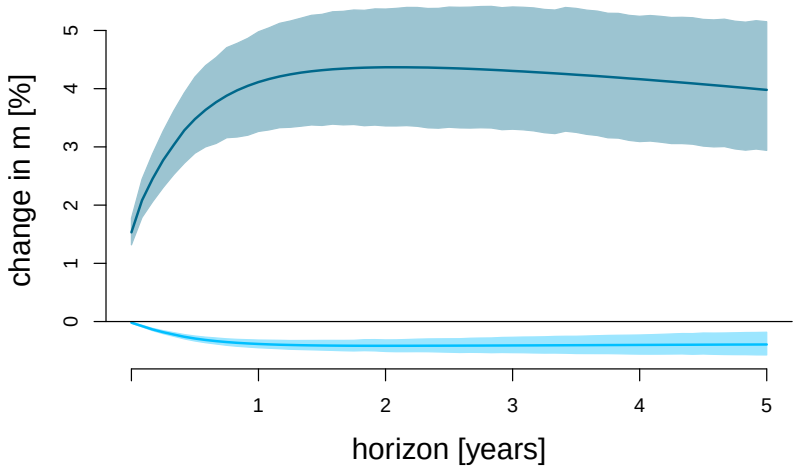


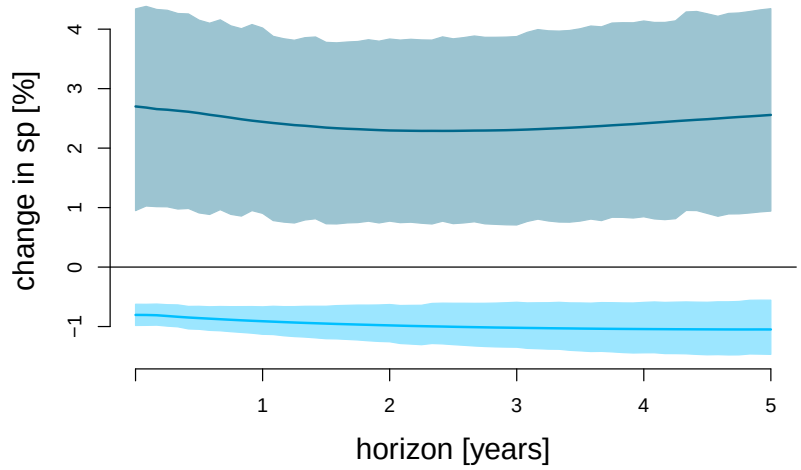


responses to mp shock









We propose a new TVI-SVAR model to show:

- time-variation in mp shock identification
  - regime 1: Taylor rule with term spread
  - regime 2: Taylor rule with money
- mp shock is identified via heteroskedasticity

bsvarTVPs

Bayesian estimation of heteroskedastic SVARs
with Markov-switching structural matrix in **R**

github.com/donotdespair/bsvarTVPs