Estimating Shadow Policy Rates in a Small Open Economy and the Role of Foreign Factors

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Motivation

Recently, the Covid-19 pandemic have led to unprecedented macroeconomic policy responses in many countries. Its deepness compares with the global financial crisis (GFC) of 2008-09.

Regarding monetary policy:

- Short-term interest rates have reached their effective lower bounds (ELB).
- Complementarily, unconventional monetary policies provided additional stimulus to economic activity. As result:
  - traditional monetary aggregates increased.
  - size of central banks' balance sheets enlarged.

How to correctly measure the total monetary stimulus in this context?

The Model

The DFM is standard. Let $y_t = y_1, \dots, y_T$, denote a sequence of vectors with n stationary and standardized observed variables, which may have missing data.

It is asumed that y_t admits a dynamic representation in terms of r unobserved factors. Let $f_t = \{f_1, \dots, f_T\}$ be a sequence of factor vectors. Measurement eq.:

$$y_t = \Lambda f_t + e_t, \qquad e_t \sim N(0, R), \tag{1}$$

where Λ is a matrix of $n \times r$ factor loadings and the idiosyncratic innovations $e_t = [e_{1,t}, \dots, e_{n,t}]'$, correspond to i.i.d errors with zero mean and diagonal variance-covariance matrix R.

The joint dynamics of the latent factors follow a VAR of order p:

$$f_t = \sum_{i=1}^{p} A_i f_{t-i} + u_t, \qquad u_t \sim N(0, Q), \tag{2}$$

where A_i denotes a matrix of autoregressive coefficients and Q is the variance-covariance matrix of the shocks to f_t, possibly correlated. The idiosyncratic shocks are uncorrelated and $E[e_t u'_{t-s}] = 0$, for $s \in \{1, 2, \dots\}$.

We extend [2] and assume block exogeneity restrictions on Λ and A (SOE):

$$\Lambda = \begin{bmatrix} \Lambda_{11} & 0 \\ \Lambda_{21} & \Lambda_{22} \end{bmatrix}, \qquad A = \begin{bmatrix} A_{11} & 0 \\ A_{21} & A_{22} \end{bmatrix}, \tag{3}$$

where Λ_{11} (A_{11}) is a matrix of dimension $n_e \times r_e$ ($r_e \times r_e$), Λ_{21} (A_{21}) is $n_d \times r_e$ ($r_d \times r_e$), and Λ_{22} (A_{22}) is $n_d \times r_d$ ($r_d \times r_d$) with $n_e + n_d = n$ and $r_e + r_d = r$.

The vectors of observed variables and unobserved factors are partitioned into external and domestic blocks denoted by super-indices "e" and "d", respectively:

$$y_t = \begin{bmatrix} y_t^e \\ y_t^d \end{bmatrix}, \qquad f_t = \begin{bmatrix} f_t^e \\ f_t^d \end{bmatrix}, \tag{4}$$

Eqs. (1) to (4) specify the DFM that we will use to estimate the SMPR for Chile.

As in [2], we consider missing observations for (foreign and domestic) interest rates when they reach their ELB.

Data and Model's specification

We use monthly data for Chile and the U.S. spanning from Sept. 2002 to Oct. 2020, following the structure by [2]:

1. Block 1: Interest rates
2. Block 2: Monetary aggregates
3. Block 3: Federal Reserve balance sheet (assets)
4. Block 4: Federal Reserve balance sheet (liabilities)

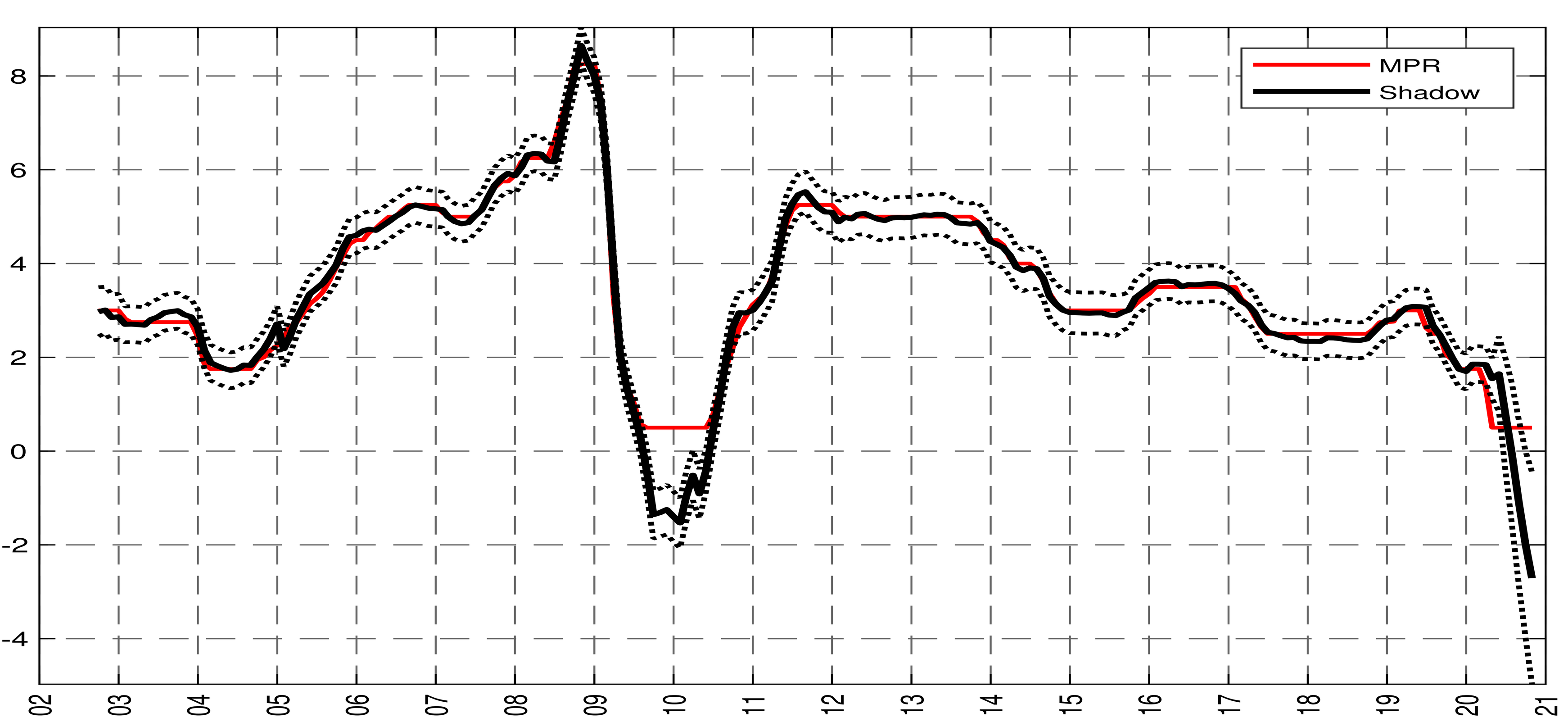
To set the number of factors, we apply the ABC criterion developed in [1]. We choose 4f for the external block and 5f for the domestic one. These factors explain 87 and 94% of the variance in each block, respectively.

The VAR(1) is based on standard information criteria (AIC, SIC, HQC).

Main Results

1. The evolution of the estimated SMPR is coherent with the timing and scope of the monetary policy actions taken by the CBC.
2. Driving factors behind SMPR variability:
   a. In the short run, shocks to domestic factors explain the largest share.
   b. As time horizon increases, contributions of shocks to domestic factors declines monotonically. In the long run, shocks to foreign factors play a dominant role.
   c. Robust results to changes in model specification and in the set of observed variables.

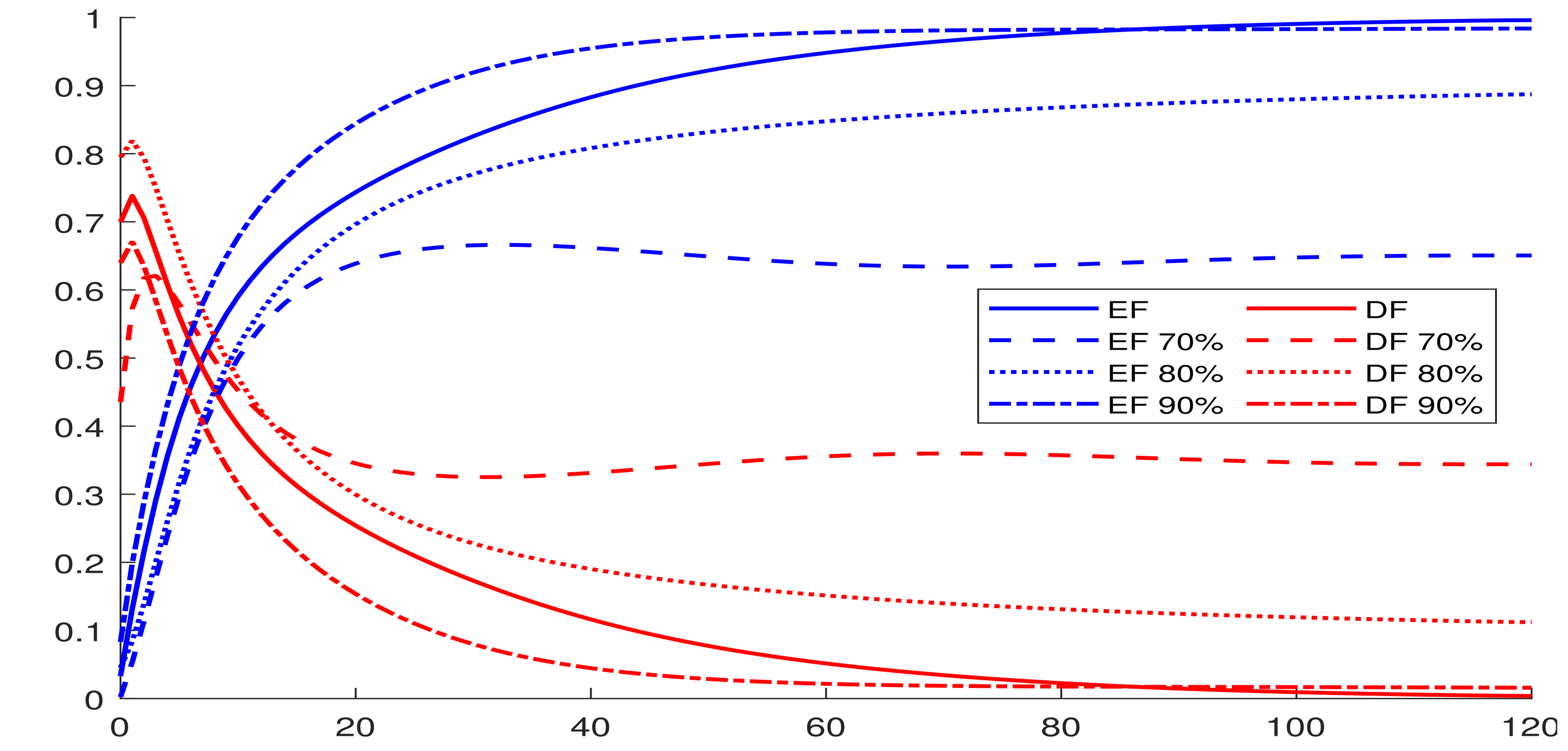
Estimated SMPR for Chile



Chile: Effective MPR and estimated SMPR

Notes: The black line depicts the estimated SMPR, and dotted ones are the corresponding 95% confidence intervals. The red line shows the observed MPR.

The role of foreign versus domestic factors



Forecast error variance decomposition (FEVD) for the SMPR

Notes: Factors are ordered from the most exogenous (external) to the most endogenous (domestic) and shocks identified through the Cholesky decomposition. To obtain the contribution of external (EF) and domestic factors (DF), the contributions of the shocks to each of the external and domestic factors are aggregated. Robustness is studied with alternative specifications that capture approximately 70, 80, and 90% of the variance in each block and have 2 external factors and 2 domestic ones, 3 external factors and 2 domestic ones, and 5 external factors and 4 domestic ones, respectively.

Conclusions

- Shadow rates are concise and consistent measures of the monetary stimulus provided by monetary authorities in a broad sense.
- We contribute to the literature by developing a DFM to estimate a SMPR for a SOE like Chile. Our methodology allows to identify the relative contributions of foreign and domestic factors to the dynamics of the SMPR.
- Main robust results:
  1. Chile's SMPR exhibits dynamics consistent with the monetary policy actions implemented by the CBC: it is negative for several months during 2009-10 and since April 2020 (till end of the sample).
  2. In the short run, shocks to domestic factors explain most of the variance of the SMPR. At longer horizons, shocks to foreign factors explain the largest share of the variance.

References

[1] Lucia Alessi, Matteo Barigozzi, and Marco Capasso. "Improved Penalization for Determining the Number of Factors in Approximate Factor Models". In: *Statistics and Probability Letters* 80 (2010), pp. 1806–1813.

[2] Marco Lombardi and Feng Zhu. "A Shadow Policy Rate to Calibrate U.S. Monetary Policy at the Zero Lower Bound". In: *International Journal of Central Banking* 14.5 (2018), pp. 305–246.