Liquidity Shocks and Monetary Policy in Peru

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BCRP

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Motivation

- Monetary policy (MP) implementation through OMAs has recently received increased attention due to the growing number of Asset Purchase Programs (APPs) implemented by Central Banks (CBs) in developed economies since the GFC and more recently due to the Covid-19 pandemic (For a literature review, see (Bhattarai and Neely, 2022)).
- CBs in developing economies have also implemented APPs, although these programs have received less attention in the literature of Unconventional Monetary Policy (UMP). These studies primarily concentrate on their impact on financial market variables using event study methodologies and covering a shorter time span of data (For an example, see Fratto *et al.*, 2021).
- This article contributes to the existing literature by examining the implementation and macroeconomic effects of the UMP conducted by the BCRP, a CB in a developing country, over a relatively long period (2005 – 2023).

Motivation

- The BCRP implement its MP through an explicit inflation targeting scheme in which the CB modify its reference interest rate in order to maintain inflation at the target level.
- In this framework, the BCRP regulates the liquidity on the interbank money market to induce the interbank interest rate's adjustment to the level of the reference interest rate.
- Particularly, the operations that the BCRP uses to accomplish this objective can be grouped into liquidity injections, issuing Repo agreements, and sterilization operations, including the issuance of its own Certificates of Deposit.
- The liquidity injections from the BCRP have had various maturities, ranging from overnight to four years. We classify Term Repo operations with maturities longer than one week as part of the BCRP's unconventional monetary policy.
- In this context, our interest lies in estimating the macroeconomic effects of term liquidity shocks conducted by the BCRP, particularly examining their effects on economic activity and prices.

Motivation

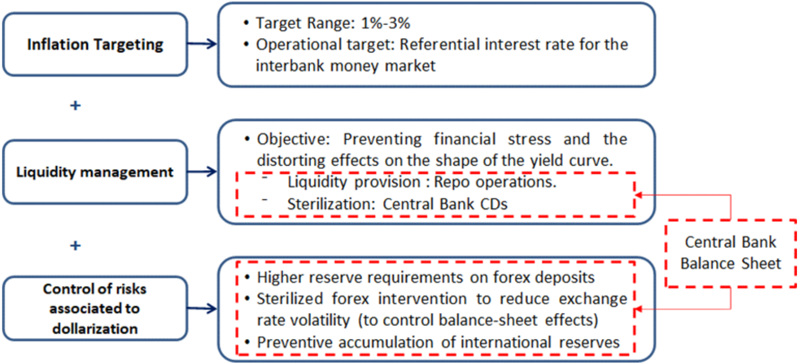


Figure: BCRP Monetary Policy Framework (Vega *et al.*, 2014; Florián *et al.*, 2022)

Motivation

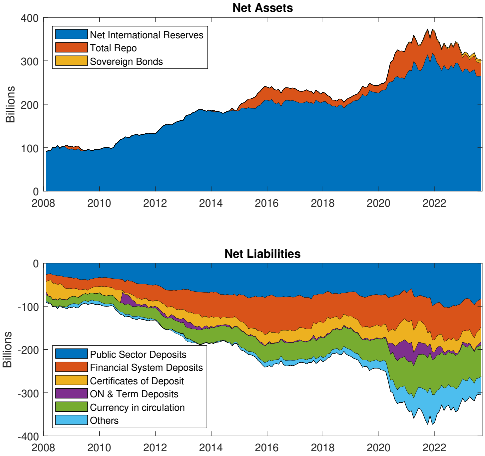


Figure: BCRP's Balance Sheet

Motivation

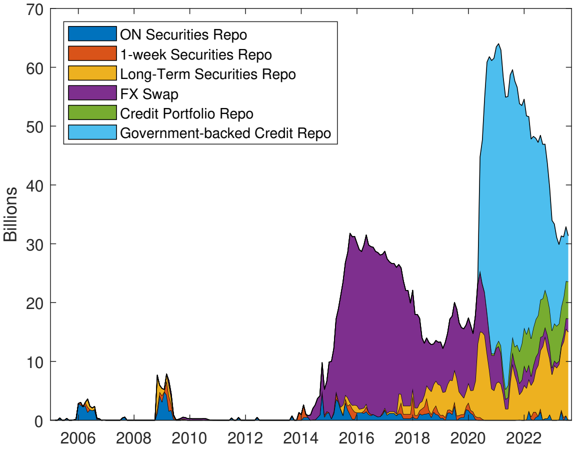


Figure: BCRP Repo operations

Motivation

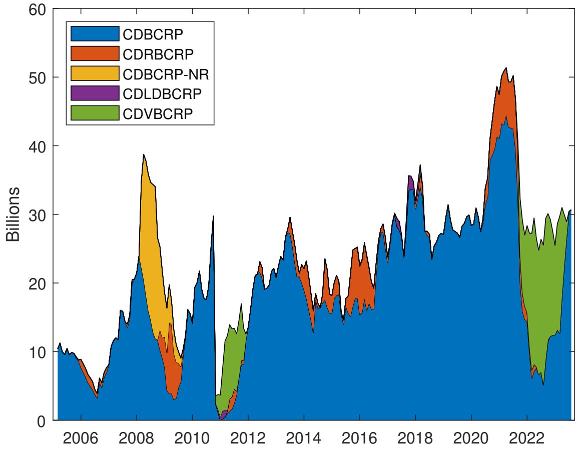
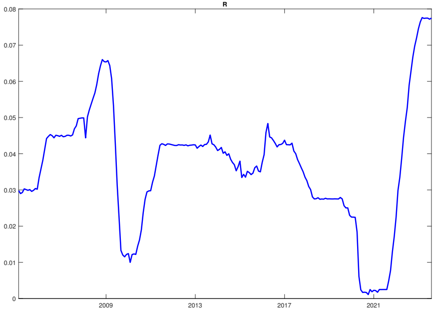


Figure: BCRP Certificates of Deposit

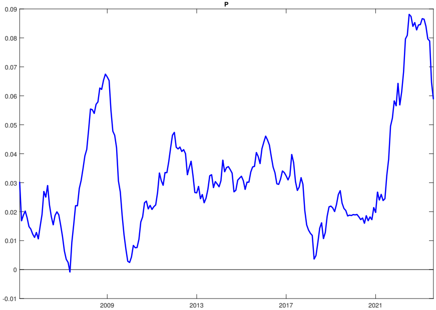
This paper

- Using a Bayesian Threshold Vector Autorregressive model with Stochastic Volatility (TBVAR-SV) and volatility feedback (Alessandri and Mumtaz, 2019) with a nonlinear zero-sign restriction identification scheme Canova and Pérez Forero (2015), we find that:
  1. An expansionary liquidity shock for a given reference rate reduces the 3-month interest rate spread, stimulating economic activity, particularly in a low inflation regime.
  2. There is no significant response in prices. One possible explanation is that the BCRP's liquidity injections, given a constant interbank interest rate, are effectively meeting the economy's demand for money.

Data



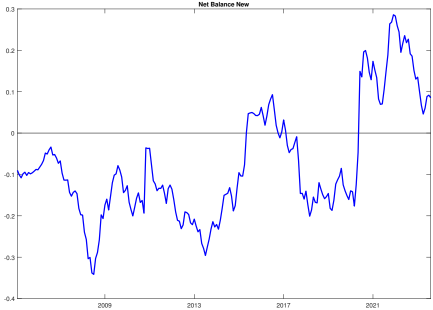
(a) Policy Rate



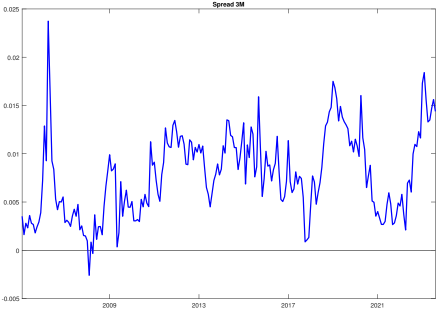
(b) Inflation

Figure: Monetary Indicators: 2005-2023

Data



(a) Net Balance



(b) Spread

Figure: Monetary Indicators: 2005-2023

Related literature

- Threshold VAR: Alessandri and Mumtaz (2019)
- SVARs and Monetary Policy:
  - Regime Switching: Sims and Zha (2006)
  - Continuous Time varying parameters: Cogley and Sargent (2005), Primiceri (2005) , Canova and Gambetti (2009), Canova and Pérez Forero (2015)
  - Identification schemes: Sims (1980), Sims (1986), Bernanke and Blinder (1992), Leeper *et al.* (1996), Amisano and Giannini (1997), Bernanke and Mihov (1998), Christiano *et al.* (1999)
  - Non-recursive identification schemes and Bayesian Estimation: Waggoner and Zha (2003), Canova and Pérez Forero (2015)
  - Partial identification and sign restrictions: Canova and De Nicoló (2002), Uhlig (2005), Rubio-Ramírez *et al.* (2010), Baumeister and Hamilton (2015), Baumeister and Hamilton (2021).

Related literature

- Structural Liquidity: Robertson (2017), Aamodt and Tafjord (2013), Jónsdóttir (2019)
- Macroeconomic effects of Unconventional Monetary Policy:
  - Developed economies: Boeckx *et al.* (2017), Gambacorta *et al.* (2014), Baumeister and Benati (2013), Cahn *et al.* (2017), Hesse *et al.* (2018)
  - Emerging markets: Fratto *et al.* (2021), MacDonald and Popiel (2017), Hofman and Kamber (2020)

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Threshold-BVAR Model

- Consider the following setup (Alessandri and Mumtaz, 2019):

$$Z_t = \left(c_1 + \sum_{j=1}^{P} \beta_1 Z_{t-j} + \sum_{j=0}^{J} \gamma_1 ln\lambda_{t-j} + \Omega_{1t}^{1/2} e_t \right) \tilde{S}_t + \left(c_2 + \sum_{j=1}^{P} \beta_2 Z_{t-j} + \sum_{j=0}^{J} \gamma_2 ln\lambda_{t-j} + \Omega_{2t}^{1/2} e_t \right) \left(1 - \tilde{S}_t\right) \tag{1}$$

  where $Z_t = (TOT_t, \pi_t, \pi_t^e, Y_t, R_t, Spread3M_t, NetBalance_t, E_t)'$.

- The volatility component λ_t can also be interpreted as an Uncertainty measure.
- TOT_t measures Terms of Trade YoY growth rate, π_t is the YoY inflation rate, π_t^e is the expected YoY inflation rate, Y_t is the economic activity YoY growth rate, R_t is the interbank interest rate, E_t is the YoY depreciation rate
- $Spread3M_t$ is the spread between the 90-days corporate prime rate and the 3-month BCRP-CDs rate
- $NetBalance_t$ is the net injection of liquidity.

Threshold-BVAR Model(2)

- The covariance matrix is as follows:

$$\Omega_{1t} = A_1^{-1} H_t (A_1^{-1})' \tag{2}$$

$$\Omega_{2t} = A_2^{-1} H_t (A_2^{-1})' \tag{3}$$

where A_1 and A_2 are non-recursive matrices such that $vec\,(A_i) = S_A \alpha_i + s_A$ (Amisano and Giannini, 1997), with S_A and s_A being matrices governed by 0s and 1s. This is a useful transformation in order to sample the full parameter vector α_i (Canova and Pérez Forero, 2015).

- The regime indicator $\tilde{S}_t$ is defined by

$$\tilde{S}_t = 1 \iff P_{t-d} \leq Z^* \tag{4}$$

where both the delay parameter d and the Threshold Z^* are unknown parameters.

Threshold-BVAR Model(3)

- The volatility process is defined by:

$$H_t = \lambda_t \Sigma \quad (5)$$

$$\Sigma = diag\left(\sigma_1^2, \ldots, \sigma_8^2\right) \quad (6)$$

$$ln\lambda_t = \mu + F\left(ln\lambda_{t-1} - \mu\right) + \eta_t \quad (7)$$

where η_t is an i.i.d. process with variance Q.

- A single scalar process governs the time varying volatility (Carriero *et al.* (2016), Alessandri and Mumtaz (2019)).

Threshold-BVAR Model(4)

Sign restrictions are imposed for $t = 0, 1, 2$.

Variable - Shock	Monetary Policy (MP)		Liquidity	
	Zero	Sign	Zero	Sign
Terms of Trade (TI)	0	$?$	0	$?$
Inflation (P)	0	≤ 0	0	$?$
Inflation Expectations (EXP)	0	≤ 0	0	$?$
Economic Activity (Y)	0	≤ 0	0	$?$
Interest Rate (R)	X	> 0	0	0 *
Interest Rate Spread (Spread 3M)	X	$?$	X	≤ 0
Net Monetary Op. Balance (Net Balance)	X	≤ 0	X	> 0
Exchange Rate YoY Depreciation (E)	X	≤ 0	X	$?$

Table: Identification Zero and sign restrictions

* For the liquidity shock, the response of the interest rate is imposed to remain 0 for all periods.

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Bayesian Estimation

Given the specified priors and the joint likelihood function, we combine efficiently these two pieces of information in order to get the estimated parameters included in Θ. Using the Bayes' theorem we have that:

$$p\left(\Theta \mid Y\right) \propto p\left(Y \mid \Theta\right) p\left(\Theta\right) \tag{8}$$

Gibbs Sampling

Recall that $\Theta = \left\{Z^*, d, \Phi_{1:2}, \alpha_{1:2}, s_{1:6}, \lambda^T, \mu, F, Q\right\}$. Then, use the notation Θ/χ whenever we denote the parameter vector Θ without the parameter.
Set $k = 1$ and denote K as the total number of draws. Then follow the steps below:

1. Draw $p\left(Z^* \mid \Theta/Z^*, Z^T\right)$: Adaptive Metropolis-Hastings step (Haario *et al.*, 2001)
2. Draw $p\left(d \mid \Theta/d, Z^T\right)$: Multinomial Distribution
3. Draw $p\left(\Phi_i \mid \Theta/\Phi_i, Z^T\right)$: Normal Distribution, $i = 1, 2$
4. Draw $p\left(\alpha_i \mid \Theta/\alpha_i, Z^T\right)$: Metropolis step (Canova and Pérez Forero, 2015), $i = 1, 2$
5. Draw $p\left(s_j \mid \Theta/s_j, Z^T\right)$: Inverse-Gamma Distribution, $j = 1, \ldots, M$
6. Draw $p\left(\lambda^T \mid \Theta/\lambda^T, Z^T\right)$: Single-Move Kalman Smoother (Kim *et al.*, 1998)
7. Draw $p\left(\mu \mid \Theta/\mu, Z^T\right)$: Normal Distribution
8. Draw $p\left(F \mid \Theta/F, Z^T\right)$: Truncated Normal Distribution
9. Draw $p\left(Q \mid \Theta/Q, Z^T\right)$: Inverse-Gamma Distribution
10. If $k < K$ set $k = k + 1$ and return to Step 1. Otherwise stop.

Estimation Setup

We run the Gibbs sampler for $K = 100,000$ and discard the first $50,000$ draws in order to minimize the effect of initial values. Moreover, in order to reduce the serial correlation across draws, we set a thinning factor of 10, i.e. given the remaining $100,000$ draws, we take 1 every 10 and discard the remaining ones. As a result, we have $10,000$ draws for conducting inference.

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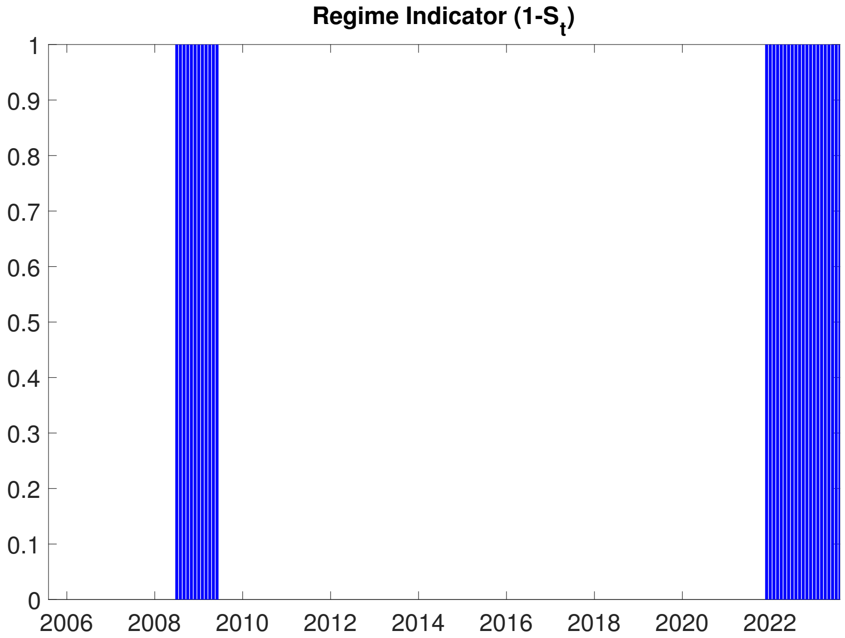

Figure: Peru Inflation Regimes 2005-2023

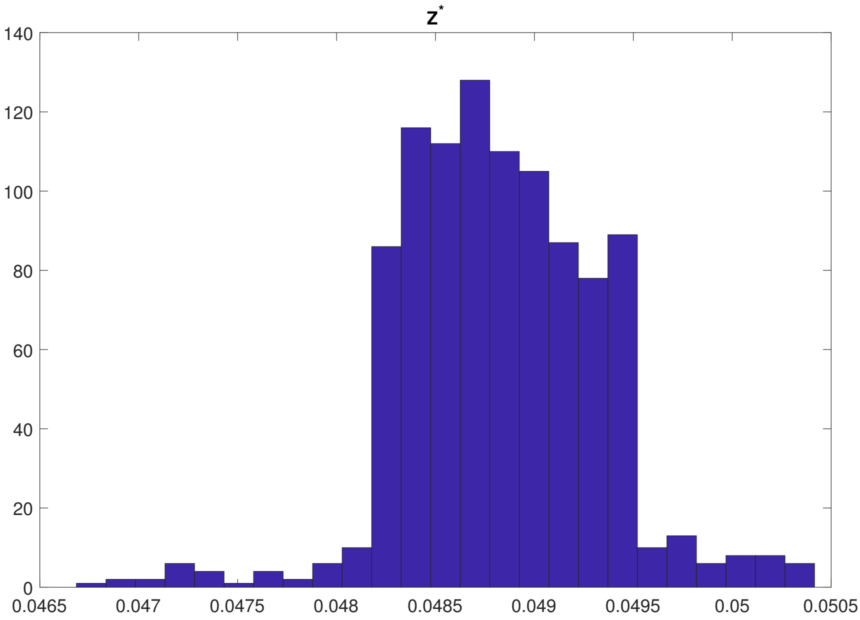

Figure: Estimated Threshold parameter Z^*

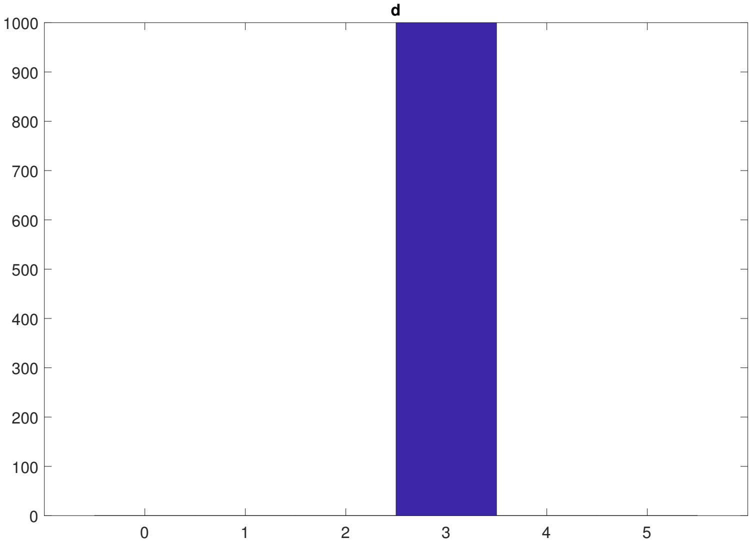

Figure: Estimated delay parameter d

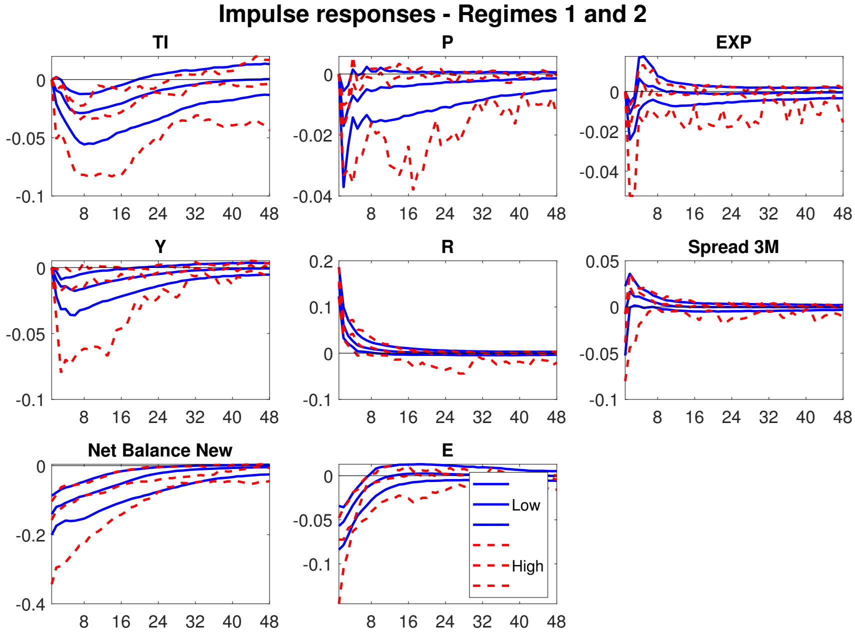

Figure: Monetary Policy Shocks for different inflation regimes (contractionary)

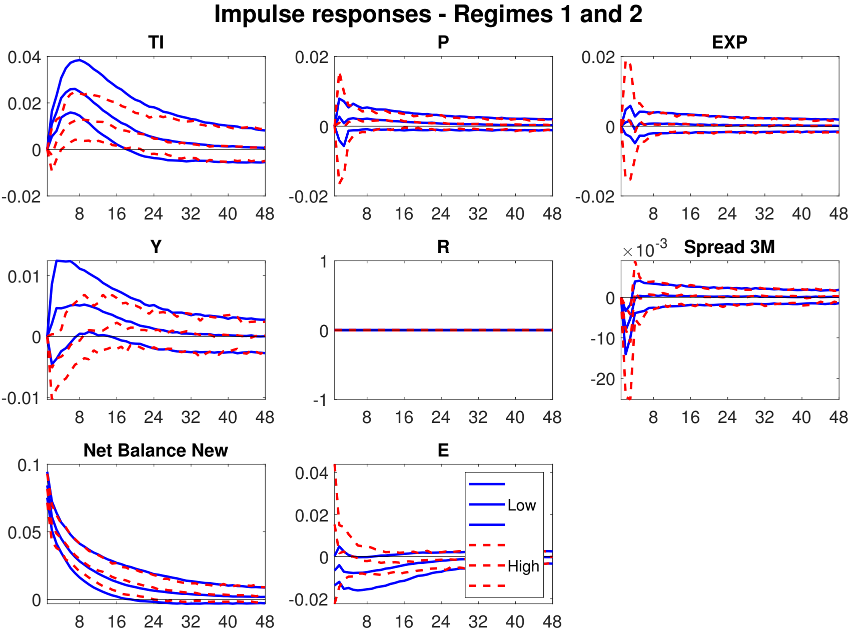

Figure: Liquidity Shocks for different inflation regimes

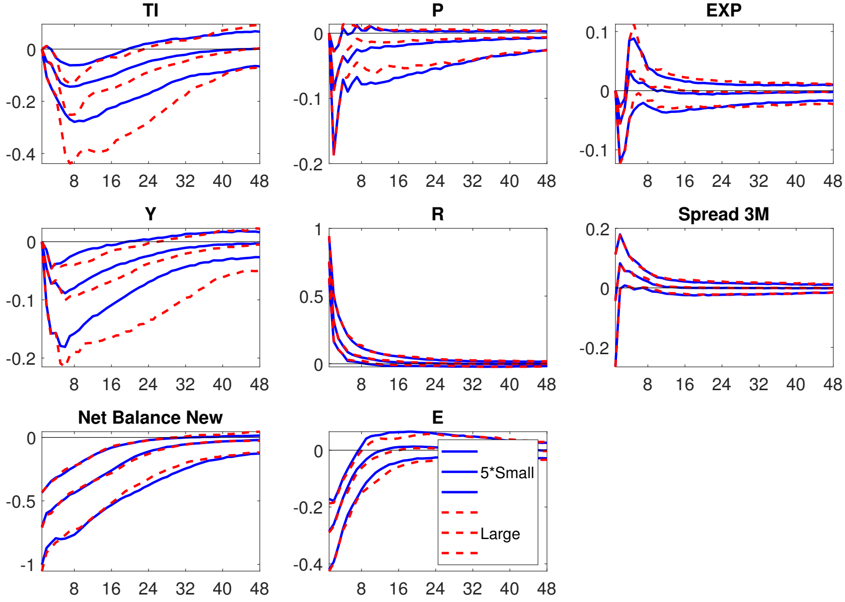

Figure: Monetary Policy Shocks for low inflation regime

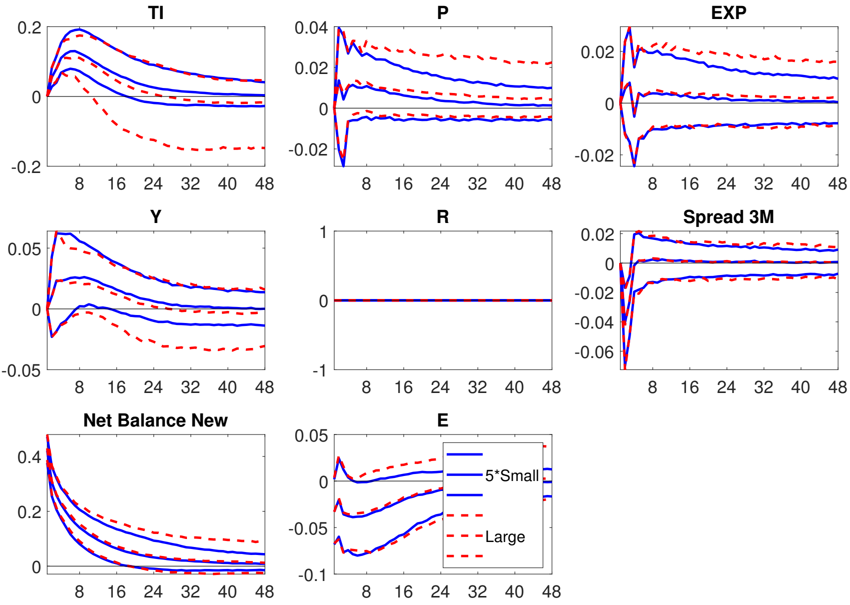

Figure: Liquidity Shocks for low inflation regime

Concluding Remarks

We identify a liquidity injection shock alongside the conventional monetary policy shock and estimate its dynamic macroeconomic effects. Our findings indicate the following:

- A positive liquidity shock, for a given policy rate rate, reduces the liquidity spread and stimulates economic activity, particularly in a low inflation regime.
- On the other hand, a liquidity scarcity shock could result in severe macroeconomic consequences, especially for economic activity.
- Therefore, the medium- and long-term liquidity management of the BCRP is crucial for the economy as it complements the establishment of an appropriate reference interest rate for the interbank market.
- This emphasizes the importance of accurately projecting the financial system's liquidity demand as well as programming the central bank's monetary operations.

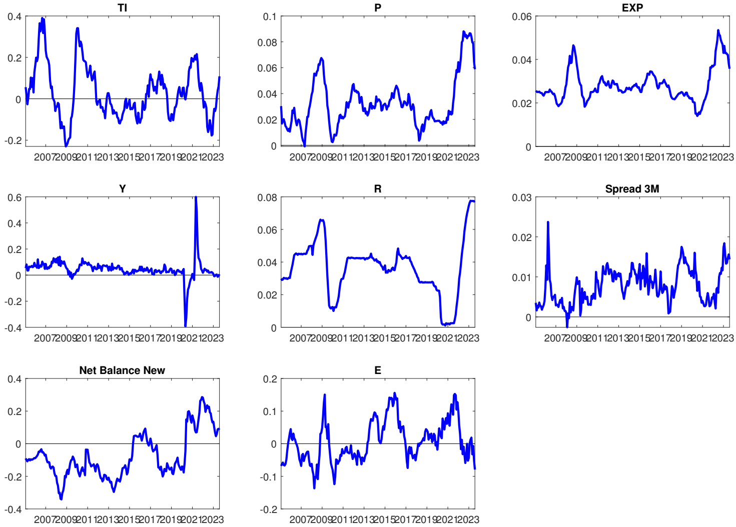

Figure: Peruvian Macroeconomic Data: 2005-2023

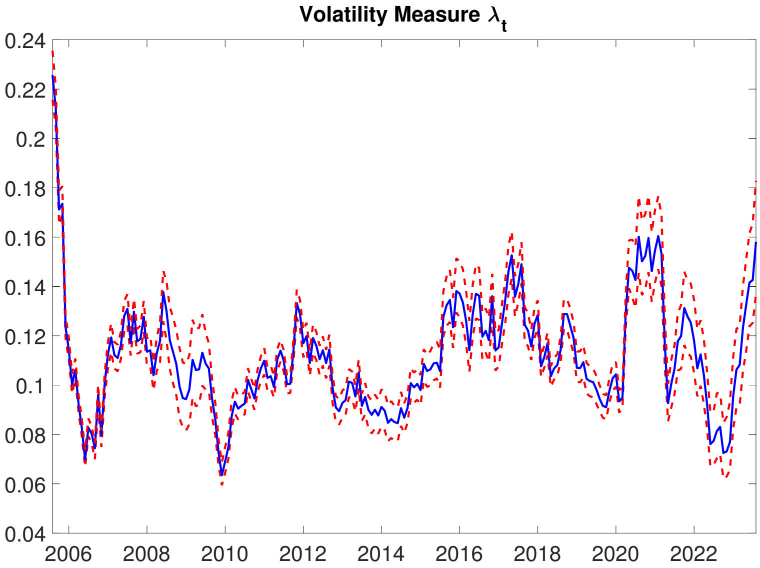

Figure: Volatility Measure (2005 - 2023)

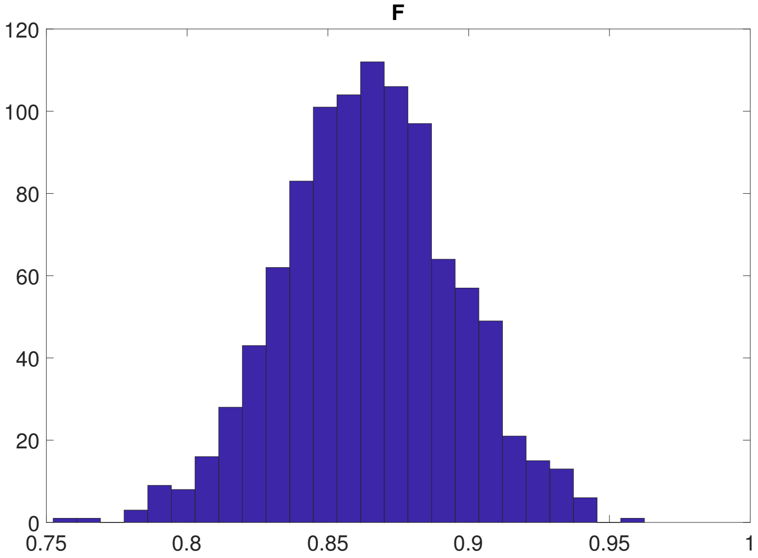

Figure: Estimated persistence parameter F

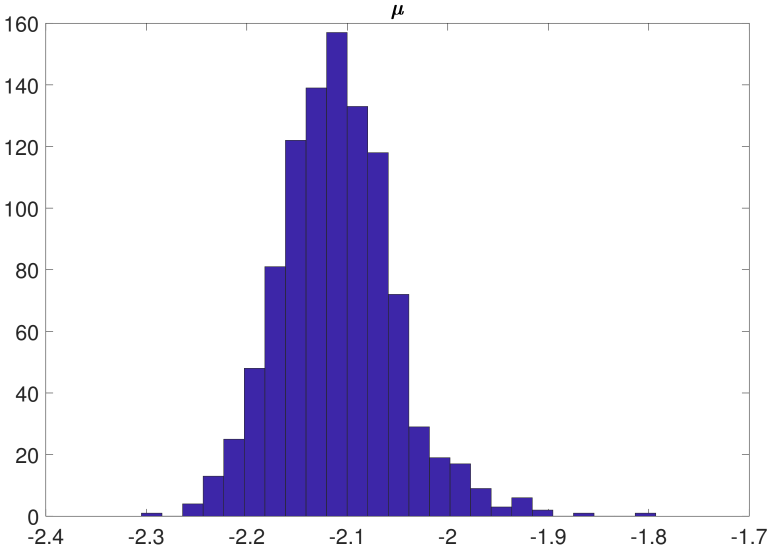

Figure: Estimated mean parameter μ

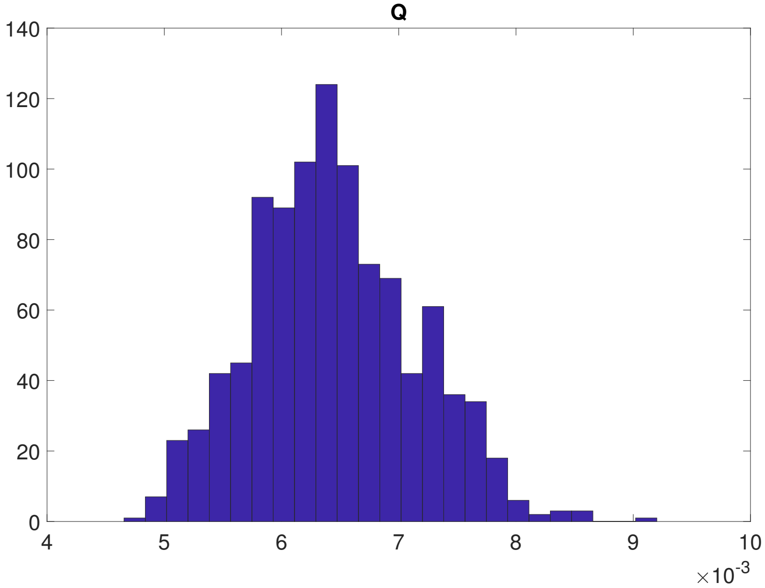

Figure: Estimated variance parameter Q

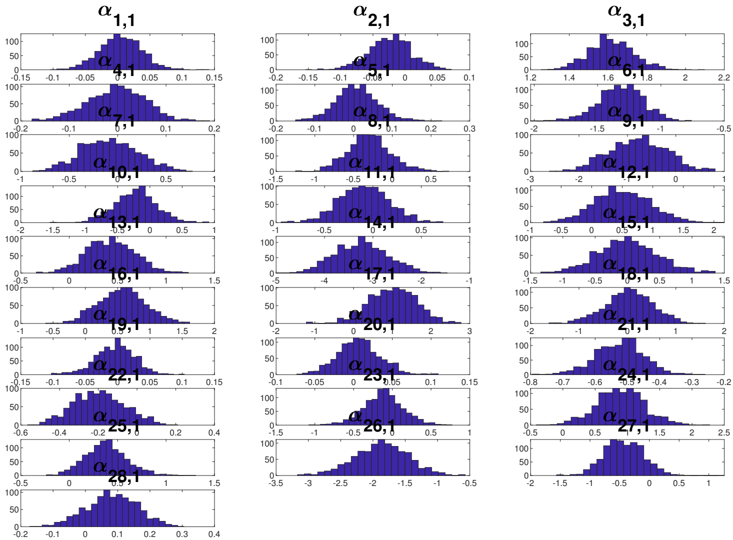

Figure: Estimated structural parameters α of Regime $S_t = 1$

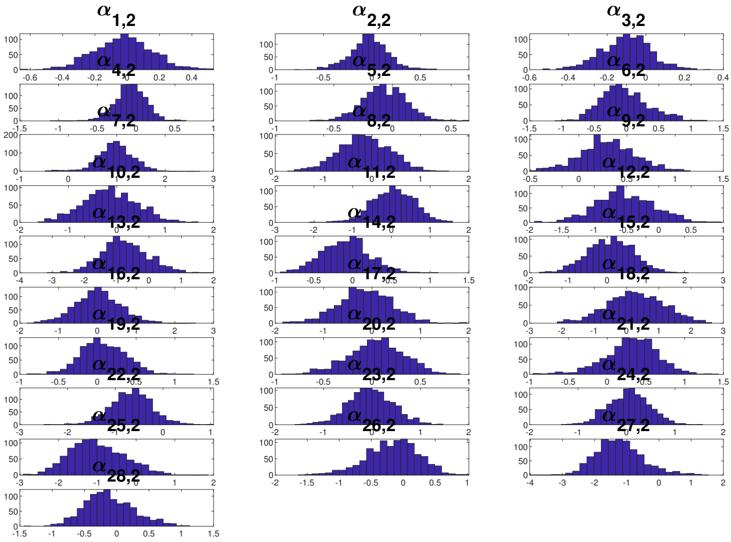

Figure: Estimated structural parameters α of Regime $S_t = 0$

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