China's Monetary Policy: A Mixed Rule in An Open Economy DSGE Model

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Rules to characterize monetary policy

- Ever since Taylor's (1993) seminal work, the Taylor-type interest rate rule has been recognized as a good way to characterize monetary policy
- New Keynesion dynamic stochastic general equilibrium (DSGE) models have become the standard framework for monetary policy analysis.
- Simple rules: the Taylor -type interest rule (price rule) or the money growth rule (quantity rule).
- If a rule-based DSGE framework can be simply used to analyzed the developing countries is still unclear.

China has its own unique features

- Regarding the institutions for monetary policy, there exist huge differences between China and the advanced economies.
  1. The People's Bank of China (PBoC), tries to realize more ultimate objectives than the advanced economies.
     1. maintain price stability
     2. maximize employment
     3. promote economic growth
     4. achieve balance of payments
  2. There exist ongoing debates on the intermediate targets of China's monetary policy.
  3. China employs not only indirect tools but also direct tools such as specific central bank lending schemes and window guidance.

Rule-based DSGE becomes more and more popular

- Analyzing China's monetary policy in the standard rule-based DSGE framework becomes a challenging task.
- The rule-based DSGE framework still becomes more and more popular in China's monetary policy analysis.
- Li and Meng (2006), G.Xu (2008), and Tong (2010) choose quantity rules while Xi and He (2010); W.Xu and Chen (2009), and Y.Ma (2015) choose price rules in their respective works.
- Another line of literature has explored a mixed monetary policy framework that contains both nominal interest rate and money growth as policy targets, e.g., Liu (2008), Liu and Zhang (2010), and Wu and Lian (2016).
- If monetary policy analysis is based on an inappropriate rule, the corresponding results might be biased and misleading.

What we do

- In an open economy DSGE model, we employ Bayesian methods to estimate a Taylor-type interest rate rule, a money growth rule and a mixed rule, respectively.
- We also examine if the data favors the monetary policy rule where the PBoC responds to the change of exchange rate.
- We apply model comparisons to identify the monetary policy rule for China as the one with which the DSGE model obtains the best empirical fit to the data.

Contribution

- We provide statistically solid evidence within the open economy DSGE framework that helps to establish the consensus on the rule for China's monetary policy.
- We show that in the DSGE framework, monetary policy rules with or without money provide very different implications for the policy behavior.
- We show that whether to have nominal interest rate targeted in the rule as well does not fundamentally affect our qualitative understanding of the PBoC's policy influences on the real economy.

'Right' model or 'Useful' model

- Our purpose in this paper is not to find out the correctly specified or "right" model framework for China.
- The goal of our paper is to find out a "useful" model that provides more reliable policy implications
- There can be many other features such as structure transformations, large share of state-owned enterprises (SOE), tight credit constraints, and inefficient financial market.

Households

A representative domestic household seeks to solve the following decision problem

$$max E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_t/Z_t)^{1-\sigma} - 1}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} + \upsilon_t ln(\frac{M_t}{P_t}) \right]$$

subject to

$$P_t C_t + E_t(Q_{t,t+1} D_{t+1} + \varepsilon_t Q^*_{t,t+1} D^*_{t+1}) + M_t - M_{t-1} \leq W_t N_t + D_t + \varepsilon_t D^*_t + \int \Theta_t(i) di \quad (1)$$

Firms

- Firstly, perfectly competitive firms producing composite goods used for consumption solve the problem

$$maxP_t C_t - P_{H,t} C_{H,t} - P_{F,t} C_{F,t}$$

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{2}$$

- Secondly,perfectly competitive firms buy the domestic intermediate goods $Y_t(i)$, package them, and resell the composite good to the firms that aggregate $C_{H,t}$and $C_{F,t}$.

$$maxP_{H,t} Y_t - \int_0^1 P_{H,t}(i) Y_t(i) di$$

$$Y_t = \left[\int_0^1 Y_t(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{3}$$

- Lastly, the producers of the domestic intermediate goods $Y_t(i)$ are monopolistic competitors.

$$Y_t(i) = Z_t N_t(i) \tag{4}$$

Price Setting

$$max E_0 \sum_{j=0}^{\infty} \theta^j Q_{t,t+j} Y_{t+j}(i) \left[\tilde{P}_{H,t}(i)(\bar{\pi}_H^{\chi j})^{1-\mu} (\Pi_{t-1,t+j-1}^{\chi})^{\mu} - MC_{t+j} \right]$$

subject to

$$Y_{t+j}(i) = \left[\frac{\tilde{P}_{H,t}(i)(\bar{\pi}_H^{\chi j})^{1-\mu} (\Pi_{t-1,t+j-1}^{\chi})^{\mu}}{P_{H,t+j}} \right]^{-\varepsilon} Y_{t+j} \tag{5}$$

and

$$\Pi_{t,t+j} = \begin{cases} \left(\frac{P_{H,t+1}}{P_{H,t}}\right)\left(\frac{P_{H,t+2}}{P_{H,t+1}}\right) \times \cdots \times \left(\frac{P_{H,t+j}}{P_{H,t+j-1}}\right) & for \quad j = 1, 2, \ldots \\ 1 & for \quad j = 0 \end{cases} \tag{6}$$

International Risk Sharing, Terms of Trade, Real Exchange Rate and Resource Constraint

- International Risk Sharing $\left(\frac{c_{t+1}}{c_t}\right)^{\sigma} \pi_{t+1} = \left(\frac{c^*_{t+1}}{c^*_t}\right)^{\sigma} \pi^*_{t+1} e_{t+1}$
- The law of one price holds so that $P_{F,t} = \varepsilon_t P^*_{F,t} \approx \varepsilon_t P^*_t$
- The terms of trade is defined as $Q_t \equiv \frac{P_{H,t}}{P_{F,t}}$
- The real exchange rate is defined as $S_t = \frac{\varepsilon_t P^*_t}{P_t}$
- The market for domestically produced goods clears $y_t = c_{H,t} + c^*_{H,t}$
- Global resource constraint $c_t + S_t c^*_t = Q_t S_t y_t + S_t y^*_t$

Monetary Policy

$$log R_t = \rho_R log R_{t-1} + (1-\rho_R)[log \bar{R} + \phi_\pi (log \pi_t - log \bar{\pi}) +$$

$$\phi_y (log y_t - log \bar{y}) + \phi_e (log e_t - log \bar{e})] + \varepsilon_t^R \quad (7)$$

Estimation Strategy

Rational expectations solutions under indeterminacy, Lubik and Schorfheide (2003, 2004)

$$\varrho_t = \Phi_\varrho(\xi)\varrho_{t-1} + \Phi_\varepsilon(\xi, \tilde{M})\varepsilon_t + \Phi_\varsigma(\xi)\zeta_t \tag{8}$$

$$\tilde{M} = M^*(\xi) + M \tag{9}$$

Bayesian estimation with Sequential Monte Carlo algorithm, Herbst and Schorfheide (2014, 2015)

Data

- Our baseline estimation uses China's quarterly data covering the period 1996Q2--2019Q4. The model is estimated using six key macro variables: the growth rates of real GDP, nominal M2, exchange rate, terms of trade, the inflation rate and the nominal interest rate. The data for real GDP, CPI and M2 are taken from Chang, Chen, Waggoner and Zha (2016). All these data are originally from China's National Bureau of Statistics, the People's Bank of China, and CEIC. The inflation is the log difference in the CPI. For nominal interest rate, we select the 7-day CHIBOR (China inter-bank offered rate) from Wind. The nominal exchange rate indices are obtained from FRED. The terms of trade is measured using export prices over import prices, which are available from Wind. All series are seasonally adjusted and demeaned prior to estimation.

Calibration

- Discount factor $\beta = 0.99$
- The steady-state markup at around ten percent $\varepsilon = 11$
- Inverse of the labor supply elasticity $\sigma = 0$
- Substitutability between domestic and foreign goods $\eta = 1$
- Indexation $\chi = \mu = 0$
- Trend inflation $\bar{\pi}_H = 1.015/1.006$

Conclusion

- The mixed rule with the exchange rate is very strongly favored by the data relative to the price rule and the quantity rule.
- The monetary policy rules with or without money provide very different implications for the policy behavior.
- As long as money is targeted in the policy rule, our results demonstrate that the models under a mixed rule and the quantity rule are nearly indistinguishable qualitatively.