Efficient monetary policy frontier for Iceland

A report to taskforce on reviewing Iceland's monetary and currency policies

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1 Introduction

A central bank conducting monetary policy faces a trade-off between inflation and output fluctuations - less inflation fluctuations come at the cost of more output fluctuations (and vice versa). An efficient monetary policy frontier gives the pairs of inflation and output gap fluctuations that give the smallest possible inflation fluctuations for given output gap fluctuations (or the smallest possible output gap fluctuations for given inflation fluctuation) given the structure of the economy.

In this paper, we present efficient monetary policy frontiers for Iceland. The aim is to (i) analyse whether and how the frontier for Iceland has changed during the past two decades, (ii) compare frontiers for Iceland using different measures of inflation and (iii) compare the frontier for Iceland with the frontier for a foreign economy.

An efficient monetary policy frontier is based on an estimated macroeconomic model for the economy which is used to calculate the optimal monetary policy rules that maximizes a welfare objective for the economy. The model is then simulated using the optimal policy rules giving the pairs of standard deviations of output gap and inflation that make up the frontier.

The paper is organized as follows: The macroeconomic model and its estimation is discussed in chapter 2 and the calculation of the optimal policy rules is discussed in chapter 3. The results are presented in chapter 4, which concludes the paper.

2 The model and estimation

We use a model and estimation techniques similar to the ones in Hunt (2006). The macroeconomic model can be described by the following equations:

$$\begin{aligned}
\hat{y}_t &= \beta_1 \hat{y}_{t-1} + \beta_2 E_t(\hat{y}_{t+1}) - \beta_3 \hat{r}_{t-1} + \beta_4 \hat{z}_{t-1} + \beta_5 \hat{y}_t^* + \varepsilon_{y,t} \\
\pi_t &= \delta_1 E_t(\pi_{4,t+4}) + (1-\delta_1)\pi_{4,t-1} + \delta_2 \hat{y}_{t-1} + \delta_3 \Delta z_t + \varepsilon_{\pi,t} \\
z_t &= \phi E_t(z_{t+1}) + (1-\phi) z_{t-1} - \frac{r_t - r_t^* - \sigma_t}{4} + \frac{\varepsilon_{z,t}}{4} \\
i_t &= \alpha_1 i_{t-1} + (1-\alpha_1)\left[\bar{r}_t + \pi_{4,t} + \alpha_2 (E_t(\pi_{4,t+4}) - \pi_T) + \alpha_3 \hat{y}_t\right] + \varepsilon_{i,t} \\
\hat{y}_t^* &= \beta_1^* \hat{y}_{t-1}^* + \beta_2^* E_t\left(\hat{y}_{t+1}^*\right) - \beta_3^* \hat{r}_{t-1}^* + \varepsilon_{y,t}^* \\
\pi_t^* &= \delta_1^* E_t\left(\pi_{4,t+4}^*\right) + (1-\delta_1^*)\pi_{4,t-1}^* + \delta_2^* \hat{y}_{t-1}^* + \varepsilon_{\pi,t}^* \\
i_t^* &= \alpha_1^* i_{t-1}^* + (1-\alpha_1^*)\left[\bar{r}_t^* + \pi_{4,t}^* + \alpha_2^*\left(E_t\left(\pi_{4,t+4}^*\right) - \pi_T^*\right) + \alpha_3^* \hat{y}_t^*\right] + \varepsilon_{i,t}^*
\end{aligned}$$

where $\hat{y}$ ($\hat{y}^*$) is the domestic (foreign) output gap, which is the difference between output and equilibrium output, $\hat{r}$ ($\hat{r}^*$) is the domestic (foreign) real interest rate gap, which is the difference between domestic (foreign) real interest rates r (r^*) and domestic (foreign) equilibrium real interest rates $\bar{r}$ ($\bar{r}^*$), $\hat{z}$ is the domestic real exchange rate gap, which is the difference between the real exchange rate (z) and equilibrium real exchange rate[1], π (π^*) is domestic (foreign) annulized quarterly inflation, π_4 (π_4^*) is a four period moving average of domestic (foreign) annualized quarterly inflation, $\Delta z = z - z_{-1}$, σ is domestic equilibrium risk premium, i (i^*) is domestic nominal interest rate, π_T (π_T^*) is the domestic (foreign) inflation target rate, $E_t()$ is an expectations operator given the available information at time t, ε_y, ε_π, ε_z, ε_i, ε_y^*, ε_π^* and ε_i^* are shocks, which are all modelled as (stationary) $AR(1)$ processes except ε_z, which is modelled as a white noise process. Finally, β_1, β_2, β_3, β_4, β_5, δ_1, δ_2, δ_3, ϕ, α_1, α_2, α_3, β_1^*, β_2^*, β_3^*, δ_1^*, δ_2^*, α_1^*, α_2^* and α_3^* are estimated parameters.

The first four equations represent the domestic economy and the last three the foreign or the "rest of the world" economy. The first and fifth equations describe aggregate demand (modified Euler equations), the second and sixth describe aggregate supply (modified Philips curves) and the fourth and seventh are monetary policy equations (modified Taylor rules). The third equation gives development of the real exchange rate in for the domestic economy (a modified real interest rate parity equation).

The model is estimated for Iceland for two periods, i.e. 2001-2007 and 2010-2017, and using two measures of domestic inflation, i.e. consumer price index (CPI) inflation and harmonized CPI (HCPI) inflation - a total of four models are therefore estimated for Iceland. The model is also estimated for the United Kingdom (UK) for the two periods using CPI inflation.

When estimating the models for Iceland, trade-weighted averages of foreign output gap, inflation, equilibrium real interest rates and inflation are used for

[1] The real exchange rate is here defined such that an increase in z gives a depreciation of the real exchange rate.

foreign or variables. When estimating the models for UK, data on these variables for the Euro Area are used as a proxy for foreign variables.

The models are estimated using Bayesian estimation techniques available in the computer program Dynare (see Dynare) using quarterly data for 2001-2007 (second quarter 2001 - fourth quarter 2007) and 2010-2017 (first quarter 2010 - third quarter 2017).

All data used in estimating the models for Iceland was obtained from the Central Bank of Iceland's QMM database (see QMM) except for data on domestic HCPI, which was obtained from Statistics Iceland (see Statistics Iceland). Data on foreign output gap was calculated by the author as deviations in foreign gross domestic product (GDP) from trend using the Hodrick-Prescott (HP) filter. Data on equilibrium foreign real interest rates was calculated by the author as HP-trend for the foreign real interest rates using the HP-filter.

The data used in estimating the model for UK was obtained from the International Monetary Fund (data on domestic and foreign CPI) (see IMF), OECD (data on domestic and foreign GDP and nominal interest rates) (see OECD), the Bank for International Settlements (data on domestic real exchange rate) (see BIS). Data on domestic and foreign output gap and equilibrium real interest rates were calculated by the author using HP-filter.

3 Optimal policy

Given the estmated parameters of the model (β_1, β_2, β_3, β_4, β_5, δ_1, δ_2, δ_3, ϕ, β_1^*, β_2^*, β_3^*, δ_1^*, δ_2^*, α_1^*, α_2^* and α_3^*), the estimated parameters of the $AR(1)$ processes for the shocks as well as the estimated standard deviations of the shocks, the optimal policy parameters (α_1, α_2, α_3) are chosen such that the following loss function is minimized:

$$L = \sum_{t=0}^{\infty} \left[\lambda \left(\pi_t - \pi_T \right)^2 + (1 - \lambda) \hat{y}_t^2 \right]$$

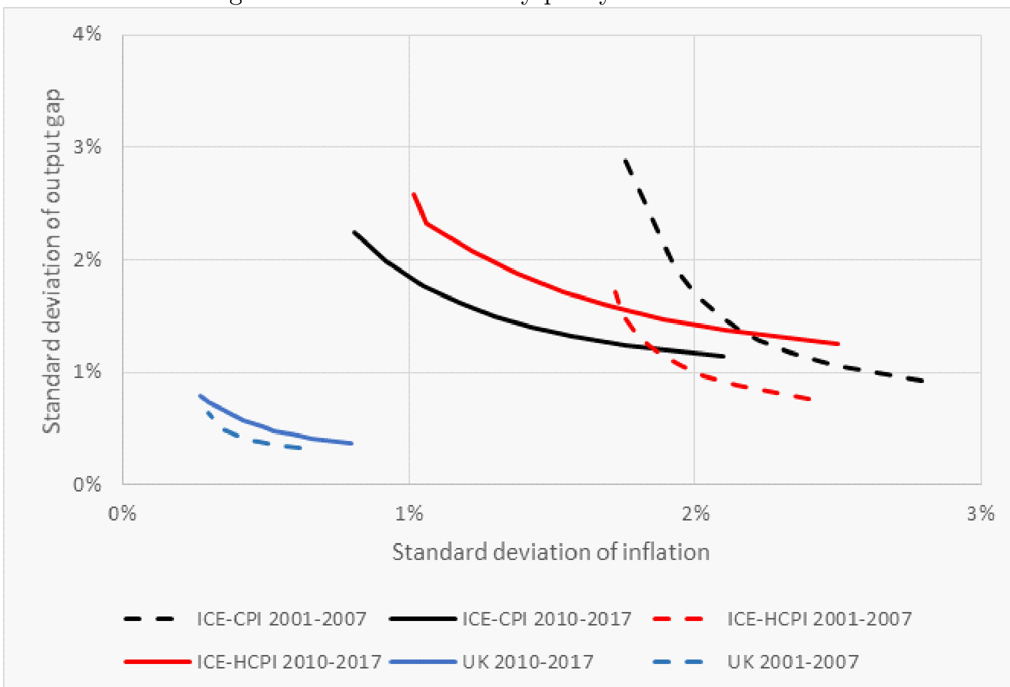
conditional on $\alpha_1 \in [0, 1]$ where $\lambda \in (0, 1)$ gives the relative weight assigned to inflation fluctuations in the loss function. According to the function, loss (welfare) is increasing (decreasing) in both inflation and output gap fluctutations. The policy parameters are chosen and the model is simulated for each value of $\lambda = 0.1, 0.2, ...0.9$ giving the pairs of standard deviations of inflation and output gap that make up the efficient monetary policy frontier.

The efficient monetary policy frontier is constructed for each of the six estimated macroeconomic model discussed above.

4 Results

The resulting efficient monetary policy frontiers are given in the following figure:

Figure 1. Efficient monetary policy frontiers



The whole lines show the frontiers for 2010-2017 while the dotted lines show the frontiers for 2001-2007. The frontiers for UK are blue, the frontiers for Iceland using CPI inflation are black and red where HCPI inflation is used.

A few conclusions can be drawn from the figure:

- The frontiers for the UK lie closer to the origin than the frontiers for Iceland indicating that the structure of the Icelandic economy is such that it faces worse options in terms of inflation and output gap fluctuations in conducting monetary policy than the UK.

- The frontiers using CPI inflation for Iceland has moved closer to the origin between the two periods implying better options in terms of inflation and output gap fluctuations in conduction monetary policy in 2010-2017 than in 2001-2007.

- The frontier using HCPI inflation in Iceland lies closer to the origin than the frontier using CPI inflation in 2001-2007 but further from the origin in 2010-2017. It is therefore inconclusive whether using HCPI inflation instead of CPI inflation as a measure of inflation in the economy improves the policy options in terms of inflation and output gap fluctuations in conduction monetary policy in Iceland.

References

[1] BIS: www.bis.org

[2] Dynare: www.dynare.org

[3] IMF: www.imf.org

[4] Hunt, B. (2006), Simple efficient policy rules and inflation control in Iceland, Central Bank of Iceland's Working Paper No. 30.

[5] OECD: www.oecd.org

[6] QMM: https://www.sedlabanki.is/library/Skraarsafn/Peningamal/2018/Februar-2018/QMM_Gagnagrunnur_(.xlsx)_7_februar_2018.xlsx

[7] Statistics Iceland: www.statice.is