DISENTANGLEMENT OF NATURAL INTEREST RATE SHOCKS AND MONETARY POLICY SHOCKS NEXUS


Gleb Kurovskiy, 2020
# Procedure of estimation of monetary policy shocks and natural interest rate shocks

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1:</strong></td>
<td>Identify monetary policy shocks analogously to Arias et al. (2019) using original data</td>
</tr>
<tr>
<td><strong>Step 2:</strong></td>
<td>Perform counterfactual simulations to obtain all the series which are cleaned from the monetary policy shocks</td>
</tr>
<tr>
<td><strong>Step 3:</strong></td>
<td>Perform (Uhlig 2004) approach to get natural interest rate shocks in simulated data</td>
</tr>
</tbody>
</table>
Model

Step 1: Identify monetary policy shocks

\[ Y_t = B_0 + B_1 Y_{t-1} + \ldots + B_k Y_{t-k} + A_0 \varepsilon_t \]  

(1)

where \( Y_t \) is the vector of \( n \times 1 \) endogenous variables at period \( t \), \( B_k \) is the \( n \times n \) matrix of parameters given \( k \in [0,1,\ldots,k+1,\ldots p] \), \( p \) is a maximum lag order of VAR in canonical form, the lag order is the maximum order by Hannan-Quinn and BIC criteria. \( A_0 \) is the \( n \times n \) matrix of structural shocks, \( \varepsilon_t \) is the vector of \( n \times 1 \) structural shocks at period \( t \).

Step 2: Perform counterfactual simulations to obtain all the series which are cleaned from the monetary policy shocks

Step 3: Get natural interest rate shocks in simulated data

\[ \hat{Y}_t = C_0 + C_1 \hat{Y}_{t-1} + \ldots + C_k \hat{Y}_{t-k} + D_0 u_t \]  

(2)

where \( C_k \) is the \( n \times n \) matrix of parameters given \( k \in [0,1,\ldots,k+1,\ldots p] \), \( p \) is a maximum lag order of VAR in canonical form identical to the first step, \( D_0 \) is the \( n \times n \) matrix of structural shocks, \( u_t \) is the vector of \( n \times 1 \) structural shocks at period \( t \).
Monetary policy rules: set of restrictions

Monetary policy rule I:
- The central bank hikes policy rate in response to inflation increase
- The central bank does not respond to changes in the exchange rate, output or unemployment
- Contractionary monetary policy shock results in the hike of interest rates and lowering of inflation

Monetary policy rule II:
- The central bank hikes policy rate in response to inflation increase, exchange rate weakening (pass-through on inflation)
- The central bank does not respond to changes in output or unemployment
- Contractionary monetary policy shock results in the hike of interest rates and lowering of inflation

Monetary policy rule III:
- Central bank hikes policy rate in response to inflation increase, output increase, exchange rate weakening.
- The central bank does not respond to changes in unemployment
- Contractionary monetary policy shock results in the hike of interest rates and lowering of inflation
Data

Monthly Russian data on
- oil prices (Oil)
- interbank interest rate (MIACR)
- consumer price index (CPI)
- unemployment (U)
- exchange rate USD/RUB (ExR)

two economic activity series:
- index of industrial production (IPI)
- index of core industries output (IBI)

from January 2014 to July 2019

Monthly growth rates of oil prices, exchange rate, CPI, IPI, IBI and keep unemployment and MIACR at levels.
Step 1: Impulse response functions to unit monetary policy shock under monetary policy rule II

Notes. The black line is median point estimate of the draws that satisfy monetary policy rule II. The grey lines are one-standard deviation confidence intervals: 16% and 84% percentiles. The period is equal to 1 month.
Monetary policy feedback rule contemporary coefficients

\[ MIACR_t = \beta_0 + \beta_y IPI_t + \beta_{\pi} CPI_t + \beta_{er} EXR_t + \beta_u U_t + \]
\[ + \sum_{k=1}^{L} \left[ L_k (\beta_y IPI_t + \beta_{\pi} CPI_t + \beta_{er} EXR_t + \beta_u U_t) \right] + \sum_{i=1}^{N} \alpha_i \varepsilon_i t \]

(3)

Where \( \beta_j \) are feedback coefficients of our interest \( j = 1, \ldots, N+1 \), \( N \) is a number of variables, \( L_k \) is a lag operator of order \( k \), the maximum lag order is equal to one, \( \alpha_i \varepsilon_i t \) is a multiple of the first raw structural shocks coefficients by structural shocks.

<table>
<thead>
<tr>
<th>Models</th>
<th>MP I</th>
<th>MP II</th>
<th>MP I sign</th>
<th>MP II sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_\pi )</td>
<td>2.25</td>
<td>1.74</td>
<td>2.55</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>(1.57 3.22)</td>
<td>(0.70 3.27)</td>
<td>(1.87 3.54)</td>
<td>(0.76 3.20)</td>
</tr>
<tr>
<td>( \beta_{er} )</td>
<td>0</td>
<td>0.10</td>
<td>0</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.03 0.21)</td>
<td></td>
<td>(0.03 0.20)</td>
<td></td>
</tr>
<tr>
<td>( \beta_y )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes. The confidence intervals are 16% and 84% percentiles. All the other contemporary coefficients are equal to zero. “MP” stands for the abbreviation of monetary policy rule, the mark “sign” means that I additionally impose sign restrictions on exchange rate and output.
Monetary policy shocks under monetary policy rule II

Notes. The black line is median point estimate of the draws that satisfy monetary policy rule II. The grey lines are one-standard deviation confidence intervals: 16% and 84% percentiles. The dotted grey lines are two-standard deviation confidence intervals: 5% and 95% percentiles.
Step 3: counterfactual simulations of the series driven by only natural interest rate shocks

Notes. The black line is the median estimate of the series driven by only natural interest rate shocks. The light grey lines are one-standard deviation confidence intervals: 16% and 84% percentiles. The grey lines are actual series.
Results

1. The ACRR (2019) identification scheme allows to get canonical impulse responses to a monetary policy shock (there is no price or output puzzle)

2. Implicit monetary policy analysis shows that the past monetary policy rules assumes reaction to inflation and exchange rate (pass-through) movements

3. A 1 p.p. increase in policy rate results in 0.5 p.p. decrease on inflation in 2 months, while the effect dissipates in 10 months

4. Monetary policy shocks together with monetary policy shocks explain around 60% of total inflation variance (20% and 40%)

5. During the Q2 2019 the natural interest rate is lower than the MIACR for almost 1.5 percentage points
Appendix A: FEVDs of natural interest rate shocks

Notes. The black line is median point estimate of the draws that satisfy monetary policy rule II. The grey lines are one-standard deviation confidence intervals: 16% and 84% percentiles. The period is equal to 1 month.
Appendix B: FEVDs of monetary policy shocks

Notes. The black line is median point estimate of the draws that satisfy monetary policy rule II. The grey lines are one-standard deviation confidence intervals: 16% and 84% percentiles. The period is equal to 1 month.