The Bank of Thailand’s Practical Model-Based Forecasting and Policy Analysis System

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Bank of Thailand

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The new model is currently being developed by the staff of the Bank of Thailand’s Monetary Policy Group with the technical assistance provided by the Economic Modeling Unit of the IMF Research Department.

The views expressed in this paper are those of the authors and do not necessarily represent the Bank of Thailand’s policies or the views of the IMF.
1. Overview

- **Objective**
  - A suite of economic models

- **Primary focuses of new model**
  - Economic projection
  - Monetary policy formulation

- **Key features of model**
  - Transmission mechanism and various pass-throughs
  - Inflation and output stabilization
  - Endogenous interest rate projection
Outline of presentation

1. Describing the model structure
   - Semistructural New Keynesian model
2. Examining model properties
3. Evaluating the model
4. Applying the model
   - Macroeconomic projection
   - Monetary policy formulation
2. Model specification

2.1. Model structure

Modeling philosophy

- Monetary policy stabilizes inflation and output by managing business cycles
- Business cycles are transitory in that they are independent of, and do not affect, the long-term trends in the economy
Inflation expectations are influenced by future and past inflation

- Inflation eventually converges to expected inflation
- Changes in inflation persist only if inflation expectations change

Excess demand puts upward pressure on core inflation via output gap

Exchange rate directly and indirectly passes through to core inflation

Higher food and energy prices ratchet up underlying inflation

\[
\pi_t = \theta_f \pi_{t+1} + (1 - \theta_f) \pi_{t-1} + \alpha^y \hat{y}_t \\
+ \alpha^M \left( \pi^M_t - d\bar{z}_t - \pi^H_{ss} \right) + \alpha^z (z_t - \bar{z}_t) \\
+ \alpha^F \left( \pi^F_t - \pi^F_{ss} \right) + \alpha^E \left( \pi^E_t - \pi^E_{ss} \right) + \varepsilon_t
\]
Output gap is based on the view that forward-looking economic agents adjust their current spending to reflect expected income. Monetary policy affects output gap through real interest rate and real exchange rate gaps. An increase in foreign excess demand also creates additional demand for domestic goods.

$$\hat{y}_t = \theta_f \hat{y}_{t+1} + \theta_b \hat{y}_{t-1} - \beta^r (r_t - \bar{r}_t) + \beta^z (z_t - \bar{z}_t) + \beta^y \hat{y}_t^* + \epsilon_t^y$$
For the exchange rate to be stable:

- Domestic interest rate must equal foreign rate plus country risk
- Current account must be balanced
- Domestic inflation must equal foreign inflation

\[ s_t = \rho^s \left[ s_{t-1} + \frac{1}{4} \left( d\bar{z}_t - \pi_t^* + \pi_t^H \right) \right] \]
\[ + (1 - \rho^s) \left[ s_{t+1} - \frac{1}{4} (i_t - i_t^* - \mu) - \chi \Lambda_t \right] + \epsilon_t^s \]
Central bank gradually moves policy rate around its trend in response to
- Deviations of output from trend
- Deviations of inflation from target

\[ i_t = \rho^i i_{t-1} + (1 - \rho^i) \left[ \bar{r}_t + \pi^H_{ss} + \phi^y \hat{y}_t + \phi^\pi \left( \pi_{4t+3} - \pi_{\text{target}} \right) \right] + \epsilon^i_t \]
2. Model specification

2.2. Model parameterization

Calibration of model parameters must yield

- Inherent instability
  - If the policy rule is turned off, the model gives no unique solution
  - If the model is inherently stable, simulation/projection will converge to steady state even without monetary policy

- Sensible impulse responses
Inherent instability
with the interest rate rule turned off

The economy in the green region will stabilize itself even without monetary policy’s role
Region of determinacy
for a nonforward-looking interest rate rule

\[
y_t = E_t y_{t+1} - \frac{1}{\sigma} (i_t - E_t \pi_{t+1} - r_t^n)
\]
\[
\pi_t = \beta E_t \pi_{t+1} + \kappa y_t
\]
\[
i_t = r_t^n + \phi_\pi \pi_t + \phi_y y_t
\]

\[
\begin{bmatrix}
    y_t \\
    \pi_t
\end{bmatrix} = A_T
\begin{bmatrix}
    E_t y_{t+1} \\
    E_t \pi_{t+1}
\end{bmatrix}
\]

\[
A_T = \Omega
\begin{bmatrix}
    \sigma & 1 - \beta \phi_\pi \\
    \sigma \kappa & \kappa + \beta (\sigma + \phi_y)
\end{bmatrix}
\]

\[
0 < \kappa (\phi_\pi - 1) + (1 - \beta) \phi_y
\]

Source: Gali (2008), Monetary Policy, Inflation, and Business Cycle
Region of determinacy
for a forward-looking interest rate rule

\[ y_t = E_t y_{t+1} - \frac{1}{\sigma}(i_t - E_t \pi_{t+1} - r^n_t) \]
\[ \pi_t = \beta E_t \pi_{t+1} + \kappa y_t \]
\[ i_t = r^n_t + \phi_y E_t \pi_{t+1} + \phi_y E_t y_{t+1} \]

\[ A_F = \begin{bmatrix} 1 - \sigma^{-1} \phi_y & -\sigma^{-1} \phi_y \\ \kappa (1 - \sigma^{-1} \phi_y) & \beta - \kappa \sigma^{-1} \phi_y \end{bmatrix} \]

\[ 0 < \kappa (\phi_{\pi} - 1) + (1 - \beta) \phi_y \]
\[ 2\sigma (1 + \beta) > \kappa (\phi_{\pi} - 1) + (1 + \beta) \phi_y \]

Source: Gali (2008), *Monetary Policy, Inflation, and Business*
Region of determinacy
for an interest rate rule in Apaitan and Tanboon (2012)
Important impulse response functions

See Handout 1

- Interest rate shock
- Demand shock
- Inflation shock
- Exchange rate shock
- Foreign demand shock
3.2 Demand shx
3.3 Core infl shx
3. Model evaluation

Recursive forecasts and RMSEs

- Output
- Inflation
- Interest rate
1 Output Growth

Output Growth (%YoY)

RMSE

<table>
<thead>
<tr>
<th>n=0</th>
<th>n=1</th>
<th>n=2</th>
<th>n=3</th>
<th>n=4</th>
<th>n=5</th>
<th>n=6</th>
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2 Core Inflation

Core Inflation (%YoY)

RMSE

\[
\begin{array}{cccccccc}
 n=0 & n=1 & n=2 & n=3 & n=4 & n=5 & n=6 & n=7 & n=8 \\
 0.07 & 0.36 & 0.64 & 0.97 & 1.40 & 1.61 & 1.85 & 1.93 & 1.94 \\
\end{array}
\]
4 Interest Rate

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<th>n=1</th>
<th>n=2</th>
<th>n=3</th>
<th>n=4</th>
<th>n=5</th>
<th>n=6</th>
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<td>0.16</td>
<td>0.68</td>
<td>0.72</td>
<td>0.99</td>
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<td>1.37</td>
<td>1.48</td>
<td>1.64</td>
<td>1.81</td>
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4. Model application

4.1. Economic projection

See Handout 2: Baseline projection as of February 2012

- Output
- Inflation
- Interest rate
1 Output Growth

<table>
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<tr>
<th></th>
<th>1Q1</th>
<th>1Q2</th>
<th>1Q3</th>
<th>1Q4</th>
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<td>3.72</td>
<td>-8.98</td>
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<tr>
<td>% QoQ, not annualized</td>
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</table>

Output Growth (%YoY)

Output Growth (%QoQ, not annualized)
3 Core Inflation

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<thead>
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<th></th>
<th>11Q1</th>
<th>11Q2</th>
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<th>13Q3</th>
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<td>%YoY</td>
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<tr>
<td>%QoQ, not annualized</td>
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<tr>
<td>Current Projection</td>
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<td>0.29</td>
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<td>1.13</td>
<td>0.46</td>
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Core Inflation (%YoY)

Core Inflation (%QoQ, not annualized)
7 Policy Interest Rate

<table>
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<tr>
<th></th>
<th>11Q1</th>
<th>11Q2</th>
<th>11Q3</th>
<th>11Q4</th>
<th>12Q1</th>
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<tr>
<td>Outturn</td>
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<td>2.79</td>
<td>3.33</td>
<td>3.42</td>
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</table>

Interest rate (%)

- **Current Projection**
- **Outturn**
4. Model application

4.2. Monetary policy analysis

4.2.1. Effects of floods on output and potential output

- Although output significantly contracted in 2011Q4, potential output also declined.

See Handout 3 for scenario analysis with and without changes in potential output.
App1: Effects of floods on output and potential output

- Baseline
- Potential output unaffected
App1: Effects of floods on output and potential output

- Baseline
- Potential output unaffected
App1: Effects of floods on output and potential output

- Baseline
- Potential output unaffected
4. Model application

4.2. Monetary policy analysis

4.2.2. VAT increase and monetary policy relevant inflation

- Part of inflation caused by VAT increase is disregarded monetary policy

See Handout 3
App2: Monetary policy relevant inflation

- Targeting actual inflation
- Targeting policy relevant inflation
4.2.3. Interest rate path scenarios

1. Endogenous interest rate path
2. Endogenous interest rate path with judgment added at the start of the forecast period

See Handout 3
App3: Interest rate path scenarios

- **Baseline**
  
<table>
<thead>
<tr>
<th>Annual Growth Rates (%)</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>0.05</td>
<td>4.46</td>
<td>6.33</td>
</tr>
<tr>
<td>Core Inflation</td>
<td>2.36</td>
<td>2.29</td>
<td>1.32</td>
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<tr>
<td>Headline Inflation</td>
<td>3.81</td>
<td>3.08</td>
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</table>

- **Alternative**

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<th>Annual Growth Rates (%)</th>
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<th>2012</th>
<th>2013</th>
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<tbody>
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<td>Real GDP</td>
<td>0.05</td>
<td>4.52</td>
<td>6.27</td>
</tr>
<tr>
<td>Core Inflation</td>
<td>2.36</td>
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<td>3.81</td>
<td>3.10</td>
<td>2.72</td>
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Conclusions

- “All models are wrong, some are useful”
- “The model does not forecast, economists do”