Forecasting and Monetary Policy Analysis in Emerging Economies: The case of India

(preliminary)

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Outline of Presentation

- Introduction on FPAS model
- Simple output gap model for India
- Data and calibration
- Interpreting the results
  - Impulse Response Functions
  - Historical Decomposition
  - Forecasting
- Extensions/Conclusion
**Forecasting and Policy Analysis System (FPAS) models**

- **What are the different forecasting models – VAR, DSGE, FPAS…**
  - VAR, VECM etc for short term forecasting, FPAS for medium term forecasting.
  - Convergence between empirically motivated IS/LM models and DSGE model that takes into account expectation and are micro-founded.

- **What is a FPAS model?**
  - A structural model as each of its equations has an economic interpretation
  - New Keynesian emphasis on nominal and real rigidities and a role of aggregate demand in output determination.

- **How and where are they used?**
  - Useful where fundamental role of monetary policy is to provide anchor to inflation and inflation expectation.

- **Advantages of using FPAS model.**
  - Medium term forecasting
  - Scenario analysis
Structural model for India

The model has 4 main features (behavioral equations)

- Aggregate demand side (IS curve)
- Supply side (Phillips curve)
- Monetary policy (Taylor rule)
- Exchange rate (UIP condition)
Aggregate Demand (IS Curve)

- Describes the behavior of aggregate demand in India.
- Output gap depends on
  - Own lagged value/past level
  - Real monetary conditions
    - Real exchange rate gap
    - Real interest rate gap
  - Expected output gap
  - Foreign output gap
  - Shock

Forward looking Monetary Policy (Taylor rule)

- Describes behavior of the central bank
- The central bank reacts ...
  - When expected inflation deviate from price objective
  - While taking into account real economic activity
- Or does not react : policy shock
 Aggregate supply (Phillips Curve)
  - Describes the supply side of Indian economy.
  - Inflation depends on
    - Own lagged value/past level
    - Inflation expectation
    - Real Marginal cost
      - Real exchange rate gap
      - Output gap
    - Shock

 Exchange rate (UIP)
  - Relates domestic and foreign interest rate with expected change in exchange rate.
  - Exchange rate depends on
    - Domestic interest rate
    - Foreign interest rate
    - Premium
    - PPP condition
    - shock
**FPAS: Schematic Transmission Mechanism**

- **Financial shocks:**
  - Foreign interest rates
  - Portfolio changes

- **Demand shocks:**
  - Foreign demand
  - Fiscal policy

- **Inflation shocks:**
  - Indirect taxes
  - Energy prices
  - Food prices

**Source:** Doughlas Laxton (2009)
Data

- Inflation: WPI indices
- Interest rate: 91 days T-bill rate
- Output: GDP at constant price (2004-05)
- Exchange rate: INR/USD
- Foreign interest rate: Fed short term interest rate
- Foreign output: GDP at constant price
- Foreign Inflation: CPI indices


**Steady state values**

Calculated based on historical data and judgment about Indian economy.

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation target</td>
<td>$\pi_{ss}^T = 5.0$</td>
</tr>
<tr>
<td>Real interest rate trend</td>
<td>$r_{ss} = 2.0$</td>
</tr>
<tr>
<td>Real exchange rate trend</td>
<td>$\Delta z_{ss} = -2$</td>
</tr>
<tr>
<td>Output trend</td>
<td>$\Delta y_{ss} = 6.5$</td>
</tr>
<tr>
<td>Foreign real interest rate trend</td>
<td>$r_{ss}^* = 0.5$</td>
</tr>
<tr>
<td>Foreign inflation target</td>
<td>$\pi_{ss}^* = 2$</td>
</tr>
</tbody>
</table>
Model Equation and Calibration

- **Aggregate Demand (IS Curve)**
  \[
  \hat{y}_t = 0.75\hat{y}_{t-1} - 0.11\hat{r}_{t-1} + 0.15\hat{z}_{t-1} + 0.05\hat{y}_{t+1} + 0.12\hat{y}^F + \varepsilon_t^y
  \]

- **Aggregate supply (Phillips Curve)**
  \[
  \pi_t = 0.72\pi_{t-1} + 0.28E_t\pi_{t+1} + 0.25\hat{\phi}_t + \varepsilon_t^{\pi}
  \]
  \[
  \hat{\phi}_t = 0.21\hat{z}_t + 0.79\hat{y}_t
  \]

- **Forward looking Monetary Policy (Taylor rule)**
  \[
  i_t = 0.69i_{t-1} + 0.31(i^n_t + 1.23(E\Delta\pi_t) + 0.75\hat{y}_t) + \varepsilon^i_t
  \]
  \[
  i^n_t = r_t + \pi_{t+1}^{tar}
  \]
  \[
  E\Delta\pi_t = \pi_{t+4} - \pi_{t+4}^{tar}
  \]

- **Exchange rate (UIP condition)**
  \[
  s_t = 0.7s_{t+1} + 0.31s^e_t + (-i_t + i^*_t + prem_{t}) / 4 + \varepsilon_t^s
  \]
  \[
  s^e_t = s_{t-1} + 0.5(\Delta\bar{z} + \pi^{tar} - \pi^{us}_{t})
  \]
  \[
  z_t = s_t + cpi^*_t - wpi_t
  \]
Aggregate demand shock

• Giving 1% temporary shock in first quarter in output gap equation
Aggregate supply shock

- Giving 1% temporary shock in first quarter in Phillips equation
Historical decomposition of output gap and interest rate

Decomposition of Output Gap

Dashed line: actual minus shock
Solid line: actual

Decomposition of MP rate

Source: Author’s calculation
Shock decomposition of Inflation

Source: Author’s calculation
Explaining a historical episode

• 2009-2011 expansion

• During 2009-2010 period, actual monetary policy rate remained below the path implied by Taylor rule.

• This accommodative monetary policy in 2009-2010 contributed to high persistent inflation, and also pushed aggregate demand high.

• High aggregate demand because of government fiscal stimulus and accommodative monetary policy led inflation to rise during 2010-2011 period.
Current scenario

• Slowing down of investment in 2013 is causing output gap to fall further captured by exogenous shock to aggregate demand equation.

• Model suggests that RBI should tighten its monetary policy in response to high inflation expectations, which RBI did.
**Forecasting**

**Assumptions for baseline scenario:**
1. US Fed interest rate forecast: WEO, IMF
2. US Inflation forecast: WEO, IMF
3. US GDP forecast: WEO, IMF
4. Structural constraints

<table>
<thead>
<tr>
<th>Year</th>
<th>US Inflation</th>
<th>US - Short term interest rates</th>
<th>US- GDP growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>1.5</td>
<td>0.092</td>
<td>2.58</td>
</tr>
<tr>
<td>2015</td>
<td>1.77</td>
<td>0.16</td>
<td>3.35</td>
</tr>
<tr>
<td>2016</td>
<td>1.94</td>
<td>0.925</td>
<td>3.47</td>
</tr>
<tr>
<td>2017</td>
<td>2.1</td>
<td>2.07</td>
<td>3.36</td>
</tr>
</tbody>
</table>
Baseline model forecast

With 50% and 95% confidence interval

Source: Author’s calculation
Scenario 1: Aggressive tapering

• Aggressive scenario: Tapering starts earlier than expected, Fed short term interest rate become 1.42% by end of 2015.

<table>
<thead>
<tr>
<th>Year (average)</th>
<th>WEO projection (US short term interest rate)</th>
<th>Aggressive tapering (US short term interest rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>0.0925</td>
<td>0.0925</td>
</tr>
<tr>
<td>2015</td>
<td>0.16</td>
<td>0.925</td>
</tr>
<tr>
<td>2016</td>
<td>0.925</td>
<td>2.075</td>
</tr>
<tr>
<td>2017</td>
<td>2.075</td>
<td>3.27</td>
</tr>
</tbody>
</table>

Source: WEO, IMF/US FED
Scenario 1: Aggressive tapering

Source: Author’s calculation
**Scenario 2: Fiscal expansion in 2014-15**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Fiscal Policy</th>
<th>Magnitude (shock in aggregate demand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013Q4</td>
<td>Fiscal contraction</td>
<td>-0.4</td>
</tr>
<tr>
<td>2014Q1</td>
<td>Fiscal contraction</td>
<td>-0.6</td>
</tr>
<tr>
<td>2014Q2 (Election quarter)</td>
<td>Return to normalcy</td>
<td>0</td>
</tr>
<tr>
<td>2014Q3</td>
<td>Fiscal expansion</td>
<td>0.1</td>
</tr>
<tr>
<td>2014Q4</td>
<td>Fiscal expansion</td>
<td>0.3</td>
</tr>
<tr>
<td>2015Q1</td>
<td>Fiscal expansion</td>
<td>0.6</td>
</tr>
<tr>
<td>2015Q2</td>
<td>Fiscal expansion</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Scenario 2: Fiscal expansion in 2014-15

Source: Author’s calculation
Further work...

- Extending the model to incorporate disaggregated inflation (core, food and oil).
- Extending the model to incorporate CPI.
- Adding fiscal block in the model.
Thank you