Monetary Regime Switches in India: Policy or Structure?

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Outline

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Introduction: Objectives

- Context: Central banks have shifted from discretion to rules
- We investigate whether Indian monetary policy conduct can be described by a rule
- Essentially a revealed preference exercise, in the absence of an explicit rule
- Have to allow for some flexibility
  - Changes in policy conduct
  - Changes in economic structure
- Regime-switching model
Introduction: Literature

- Taylor (1993), basic idea of a rule paying attention to inflation and output gap
- Woodford (1999), added inertia
- Taylor (2001), added exchange rate
- Woodford (2001), provided formal normative foundations
- Aizenman et al. (2009), Mohanty and Klau (2005), Virmani (2004), monetary policy rules for emerging economies – no regime switching
India: Structure and Policy

- Changes in Indian economy (Shah, 2008)
  - Shift toward a more conventional business cycle, rather than agricultural shocks dominating economic fluctuations
  - Much greater openness, rather than an almost completely autarkic situation
  - Major reform of a tax system that was marked by highly distortionary direct and indirect taxes
  - Significant development of financial markets, rather than a situation of extreme financial repression
  - Movement away from a situation where fiscal deficits were automatically parked with public sector banks, or passively monetized by the RBI
India: Structure and Policy

- Late 1980s: beginnings of freeing up of interest rates
- Between 1991 and 1997
  - Lending rates of commercial banks deregulated
  - Issue of ad hoc treasury bills was phased out (thereby eliminating automatic monetization of the budget deficit)
  - Statutory Liquidity Ratio (SLR) and Cash Reserve Ratio (CRR) rates reduced
  - RBI reactivated the refinance rate or bank rate (now used as a signaling rate to reflect the monetary policy stance).
- In 1994, India switched over to a more market-determined exchange rate system and instituted current account convertibility.
India: Structure and Policy

- From 1999 onwards
  - RBI followed a multiple indicator approach to monetary policy
  - Relaxed various capital controls
  - Introduced a Liquidity Adjustment Facility
  - Engaged in sterilization to manage capital flows
“Thus the overall objective has had to be approached in a flexible and time variant manner with a continuous rebalancing of priority between growth and price stability, depending on underlying macroeconomic and financial conditions.”

Rakesh Mohan in a 2006 speech, as Deputy Governor of the Reserve Bank of India
Methodology: Taylor-type rules

- Woodford (2001) version, with exchange rate

\[ i_t = c + \alpha y_t + \beta \pi_t + \chi \Delta e_t + \delta i_{t-1} + \epsilon_t \]

- Regime switching version

\[ i_t = c + \alpha_{st} y_t + \beta_{st} \pi_t + \chi \Delta e_t + \delta i_{t-1} + \epsilon_t \]

- \( s = 1,2 : \) Hawk and Dove
Methodology: Markov Switching

- Two-state, first order Markov switching process
- Constant transition probabilities
  \[ p_{nm} = \Pr\{S_t = m|S_{t-1} = n\} \]
- Transition probability matrix
  \[ P = \begin{bmatrix} p_{11} & p_{21} \\ p_{12} & p_{22} \end{bmatrix} \]
Methodology: Markov Switching

- Joint distribution of $i_t$ and $S_t$ conditional on past information
  \[ f(i_t, S_t \mid \Psi_{t-1}) = f(i_t \mid S_t, \Psi_{t-1}) f(S_t \mid \Psi_{t-1}) \]

- Likelihood function
  \[ \ln L = \sum_{t=1}^{T} \ln \left\{ \sum_{m=1}^{2} f(i_t \mid S_t, \Psi_{t-1}) \Pr(S_t = m \mid \Psi_{t-1}) \right\} \]
Methodology: Markov Switching

- Weighting term \( \Pr(S_t = m \mid \Psi_{t-1}) \) is the probability of being in each regime and is also referred to as filtered probability.

- Updating of filtered probabilities

\[
\Pr(S_t = m \mid \Psi_{t-1}) = \sum_{n=1}^{2} \Pr(S_t = m \mid S_{t-1} = n) \Pr(S_{t-1} = n \mid \Psi_{t-1})
\]

\[
\Pr(S_t = m \mid \Psi_t) = \frac{\frac{1}{2} \sum_{m=1}^{2} f(i_t \mid S_t = m, \Psi_{t-1}) \Pr(S_t = m \mid \Psi_{t-1})}{\sum_{m=1}^{2} f(i_t \mid S_t = m, \Psi_{t-1}) \Pr(S_t = m \mid \Psi_{t-1})}
\]
Methodology: Data

- Quarterly data
- Sample period: 1987q1 to 2008q4
- Interest rate: overnight call/money market rate
- Inflation: annual percentage change in the Wholesale Price Index (WPI)
- Output: Index of Industrial Production (IIP), deseasonalized
- Potential output: Hodrick-Prescott (HP) filter applied to IIP
- Exchange rate: first difference of nominal rupee-dollar exchange rate
## Empirical Results: Preliminaries

### Table 1: Correlations

<table>
<thead>
<tr>
<th></th>
<th>1987q1-2008q4</th>
<th>1987q1-1995q4</th>
<th>1996q1-2008q4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output gap-Inflation</strong></td>
<td>-0.0246</td>
<td>-0.0373</td>
<td>0.0625</td>
</tr>
<tr>
<td><strong>Output gap-Interest rate</strong></td>
<td>0.3541***</td>
<td>0.5140***</td>
<td>0.3525**</td>
</tr>
<tr>
<td><strong>Inflation-Interest rate</strong></td>
<td>0.3530***</td>
<td>0.2821*</td>
<td>0.0329</td>
</tr>
</tbody>
</table>

Note: *** (**) (*) denotes significance at the 1%, 5% and 10% level, respectively.
Figure 1: Output Gap and Inflation
Figure 2: Interest Rate and Inflation
Figure 3: Interest Rate and Output Gap
Empirical Results: Constant Coefficients

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Constant-Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.5394*** (0.1858)</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.3298*** (0.1047)</td>
</tr>
<tr>
<td>$\chi$</td>
<td>3.1329 (12.5261)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.3961*** (0.0950)</td>
</tr>
<tr>
<td>Constant</td>
<td>3.4411*** (0.8300)</td>
</tr>
<tr>
<td>Adj. R Squared</td>
<td>0.3647</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Interpretation

- Some inertia – immediate response is about 60% of the total response

- Long run responses
  - Inflation 0.55
    - Coefficient is right sign, but not large enough to be consistent with a rule that stabilizes inflation
  - Output gap 0.89

- Exchange rate coefficient is not significant
### Empirical Results: Regime Switching

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Switching-Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_1$</td>
<td>0.1147 (0.1141)</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>0.3883*** (0.0577)</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.2346** (0.1021)</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>0.2325 (0.1502)</td>
</tr>
<tr>
<td>$\chi$</td>
<td>-1.7004 (4.3896)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.8144 *** (0.1023)</td>
</tr>
<tr>
<td>$p_{11}$</td>
<td>0.90</td>
</tr>
<tr>
<td>$p_{22}$</td>
<td>0.98</td>
</tr>
<tr>
<td>$\sigma_1^2$</td>
<td>0.1781*** (0.0485)</td>
</tr>
<tr>
<td>$\sigma_2^2$</td>
<td>20.0594*** (1.6616)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0000 (0.0005)</td>
</tr>
<tr>
<td>Expected Duration Regime 1</td>
<td>10.43</td>
</tr>
<tr>
<td>Expected Duration Regime 2</td>
<td>44.23</td>
</tr>
<tr>
<td>Final Log Likelihood</td>
<td>-222.0993</td>
</tr>
</tbody>
</table>
Interpretation

- Clearly two regimes – ‘Hawk’ and ‘Dove’
- High inertia – immediate response is less than 20% of the total response
- Long run responses
  - Inflation in State 1 (Hawk) 1.26
    - Coefficient is right sign, and large enough to be consistent with a rule that stabilizes inflation
  - Output gap in State 2 (Dove) 2.09
- Probabilities of staying in either state are high, but higher for state 2 – greater expected duration also
- Exchange rate coefficient is not significant
Figure 4: Estimated Regime Probabilities, Hawk Regime (state 1) and Dove Regime (state 2)
Figure 5: Probabilities of Hawk Regime (State 1) and Inflation Rate
Figure 6: Probabilities of Dove Regime (State 2) and Output Gap
External Factors

- Allowing for regime switching with respect to the exchange rate leads to unstable estimates.

- Using the change in foreign exchange reserves instead of the exchange rate also gives poor results.

- External factors seem to be less important, or at least not a stable influence on policy.
Primary question:

- Can Indian monetary policy, usually described by RBI policymakers as highly discretionary, be described by simple policy rules as has been the case for many central banks?

Estimate Taylor-type rules, but allowing for switches in the preferences of the central bank over time using a regime switching model.
Conclusions (2)

- Results suggest that
  - RBI policy may be characterized by Hawk and Dove regimes over the 1987-2008 period
  - Dove regime appears to dominate
  - Focus is on output gap in Dove regime
  - No evidence that external considerations systematically influenced RBI policy

- Could also be that policy is just highly discretionary, that output is important, and that occasional shocks sometimes produce specific responses
Back-up Slides
Plot of the density function in State 1 times the filtered probability of being in State 1
Plot of the density function in State 2 times the filtered probability of being in State 2

![Graph showing the density function over time]
Plot of the weighted average of the density function