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Monetary Regime Switches in India: Policy or Structure?

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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
- Owyang and Ramey (2004), Assenmacher-Wesche (2005) and Frommel et al. (2004), regime-switching models for monetary policy rules *for advanced economies*
- 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

India: Structure and Policy

- "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

$$i_t = c + \alpha y_t + \beta \pi_t + \chi \Delta e_t + \delta i_{t-1} + \varepsilon_t$$

- Regime switching version

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

- 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

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

$$\Pr(S_t = m \mid \Psi_t) = \frac{f(i_t \mid S_t = m, \Psi_{t-1}) \Pr(S_t = m \mid \Psi_{t-1})}{\sum_{m=1}^{2} f(i_t \mid S_t = m, \Psi_{t-1}) \Pr(S_t = m \mid \Psi_{t-1})}$$

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

	1987q1-2008q4	**1987q1-1995q4**	**1996q1-2008q4**
Output gap-Inflation	-0.0246	-0.0373	0.0625
Output gap-Interest rate	0.3541***	0.5140***	0.3525**
Inflation-Interest rate	0.3530***	0.2821*	0.0329

Note: *** (**) (*) denotes significance at the 1%, 5% and 10% level, respectively.

Figure 1: Output Gap and Inflation

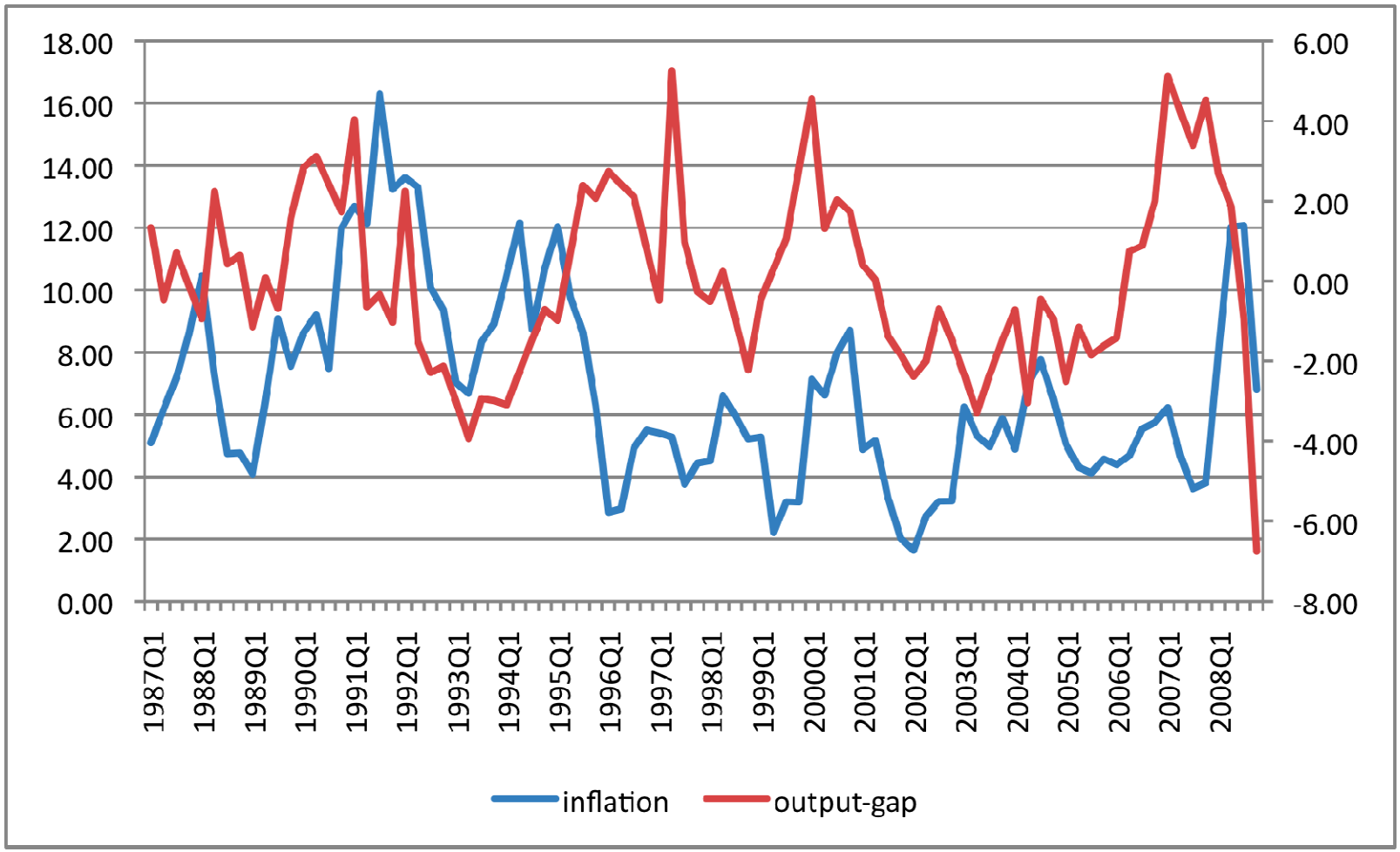


Figure 2: Interest Rate and Inflation

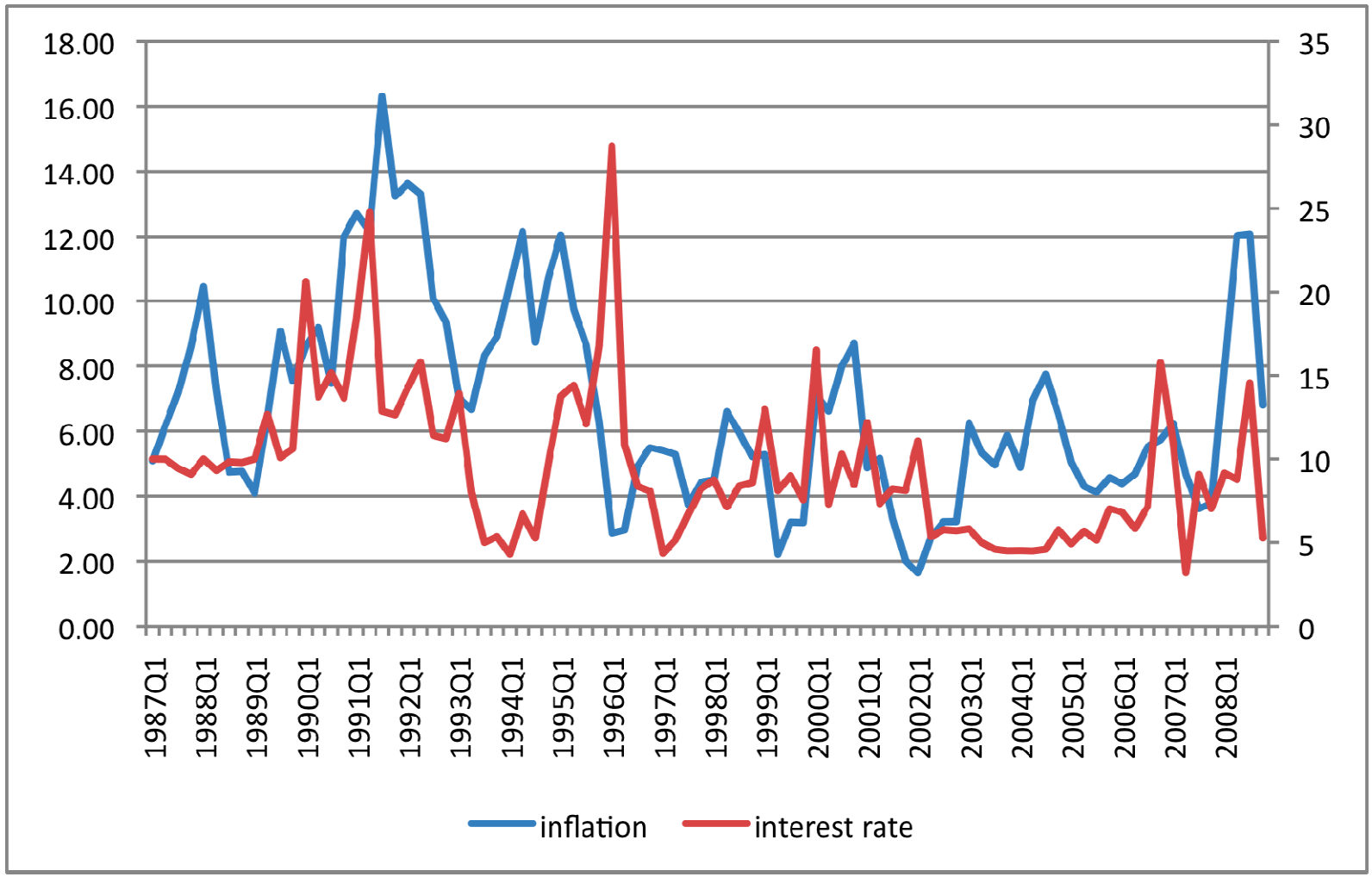
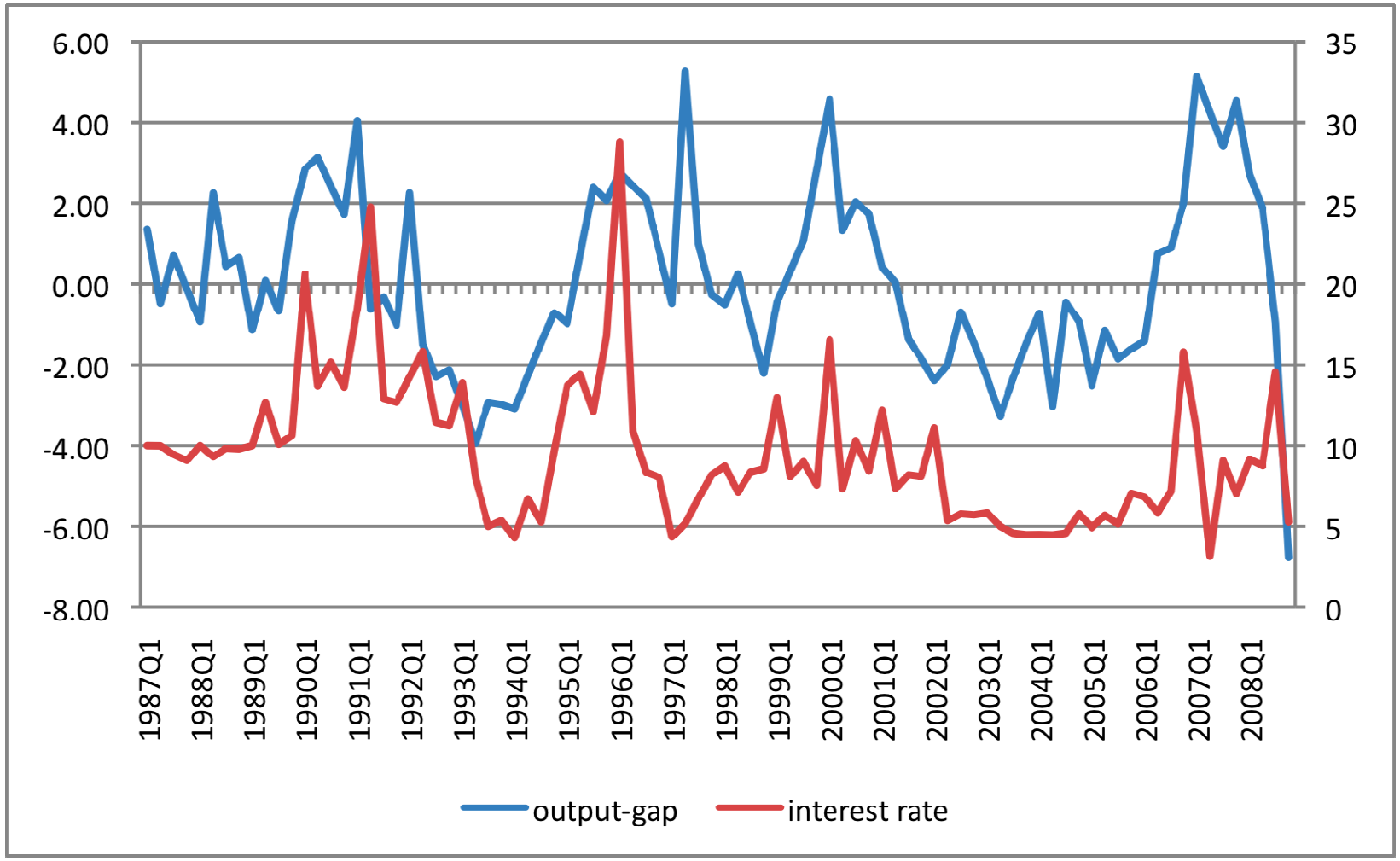


Figure 3: Interest Rate and Output Gap



Empirical Results: Constant Coefficients

Parameters	Constant-Coefficients
α	0.5394*** (0.1858)
β	0. 3298*** (0.1047)
χ	3.1329 (12.5261)
δ	0.3961*** (0.0950)
Constant	3.4411*** (0.8300)
Adj. R Squared	0.3647

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

Parameters	Switching-Coefficients
α_1	0.1147 (0.1141)
α_2	0.3883*** (0.0577)
β_1	0.2346** (0.1021)
β_2	0.2325 (0.1502)
χ	-1.7004 (4.3896)
δ	0.8144 *** (0.1023)
p_{11}	0.90
p_{22}	0.98
σ_1^2	0.1781*** (0.0485)
σ_2^2	20.0594*** (1.6616)
Constant	0.0000 (0.0005)
Expected Duration Regime 1	10.43
Expected Duration Regime 2	44.23
Final Log Likelihood	-222.0993

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)

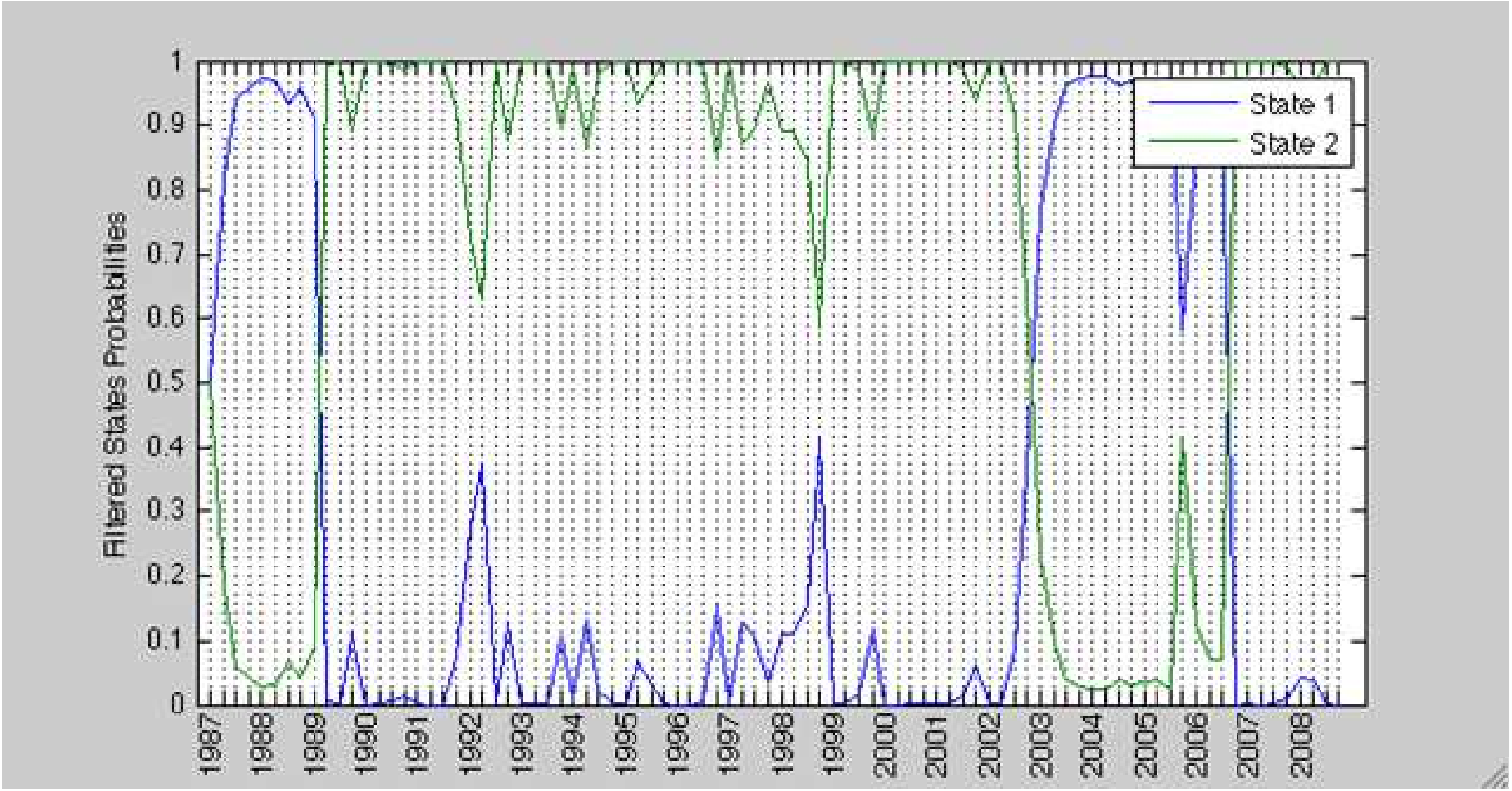


Figure 5: Probabilities of Hawk Regime (State 1) and Inflation Rate

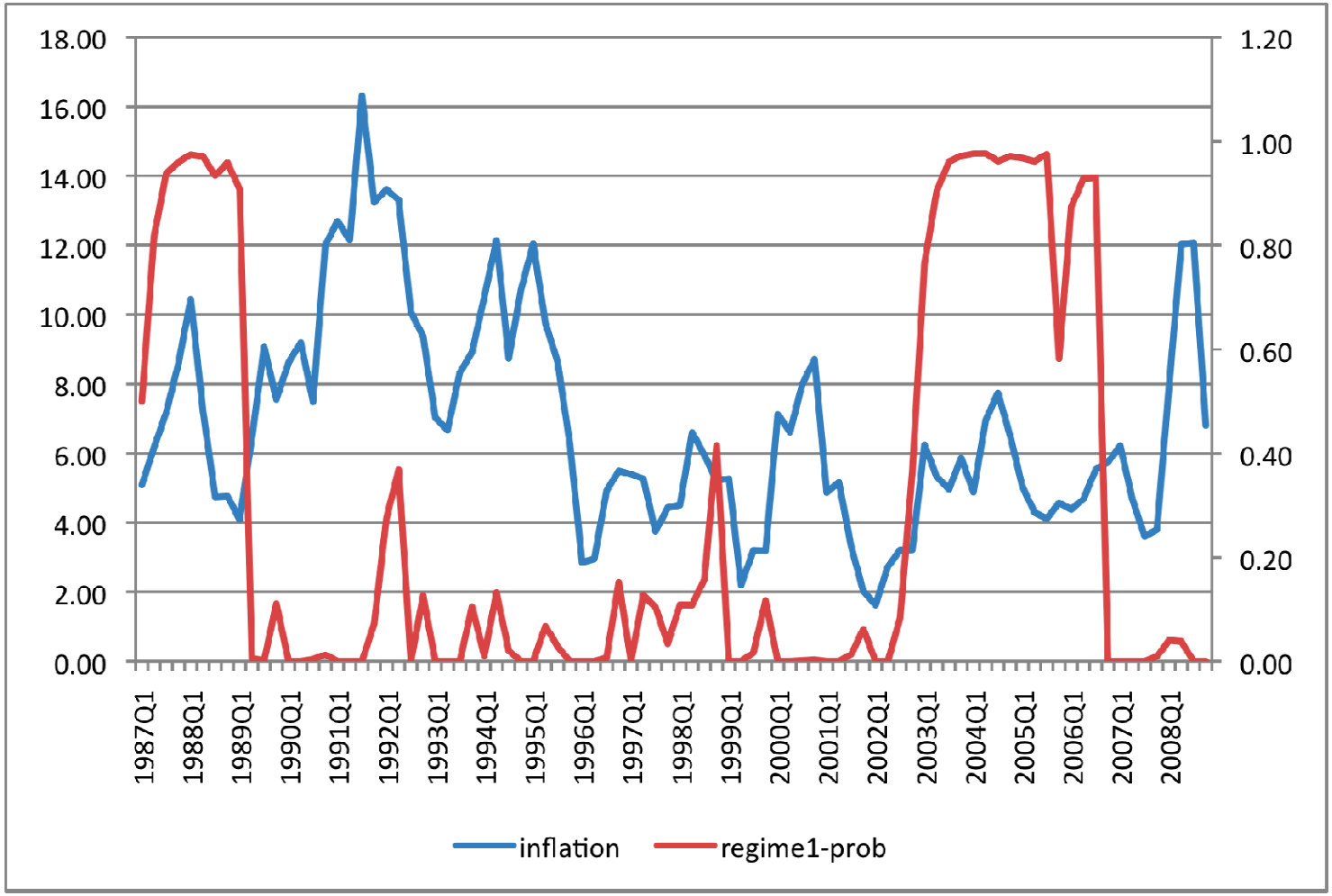
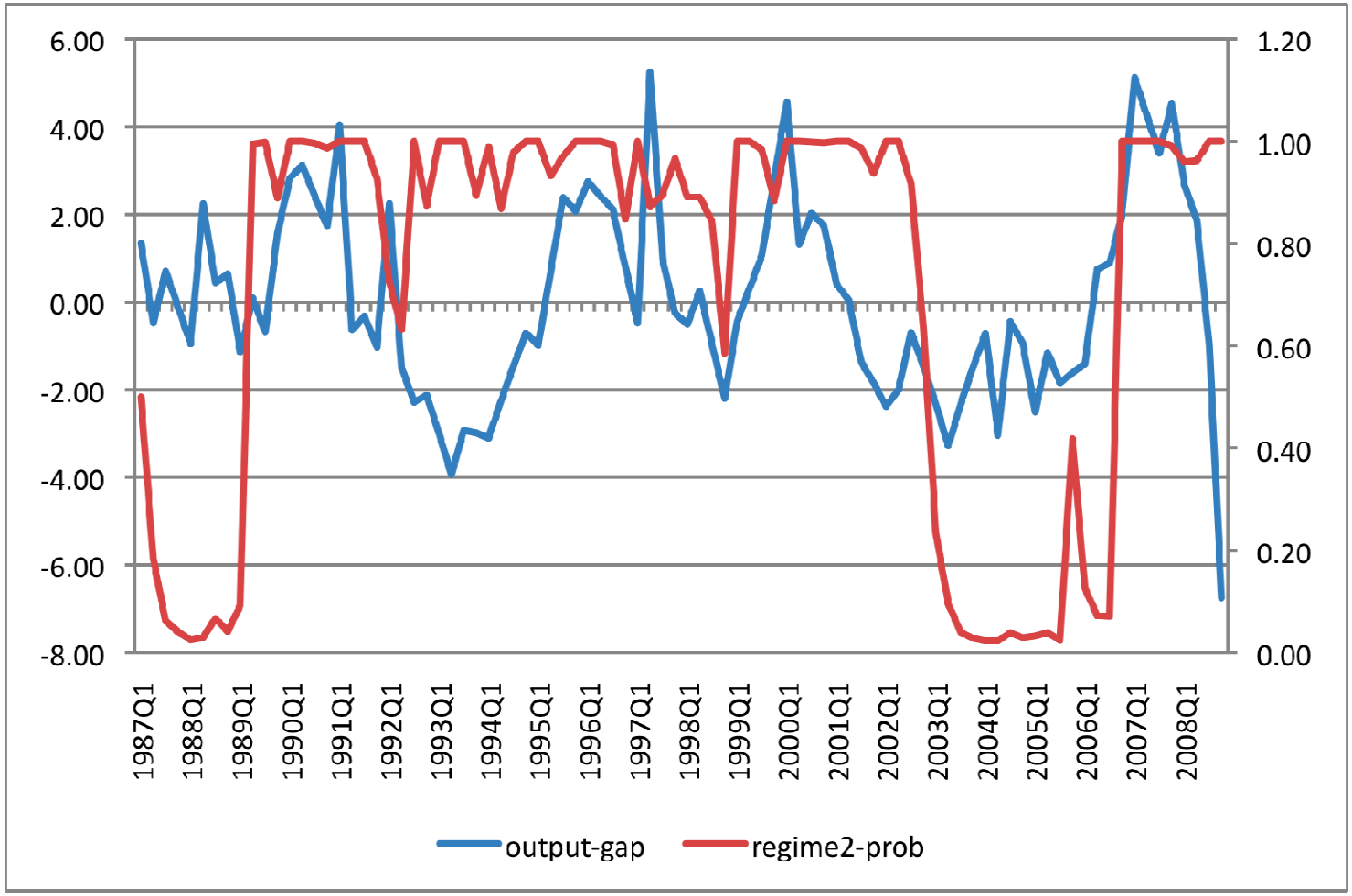


Figure 6: Probabilities of Dove Regime (State 2) and Output Gap



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

Conclusions (1)

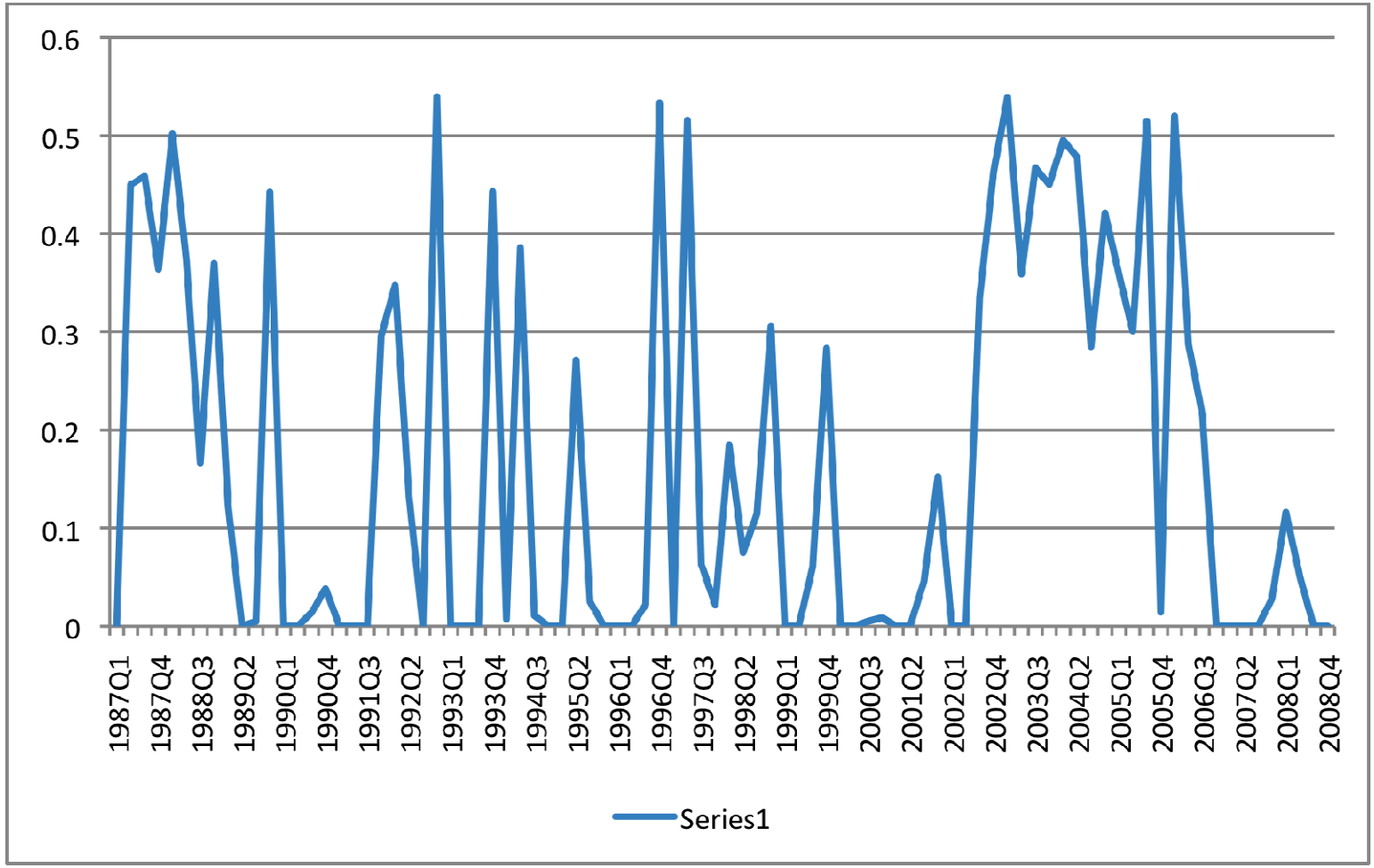
- Primary question:
  - Can Indian monetary policy, usually described by RBI policymakers as highly discretionary, be described by simple policy rules as has been the case for many central banks?
- Estimate Taylor-type rules, but allowing for switches in the preferences of the central bank over time using a regime switching model

Conclusions (2)

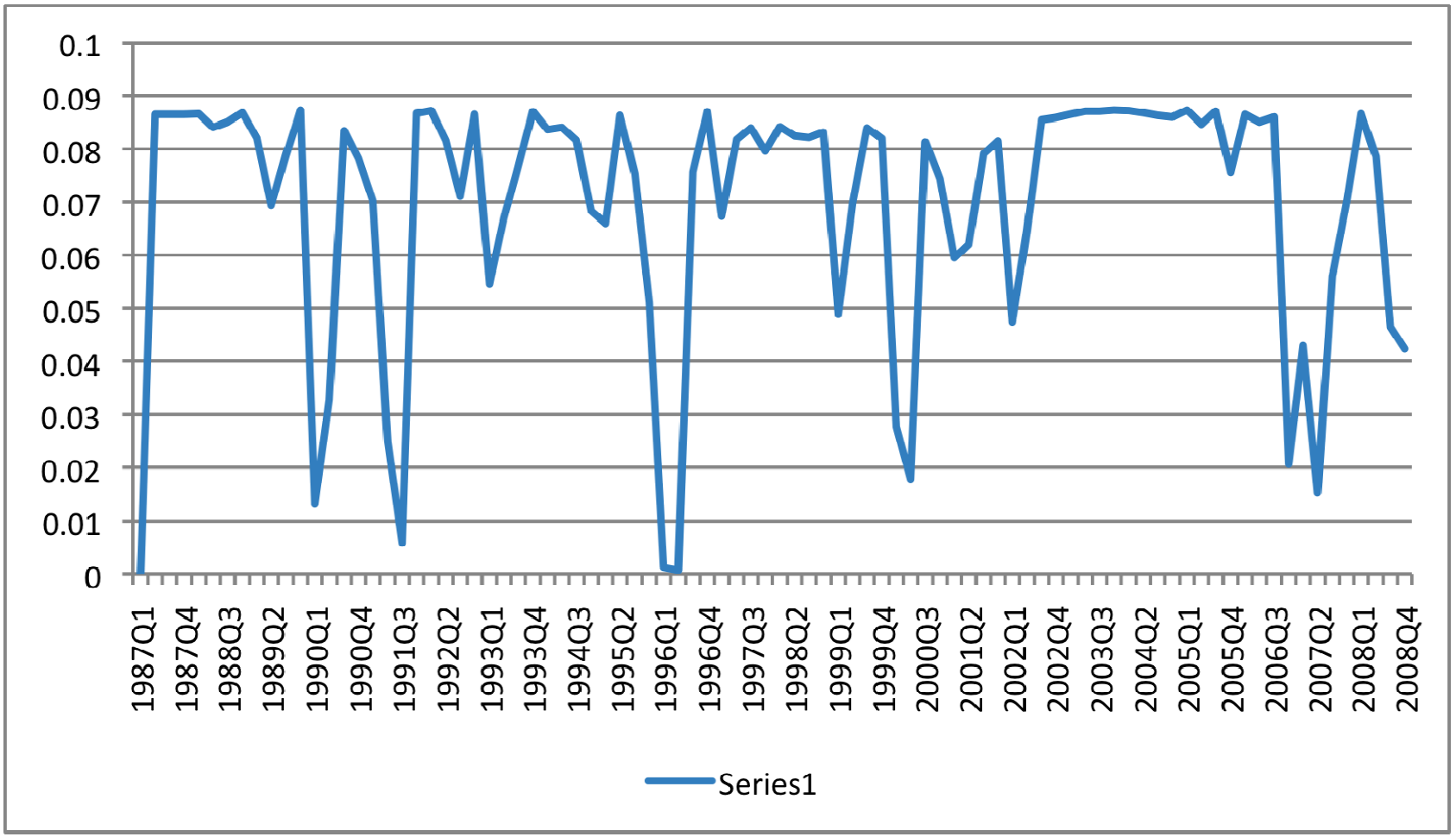
- Results suggest that
  - RBI policy may be characterized by Hawk and Dove regimes over the 1987-2008 period
  - Dove regime appears to dominate
  - Focus is on output gap in Dove regime
  - No evidence that external considerations systematically influenced RBI policy
- Could also be that policy is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



Plot of the weighted average of the density function