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)

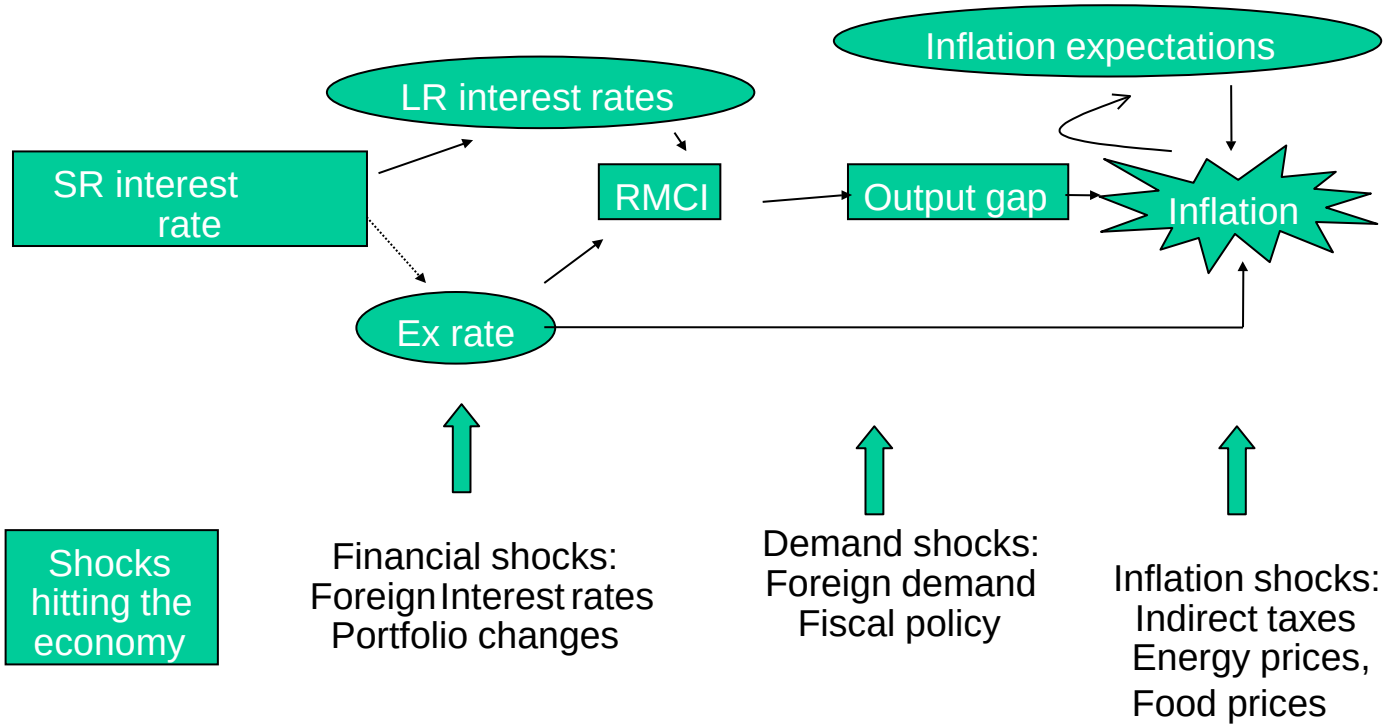
- ***Aggregate Demand (IS Curve)***
  - Describes the behavior of aggregate demand in India.
  - Output gap depends on
    - Own lagged value/past level
    - Real monetary conditions
      - Real exchange rate gap
      - Real interest rate gap
    - Expected output gap
    - Foreign output gap
  - 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



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.

Inflation target	$\pi_{ss}^{T} = 5.0$
Real interest rate trend	$\bar{r}_{ss} = 2.0$
Real exchange rate trend	$\Delta \bar{z}_{ss} = -2$
Output trend	$\Delta y_{ss} = 6.5$
Foreign real interest rate trend	$\bar{r}_{ss}^{*} = 0.5$
Foreign inflation target	$\pi_{ss}^{*} = 2$

Model Equation and Calibration

- ***Aggregate Demand (IS Curve)***

$$\hat{y}_t = 0.75\hat{y}_{t-1} - 0.11\hat{r}_{t-1} + 0.15\hat{z}_{t-1} + 0.05\hat{y}_{t+1} + 0.12\hat{y}^F + \varepsilon_t^{\hat{y}}$$

- ***Aggregate supply (Phillips Curve)***

$$\pi_t = 0.72\pi_{t-1} + 0.28E_t\pi_{t+1} + 0.25\hat{\varphi}_t + \varepsilon_t^{\pi}$$

$$\hat{\varphi}_t = 0.21\hat{z}_t + 0.79\,\hat{y}_t$$

- ***Forward looking Monetary Policy (Taylor rule)***

$$i_t = 0.69\,i_{t-1} + 0.31(i_t^n + 1.23(E\Delta\pi_t) + 0.75\,\hat{y}_t) + \varepsilon_t^i$$

$$i_t^n = \bar{r}_t + \pi_{t+1}^{tar} \qquad E\Delta\pi_t = \pi_{t+4} - \pi_{t+4}^{tar}$$

- ***Exchange rate (UIP condition)***

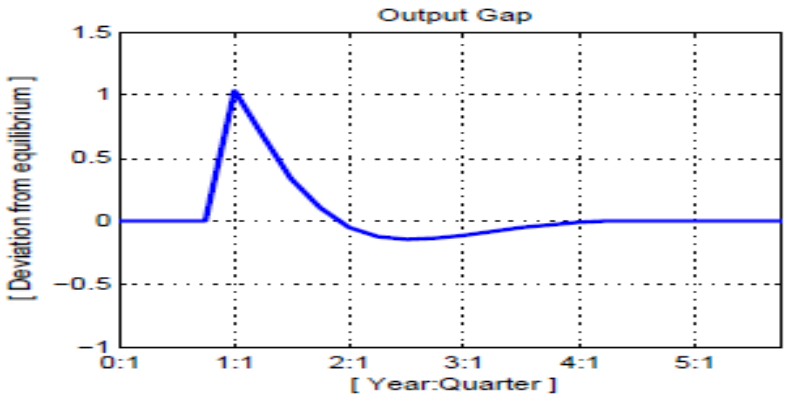
$$s_t = 0.7s_{t+1} + 0.31s_t^e + (-i_t + i_t^* + prem_{tt})/4 + \varepsilon_t^s$$

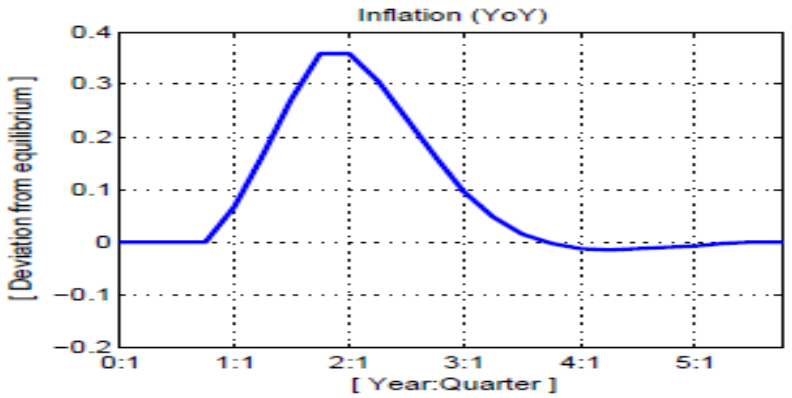
$$s_t^e = s_{t-1} + 0.5(\Delta\bar{z} + \pi^{tar} - \pi_{ss}^{us})$$

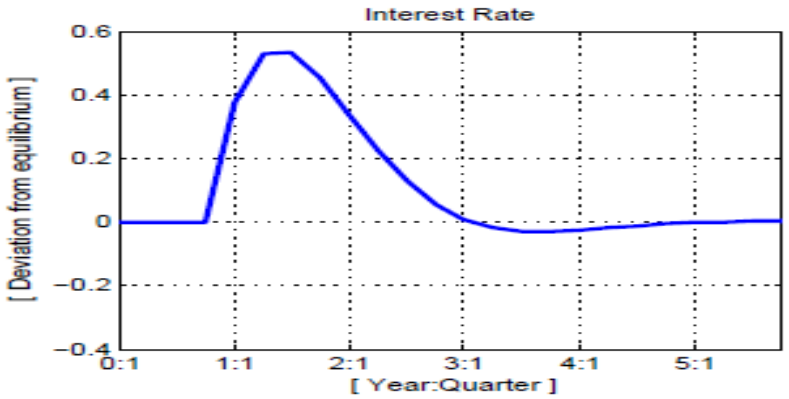
$$z_t = s_t + cpi_t^* - wpi_t$$

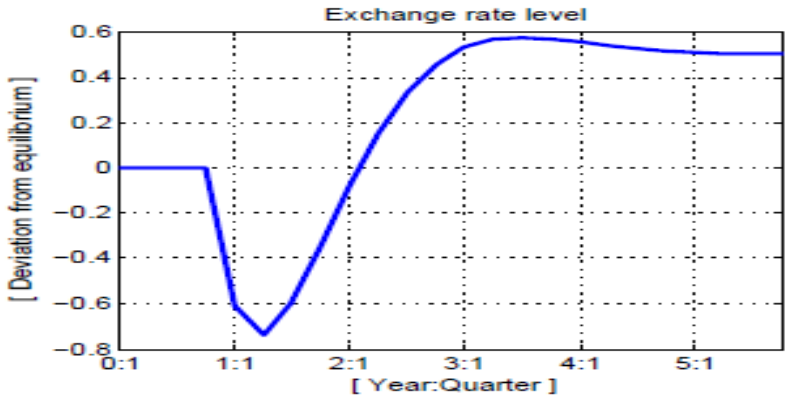
Aggregate demand shock

- Giving 1% temporary shock in first quarter in output gap equation





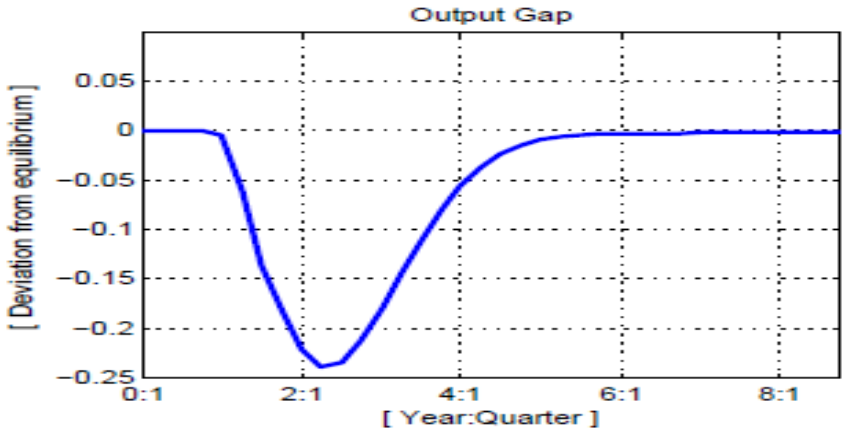


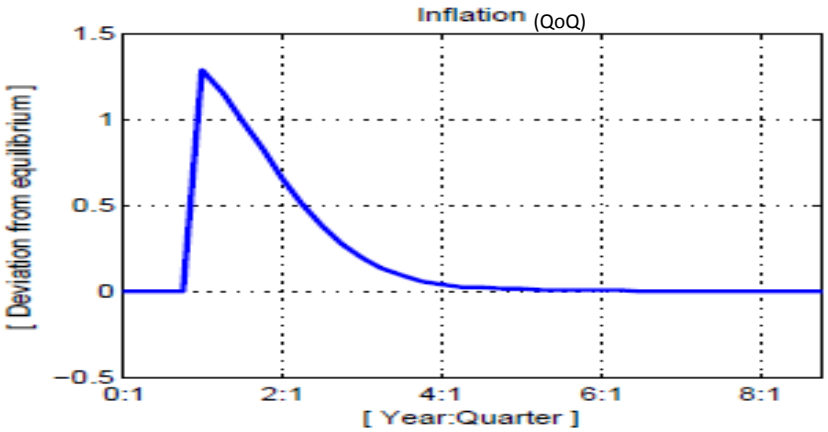


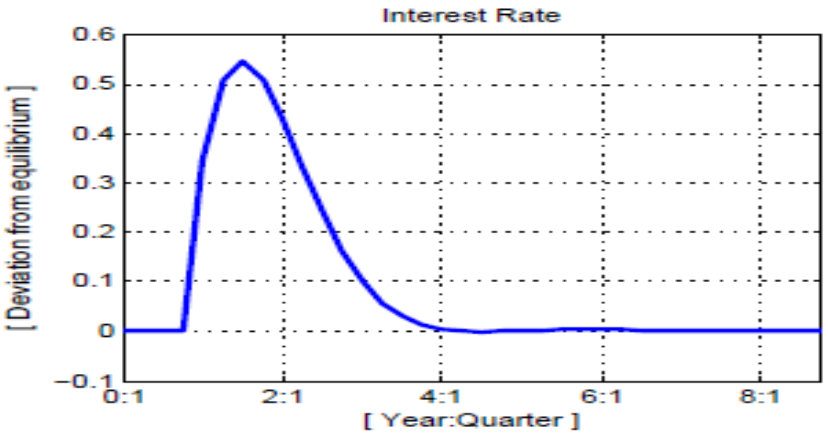
Source: Author's calculation

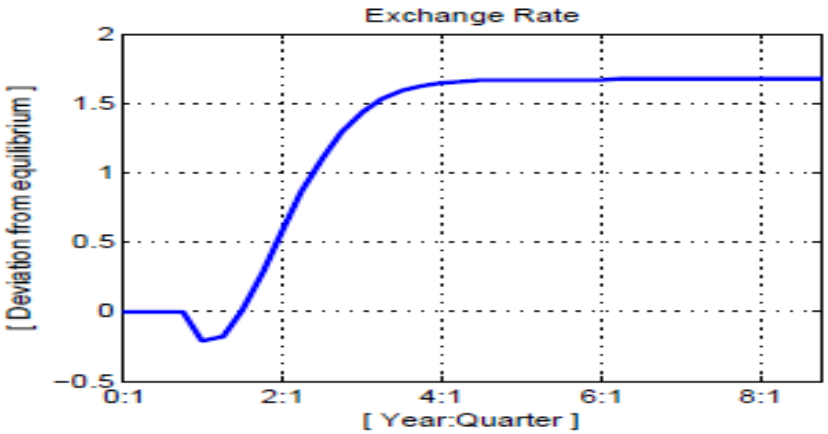
Aggregate supply shock

- Giving 1% temporary shock in first quarter in Phillips equation



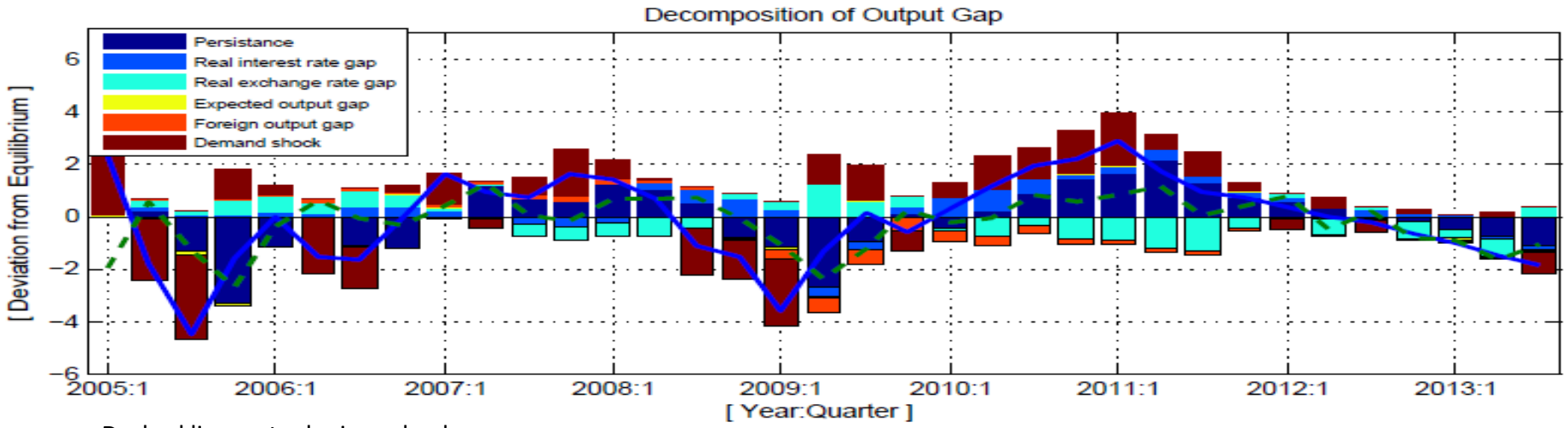




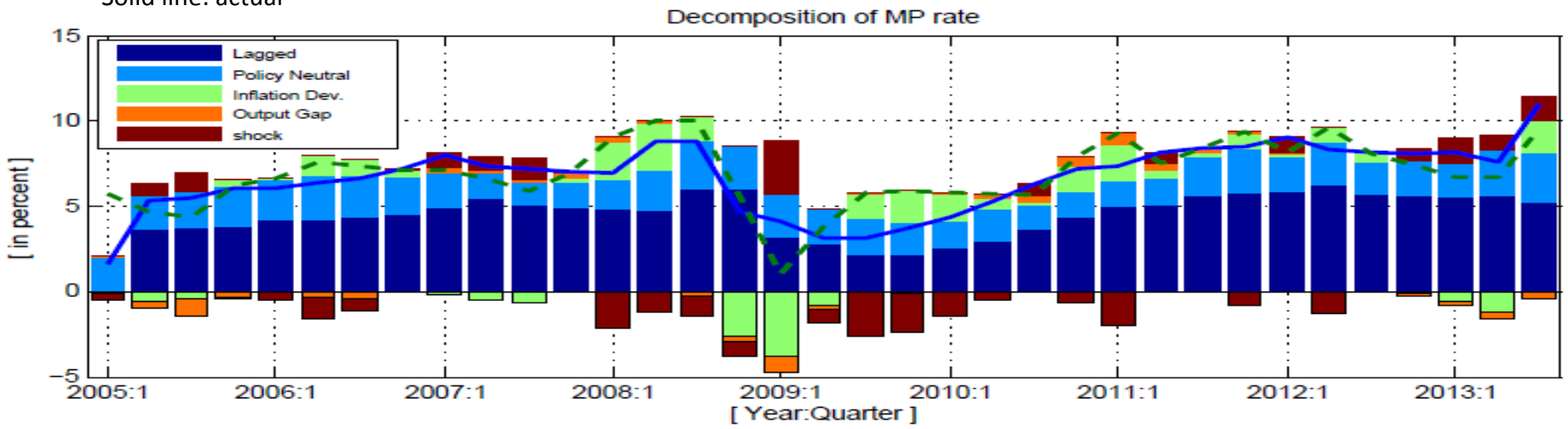


Source: Author's calculation

Historical decomposition of output gap and interest rate

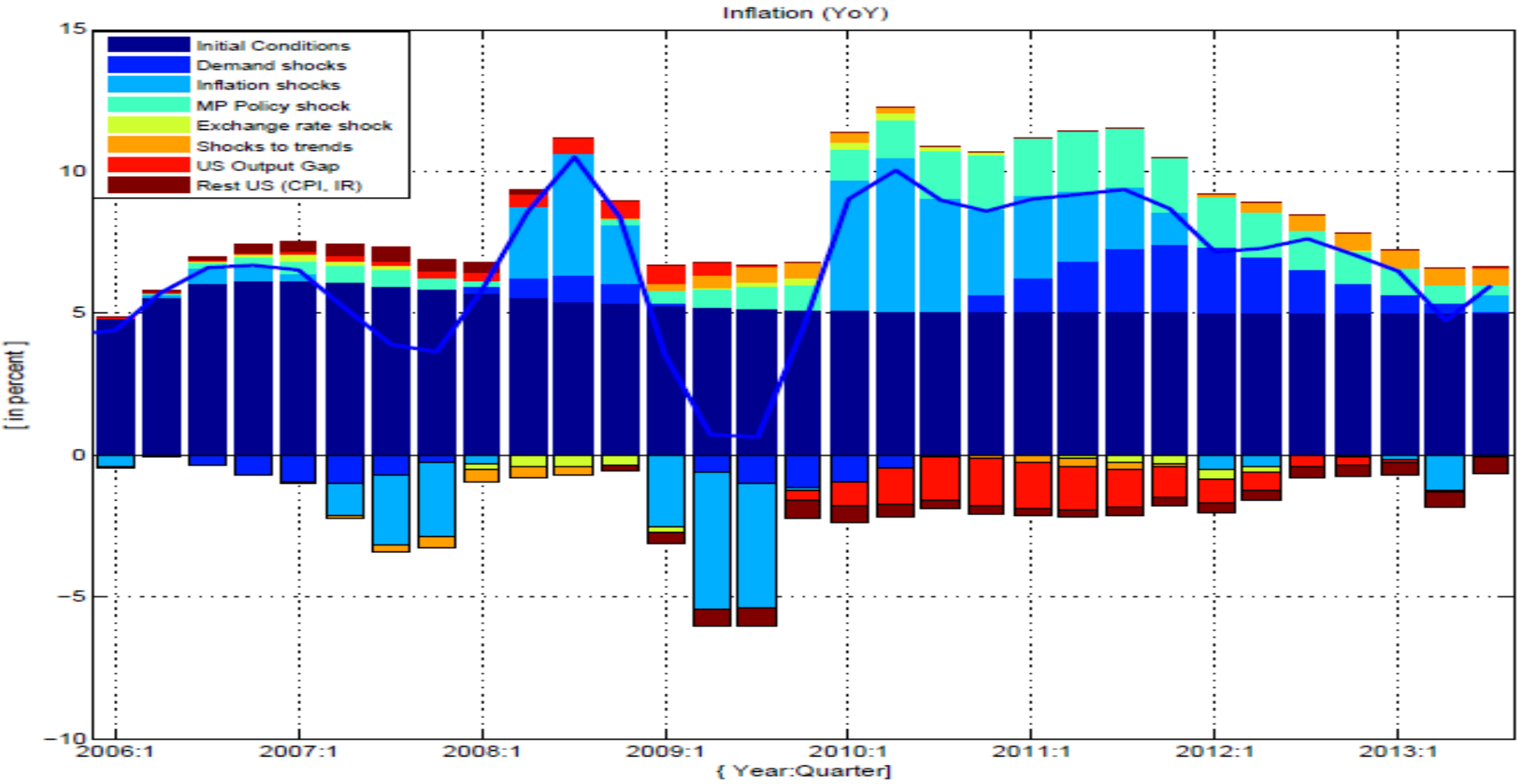


Dashed line: actual minus shock
Solid line: actual



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.

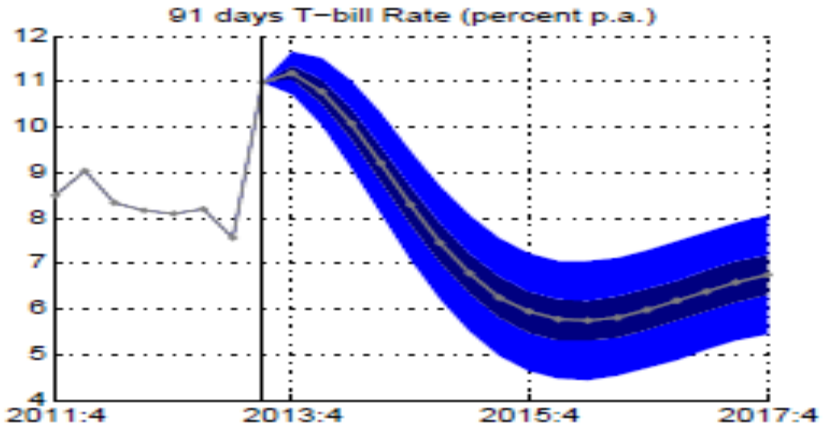
Forecasting

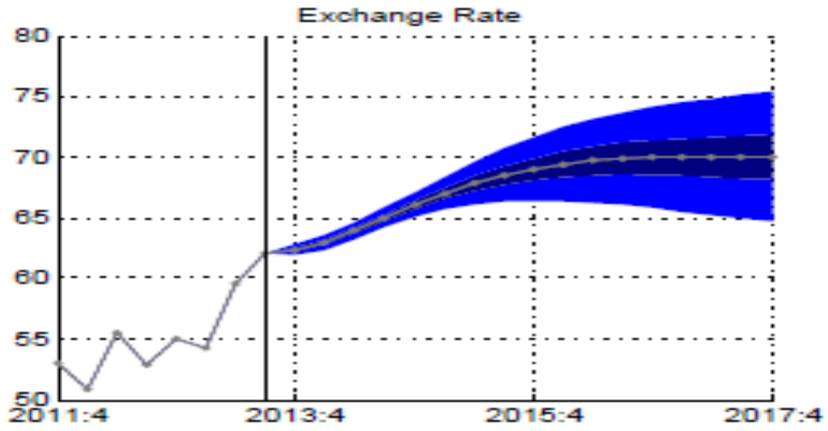
Assumptions for baseline scenario:

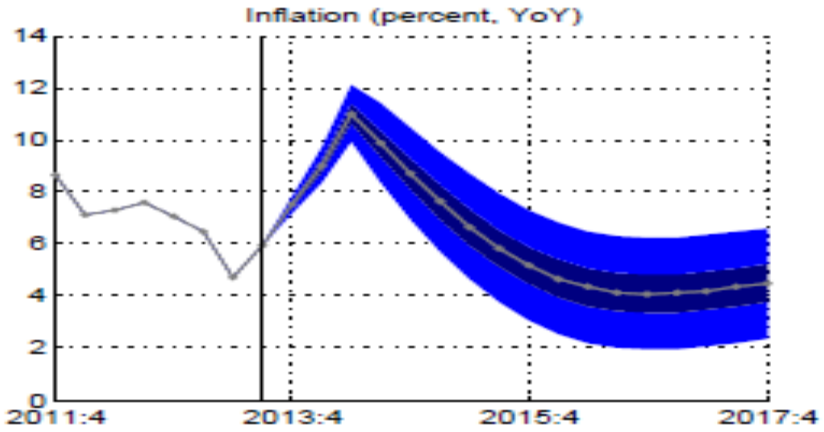
1. US Fed interest rate forecast : WEO, IMF
2. US Inflation forecast : WEO, IMF
3. US GDP forecast : WEO, IMF
4. Structural constraints

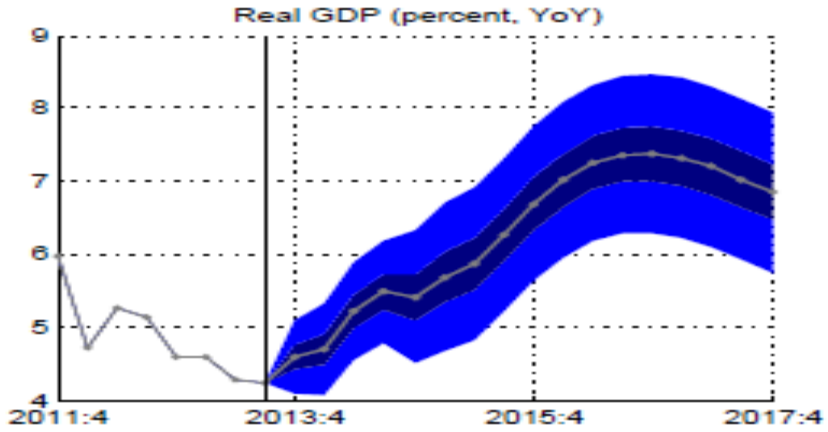
Year	US Inflation	US - Short term interest rates	US- GDP growth rate
2014	1.5	0.092	2.58
2015	1.77	0.16	3.35
2016	1.94	0.925	3.47
2017	2.1	2.07	3.36

Baseline model forecast







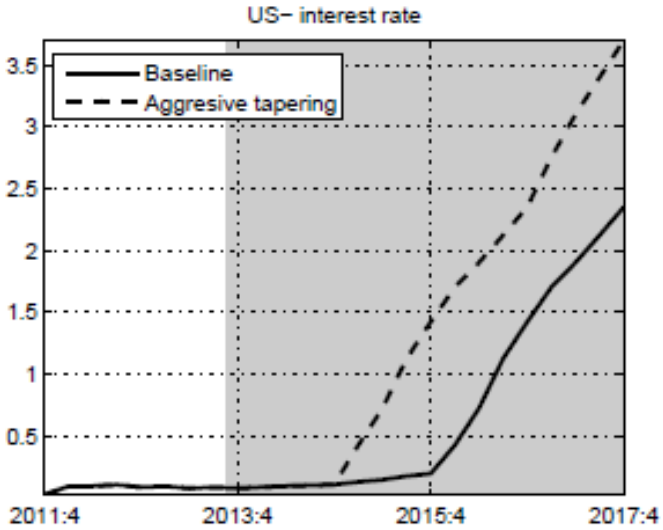


With 50% and 95% confidence interval

Source: Author's calculation

Scenario 1: Aggressive tapering

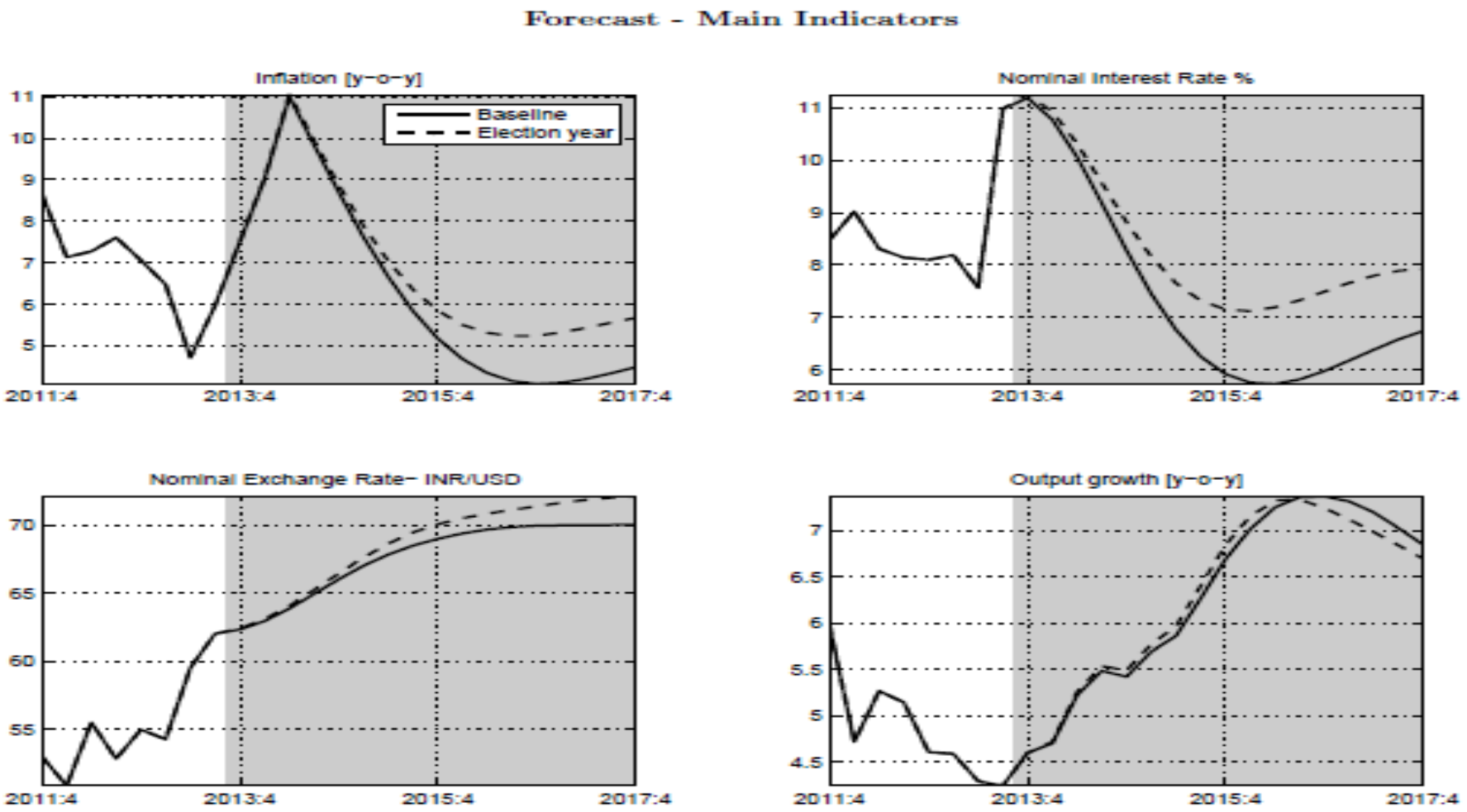
- Aggressive scenario: Tapering starts earlier than expected, Fed short term interest rate become 1.42% by end of 2015.



Year (average)	WEO projection (US short term interest rate)	Aggressive tapering (US short term interest rate)
2014	0.0925	0.0925
2015	0.16	0.925
2016	0.925	2.075
2017	2.075	3.27

Source: WEO, IMF/US FED

Scenario 1: Aggressive tapering

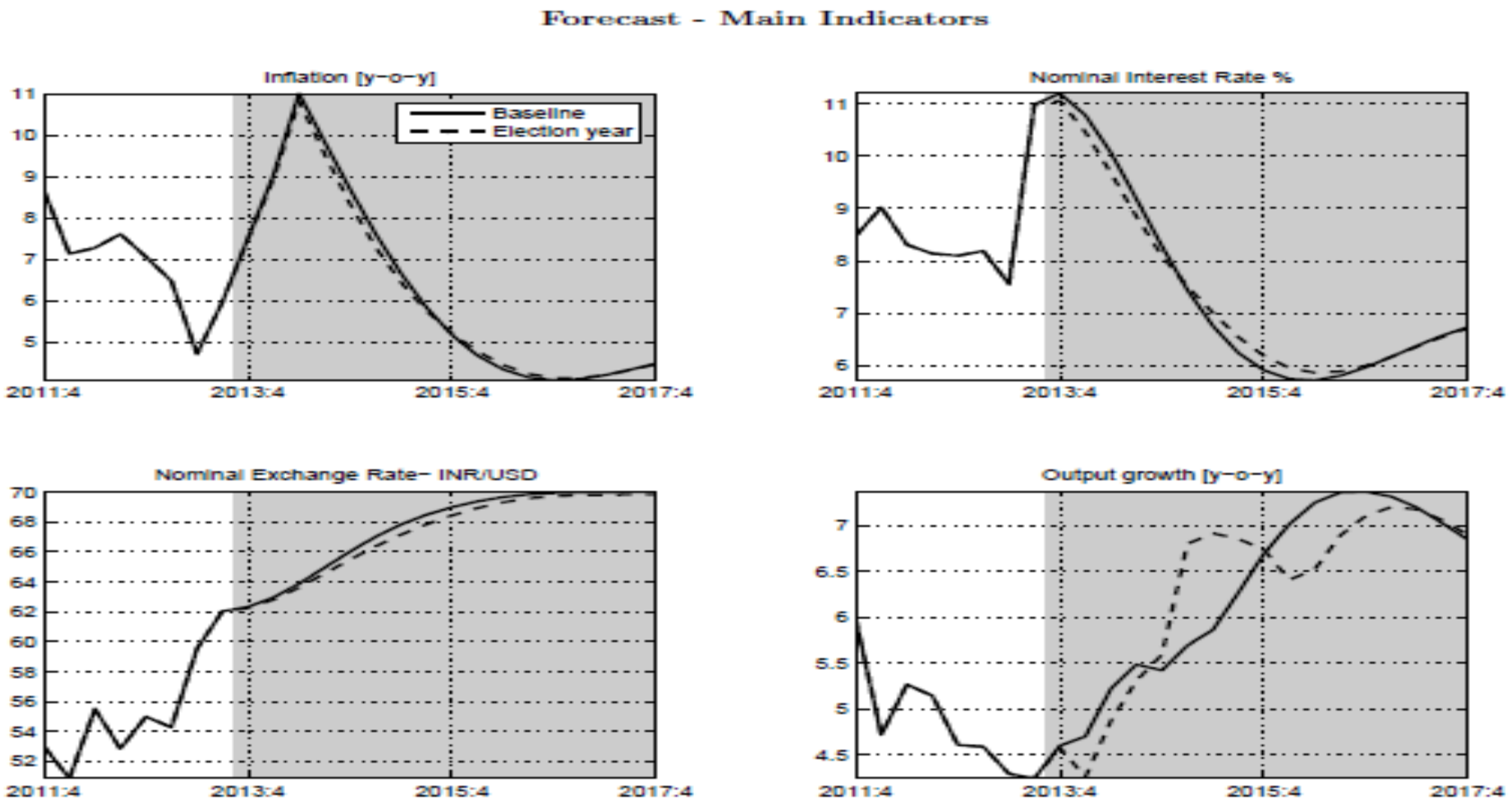


Source: Author's calculation

Scenario 2: Fiscal expansion in 2014-15

Quarter	Fiscal Policy	Magnitude (shock in aggregate demand)
2013Q4	Fiscal contraction	-0.4
2014Q1	Fiscal contraction	-0.6
2014Q2 (Election quarter)	Return to normalcy	0
2014Q3	Fiscal expansion	0.1
2014Q4	Fiscal expansion	0.3
2015Q1	Fiscal expansion	0.6
2015Q2	Fiscal expansion	0.3

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