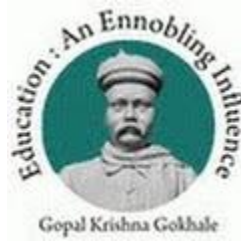


MONETARY POLICY AND INFLATION TARGETING IN INDIA

A THESIS  
SUBMITTED IN FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE  
OF  
DOCTOR OF PHILOSOPHY  
IN  
ECONOMICS  
AT



GOKHALE INSTITUTE OF POLITICS AND ECONOMICS

By

Tarun Khandelwal

*Under Guidance of*

*Prof. K.S. Hari*

&

*Prof. Ranjan Kumar Dash*

GOKHALE INSTITUTE OF POLITICS AND ECONOMICS

2025

## MONETARY POLICY AND INFLATION TARGETING IN INDIA

Number of Volumes	Thesis (One)
Name of the Student	Tarun Khandelwal
Name of the Principal Supervisor	Prof. K.S. Hari
Name of the Co-Supervisor	Prof. Ranjan Kumar Dash
Degree	Doctor of Philosophy in Economics
Name of University	Gokhale Institute of Politics and Economics
Month and Year of Submission	October, 2025

## Declaration

I Tarun Khandelwal, hereby declare that this thesis on the topic entitled "*Monetary Policy and Inflation Targeting in India*" is submitted for the award of Degree of Doctor of Philosophy in Economics to the Gokhale Institute of Politics and Economics, Pune 411004.

It is an original contribution and has been completed during my tenure as a research scholar at Gokhale Institute of Politics and Economics, Pune.

This thesis has not been submitted by me elsewhere for the award of any degree or diploma-part or full. The information gathered by me elsewhere for the thesis is original, true and factual. Such material as has been obtained from other sources duly acknowledged in the thesis. I hereby request, to consider the thesis for the award of the degree of 'Doctor of Philosophy'.

Tarun Khandelwal

Place: Pune

Date:

## Certificate

CERTIFIED that the work incorporated in this thesis entitled "Monetary Policy and Inflation Targeting in India" submitted by Tarun Khandelwal was carried out by candidate under my supervision. It is an original contribution and has not been submitted elsewhere for the award of any other degree. Such material as has been obtained from other source has been duly acknowledged in this thesis. I recommend that the thesis should be considered for the award of the degree of 'Doctor of Philosophy'.

Prof. Rajan Kumar Dash

Symbiosis School of Economics.

Symbiosis International (Deemed  
University)

Pune- 411004

Prof. K.S. Hari

Gokhale Institute of Politics and  
Economics,

Pune- 411004

Place: Pune

Date:

## Abstract

Inflation control has been one of the most crucial tools for macroeconomic management, serving as a key indicator of economic stability. For India, controlling inflation has been a recurring policy objective of the Reserve Bank of India (RBI). Since the liberalization of the Indian economy in 1991, there have been several shifts in the monetary policy framework, from monetary targeting to the Multiple Indicator Approach (MIA) in 1998, to preconditions for Flexible Inflation Targeting in 2014, and finally to Flexible Inflation Targeting (FIT) in 2016. These shifts reflect the evolution of the monetary policy architecture, the financial sector, and, importantly, the nexus between growth and inflation for the country.

One of the ways to predict the central bank reaction function has often been modelled through the Taylor Rule, the Augmented Taylor Rule and lately, the Taylor-type rules. Since liberalization, the Indian economy has undergone various economic crises, structural changes, and, most importantly, phases where the RBI had to adjust its priorities between growth and inflation control. Similarly, the credibility of the central bank can be defined as the degree to which inflation remains within the limits of the announced targets. Inconsistencies between policy announcements and outcomes may erode credibility, amplifying inflation persistence, volatility and reduction in growth.

Moreover, an enduring concern in developing economies is the existence of a threshold level of inflation. The existence of a nonlinear relationship between growth and inflation further complicates the RBI's job. There has been some empirical literature that has provided the estimates for the threshold level of inflation; however, evidence has remained fragmented. This is primarily due to the shift in the nominal anchor of inflation from WPI to CPI, as well as methodological limitations. This study, therefore, attempts to integrate these three interrelated dimensions of monetary policy by examining regime changes in the RBI, credibility shifts in the RBI, and ultimately estimating the threshold level of inflation for India.

The objectives of the study are to enhance understanding of inflation dynamics in India and the RBI's policy behaviour. The first research question for the study is to test the changes in the RBI regimes when the RBI transitioned from the pre-conditions to FIT and from FIT to 2020. Secondly,

we test for changes in the credibility from 2006 to 2020 using monthly data. To estimate regime changes and credibility switches, the study employs the Markov Switching Vector Autoregression (MS-VAR) model, which is suitable for capturing non-linearity in the reaction function. Further, the study estimates the threshold level of inflation for India using quarterly data from 1997 to 2022, employing the Logistic Smooth Transition Autoregressive (LSTAR) and Threshold Vector Autoregression (TVAR) models, given their implications for growth dynamics. Based on the estimation, the study compared the current inflation target ( $4\pm 2$  per cent) with the threshold inflation limits to check for consistency. With these objectives, the study aims to reconcile the theoretical debate between inflation control and growth promotion, providing empirical clarity for future policy formulation in India.

The results of the study provide us with a rich narrative of the transformation of the monetary policy during the last two decades. For the first research question, the study found only one regime to be stable and hence concluded that there was no regime change when examining the periods of Pre-FIT and FIT. Between 2013 and 2020, the RBI's primary focus remained on controlling inflation. The empirical evidence showed that growth did not play any significant role in interest setting. Regarding credibility, the study found that there is a credibility switch twice between 2006 and 2020. The first switch happened during the 2007 crisis, from high credibility to low credibility, and lasted till 2013. The second shift in credibility happened in 2014, when the transition condition for FIT was established. The findings have two major implications for the economy: (1) improving the effectiveness of monetary policy by enhancing credibility, (2) achieving higher growth. However, the data indicated a slowdown in economic growth during the high credible regime. The slowdown was in contrast to expectations, motivating further understanding of the dynamic relationship between inflation and growth. Therefore, the study next estimated the threshold level of inflation from 1997 to 2022. The estimated threshold level of inflation derived from TVAR and LSTAR was found to be a little more than 7 per cent, which is beyond the bandwidth of the current FIT period. The current FIT has an upper cap of 6 per cent inflation rate; however, during the study period, we found the inflation to be close to 5 per cent. This shows that inflation was significantly lower than the threshold level. According to the theoretical literature, economic growth may not respond to changes in the interest rate if the inflation rate is significantly far from the threshold

level. This has also been the case, as we find that interest rates have no significant impact on growth.

The findings of this study have major implications for the monetary policy framework. The current monetary policy framework has been adopted with a primary focus on inflation control and a secondary aim of optimizing economic growth. However, the empirical evidence suggests that the RBI has been successful in controlling inflation without optimizing growth. The growth optimization has not occurred, despite inflation remaining within the target bandwidth. Secondly, the study did not find any positive impact of credibility on economic growth despite the improvement in credibility. Furthermore, the average inflation during the period has also remained under 5 per cent within the band. This suggests there is further scope for enhancing the inflation bandwidth to maximize growth performance.

Despite these findings, the study is not without limitations. First, the study relies on the IIP series for growth due to the unavailability of monthly GDP data. Secondly, the study relies on the CPI as a proxy for inflation, which may not accurately reflect the true inflation level, as it is based on the 2012 basket of goods. Furthermore, the study has not included fiscal variables, despite their importance in monetary policy and economic growth. During the study period, various fiscal policy reforms were implemented, including the introduction of GST and demonetization, which may have shaped the monetary policy framework. These factors are beyond the scope of this study.

## Acknowledgement

The completion of this thesis marks the culmination of a journey that has been both intellectually stimulating and personally transformative. It would not have been possible without the constant guidance, encouragement, and faith of several remarkable individuals to whom I owe my deepest gratitude.

At the outset, I would like to express my heartfelt gratitude to my supervisor, Prof. K. S. Hari, and my co-supervisor, Prof. Ranjan Kumar Dash. Their unwavering support, patient guidance, and trust in my ability to think independently have been the cornerstone of this work. They gave me the freedom to explore my ideas, to make mistakes, and to learn from them - a freedom that shaped this thesis and, more importantly, my approach to research. Their insightful suggestions and constant encouragement helped me to translate abstract thoughts into meaningful analysis, and for that, I remain profoundly grateful.

My deepest gratitude goes to my parents, Mr. Dinesh Kumar Khandelwal and Mrs. Lakshmi Khandelwal, who have been my first teachers in life. Their love, sacrifices, and belief in the power of education have been the guiding light throughout this journey. I owe an equal debt of gratitude to my sister, Dr. Kriti Khandelwal, whose wisdom, warmth, and encouragement have been an unfailing source of strength. My heartfelt thanks also go to my wife, Mrs. Eti Khandelwal, for her patience, love, and unflinching support - for standing beside me through every late night, every draft, and every challenge along the way.

I wish to sincerely thank Dr. Pranav Raj, both as a teacher and as a friend, for his invaluable academic support during my coursework and for the many meaningful discussions that broadened my perspective. I also extend my gratitude to my dear friends, Dr. Varun Miglani and Dr. Bhupesh Chintamani, for their camaraderie, encouragement, and for reminding me that perseverance and laughter can coexist in research.

A special word of gratitude goes to Prof. Raaj Sah (Professor of Public Policy and Economics, Harris School of Public Policy, University of Chicago). His mentorship and thought-provoking conversations made a fundamental difference in the way I think about economic problems and

policy frameworks. I also wish to thank Dr. Viswanath Pingali (Indian Institute of Management Ahmedabad), whose lucid and inspiring teaching of econometrics not only made the subject accessible but also deepened my interest in nonlinear econometric analysis - a foundation that has enriched this research in many ways.

Finally, I extend my sincere appreciation to all those who have, directly or indirectly, contributed to this journey - through their insights, kindness, and encouragement. Each of you has left an indelible mark on this work and on me.

This thesis, though written in my name, is a reflection of the guidance, patience, and faith of everyone mentioned above - and to all of them, I remain forever indebted.

## Table of Contents

Declaration.....	iii
Certificate.....	iv
Abstract.....	v
Acknowledgement .....	viii
List of Tables .....	xiv
List of Figures.....	xv
List of Abbreviations .....	xvi
Chapter 1 Introduction .....	1
1.1 Background.....	1
1.2 Evolution of Monetary Policy in India .....	3
1.2.1 Phase -1 Reforms and shift towards Monetary Targeting (1985-1998) .....	4
1.2.2 Phase 2: The Multiple Indicator Approach (MIA) (1998-2013) .....	5
1.2.3 Phase 3: Preconditions Set for Inflation Targeting (2013-2016).....	5
1.2.4 Phase 4: Flexible Inflation Targeting (FIT) (2016-Present) .....	6
1.3 Central Bank Credibility.....	8
1.4 Threshold Level of Inflation .....	9
1.5 Research Questions.....	11
1.6 Objectives .....	11
1.7 Rationale of the Study.....	12
1.8 Data Sources .....	13
1.10 Thesis Outline .....	14

Chapter 2 Determinants of Monetary Policy .....	15
2.1 Introduction.....	15
2.2 Overview Monetary Policy Framework (Post-Reform Period).....	16
2.2.1 Monetary Targeting with Feedback (1991-1998).....	17
2.2.2 Multiple Indicator Approach (MIA) (1998-2016).....	17
2.2.3 Flexible Inflation Targeting (FIT) - (2016 Onwards).....	18
2.3 Review of Literature .....	18
2.3.1 Theoretical Outlook .....	18
2.3.2 Past Studies .....	19
2.4 Material & Methodology .....	21
2.4.1 Variables .....	21
2.4.2 Methodology .....	22
2.4.3 Model Specification.....	23
2.5 Results.....	24
2.5.1 Unit Root Test.....	24
2.5.2 Regime Switches.....	25
2.5.3 Major Determinants of Monetary Policy .....	26
2.5.4 Impulse Response Function (IRF) .....	27
2.5.5 Forecast Error Variance Decomposition.....	28
2.6 Summary.....	29
Chapter 3 Credibility Switching of Monetary Policy .....	31

3.1 Introduction.....	31
3.2 Literature review .....	33
3.3 Data and Methodology.....	34
3.3.1 Data .....	34
3.3.2 Model Specifications .....	35
3.3.3 Econometric Methodology.....	36
3.4 Results and Discussion .....	38
3.4.1 Preliminary Results.....	38
3.4.2 Unit root test .....	43
3.4.3 Regime Switches.....	44
3.4.4 Multivariate Analysis.....	46
3.4.5 Impulse Response Function (IRF) .....	49
3.5 Chapter Summary .....	50
Chapter 4 : Threshold Inflation in India .....	52
4.1 Introduction.....	52
4.2 Literature Review.....	54
4.2.1 Historical Trends of Inflation and Economic Growth .....	55
4.3 Data, Model Specification, and Methodology .....	57
4.3.1 Data .....	57
4.3.2 Model Specifications .....	58
4.3.3 Independent Variables .....	58

4.3.4 Methodology .....	61
4.4 Results and Discussion .....	64
4.4.1 Lag length Criteria .....	64
4.4.2 Unit Root Test.....	65
4.4.3 Results of the LSTAR Model .....	65
4.4.4 Results of the TVAR Model .....	67
4.5 Generalized Impulse Response Functions .....	68
4.5.1 Response of Growth Rate to Inflation Shock .....	68
4.5.2 Response of Inflation to Own Shock .....	69
4.5.3 Response of Interest Rate to Inflation Shock.....	70
4.5.4 Response of OECD Growth to Inflation Shock.....	71
4.6 Chapter Summary .....	72
Chapter 5 : Conclusion and Policy Implications.....	74
5.1 Background.....	74
5.2 Methodology of the Study .....	76
5.3 Findings of the Study .....	77
5.4 Implications of the study.....	79
5.5 Limitations and Future Prospects.....	80
Bibliography .....	82

## List of Tables

Table: 1.1: Monetary Policy Framework India.....	7
Table 2.1: List of Variables, Definition and Sources.....	21
Table 2.2: Results of ADF Unit Root Test .....	25
Table 2.3: Transition Probability Matrix .....	25
Table 2.4: Forecast Error Variance Decomposition for WACR.....	28
Table 3.1 Variable Description.....	34
Table 3.2 Results of Unit Root Test.....	44
Table 3.3: VAR Lag Order Selection Criteria .....	44
Table: 3.4: Transition Probability Matrix .....	45
Table 3.5 MS-VAR Estimation Results of Constant .....	47
Table 3.6 Common Coefficients .....	48
Table 4.1: Comparison between Pre and Post FIT .....	56
Table 4.2: List of Variables .....	57
Table 4.3: Lag Length Selection.....	64
Table 4.4 Unit Root Test.....	65
Table 4.5: Threshold Level of Inflation from LSTAR Model .....	66
Table 4.6 TVAR Estimates for the threshold level of inflation.....	67

## List of Figures

Figure 2.1: Probabilities of Regime Switch.....	26
Figure 2.2: Impulse Response Function.....	27
Figure 3.1: Trends in Weighted Average Call Money Rate (WACR).....	39
Figure 3.2 Trends in Credibility Index .....	40
Figure 3.3 IIP and Output Gap.....	41
Figure 3.4 Exchange Rate with respect to USD .....	42
Figure 3.5 Crude Oil Prices .....	43
Figure 3.6 Probabilities of Regimes.....	46
Figure 3.7: Impulse Response Function (IRF).....	50
Figure 4.1 Inflation and Growth in India .....	56
Figure 4.2: 91 Day-T-Bill .....	59
Figure 4.3 Inflation, Growth and Interest Rate in India.....	60
Figure 4.4: Growth Rate in India and the World .....	61
Figure 4.5: GRIF for Growth rate .....	69
Figure 4.6 GRIF for Inflation.....	70
Figure 4.7 GRIF for Interest Rate captured by 91-Day T-Bills.....	71
Figure 4.8: GRIF for World Growth captured by OECD countries .....	72

## List of Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
APEC	Asia-Pacific Economic Cooperation
BIC	Bayesian Information Criterion
CI	Credibility Index
COVID	Coronavirus disease
CPI	Consumer Price Index
DBIE	Database on Indian Economy
DOLS	Dynamic Ordinary Least Squares
ECB	European Central Bank
EM	Expectation-Maximization
EU	European Union
FEVD	Forecast Error Variance Decomposition
FIT	Flexible Inflation Targeting
FMOLS	Fully Modified Ordinary Least Squares
FPE	Final Prediction Error
FRBM	Fiscal Responsibility and Budget Management
FRED	Federal Reserve Economic Data
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GMM	Generalized Method of Moments
GRIF	Generalized Impulse Response Functions
HQ	Hannan-Quinn information
IIP	Index of Industrial Production
IRF	Impulse Response Function
LR	Likelihood Ratio
LSTAR	Logistic Smooth Transition Autoregressive

LSTR	Logistic Smooth Transition Regression
MIA	Multiple Indicator Approach
MLE	Maximum Likelihood Estimation
MPC	Monetary Policy Committee
MPFA	Monetary Policy Framework Agreement
MSI-VAR	Markov-Switching Intercept Vector Autoregressive Model
MS-VAR	Markov Switching Vector Autoregression
NBFC	Non-Banking Financial Companies
OECD	Organisation for Economic Co-operation and Development
PMG	Pooled Mean Group
PP	Phillips-Perron
PSTR	Panel Smooth Transition Regression
RBI	Reserve Bank of India
SIC	Schwarz Information Criterion
SME	Small and Medium Enterprises
TAVR	Threshold Vector Autoregression
US	United States of America
VAR	Vector Autoregression
WACR	Weighted Average Call Money Rate
WHO	World Health Organization
WPI	Wholesale Price Index
WTI Crude oil	West Texas Intermediate Crude Oil
WW-II	Second World War

# Chapter 1 Introduction

## 1.1 Background

According to the Reserve Bank of India (RBI) Act 1934, the primary role of the monetary policy is to maintain monetary stability. In simple terms, it means having low and stable inflation expectations (Patel Committee, 2014). Monetary policy is crucial in the contemporary world for maintaining macroeconomic stability and promoting growth. Monetary policy plays a crucial role in promoting economic growth, maintaining price stability, ensuring financial stability, regulating exchange rates, and facilitating trade. According to Fisher's quantity theory of money, the money supply is only able to affect the price level in the economy. The money supply cannot change the real variables, such as output or employment. However, monetarists have shown that the money supply can affect real variables in the short run. This allowed monetary policy to gain more importance after World War II (WWII) (Froyen, 2013; Mundell, 2000). During the Global Financial Crisis (GFC) of 2007-08 and the Covid-19 shock of 2020-2021, monetary policy was the primary response to the crises (Cukierman, 2013; Fischer, 2021).

Over the last century, the monetary policy has undergone a significant transformation. In the early 1920s, monetary policy was characterised by lower nominal interest rates and higher real interest rates. However, this policy could not prevent the Great Depression due to its greater emphasis on the supply side. This has highlighted the need to distinguish between the nominal and real interest rate (Darby & Lothian, 1986). During the Second World War, the Federal Reserve kept interest rates low to support the government. However, after World War II, in March 1951, the US Federal Reserve signed the Treasury-Federal Reserve Accord, which granted independence to monetary policy (Meltzer, 2002; Romero, 2013). According to Samuelson (1960), the monetary policy by the end of the 1950s had become more important. The new objective of the monetary policy was to ensure the economic stability which was pursued by the Fed using the Discretionary Counter-Cyclical Policy, i.e. tight monetary policy during the periods when growth or inflation are high and easing during the contractionary periods (Friedman, 1977; Meltzer, 2002, 2009). During the early 1960s (in the United States of America), inflation was less than 2 percent. The level of

inflation was benign but rose to double digits by the late 1970s. During this era, the Phillips curve suggested a long-run relationship between inflation and unemployment (Phillips, 1958). The long-run trade-off was intended to reduce inflation; however, it was not successful in reducing unemployment in the long run.

Milton Friedman, along with Edmund Phelps, argued that there was no long-run trade-off between unemployment and the inflation rate: rather, the economy would gravitate to some natural rate of unemployment in the long run (Friedman, 1968; Phelps, 1967). In simple terms, the trade-off between unemployment and inflation will disappear, or monetary policy will be unable to affect output in the long run (Modigliani & Papademos, 1975). In the 1970s, Lucas Jr. (1972) launched the rational expectations revolution, which demonstrated that the public's and markets' expectations of policy actions have important effects on almost every sector of the economy (Lucas Jr., 1972). The implication of rational expectations in a world of flexible wages and prices was the policy ineffectiveness proposition, which indicated that if monetary policy were anticipated, it would have no real effect on output; only unanticipated monetary policy could have a significant impact.

A high-inflationary environment leads to overinvestment in the financial sector, allowing individuals and businesses to escape some of the costs of inflation as they tend to shift away from holding currency (English, 1999). Inflation leads to uncertainty about relative prices and the future price level, making it more difficult for firms and individuals to make informed decisions, thereby decreasing economic efficiency.

The recognition of the high costs of inflation led to the view that low and stable inflation can increase the level of resources productively employed in the economy, and might increase the rate of economic growth. This led to a need for a nominal anchor—a nominal variable that monetary policymakers use to tie down the price level, such as the inflation rate, an exchange rate, or the money supply—is such a crucial element in achieving price stability. Adhering to a nominal anchor that keeps the nominal variable in a narrow range supports price stability by directly promoting low and stable inflation expectations. Since monetary expansion cannot produce ever-increasing employment, and at times stability in the monetary policy can help the private sector for better planning for the future, the central banks of developed nations have moved towards a nominal anchor for monetary policy (Gürkaynak et al., 2010). Therefore, in the twentieth century, the

monetary policy has undergone various transformations, from a limited role to the main policy tool for economic stability and promoting growth through inflation targeting (Bernanke, 2019; Beyer & Reichlin, 2006; Friedman, 1968; Mundell, 2000).

Like other countries, the monetary policy in India has undergone significant change over the last six decades. Before liberalisation, the main objectives of monetary policy were to support fiscal policy and maintain price stability. Following the Chakravarty Committee (1985), the monetary policy underwent a significant transformation in terms of its objectives. The new monetary policy had a clear objective to control inflation by monitoring the growth rate of the monetary aggregate (M3) (Das, 2020). This had major implications as the growth of the money supply was determined by projecting the growth and inflation in the economy (Mohan & Patra, 2009). However, as the economy becomes more integrated with the world economy, the monetary policy has evolved further. As monetary policy evolves, we need to ensure that it remains efficient. Thus, in this study, we evaluate India's monetary policy in various dimensions.

This chapter is divided into different sections. The first section provides a brief background of the evolution of monetary policy in the global context. Section 1.2 provides an overview of the dynamics of monetary policy in India since the 1991 reforms. Section 1.3 defines the credibility of central banks. This section also elaborates on the impact of external economic shocks and a range of contextual factors on the credibility of the central bank; Section 1.4 provides a discussion on the nexus between growth and inflation dynamics and the evolution of the threshold level of inflation. Sections 1.5 and 1.6 provide the research questions and objectives for this study, respectively. Section 1.7 explores the need for research on these topics. Section 1.8 provides an overview of the data used in this thesis, and Section 1.9 outlines the methodology employed. And finally, Section 1.10 provides an outline for the entire thesis.

## **1.2 Evolution of Monetary Policy in India**

Prior to the 1991 reforms, the government had significant control over the economy, and India was classified as a command-and-control economy. The focus of monetary policy was on accommodating the government's funding requirements and allocating credit in accordance with national priorities (McCarten, 2003; Mohanty, 2010). The price stability was not an explicit focus of the monetary policy. Monetary Policy was largely compliant with the fiscal stance of the

government. The major role of the RBI was to act as the banker to the government. This was achieved with the help of policies such as the automatic monetisation of budget deficits through instruments like ad-hoc treasury bills. Interest rates were administered, and the economy also had quantitative credit controls (Rangarajan, 2021). Chakravarty (1985) emphasised the need to regulate money supply growth in line with real growth and acceptable inflation. Chakravarty (1985) also emphasized the need for coordination between fiscal and monetary policy. This still led to high growth in the money supply, fueled by the high deficits till the 1990s. This led to a severe balance of payment crisis, which in turn led to reforms in the Indian economy.

Since 1991, the monetary policy in India has undergone a metamorphosis, evolving from a system that was characterized by direct controls and fiscal dominance towards a more independent, market-oriented system (Subbarao, 2022). Further, the transparency of the monetary policy has also been focused. This evolution of monetary policy can be broadly classified into 4 phases:

### ***1.2.1 Phase -1 Reforms and shift towards Monetary Targeting (1985-1998)***

The crisis of 1991 acted as a catalyst for huge reforms in the Indian economy, ranging from privatization, liberalization, and globalization, which fundamentally transformed the economic environment and laid the groundwork for the reforms in monetary policy. Post the reforms, phasing out of ad-hoc treasury bills by 1997 and automatic monetisation of the deficits allowed the RBI to have a greater degree of operational autonomy (Rangarajan, 2021). The administered interest rates were gradually removed to allow market forces to play a larger role in determining the cost of credit, thereby allowing interest rates to emerge as a policy instrument. The exchange rate controls were also liberalized. Market-based instruments, such as open market operations (OMOs), were given greater importance (Mohan, 2005b). These reforms had set the stage for a shift from direct to market-based monetary management. However, some fundamental challenges still exist due to the monetary targeting policy. The monetary targeting policy was focused on the M3 as the target. However, due to liberalization and globalization of the economy, the M3 targeting was not attainable as the economy had capital flows from external factors (Gupta & Sengupta, 2013). This weakened the monetary targeting framework and thereby led to further reforms in the monetary policy.

### ***1.2.2 Phase 2: The Multiple Indicator Approach (MIA) (1998-2013)***

Responding to the limitations in the monetary targeting framework, the RBI adopted a new monetary policy framework called the Multiple Indicator Approach (MIA) under the recommendations of the Dr. YV. Reddy Committee of 1998 (Dua, 2020). RBI realised that relying on one indicator to guide the monetary policy was not sufficient, and hence, the monetary policy required more indicators to guide it.

This MIA framework was adopted after the RBI had done away with the automatic monetization of the fiscal deficit, which allowed the RBI to have greater independence from the government. This move to MIA marked the transition from quantity-based signals (monetary targeting) to price-based signals (interest rates), aligning more closely with the market-based approach (Dua, 2020). The M3 still remained an indicator but was no longer a target. The RBI also implemented forward-looking indicators, such as the industrial outlook, capacity utilisation, and inflation expectations, among others. This eclectic approach aimed to provide a more nuanced assessment of macroeconomic conditions while informing monetary policy (Dua, 2023; Mishra & Mishra, 2012). Price stability and economic growth still remain the objectives of monetary policy. The MIA framework was designed to manage multiple targets, such as exchange rates, which were particularly important given the capital inflows and outflows. This sometimes led to uncertainty towards the objectives of the monetary policy. The Weighted Average Call Money Rate (WACR) emerged as the effective operating target by 2011, with the repo rates serving as the signalling tool (Dua, 2020).

### ***1.2.3 Phase 3: Preconditions Set for Inflation Targeting (2013-2016)***

After the Global Financial Crisis (GFC), the inflation in the Indian economy began to rise steadily. As a result of this rise in inflation and weakening of growth, the credibility of the monetary policy framework had been adversely affected in the process (Das, 2020). Therefore, it was necessary to revisit the monetary policy framework, which was done under the Urjit Patel Committee to strengthen the monetary policy. This committee recommended the changes in the nominal anchor

of inflation to CPI and gradually bring the inflation from a 11.5 percent in November 2013 to 5 percent before the implementation of FIT in 2016 (Patel Committee, 2014).

#### ***1.2.4 Phase 4: Flexible Inflation Targeting (FIT) (2016-Present)***

MIA offered flexibility in its target; however, following the GFC and Taper Tantrum, concerns about inflation became a more prominent feature of the economy (Erken, 2017). This persistent high inflation paved the way for further reforms in the monetary policy framework. This new framework was guided by the recommendations of the Patel Committee (2014). The committee highlighted the need for a clear nominal anchor to stabilize the inflation expectations and improve the credibility of monetary policy. The formal adoption of the recommendations led India to adopt a new monetary policy framework, Flexible Inflation Targeting (FIT). This FIT was established through the Monetary Policy Framework Agreement (MPFA) signed between the Government of India and the RBI in February 2015 (Goyal, 2022; Mohan & Ray, 2019). The primary objective of the new monetary policy was to attain price stability while ensuring that growth is also optimized. The new monetary policy framework also had an explicit inflation target of 4 percent with a bandwidth of 2 percent in either direction. Another major change aimed at enhancing the transparency and credibility of monetary policy was the switch from the Wholesale Price Index (WPI) to the Consumer Price Index (CPI) (Dua, 2020; Goyal, 2022). This agreement was further renewed without any changes in the inflation target in March 2021. Therefore, the inflation target for the monetary policy will remain at 4 percent with the same bandwidth. The framework also puts some accountability on the RBI in case of failure to maintain the inflation within the targeted bandwidth, by providing a report to the government about the reasons for the failure and proposed remedial measures. The new framework also allowed the formation of Monetary Policy Committee (MPC). The MPC is comprised of the six members. Three members from RBI that include Governor and three external members appointed by the central government. The interest rates were now determined by this MPC as compared to the earlier policy where the Governor used to decide the interest rate. However, given the six members in the MPC, in case of a tie, the Governor has a casting vote. Further to improve the transparency in the monetary policy, MPC minutes of the meeting have to be published within 14 days of the meeting (Pandey et al., 2024).

The WACR remained the operating target while repo rates are the key instruments under the new monetary policy framework of FIT (Khandelwal et al., 2023). The forward guidance about the future path of the policy has become an important tool for signaling of the monetary policy stances. This evolution of the monetary policy framework in India has demonstrated a clear progression towards greater independence, transparency, and a more explicit focus on price stability (Ahmed et al., 2022). This transformation of monetary policy reflects a gradual path-dependent process where each regime had some limitations that were addressed in the subsequent monetary policy framework. The latest monetary policy framework of FIT has metamorphosed the central bank communication from a passive reporting function to an active role in monetary policy via the anchoring of inflation. The monetary policy framework since liberalization is represented in Table 1.1.

**Table: 1.1: Monetary Policy Framework India**

<b>Policy Regime</b>	<b>Period</b>	<b>Key Stated Objectives</b>	<b>Operational/Intermediate Targets</b>	<b>Key Observations</b>
Post-Reform/ Adapting Monetary Targeting (MT)	Early 1990s- 1998	Price Stability, Growth, Post- Crisis Stabilization	Adapting from Money Supply (M3), Reserve Money; and Developing Market Instruments (OMO, Rates)	Navigating reforms, Fiscal consolidation begins
Multiple Indicator Approach (MIA)	1998- 2014	Price Stability, Growth, Financial Stability, Exchange Rate Management	Broad indicators (Rates, Quantity, Forward- looking); WACR (Operating Target), Repo Rate (Signal)	Managed through GFC, Taper Tantrum; Rising NPAs later in period
Preconditions Set for Inflation Targeting	2013 - 2016	Decreasing the inflation for the implementation of FIT	Forward-looking); WACR (Operating Target), Repo Rate (Signal)	Taper Tantrum; Rising NPAs later in the period
Flexible Inflation Targeting (FIT)	2016- Present	Price Stability (Primary: 4% +/- 2% CPI),	Policy Repo Rate (Key Instrument), WACR (Operating Target), Interest Rates (Intermediate)	Resilient financial sector; Food inflation

		Growth (Secondary)		volatility challenge
--	--	-----------------------	--	-------------------------

Source: Authors' compilation

**1.3 Central Bank Credibility**

The credibility of monetary policy is the cornerstone of its effectiveness. This represents the faith that the public and financial markets place in the monetary authority’s commitment towards the stated objective and its ability to achieve it (Blinder, 2000; Bordo & Siklos, 2014). Therefore, defining credibility and the challenges in building and maintaining it are crucial for the economy. Credibility refers to the trustworthiness of the central bank's announcements and policy commitments (Blinder, 2000). Monetary Policy credibility hinges on whether the public maintains faith in the institution's capacity to achieve its objectives despite a crisis situation (Bordo & Siklos, 2015). Credibility is often regarded as a dynamic or flow concept (Bordo & Siklos, 2014). The reputation of the monetary policy authority is closely related and is built over time through a consistent track record of matching actions (deeds) to the announcements (words) (Blinder, 2000). Credibility is demonstrated by the ability to deliver the agreed-upon outcomes. In the case of the RBI, the agreed-upon outcomes were to maintain stable prices by keeping inflation within the targeted limits. Measuring the credibility of the central bank is a challenging task. However, some recent works have measured credibility by directly linking it to inflation expectations and other indices (Garga et al., 2022; Patnaik, 2023).

Building and maintaining credibility can be challenging for developing countries due to the following factors. First, developing economies must face fiscal dominance, characterized by a high level of government debt. This can lead to a fear of high inflation and thereby create a hindrance in anchoring inflation expectations (Kose et al., 2019). According to Choudhri & Malik (2012), the monetary policy of developing countries is dominated by fiscal deficits, and they found that inflation is more inconsistent under fiscal dominance. Using the Taylor rule, Kumhof et al. (2010) found that inflation becomes more variable under fiscal dominance. Eijffinger & Hoeberichts (2002) found that accountability, which is induced through transparency, can reduce the expected inflation. If the accountability is shifted to the government, it can lead to more volatile inflation but more stabilisation is required to supply shocks. The accountability framework is very crucial

to the credibility of the monetary policy. This can be more susceptible to political interference, undermining belief in their commitment to stated goals (Claessens et al., 2025). According to Blinder, (1999) institutional quality is built by creating a history of matching words to deeds.

Secondly, developing countries are more vulnerable to shocks such as fluctuations in commodity prices, oil prices, abrupt shifts in global capital flows, and changes in the terms of trade. These shocks can make inflation more volatile and difficult to control (Kose et al., 2019). These external factor affects the credibility of central banks. Gelos & Ustyugova (2017). Using panel data from more than 90 countries, they demonstrated that commodity prices have a lasting impact on inflation in developing countries. They also suggested that institutional credibility is more important for inflation-targeting regimes. With the rise in volatility of commodity prices, maintaining credibility requires a larger effort. The dynamic nature of credibility underscores an evolving state influenced by the very policy decisions and economic outcomes. While success breeds credibility and failure erodes it (Bordo & Siklos, 2014).

Thirdly, transparency of the monetary policy is also crucial in building and maintaining credibility. Transparency in monetary policy ensures that it is independent and effective. The adoption of inflation targeting by various countries in the 1990s enhanced the transparency of monetary policy through regular dissemination and clear policy stances. These monetary policy reports allow the private sector to form expectations about the future (Geraats, 2014). A high degree of monetary policy credibility leads to well-anchored inflation expectations (Guler, 2013; Kose et al., 2019). In this context, short-term shocks, such as economic news or temporary fluctuations in actual inflation, do not lead to a change in expectations about future inflation (Kose et al., 2019). This anchoring mechanism is strengthened by the monetary policy framework, such as FIT. A well-anchored inflation expectation tends to make the Phillips curve flatter, representing a smaller trade-off between inflation and unemployment (Albrizio et al., 2023).

#### **1.4 Threshold Level of Inflation**

The concept of the threshold inflation is an attempt to capture the non-linear relationship between inflation and growth (Omay & Öznur Kan, 2010; Pollin & Zhu, 2009). The high and volatile inflation is often considered as detrimental to growth, while low and stable inflation effects are more conducive. Therefore, the central question for the monetary policy authority is to assess a

critical point or range beyond which inflation starts to exert negative implications for economic growth. This critical point is referred to as the threshold level of inflation (Khan & Senhadji, 2001). This concept redefines the simple relationship between inflation and growth. Ignoring this non-linear relationship will result in a unidirectional relationship between inflation and growth, which may not depict the actual relationship. Therefore, identifying this critical point is vital, as threshold inflation has a profound impact on the functioning of the monetary policy framework. Since India adopted the FIT regime, which has a dual mandate of keeping prices stable while promoting growth, estimating the threshold level of inflation has become more important (Dua, 2020; Rangarajan, 2020). If the inflation target is significantly off the threshold level, it can adversely affect growth performance. If the inflation is below the threshold level, inflation can have a statistically insignificant impact on growth. If inflation exceeds the threshold level, it can adversely affect growth (Khan & Senhadji, 2001). Therefore, policymakers must be very careful when setting inflation targets. Empirical evidence suggests that the threshold level of inflation varies between 1% and 3% for developed economies (Ball et al., 2003; Khan & Senhadji, 2001; Siekmann, 2023). For developing countries, the empirical evidence suggests a higher threshold level of inflation (as high as 12.23 per cent) (Azam & Khan, 2022).

For India, there has been considerable research on estimating the threshold level of inflation (Bhoi & Tabasum, 2024; Dholakia, 2020; Pattanaik & Nadhanael, 2013; Rangarajan, 1998; Singh & Kalirajan, 2003; Singh, 2010). Various studies have estimated the threshold level of inflation to range from 4 to 7 per cent (Kannan & Joshi, 1998; Pattanaik & Nadhanael, 2013; Rangarajan, 1998; Singh & Kalirajan, 2003; Singh, 2010). However, all these studies are based on WPI inflation. Recently, the RBI has shifted from WPI to CPI to enhance the transparency of monetary policy, as recommended by the Patel Committee (2014). Only a limited number of studies estimate the threshold level of inflation using the CPI as the reference rate, and the results indicate a significantly higher threshold level compared to WPI-based studies covering the FIT regime (Bhoi & Tabasum, 2024; Dholakia, 2020). For example, Bhoi & Tabasum (2024) and Dholakia (2020) estimated the threshold level of inflation over 5.5 per cent. However, these estimates were below the RBI upper band.

It is clear that monetary policy in India has undergone significant change in terms of policy framework, institutions, tools, and objectives. These policy changes can have a wide range of implications for the Indian economy. First, the change of the nominal anchor from Wholesale Price

Index (WPI) to Consumer Price Index (CPI) may have implications for the transparency and credibility of monetary policy. This change was made to improve and, therefore, bring more credibility to the monetary policy. During the present era, monetary policy in India has also evolved to incorporate the global practice of inflation targeting. However, India did not adopt the very strict inflation targeting, as the targeted inflation ranged from 2 to 6 per cent, or 4 per cent with a bandwidth of 2 per cent in either direction, to maximise the growth rate. Against this backdrop, the present study addresses these gaps by conducting an in-depth examination of the FIT regime. This will help academics comprehend the changes in monetary policy that have occurred over the last two decades and their impact on the Indian economy.

### **1.5 Research Questions**

Based on the above discussion, this study brings out the following research questions:

- a) Since the monetary policy has undergone a significant change under the Flexible Inflation Targeting (FIT), does it have an effect on the regime changes?
- b) Has the credibility of monetary policy changed since the implementation of the new FIT framework of monetary policy?
- c) Does there exist a threshold level of inflation? Is it time varying? What is the relationship between the threshold inflation and growth dynamics in India?

### **1.6 Objectives**

Based on the discussion and research questions, the study objectives are:

1. To analyse the impact of the Flexible Inflation Targeting (FIT) framework on monetary policy regime changes in India.
2. To investigate the shifts in monetary policy credibility before and after the implementation of the new FIT framework in India.
3. To examine the existence, time variation, and relationship between threshold inflation levels and economic growth dynamics in India.

## 1.7 Rationale of the Study

The rationale of this study is as follows:

- a. The check for the regime changes in the RBI. The regime is defined as the preference for growth over inflation or inflation over growth when deciding the interest rate in the economy. (Taylor, 1993, 1994), provided the framework for the forward-looking policy rules. We examine India's monetary policy from September 2013 to March 2020 to examine the changes in the monetary policy regimes. This was the period when monetary policy began to shift towards the global practice of transitioning to FIT and switching from WPI to CPI.
- b. The credibility of the monetary policy is very important to central bankers, as discussed in detail by Blinder (2000). In the Indian context, there have been very limited studies conducted on the credibility of the RBI (Garga et al., 2022; Patnaik, 2023). To assess the change in credibility, we utilise data from June 2006 to January 2020, spanning the pre-GFC period to the pre-COVID period. This is particularly important, as we also estimate the timeframe during which the transition from a low to a high credibility regime occurs. The literature has broadly identified that the credibility of the RBI has increased since the implementation of FIT. However, the literature has not provided an estimate of the time frame during which this transition occurred.
- c. Determining the threshold level of inflation. This was done to examine the dynamic relationship between inflation and growth. To estimate the threshold level of inflation, the study used the quarterly data from April 1997 to December 2022. The time period is selected based on the availability of data. After the implementation of FIT, the monetary policy is facing a crisis in the transmission mechanism (Acharya, 2017; Das, 2015; Pandey et al., 2025). Furthermore, according to Khan & Senhadji (2001), the nexus between inflation and growth can become weak if the level of inflation is significantly below the threshold level of inflation. The limited literature motivates us to estimate the threshold level of inflation.

## **1.8 Data Sources**

This thesis primarily utilises data from the Database on Indian Economy (DBIE) and the RBI website, which provide data on the Indian economy. The website provides data on various frequencies, including annual, quarterly, monthly, and some variables, as well as weekly. Since we also require some variables for which data were not available in the DBIE, we had source data on crude oil prices and the Organisation for Economic Co-operation and Development (OECD) growth rate from FRED and the OECD website. FRED is the Federal Reserve Economic Data, which also has data on a large number of variables, but is not limited to data specific to the US. We also use the OECD website to source the growth rate of the OECD countries while estimating the threshold level of inflation.

For estimating the regime change and credibility switches in monetary policy, monthly data from September 2013 to March 2020 and from June 2006 to January 2020, respectively, were used. For the first research objective, we initiated our study period when the transition in the RBI governor had occurred and the RBI had just entered a new phase of monetary policy, where it was expected to provide a strong foundation for the FIT. The data for the second research objective begins before the GFC, to capture the impact of the GFC on the monetary policy of India

## **1.9 Methodology**

The study employs advanced time series methods, including unit root tests, MS-VAR, LSTAR, and TVAR, to examine the dynamics of monetary policies in multiple steps.

First, we test data for stationarity, using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. We also make adjustments for seasonality wherever necessary. In the second step, the study applies the Markov Switching Vector Autoregression (MS-VAR) to examine regime switches in monetary policy and credibility switches. The use of MS-VAR enables us to estimate the timeline of each state and the probability of the economy transitioning from one state to another. These economic variables are known to have such time-varying relations. Therefore, using MS-VAR to estimate such relations enables us to obtain more robust results than those presented in the existing literature. In the next step, we also estimate the Impulse Response functions to estimate the impact of the shocks on the variables.

In Chapter 4 of this thesis, we use the LSTAR and TVAR to estimate the threshold level of inflation for India in the second and third steps, respectively. The usage of TVAR is particularly important as it allows for the estimation of the threshold level even in the presence of regime switches. We also expand on the Generalized Impulse Response function to estimate the impact of shocks on the variables. Therefore, this study uses non-linear methodologies to estimate the dynamic nature of the monetary policy. A detailed methodology has been discussed in the respective chapters.

### **1.10 Thesis Outline**

The outline of the thesis is as follows: Chapter 1 provides background information, research questions, objectives, data, and relevant mythologies. Chapter 2 of the thesis examines the regime changes in the RBI. Chapter 3 examines the credibility regime switches in the monetary policy. The chapter also examines the impact of the GFC on India's monetary policy. Chapter 4 provides an estimation of the threshold level of inflation in India. The chapter also provides the generalised impulse response function. Finally, Chapter 5 presents the summary, conclusion, limitations, and future scope.

## Chapter 2 Determinants of Monetary Policy

### 2.1 Introduction

The economic reforms initiated in India since 1991 have significantly enhanced India's integration into the global economy. This integration into the global economy has major ramifications for monetary and fiscal policies, paving the way for India to adopt a monetary policy framework coherent with global practices. As the majority of countries have shifted towards monetary policy with defined, systematic rules and less discretion, this shift is also evident in India. The search for a nominal anchor of monetary policy led to inflation targeting, which was first implemented by New Zealand in 1990, and subsequently adopted by other countries. These rules provide the basis for adjustments in the operating instrument (interest rate) of monetary policy, i.e., a response to inflation, the output gap, and other external factors (Benchimol & Fourçans, 2019; Mertens & Williams, 2019). In a similar vein, the framework of monetary policy in India has evolved in response to financial advancements and shifting macroeconomic conditions. The operational structure of monetary policy has undergone considerable modifications regarding the tools and targeting procedures (Dua, 2023). Since the late 1990s, the Reserve Bank of India (RBI) has adopted the "Multiple Indicator Approach" (MIA) for the monetary policy, which lasted till 2015 and was further replaced by the "Flexible Inflation Target" (FIT) in 2016.

The core objective of FIT is to enhance the effectiveness of monetary policy in promoting economic growth with low inflation, alongside macroeconomic stability. To implement FIT, RBI initiated institutional change by setting the Monetary Policy Committee (MPC) in 2015. The MPC, which comprises six members, and its decisions are binding for interest setting. Further, the repo rate was aligned with the Weighted Average Call Money Rates (WACR). The repo and reverse repo rates used as the instruments for changing the liquidity level according to business cycles (Dua, 2023). As per the FIT mandate, inflation was the primary focus of RBI and the targeted inflation rate was set to be 4 percent with the band of  $\pm 2$  percent (Misra, 2019). Accordingly, the aim of monetary policy was to optimize economic growth while keeping a check on inflation (Eichengreen et al., 2020).

During the MIA era, monetary policy stance was communicated predominantly through governors' statements and frequently through circulars released on the RBI's website. To better communicate the monetary policy stance and increase the efficiency of monetary policy, the RBI switched to more precise monetary policy documents, including monetary policy statements, circulars, and mid-quarter reviews (Mathur & Sengupta, 2019). These changes may have induced a shift in the monetary policy regime. From the above discussion, it is clear that there has been a significant shift in the monetary policy framework, the instruments used, and the policy targets. The objective of this chapter is to examine whether a regime change in monetary policy has occurred, using a non-linear method in the form of the MSVAR model, which covers monthly data from September 2013 to March 2020<sup>1</sup>. The study contributes to the literature in the following way: First, the study applies a non-linear model to examine the regime shift covering more recent data. Second, the roles of inflation rate, economic growth, crude oil prices, and exchange rates in influencing monetary policy are analysed using impulse response functions and forecast error variance decomposition. Given the controversy on the efficacy of monetary policy on economic growth and inflation rate, the study provides new evidence using recent data.

This chapter is structured into five sections. Section 2.2 provides a brief overview of India's monetary policy since the 1991 reforms. Section 2.3 provides a comprehensive review of the literature, encompassing the Taylor rule and its empirical applications in testing monetary policy regimes. Section 2.4 explains the MS-VAR methods and model specifications. Section 2.5 presents the results of the MS-VAR model, analysing the impulse response function and forecast error variance decomposition. Finally, the chapter summary is presented in Section 2.6.

## **2.2 Overview Monetary Policy Framework (Post-Reform Period)**

This section provides a brief review of the monetary policy framework since the economic reforms in India (1991). The monetary policy of the post-reform period can be characterised in 3 regimes:

---

<sup>1</sup> The study timeframe starts in September 2013, when RBI had changed the governor to Raghuram Rajan, and the study ends in the March 2020, when Shaktikanta Das was holding the office. Post March 2020 not considered due to pandemic lockdown.

Monetary Targeting with Feedback (1991-1998), Multiple Indicator Approach (1998-2016), and Flexible Inflation Targeting (2016 onwards).

### ***2.2.1 Monetary Targeting with Feedback (1991-1998)***

In India, monetary policy underwent significant changes after the Chakravarty Committee report in 1985. According to the recommendations, the RBI followed a policy of monetary targeting with feedback (Karmakar & Jana, 2019; Nair & Anand, 2020; Sharma & Nurudeen, 2019). The sole objectives of monetary policy were to control and support the government's borrowing and control inflation. However, following the economic reforms, the interest rate was deregulated, the external sector opened up, and the exchange rate was changed from a fixed to a flexible one (Ray et al., 1998). The objective of monetary policy during this phase was to stabilize inflation by controlling the reserve money through instruments such as cash reserve ratio (CRR), open market operations (OMOs), and foreign exchange operations. Following the liberalisation of the economy, India experienced capital inflows, volatility in exchange rates, and a changing global monetary policy framework. The studies suggest that during this period, RBI failed to control inflation due to a rise in capital inflows and government borrowing (Dua, 2023; Mohanty & Mitra, 1999; Rangarajan, 2001). This led to the RBI shifting to a Multiple Indicator Approach.

### ***2.2.2 Multiple Indicator Approach (MIA) (1998-2016)***

The objective of the MIA approach was to support the productive sectors of the economy with the flow of credit and price stability. For this purpose, MIA focused on multiple indicators such as the interest rates on sovereign bonds, credit markets, various rates of inflation, asset prices, and exchange rates. During this period, the RBI set up a liquidity adjustment facility for the use of repo and reverse repo rates for signaling the key policy rate (Mohan & Ray, 2019). The developments of the monetary policy during this tenure led to the addition of forward-looking variables and time series models. The data on forward-looking variables were gathered from various surveys conducted by the RBI. These surveys provided data on industrial outlook and capacity utilization. Inflation expectations and estimates from the professional forecasters (Mohanty, 2011; Nair & Anand, 2020). The monetary policy was based on the rate of returns on various instruments linked

to capital markets and exchange rates. The MIA had serious limitations, as it was found to be ineffective due to the absence of a nominal anchor (Jha, 2008).

### ***2.2.3 Flexible Inflation Targeting (FIT) - (2016 Onwards)***

More importantly, developed countries initiated the withdrawal of quantitative easing in 2013, which led to an increase in interest rates and exchange rate volatility in emerging countries. This led to the RBI switching from MIA to FIT. To implement FIT, an MPC was established to determine the interest rate. To optimise economic growth, a 4 per cent inflation target was set from 2016 to 2021, with a flexibility of 2 per cent in either direction. Also, the WACR was set as a policy rate. To achieve the objectives, the RBI used open market operations, reserve requirements, repo rates, and exchange rates (Dua, 2023). The shift to FIT aligns with global practices. The literature supports the FIT approach, which is more effective in inflation targeting than the previous monetary policy framework. The improvements in credibility enable the central bank to anchor the inflation expectations more effectively (Güler, 2021). The above literature suggests that a regime change may occur due to the shift from MIA to FIT.

## **2.3 Review of Literature**

### ***2.3.1 Theoretical Outlook***

The macroeconomic uncertainties resulting from oscillations in the price of crude oil, global macroeconomic shocks, and others bring some challenges that policymakers in all countries must confront. This has resulted in a debate between having discretion on the monetary policy or monetary policy based on systematic rules (Kydland & Prescott, 1977; Taylor, 2019). There is a debate on the efficacy of monetary policy based on discretion or systematic rules. The use of discretionary monetary policy also has some advantages, *viz.*, more effective during the period of high macroeconomic volatility, and flexible to respond to economic shocks. On the other hand, the rule-based policy also has no scope for surprises, making monetary policy more effective under certain conditions (Mohanty, 2013). The seminal paper by Taylor (1993) on monetary policy proposed a model for setting the federal funds interest rate based on changes in real income and the price level. This method has been extended to developing countries by augmenting the effect

of the exchange rate (Taylor, 2000). The Taylor rule framework offers insights about the trade-off between growth and inflation in the conduct of monetary policy (Orphanides, 2003).

The Taylor rule shows the interest rate as a function of the inflation and growth rates. In the original work of Taylor (1993b), both inflation and economic growth are given equal importance as shown by equation 2.1. According to the Taylor rule, the interest rate is based on inflation deviations from the target level and output deviations from potential output, as shown in equation 2.1.

$$r = p + 0.5y + 0.5(p - 2) + 2 \quad 2.1$$

Where the  $r$ ,  $p$ , and  $y$  represent the interest rate, the inflation rate, and the percentage deviation of real GDP from a target growth rate, respectively.

A plethora of literature suggests that the interest rate setting is at the core of the monetary policy of the Taylor rule. For instance, a study on Sri Lanka by Mayandy (2019) demonstrated that monetary policy was guided by Taylor's rule in setting interest rates. Similarly, an Augmented Taylor rule is followed for setting interest rates in Malaysia, Thailand, and Singapore (Tan & Mohamed, 2020). The Augmented Taylor rule defines interest rates as a function of the exchange rate in addition to the growth rate and inflation (Taylor, 1993, 2001). The exchange rate is a crucial determinant of monetary policy, as it impacts exports and imports by influencing competitiveness (Mayandy, 2019).

### **2.3.2 Past Studies**

Prior literature on monetary policy has focused on issues such as the effectiveness of monetary policy, the instruments used, and the credibility of monetary policy. A study by Virmani (2004) predicted the movements in the call money rates using the Taylor rule from 1992 to 2001. The need to include the exchange rate in the model for developing countries was further highlighted by Mohanty & Klau (2005). Takeshi & Shigeyuki, (2009) examined role of the inflation rate in determining the interest rate in India covering data from 1998 to 2007. The results of the study suggested that inflation did not play an important role in determining the rate of interest in India.

Bhuyan & Sethi (2016) investigated the impact of interest rates on inflation, economic growth, and exchange rates from 1997 to 2015 using the augmented Taylor rule framework. The results

showed that the Taylor rule framework was suitable for studying the dynamic relationship between the interest rate and other macroeconomic variables. On the contrary, Sawhney et al. (2017) concluded that Taylor's rule did not exist for India, covering the period from 2008 to 2015. Compared to the above studies, Bhattacharya & Bhattacharyya (2001) find that oil prices play a significant role in determining the inflation and growth rate of the economy. A similar conclusion is reached by Sarmah & Bal (2021) for India. A study by Hutchison et al. (2013) categorised the RBI's monetary policy into Dovish (focusing on growth and exchange rates) and Hawkish (focusing on inflation control) from 1987 to 2008. The study found a balance between the dovish and hawkish policies.

Khundrakpam (2011) examines the effectiveness of various transmission channels for India. Using quarterly data and a structural VAR model, the study finds that a positive shock in monetary policy leads to a slowdown in credit growth and has a negative impact on growth and inflation after two quarters. Similarly, another study found that the output growth reacts negatively to an increase in interest rate (Mohanty, 2012). In contrast to the above studies, Mishra et al. (2016) and Subramanian & Felman (2019a) found that output does not react to changes in interest rate. However, the literature on the impact of monetary policy on output has remained inconclusive, and the impact varies from study to study, depending on the sample size and period of study (Twinoburyo & Odhiambo, 2018).

A recent study for the US by Rechar & Regmi, (2023) investigated the deviation of the Federal Funds Rate from the estimates calculated using the Taylor Rule model over the period 2003-2006. The study focused on the housing bubble in the US before the Great Recession of 2007. The authors employed the MS-VAR model to investigate regime changes. The results of this study suggest that there is no evidence of regime change during the sample period. Drakos & Kouretas, (2015) examined the presence of the Taylor rule for the EU, covering data from 2001 to 2013. Using the MS-VAR model, the study finds that before the financial crisis of 2007, European Central Bank (ECB) monetary policy followed a Taylor rule, but the focus of the monetary policy switched to mainly to the output gap to propel economic growth in the European Union (EU) (Drakos & Kouretas, 2015). In the Indian context, (Mustafi & Sengupta, 2020), examine regime switch linking with discretionary policy with specific Governors. The study finds there are three monetary policy regime one attached to Governor Jalan, another to Governor Reddy and third

regime with Governor Rajan. Contrarily, Eichengreen et al., (2020) finds no regime switch in monetary policy for India after the FIT.

## 2.4 Material & Methodology

### 2.4.1 Variables

Monthly data on the inflation rate (Consumer Price Index), growth rate (the Index of Industrial Production), and Weighted Average Call Money Rates (WACR) have been collected from the RBI Database for Indian Economy (DBIE). Further, data on WTI Crude oil monthly prices is collected from the Federal Reserve Bank of St. Louis database. The time period for the study has been limited to March 2020, since post that time period, there was a lockdown in the Indian economy, and therefore, data post lockdown would not capture the system. Table 2.1 presents the list of variables used in the study, along with their respective sources of data.

**Table 2.1: List of Variables, Definition and Sources**

Variable Name	Definitions	Period of Study	Sources
INF	Inflation is measured using the Consumer Price Index	September 2013 to March 2020	DBIE
WACR	Weighted Average Call Money Rates	September 2013 to March 2020	DBIE
IIP	Index for Industrial Production	September 2013 to March 2020	DBIE
EX	Rupees per unit of the United States Dollar	September 2013 to March 2020	DBIE
WTI_CRUDE	Crude Oil Prices in USD	September 2013 to March 2020	FRED

*Source: Authors Compilation*

### 2.4.2 Methodology

For empirical analysis, the study first examines the stationary properties of variables using the ADF unit root test. In the second stage, the MS-VAR model is applied to detect regime changes. In the third stage, the Impulse Response Function (IRF) and the Forecast Error Variance Decomposition (FEVD) derived from the MS-VAR model are analysed to examine the role of economic growth, inflation rate, oil price, and exchange rate in influencing the monetary policy.

#### *Markov Switching Vector Autoregression Model (MS-VAR)*

The MS-VAR model is a statistical framework used for time series analysis, where the underlying parameters of the model may change over time. In other words, it allows for the possibility that the relationship between variables in a system may differ in different time periods or “regimes.” The present study aims to test for regime change, for which an MS-VAR (Markov switching Vector Autoregression model) has been performed. These models are employed in economics when economic variables exhibit different behaviour across different periods (Hamilton, 1989, 1996). To make the VAR model time-varying, a parameter  $\theta$  has been added to the VAR process. The model may be time invariant when conditioned on  $s_t$ , an unobservable variable indicating the regime in the prevailing period  $t$ . Let us suppose that we have  $M$  different regimes, such that  $s_t \in [1, \dots, M]$ . The conditional probability density of the alleged time series vector  $y_t$  is –

$$p(y_t | Y_{t-1}, s_t) = \begin{cases} f(y_t | Y_{t-1}, \theta_1) & \text{if } s_t = 1 \\ \vdots & \\ f(y_t | Y_{t-1}, \theta_M) & \text{if } s_t = M \end{cases} \quad 2.2$$

where  $\theta_m$  represents regime's parameter vector,  $m = 1, \dots, M$  and  $Y_{t-1}$  are the observations  $\{y_{t-j}\}_{j=1}^{\infty}$ .

If the VAR process is expressed conditionally on an invisible regime, as shown in equation 2.2. Assumptions about the regime-producing process must be made to complete the description of the data-generating mechanism. The MS-VAR model is part of a wider family of models that confine a non-linear data-generating process to being linear in each regime, characterizing the process as piecewise linear. Only a limited number of regimes are possible since the regime depends on an unobservable variable. As a result, the model may describe the process of creating the data as piecewise linear.

Markov-Switching Vector Autoregression is an extension of the fundamental limited order VAR model of order  $p$ . Consider the  $p$ -th order Autoregression for the vector of  $K$ -dimensional time series vector  $y_t = (y_{1t}, \dots, y_{Kt})'$ ,  $t = 1 \dots, T$ ,

$$y_t = v + A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \quad 2.3$$

where  $u_t \sim \text{IID}(0, \Sigma)$  and  $y_0, \dots, y_{1-p}$  are fixed.

In this model, the parameters of the fundamental data-producing process of the witnessed time series vector  $y_t$  are determined by the unobservable regime variable  $s_t$ , which indicates the likelihood of being in a distinct state of the world.

$$\mu(s_t) = \begin{cases} \mu_1 & \text{if } s_t = 1 \\ \vdots & \\ \mu_M & \text{if } s_t = M \end{cases} \quad 2.4$$

### 2.4.3 Model Specification

The model follows the Taylor rule, which tries to predict the forward-looking behaviour of the interest rates. In developing countries, the modified Taylor rule says that the interest rate is a function of growth, inflation, and exchange rates. Literature also suggests that oil prices have a considerable effect on the rate of inflation in oil-importing countries, such as India (Nazlioglu et al., 2020). Therefore, the augmented Taylor rule can be written as:

$$\begin{aligned} & \textit{interest rate} && 2.5 \\ & = f(\textit{economic growth, inflation rate, exchange rate, oil prices}) \end{aligned}$$

Equation (5) can be written in the VAR framework as:

$$\begin{pmatrix} \Delta(\text{OilPrice}_t) \\ \Delta(\text{IIP}_t) \\ \Delta(\text{ExchRate}_t) \\ \Delta(\text{CPI Inflation}_t) \\ \Delta(\text{WACR}_t) \end{pmatrix} = \begin{pmatrix} \alpha_{1St} \\ \alpha_{2St} \\ \alpha_{3St} \\ \alpha_{4St} \\ \alpha_{5St} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} & \beta_{35} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} \end{pmatrix} \begin{pmatrix} \Delta(\text{OilPrice}_{t-1}) \\ \Delta(\text{IIP}_{t-1}) \\ \Delta(\text{ExchRate}_{t-1}) \\ \Delta(\text{CPI Inflation}_{t-1}) \\ \Delta(\text{WACR}_{t-1}) \end{pmatrix} + \begin{pmatrix} \epsilon_{1St} \\ \epsilon_{2St} \\ \epsilon_{3St} \\ \epsilon_{4St} \\ \epsilon_{5St} \end{pmatrix} \quad 2.6$$

$$\text{Var} ((\epsilon_{1St} \ \epsilon_{2St} \ \epsilon_{3St} \ \epsilon_{4St} \ \epsilon_{5St})') = \Omega_{5 \times 5}^{St} \quad 2.7$$

The model is based on the idea of a Markov process, where the probability of transitioning from one regime to another depends only on the current regime and not on any previous regimes. In the MS-VAR model, the states or regimes are unobserved, but they can be estimated from the observed data. The MS-VAR model is similar to a standard VAR model but with the addition of a regime-switching component. The model includes lagged values of each variable as well as dummy variables that indicate which regime the system is in. The model parameters are estimated using a non-linear iteration process (maximum likelihood estimation).

## 2.5 Results

### 2.5.1 Unit Root Test

Before we examine the regime change in monetary policy, the variables are checked for stationarity. For this purpose, the study uses the ADF unit root test. The results of the ADF unit test are presented in Table 2.2. Results suggest that, except for IIP, other variables are found non-stationary at the level. On the other hand, INF, WACR, OILP, and EX are stationary after the first difference.

**Table 2.2: Results of ADF Unit Root Test**

Variable Name	At Level		First. Diff.	Results
	C	C&T	C	
INF	-2.76	-2.55	-4.23**	I (1)
WACR	-2.21	-3.03	-13.20**	I (1)
IIP	-1.42	-4.25**		I (0)
EX	-0.10	-2.07	-8.02**	I (1)
WTI CRUDE	-1.87	-2.12	-5.26**	I (1)

\*\* p<0.01 and \* p< 0.05

C-constant, C&T constant with time trend. Lag-length is selected using AIC.

Source: Authors' Calculations

### 2.5.2 Regime Switches

After examining the stationary properties of the variables, the study applies the MS-VAR model to examine the regime switch in monetary policy. For this purpose, we calculate the transition probability matrix of regimes 1 and 2. State 1 (S=1) represents a monetary policy with a primary focus on inflation control. On the other hand, state 2 (S=2) focuses on the monetary policy trade-off between growth and inflation. As described earlier, before implementing FIT, the RBI had focused on controlling inflation; hence, we expect the transition in regimes from S1 to S2. Table 2.3 reports the transition probability matrix of both regimes. The results indicate that the probability of remaining in state 1 is 0.78, and the probability of transitioning to state 2 is 0.22, suggesting that state 1 is a stable condition. Further, when the monetary policy is in state 1, it is highly probable to stay in state 1 (controlling inflation). The monetary policy in S2 has a probability of 0.44, with a slightly higher probability (0.56) of transitioning to S1, indicating a bias in the monetary policy favouring inflation control. This implies that the probability of moving out from state 2 to state 1 is higher, and therefore, state 1 is the only stable state in this model. It can be concluded from this analysis that there is no change in monetary policy regimes in India despite RBI shifting from MIA to FIT.

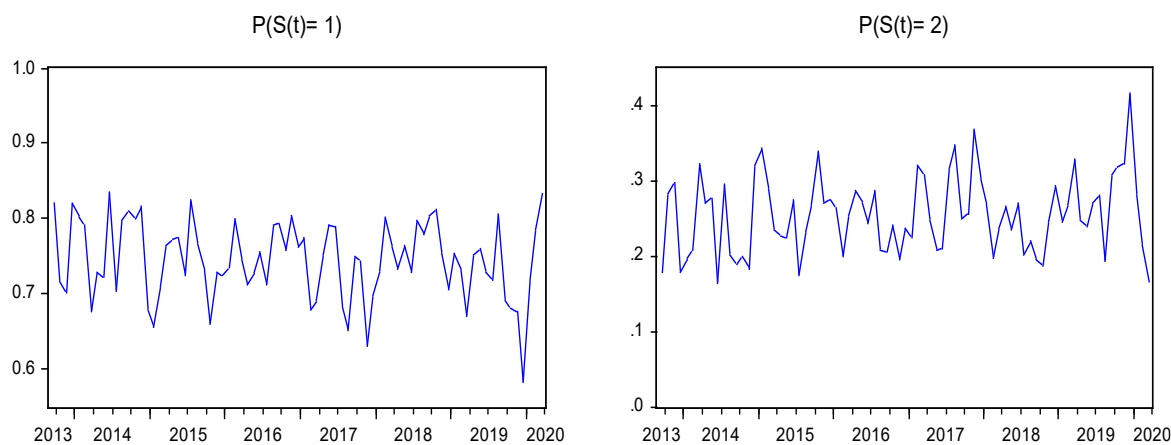
**Table 2.3: Transition Probability Matrix**

State	S-1	S- 2
S-1	0.78	0.22
S-2	0.56	0.44

Source: Author's Calculation

Figure 2.1 also represents the conditional probabilities of the two regimes as discussed above. The probability of the model being in regime 1 (state 1) is very high (0.78), indicating that there have been no changes in the regimes.

**Figure 2.1: Probabilities of Regime Switch**



*Source: Author's Calculation*

The results indicate that despite the setting of MPC and changes in the governor<sup>2</sup>, the study finds no variation in the dynamics of the monetary policy (interest setting behaviour). The probability of the regime being in state 1 highlights that monetary policy is skewed to inflation targeting instead of balancing inflation and growth targets. Given the past history of high inflation rate in India, the monetary regime biased towards inflation-controlling is not surprising

### **2.5.3 Major Determinants of Monetary Policy**

As discussed in section 3, multiple factors such as inflation rate, exchange rate fluctuations, growth rate and oil prices influence the setting of monetary policy in India. Using the MS-VAR model, we examine the role of these variables in influencing the monetary policy. For this purpose, impulse response function (IRF) and forecast error variance decomposition (FEVD) are used.

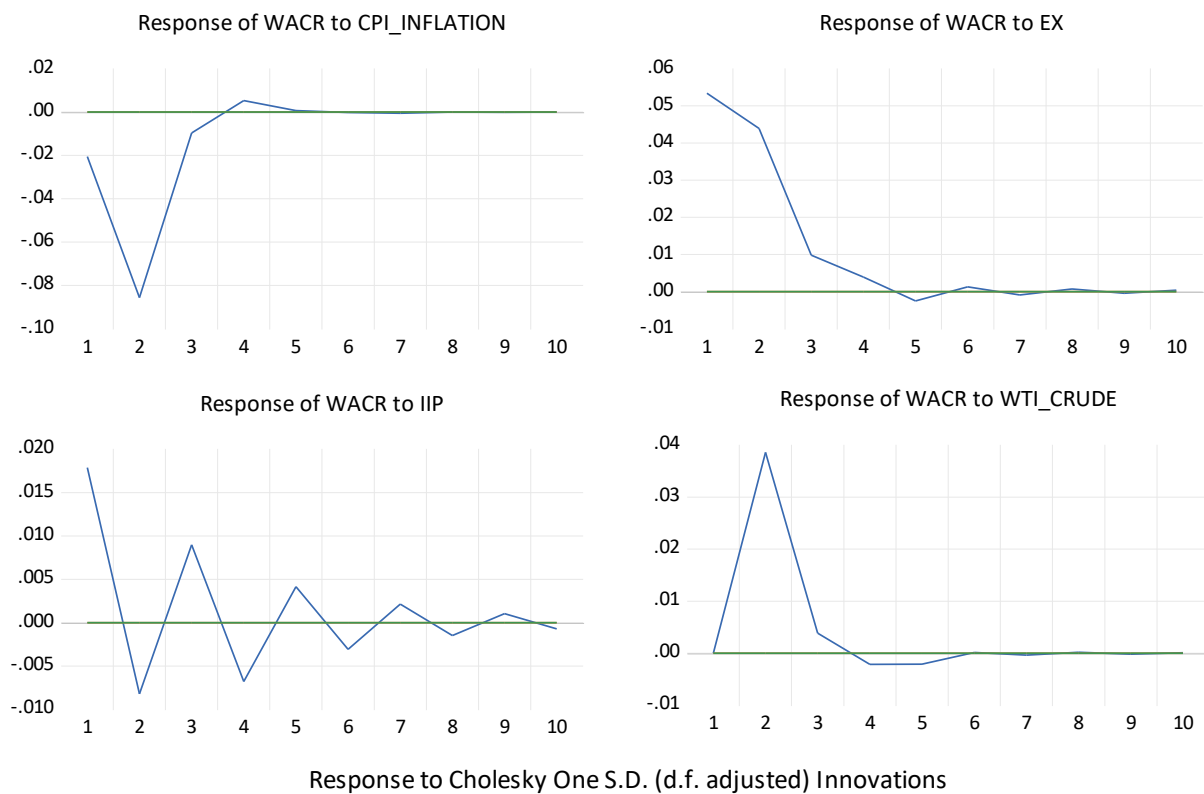
---

<sup>2</sup> During this period, RBI had multiple Governor such as: Raghuram Rajan to Urjit Patel

### 2.5.4 Impulse Response Function (IRF)

The impulse response functions map the time path of the effects of a one-standard-deviation shock to an endogenous variable and its impact on the remaining endogenous variables in the VAR. Using the IRF, we trace the response of WACR to changes in inflation, the exchange rate, oil prices, and growth. The results are presented in Figure 2.2, which illustrates the impact of changes in WACR on changes in inflation, the exchange rate, the industrial production index, and crude oil prices. Results indicate that a single standard shock to the change in inflation rate leads to an immediate decrease in the change in interest rate. However, after period 2, the interest rate starts rising and converges to an equilibrium by period 5. This implies that the interest rate initially adjusts to a negative inflation shock but responds positively after period 2.

**Figure 2.2: Impulse Response Function**



Source: Author Compilation

Further, the study reveals that a shock to the oil price results in an initial increase in the interest rate, implying rise in oil prices to a rise in interest rates. However, from the third period onwards, the interest rate responds negatively to the oil price shock and returns to equilibrium by the end of

period 6. On the other hand, a standard shock in the exchange rate results in an immediate fall in interest rates, which continues to decline for the next three months. Then, interest rates gradually start to recover and converge towards equilibrium. One standard shock in the growth rate causes the interest rates to fall immediately. After period two, the interest rate rises and hovers around the original equilibrium conditions, suggesting a cobweb pattern.

### **2.5.5 Forecast Error Variance Decomposition**

In addition to IRF, the study also presents FEVD in Table 2.4. FEVD assesses the percentage of variation explained by its own shock and other variables caused by a standard exogenous shock to the model based on the Cholesky decomposition method. It also provides the time path of shocks. The results of FEVD up to period 20 are presented in Table 2.4.

**Table 2.4: Forecast Error Variance Decomposition for WACR**

<b>Period</b>	<b>WACR</b>	<b>INF</b>	<b>IIP</b>	<b>EX</b>	<b>WTI_CRUDE</b>
<b>1</b>	82.32	2.081	1.57	14.04	0.00
<b>2</b>	53.79	24.86	1.24	15.34	4.77
<b>3</b>	53.48	24.84	1.48	15.45	4.76
<b>4</b>	53.33	24.85	1.62	15.44	4.76
<b>5</b>	53.28	24.83	1.67	15.45	4.77
<b>6</b>	53.26	24.82	1.70	15.45	4.77
<b>7</b>	53.26	24.81	1.72	15.45	4.76
<b>8</b>	53.25	24.81	1.72	15.45	4.76
<b>9</b>	53.25	24.81	1.73	15.45	4.76
<b>10</b>	53.25	24.81	1.73	15.45	4.76
<b>20</b>	53.25	24.81	1.73	15.45	4.76

*Source: Author's Calculation*

In addition to IRF, the study also presents FEVD in Table 2.4. FEVD assesses the percentage of variation explained by its own shock and other variables caused by a standard exogenous shock to the model based on the Cholesky decomposition method. It also provides the time path of shocks. The results of FEVD up to period 20 are presented in Table 2.4.

Table 2.4 shows that inflation and exchange rate have a significant impact on monetary policy (interest rate). For example, in the first period (Period 1), the variation in inflation explains only 2 per cent; however, by the end of the second period, it explains more than 24 per cent of the variation

in interest rates. After the second period, the impact of inflation variation tapers out. Similarly, in the first period, the variation in the exchange rate explains more than 14 per cent of the variation in the interest rate, and by the second period, this marginally increased to more than 15 per cent. Both variables combined explain roughly 40 per cent of the variation in interest rate by the end of period 10. On the other hand, the explanatory power of the growth rate and crude oil prices remained less than 2 per cent and 5 per cent, respectively, after the end of period 10. This implies that the growth rate and crude oil prices have no significant impact on monetary policy, supporting the results of the IRF. Although oil price has no significant effect on monetary policy, it is one of the major factors contributing to inflationary pressure in India (Bhattacharya & Bhattacharyya, 2001; Sarmah & Bal, 2021; Zakaria et al., 2021). Furthermore, the study finds that the growth rate plays no significant role in determining monetary policy. This also shows a lack of transmission of monetary policy to real output. The findings of the present study align with those of Mishra et al. (2016) and Subramanian & Felman (2019). The above analysis suggests that inflation targeting remained a major goal of the RBI's monetary policy, rather than the inflation-growth trade-off.

## **2.6 Summary**

Following the global financial crisis, India's monetary policy underwent a significant shift, transitioning from a discretionary to a rule-based policy framework. Accordingly, RBI moved from the MIA to the FIT approach from 2016 onwards. In this context, this study examines whether there is a regime change in monetary policy in view of the FIT approach. For this purpose, the study uses a non-linear approach to examine the regime change to account for time-varying behaviours of variables. Additionally, the study examines the major determinants of monetary policy. The results of this study suggest that there is no change in the monetary policy regime, and the objective of the monetary policy remained biased towards inflation control. Given the past history of high inflation rates in India, the monetary regime biased towards inflation-controlling is not surprising. This inertia effect was reflected in the subsequent monetary policy setting in India. Further, the study finds that the inflation rate and the exchange rate mostly influence the variation in the RBI policy rate. The impact of the output growth on the interest rates is limited. The study also found a very limited impact of oil prices on the monetary policy actions. Therefore, results show that more than 40 per cent of the changes in the interest rate are due to inflation and the

exchange rate. The impact of economic growth on the interest rate is less than 2 per cent, indicating that output growth has little bearing on the interest rate.

## Chapter 3 Credibility Switching of Monetary Policy

### 3.1 Introduction

In the previous chapter, we examined the regime switch of monetary policy in India and found that there was no change in the RBI's regime from September 2013 to March 2020, despite the implementation of FIT. However, due to the Global Financial Crisis (GFC), the economic growth had declined by 2.1 per cent. Prior to the GFC, the average growth for five years had been 8.8 per cent. Therefore, both monetary policy and fiscal policy were used to alleviate the economy (Bajpai, 2011). However, after the crisis, India experienced a period of high inflation. Therefore, we investigate how the changes in the execution of the monetary policy have affected the credibility of the RBI. One of the central questions about monetary policy has always been the importance of credibility, which has a significant impact on the effectiveness of monetary policy. According to Blinder (2000), credibility is defined as the public's belief that the central bank will act as it promises. Credibility is a significant theme in monetary policy literature. This has become important under the monetary policy of Inflation Targeting. A credible central bank may create disinflation without affecting employment under specific conditions, including reasonable expectations. Expectations play a vital role in determining the forward policy actions of monetary policy, which in turn are reflected in long-term interest rates and other asset prices (Blinder, 2000).

The economic reforms initiated in India since 1991 paved the way for a new monetary policy framework. This new framework of monetary policy is known as the Multiple Indicator Approach, where the central bank now considers credit growth, the exchange rate, the trade balance, unemployment, and fiscal policy when determining policy rates (Dua, 2023). After a lengthy era of fiscal domination in which the central bank played a key role in monetising budget deficits, the fiscal framework was overhauled and reinforced in the early 2000s. As a result, automatic debt monetization through central bank purchases of treasury bills was discontinued in 1997. The implementation of the Fiscal Responsibility and Budget Management (FRBM) Act of 2003 led to financial sector liberalization and interest rate deregulation (Kapur & Mohan, 2014; Mohan, 2005a). The change in the policy framework

enabled the RBI to assert greater independence in monetary policy and focus on controlling inflation. However, the global financial crisis in 2007-08 shifted the RBI's monetary policy from inflation control to promoting growth, which led to a rise in inflation. This process culminated in the February 2015 inflation-targeting accord and the May 2016 modified RBI Act, which gave the central bank a statutory inflation target. The RBI implemented a thorough inflation-targeting framework, imitating international best practices (Eichengreen et al., 2020; Mohan & Ray, 2019). All these factors may have some implications for the credibility. Therefore, this chapter examines whether the changes in RBI monetary policy, favouring inflation targeting, have led to inflation anchoring. The anchoring of inflation can lead to more credible monetary policy. Furthermore, the RBI switched from WPI to CPI to enhance credibility in its monetary policy. This study is unique in itself, as there have been very limited studies examining the changes in the credibility of the RBI. The changes in credibility have been recently examined by Garga et al. (2022) and Patnaik (2023).

The primary objective of this chapter is to assess the credibility of monetary policy using a non-linear econometric approach, which is particularly suitable when the variables are time-varying. The theoretical method used in this study is based on the work of Cecchetti & Krause (2002), de Mendonça & de Guimarães e Souza (2009), Kozicki & Tinsley (2008), and Taylor (1993). Previous studies that estimate central bank credibility are based on educated guesses and assume that the underlying parameters are time-invariant (Bordo & Siklos, 2014; Montes, 2009). The robustness of these models is questionable. In this context, numerous studies suggest that the credibility of a monetary policy is nonlinear and time-varying, and a nonlinear model is more appropriate for capturing credibility dynamics (Nogueira, 2009; Pleșa, 2025; Primiceri, 2005; Zeng, 2018). In this context, the evidence regarding the time path of credibility is presented, considering changes in macroeconomic conditions.

The rest of the chapter is organised into five sections. Section 3.2 reviews related literature, and Section 3.3 outlines the econometric framework, data, and stylised facts. Section 3.4 presents the empirical results, and Section 3.5 provides the summary.

### 3.2 Literature review

The adoption of policy credibility as a core concept by central banks has been widely studied and analyzed in economic literature. Credibility is fundamentally defined as the extent to which economic agents trust that policy objectives align with prevailing economic conditions. Cukierman (1986) emphasises that without credibility, policy announcements inconsistent with stated objectives lead to scepticism. Ball (1994) argues that credibility drives low inflation and economic expansion, identifying it as the key barrier to overcoming disinflation rather than staggered price-setting mechanisms. While this thesis builds upon such foundational definitions, it distinguishes itself by allowing for structural analysis of time-varying credibility, addressing unobserved factors to enrich the framework.

The role of policy credibility in fostering macroeconomic stability is reflected in measures such as the divergence between inflation expectations and target inflation rates. Bomfim & Rudebusch (2000); Demertzis et al. (2008) quantify policy credibility in the U.S. economy, highlighting that commitment-based monetary policies outperform discretionary approaches by reducing disinflation costs and duration due to enhanced credibility. Similarly, studies by Amisano & Tronzano (2010), Kupfer (2015), and Mariscal et al., (2011) were conducted to test the credibility for other countries. Amisano & Tronzano, (2010) and Kupfer, (2015) validate the European Central Bank's success in anchoring inflation expectations, though Kupfer, (2015) observes that inflation targeting retains credibility more effectively during stable periods than during crises, such as the 2008 financial crisis. He recommends considering risk premiums and liquidity effects in such scenarios. Mariscal et al., (2011) examine the Bank of England's policy credibility, noting that while credibility improved prior to the adoption of inflation targeting (1992–2007), it deteriorated in subsequent years.

In the South African context, researchers Addo, (2017); Kabundi et al. (2015); Kaseeram, (2012); Pierdzioch et al., (2016); Reid, (2009); Rigobon, (2007) assess the South African Reserve Bank's (SARB) credibility from varying perspectives and methodologies. Their findings suggest that while the SARB's credibility is affirmed among financial markets, inflation expectations among firms, unions, and households show marked deviations from target rates.

Empirically, the issue of credibility has been neglected in the context of India, especially, covering the FIT period. Bordo & Siklos (2019) examined the convergence between advanced economies

and emerging market economies and found that emerging market economies, such as India, are more fragile, indicating low credibility. However, a study by Garga et al. (2022) evaluated the credibility of RBI from January 2010 to February 2020 and found that the RBI's credibility has improved since the implementation of the FIT. Similarly, Eichengreen et al. (2020) found evidence of inflation expectations being anchored, indicating an increase in credibility of the RBI. Patnaik (2023) also reached a similar conclusion regarding credibility, using quarterly data from 2014Q1 to 2022Q1. Although the existing studies provide evidence of improvement in credibility, the dynamics of credibility shifts have not been explored. This study examines the dynamics of credibility shifts by developing a credibility index that measures the gap between actual inflation and the RBI's stated target. Using this index, we examine the RBI's credibility through the lens as suggested by Blinder (1999). Following Bordo & Siklos (2015), this research employs Markov-Switching Vector Autoregression (MS-VAR) with time-varying transition probabilities to analyse credibility through a nonlinear, regime-switching technique, providing a clear understanding of its evolution. This study advances the discourse by allowing underlying credibility to evolve dynamically over time.

### 3.3 Data and Methodology

#### 3.3.1 Data

The study uses monthly data from June 2006 to January 2020. Data has been compiled from various sources (see Table 3.1).

**Table 3.1 Variable Description**

<b>Variables Symbol</b>	<b>Description</b>	<b>Source</b>
<b>CRED</b>	Credibility Index	Calculated by the author from annual reports and DBIE
<b>WACR</b>	Weighted Average Call Money Rate	DBIE
<b>GAP</b>	Output Gap calculated using Index of Industrial Production (IIP)	Estimated from IIP from DBIE
<b>FD_USD</b>	Changes in the price exchange rate of US Dollar	DBIE
<b>FD_Oil</b>	Change in the price of West Texas Intermediate Crude Oil	FRED

*Source: Authors Compilation*

To measure the changes in the credibility of the RBI, this study uses the Markov switching vector auto-regression (MS-VAR) model. The MS-VAR allows the measurement of the changes in the credibility of the central bank. Therefore, to study the changes in credibility, we use a credibility indicator, the interest rate, the output gap, and the change in the price of the exchange rate and oil. We used the data till January 2020 to avoid the effect of COVID-19-induced lockdowns, which crippled the economy completely. Additionally, it was in January 2020 that the World Health Organisation (WHO) declared COVID-19 a pandemic.

### 3.3.2 Model Specifications

Following Addo (2017), this study employs the concept of credibility shifts. The study applies the following model:

$$\text{CRED} = f(\text{WACR}, \text{GAP}, \text{FD\_USD}, \text{FD\_Oil}) \quad 3.1$$

According to Equation (3.1), credibility is a function of the interest rate, output gap, changes in the exchange rate, and changes in the price of oil. The changes in the exchange rate and the price of oil are taken as control variables. The model is based on the forward-looking modified Taylor rule as explained in Chapter 2.

Equation 3.21 can be rewritten using a VAR framework as follows.

$$\begin{bmatrix} \text{CRED}_t \\ \text{WACR}_t \\ \text{GAP}_t \\ \text{FD\_USD}_t \\ \text{FD\_Oil}_t \end{bmatrix} = \begin{bmatrix} \alpha_{1S_t} \\ \alpha_{2S_t} \\ \alpha_{3S_t} \\ \alpha_{4S_t} \\ \alpha_{5S_t} \end{bmatrix} + \begin{bmatrix} \beta_{11S_t} & \beta_{12S_t} & \beta_{13S_t} & \beta_{14S_t} & \beta_{15S_t} \\ \beta_{21S_t} & \beta_{22S_t} & \beta_{23S_t} & \beta_{24S_t} & \beta_{25S_t} \\ \beta_{31S_t} & \beta_{32S_t} & \beta_{33S_t} & \beta_{34S_t} & \beta_{35S_t} \\ \beta_{41S_t} & \beta_{42S_t} & \beta_{43S_t} & \beta_{44S_t} & \beta_{45S_t} \\ \beta_{51S_t} & \beta_{52S_t} & \beta_{53S_t} & \beta_{54S_t} & \beta_{55S_t} \end{bmatrix} + \begin{bmatrix} \text{CRED}_{t-1} \\ \text{WACR}_{t-1} \\ \text{GAP}_{t-1} \\ \text{FD\_USD}_{t-1} \\ \text{FD\_Oil}_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1S_t} \\ \epsilon_{2S_t} \\ \epsilon_{3S_t} \\ \epsilon_{4S_t} \\ \epsilon_{5S_t} \end{bmatrix} \quad 3.2$$

where, CRED is the Credibility Indicator as calculated by the authors,

WACR is the Weighted Average Call Money Rate

GAP is Output Gap calculated using Index of Industrial Production

FD\_USD is the change in the price exchange rate of the US Dollar

FD\_Oil is the change in the price of West Texas Intermediate Crude Oil

The justification for including other independent variables is as follows: An increase in the price of crude oil can lead to higher energy costs and increased inflation (Sarmah & Bal, 2021). Once inflation increases, the central bank's credibility will be adversely affected (Yanamandra, 2015). Therefore, any change in the value of the rupee can also affect the central credibility. Further, output gap might affect credibility. For example, a persistent positive output gap may create inflationary pressure and increase inflationary expectations, leading to a reduction in credibility. On the other hand, a negative output gap can create downward pressure on inflation and thereby reduce inflation expectations. However, if this negative output gap increases to high levels, it can push the inflation below the limits and hence reducing the credibility. Enhanced central bank credibility can lead to improved trade-off between inflation and the output gap. With higher credibility, economic agents will form inflation expectations in accordance with the stated inflation target. Consequently, price stability can be realized predominantly through expectation anchoring, thereby reducing the need for any policy interventions (Çakmaklı & Demiralp, 2020; Tronzano, 2005).

This study also uses the concepts of the Markov process. The MS-VAR is able to capture the states or the regimes based on the observed data. The MS-VAR model is developed on the standard VAR model with the addition of the regime-switching process. The model has the lagged value of each variable along with a dummy component as 's', indicating the state of the model.

### ***3.3.3 Econometric Methodology***

The study uses advanced time-series methods to examine the credibility changes in India. A multi-step procedure has been followed. First, all the variables are checked for their time-series properties by applying the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) test. In the second stage, we calculated the credibility index. In the third stage, we examined the role of other variables such as oil price, interest rate, and output gap using a multivariate MS-VAR model. In the fourth stage, the study uses the Impulse Response Function (IRF) to further understand the impact of dependent variables on independent variables.

*Markov-Switching Intercept Vector Autoregressive Model (MSI-VAR)*

The regime shifts in the time series model can be best captured by the Markov switching models. The major driver of changes in the regimes can be the behaviour of economic variables, which may result from unobserved changes in economic regimes, such as shifts in policy regimes, crises, booms, or recessions. These models are appropriate when the variables display time-varying properties (Hamilton, 1989, 1996). (Krolzig, 1997) classified the MS-VAR model into two categories: one with the intercept switches and another with the mean switches. In the MSI(M)-VAR(p) model, only intercepts differ across regimes. The variables 'M' and 'p' denote the number of regimes and the autoregressive lag order, respectively. To analyse a K-dimensional time series,  $y_t$ , a Multivariate State-Space Integrated-VAR (MSI-VAR) model is represented by equation 3.3.

$$y_t = \begin{cases} A_{01} + \sum_{i=1}^p A_i y_{t-i} + \frac{1}{2} e_t \\ \vdots \\ A_{0M} + \sum_{i=1}^p A_i y_{t-i} + \frac{1}{2} e_t \end{cases} \quad 3.3$$

where  $e_t \sim \text{NID}(0, I_K)$ .

This particular model assumes the system switches between  $M$  regimes, primarily differing in their intercept term ( $A_{0i}$ ), while the autoregressive structure ( $A_1, \dots, A_p$ ) and variance-covariance ( $\Sigma$ ) remain consistent across these states. The idea is that an unobserved variable,  $S_t$ , reflects the prevailing economic condition and determines which intercept applies. To understand how this underlying state  $S_t$  (where  $S_t$  is dynamic and can be any integer from 1 to  $M$ ) changes over time and infer its path from data. Markov-switching models provide the tool for this, treating it as a discrete-time Markov chain with distinct states. The behaviour of this chain and the regime-switching is defined by (equation 3.4), the specific probabilities of moving from one state to another:

$$p_{ij} = \Pr(s_{t+1} = j \mid s_t = i), \sum_{j=1}^M p_{ij} = \mathbf{1}, \text{ for all } i, j \in \{1, \dots, M\}. \quad 3.4$$

The transition probabilities between the states (regimes) are ordered into the transition probability matrix  $P$  (equation 3.5)

$$P = \begin{bmatrix} p_{11} & p_{12} & \dots & p_{1M} \\ p_{21} & p_{22} & \dots & p_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ p_{M1} & p_{M2} & \dots & p_{MM} \end{bmatrix}. \quad 3.5$$

$S_t$  follows an ergodic  $M$  state Markov process. Ergodicity in a Markov chain means that all its states share the properties of being aperiodic and recurrent (Droumaguet, 2012).

### 3.4 Results and Discussion

#### 3.4.1 Preliminary Results

This section of the study describes the variables included in the study.

##### 3.4.1.1 Weighted Average Call Money Rate (WACR)

We use the Weighted Average Call Money Rate (WACR) as a measure of interest rate in the economy. WACR is also the operating target of monetary policy (Das, 2022). Figure 3.1 shows the trend in WACR over the study period. The graphical analysis shows us that when the global financial crisis hit the world, WACR reacted to it severely, as it first decreased and then increased as the crisis subsided. However, as the Federal Reserve Bank had kept interest rates very low, the Indian central bank also followed this path but had to increase rates by the end of 2009 as inflation in the economy started to rise. This increase in interest rates was mainly a response to high inflation in the economy. The high inflation in the economy remained till FIT was implemented, thereby gradually decreasing the rates of interest in the economy. Towards the end of the study period, we observe that interest rates have declined sharply, primarily in response to the declining growth rates in the economy.

**Figure 3.1: Trends in Weighted Average Call Money Rate (WACR)**



Source: Authors Compilation

### 3.4.1.2 Credibility Index (CI)

The Credibility Index (CI) of the central bank is estimated using the Equation 3.6:

$$CI_t = \begin{cases} 1 & \text{if } \pi_t = \bar{\pi}_t \\ 1 - \frac{1}{\pi_t^*} [\pi_t - \bar{\pi}_t] & \text{if } \pi_{t,\min}^* < \pi_t < \pi_{t,\max}^* \\ 0 & \text{if } \bar{\pi}_{t,\max} \leq \pi_t \leq \bar{\pi}_{t,\min} \end{cases} \quad 3.6$$

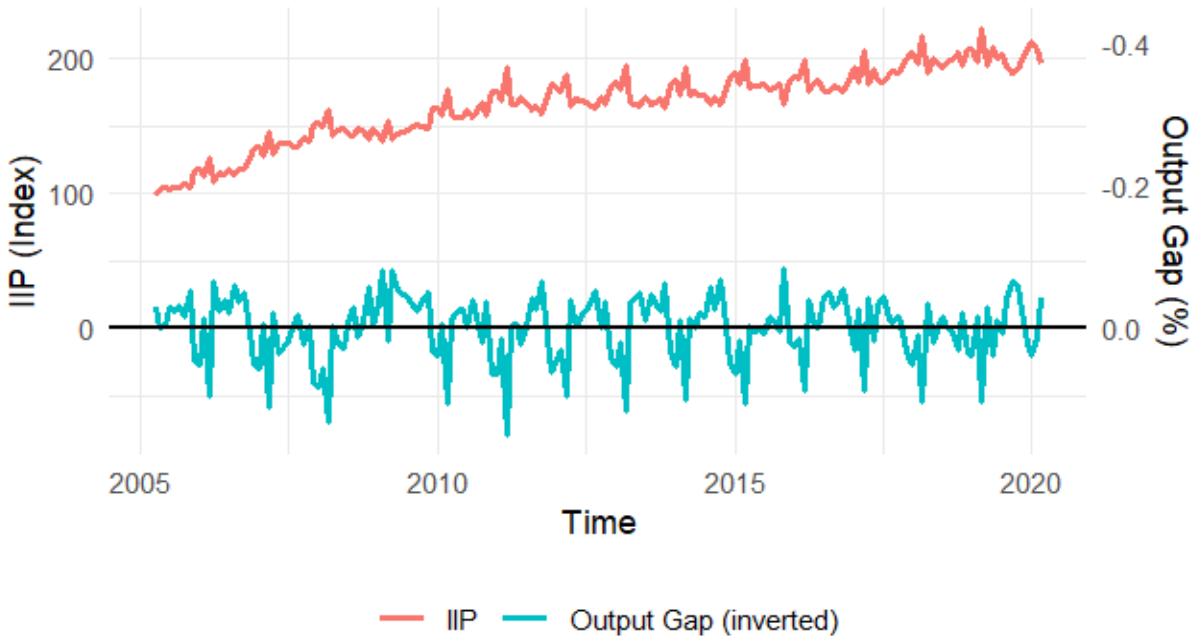
Based on the framework developed by (Addo, 2017; Cecchetti & Krause, 2002; de Mendonça & de Guimarães e Souza, 2009) where CI is the credibility index which takes the value 1, when targeted inflation rate is equal to actual inflation.  $\pi_t^*$  represents the bandwidth, which is the difference between upper and lower limits of inflation.

In case of the current FIT, it is 4 percent (6-2= 4). This allows the central bank to have a degree of flexibility to absorb shocks and take proactive actions to stimulate growth in the economy. However, if inflation is outside the bandwidth, the credibility index takes the value 0.

Before the implementation of the FIT, the RBI provided forward guidance about inflation rates through annual reports and other policy documents. To measure the inflation rate, we took the linear distance from the target to actual inflation and then standardised it. However, if the inflation



**Figure 3.3: IIP and Output Gap**



*Source: Authors Compilation*

Figure 3.3 shows the Index of Industrial Production for the Indian economy for the study period. From the IIP, we derive the output gap which has been changing with the business cycle. When there is a boom in the economy, the output is more than the potential output; as the economy contracts, the output gap falls to negative, or, in simple words, output falls below the potential level. As the world moved into recession due to the GFC, the growth rate fell below its potential level in India. This was also seen in the fall growth rate of the economy.

#### ***3.4.1.4 Exchange Rate***

The exchange rate is very important for developing countries such as India, which are open economies and are dependent on imports and exports. Various studies in the past have identified RBI as an active manipulator of exchange rates. The exchange rate also plays an important role in affecting the price level in the economy. Figure 3.4 shows the exchange rate in the economy. This study uses the changes in exchange rate to control the movements in exchange rate affecting the economy.

**Figure 3.4 Exchange Rate with respect to USD**



*Source: Authors Compilation*

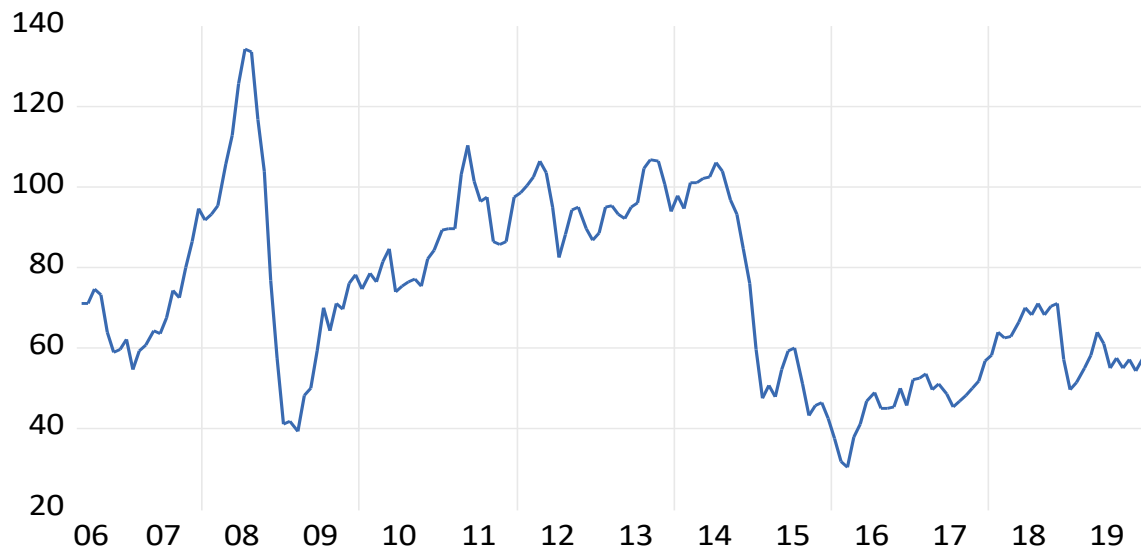
Figure 3.4 also illustrates the volatility in the USD-INR exchange rate. During the GFC in 2007, there was some appreciation in the price of the Indian rupee, and then later followed a depreciation. However, over the longer run, we find that the INR has depreciated compared to the USD, from an initial exchange rate of Rs. 45 to more than Rs. 70 per dollar.

### **3.4.1.5 Oil Prices**

India is one of the largest importers of Oil in the world; therefore, the prices of crude oil affect the Indian economy in various ways. When the price of crude oil is high, there is pressure on the exchange rate and balance of payments. Crude oil also represents the cost of energy in the economy. Crude oil plays an important role in determining the level of inflation in the economy. As the price of crude oil increases, it can result in either an increase in the domestic prices of petrol and diesel or the government can absorb the price hike by subsidising the price of fuel. When the price of fuel is increased for the general public, the cost of transportation of goods increases, thereby increasing the rate of inflation. However, the hike is not passed on to the public; the government budget deficits are bound to increase as it will have to subsidise the importers, hence putting pressure on the government budget.

The price of petrol and diesel in Delhi at the beginning of the study period was Rs. 46.85 and Rs. 32.25, respectively, and by the end of the study period, the prices of petrol and diesel were Rs. 73.27 and Rs. 66.28, respectively (Petroleum Planning & Analysis Cell, 2023). The prices of fuel have fluctuated during this period as international crude oil prices have also undergone changes. However, in India, fuel prices are not deregulated and are administered by the government from time to time. Figure 3.5 shows the price of crude oil in the international markets. The price of crude oil was initially very high at the beginning of the study period, reaching as high as \$120 per barrel, and subsequently dropped to as low as \$40 per barrel. However, the prices of crude oil have declined overall during the study period, from more than \$60 per barrel to less than \$60 per barrel.

**Figure 3.5 Crude Oil Prices**



*Source: Authors Compilation*

### **3.4.2 Unit root test**

Table 3.2 shows the results of the unit root test. We used the Augmented Dickey-Fuller test and the Phillips–Perron test to check for the stationarity of the variables. We find all the variables are stationary at the level or I(0) series. Since all the variables are I(0), the VAR model is appropriate and the optimal lag length of the model is selected using multiple criteria such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Final Prediction Error (FPE)

and Hannan-Quinn information criteria (HQ), and Likelihood Ratio (LR) test and the results are presented in Table 3.2.

**Table 3.2 Results of Unit Root Test**

Variable	ADF Test		PP Test		Results
	At Level with Intercept		At Level with Intercept		
	Adj. t-Stat	p-value	Adj. t-Stat	p-value	
<b>WACR</b>	-4.17	0.00**	-4.17	0.00**	I (0)
<b>CRED</b>	-3.54	0.01**	-3.45	0.01**	I (0)
<b>GAP</b>	-3.58	0.00**	-11.19	0.00**	I (0)
<b>FD USD</b>	-9.93	0.00**	-9.80	0.00**	I (0)
<b>FD OIL</b>	-8.66	0.00**	-8.66	0.00**	I (0)

\*\* p<0.01 and \* p< 0.05

Source: Authors Calculations

After checking the unit root of the variables, the study checks the optimal lag-order of VAR and results are presented in Table 3.3. Results from Table 3.3 suggest that the optimal lag should be 1 as suggested by all the criteria except the likelihood ratio (LR) test which shows the optimal lag should be 5. Since the majority of the test statistics predict the optimal lag length of 1, we use a lag length of 1 in our model.

**Table 3.3: VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
<b>0</b>	-884.9	NA	0.04	10.85	10.95	10.89
<b>1</b>	-648.07	456.34	0.00*	8.27*	8.84*	8.50*
<b>2</b>	-629.89	33.92	0.00	8.35	9.39	8.77
<b>3</b>	-615.2	26.51	0.00	8.48	9.99	9.09
<b>4</b>	-589.07	45.57	0.00	8.46	10.45	9.27
<b>5</b>	-557.55	53.04*	0.00	8.38	10.84	9.38
<b>6</b>	-541.04	26.77	0.00	8.49	11.42	9.68
<b>7</b>	-525.86	23.71	0.00	8.61	12.01	9.99
<b>8</b>	-505.36	30.74	0.00	8.66	12.54	10.24

Notes: Lag length is selected using FPE, AIC, SC, and HQ.

Source: Authors Calculations

### 3.4.3 Regime Switches

After checking the stationarity and appropriate lag length for our model, we apply MS-VAR to examine the regime switches in the credibility of the central bank or monetary policy. For this purpose, we estimate the transition probability matrix of the regimes: R1 and R2. Regime 1 (R1) represents the state of low credibility of the RBI. In the state R1, the public's trust is lower because the difference between actual and forecasted inflation by the RBI is significantly higher. In the state-regime 2 (R2), the public's trust is higher, as the difference between actual and forecasted inflation by the RBI is significantly lower. The results are presented in Table 3.4.

The results show that both regimes are very stable. This is because if the regime started with R1 (low credibility), the probability of staying with R1 is 0.91. The probability of switching from R1 to R2 is 0.09, or very low. On the other hand, if the regime starts with R2, the probability of staying in R2 is 0.93. The probability of switching from R2 to R1 is 0.07. Therefore, both regimes, R1 and R2, are stable in India. As a result, we can conclude that both regimes are viable in India.

**Table: 3.4: Transition Probability Matrix**

State	R1	R2
R1	0.91	0.09
R2	0.07	0.93

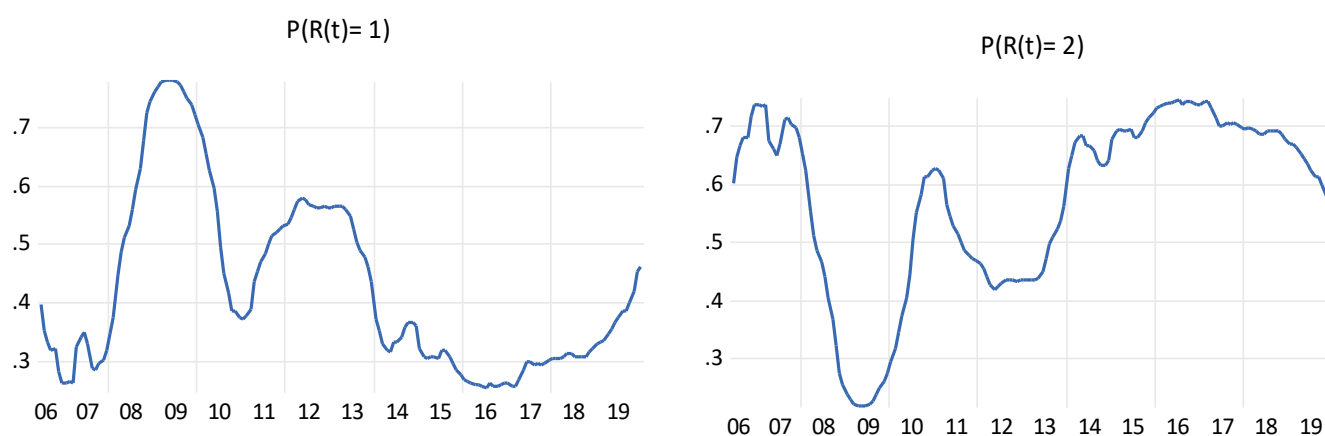
*Source: Authors' Calculations*

To study the time path of regime switches, we plotted the regime probabilities against time. The results are presented in Figure 3.6. The graph illustrates two regime switches between R1 and R2 during period from 2006 to 2020. It is observed that the first regime switch happened from R2 to R1 in the middle of 2007, as the probability of being in the state of R2 declined and the state of R1 increased significantly. The second switch from R1 to R2 occurred between 2013 and 2014, and since then, regime R2 has become more dominant.

At the beginning of the study period in 2006, we found that regime R2 was dominant, and the first regime switch happened around the beginning of 2008 or the end of 2007. This shows that during this period, the RBI followed a growth-enhancing regime instead of strict inflation control, resulting in a credibility switch from R2 to R1. During this period, the world experienced a global financial crisis (GFC). The GFC compelled the RBI to shift its focus from inflation control to growth enhancement. However, it is important to note that it took almost half of the decade, from

2008 to 2014, to return to regime R2 due to volatile global conditions. This suggests that the RBI was dealing with the after-effects of the GFC till 2014 and not focusing on inflation control. The regime shifts also coincided with the change in the monetary policy framework. To improve credibility, RBI also shifted from the Wholesale Price Index (WPI) to the Consumer Price Index (CPI) as a measure of inflation level. The rationale for shifting from WPI to CPI was recommended by the Patel Committee (2014). The choice of a new nominal anchor for monetary policy was based on improving the communication and transparency of the monetary policy. After the shift in the regime in 2014, we find that the model predicts no further change in regimes, indicating the stability of the monetary policy regime. However, towards the end of the study period, we find that the probability of R2 starts to decline following the spread of COVID-19. This has resulted in a lower growth rate experienced by the economy during that period. The study period ends in January 2020. Following this, many parts of the world have begun implementing lockdowns, and restrictions on movement have started to emerge.

**Figure 3.6 Probabilities of Regimes**



Source: Authors' Calculations

In 2016, there was a shift in the institutional framework of interest decisions by the governor to the Monetary Policy Committee (MPC). We find that this institutional shift in the monetary policy framework had no impact on the credibility of the RBI.

### 3.4.4 Multivariate Analysis

After checking the regime switches, the study analyses the role of other variables, such as the output gap, interest rate, exchange rate, and oil price, on credibility using the MAS-VAR model.

We first analyse the results of the shifts in regime (change in CRED value). The results are presented in .

Table 3.5. It is seen that Regime 1 is less credible than Regime 2, although both regimes are statistically significant. However, Regime 1 has a coefficient of 0.09, and Regime R2 has a coefficient of 0.74, indicating the R2 regime is more credible. The rise in the credibility of the RBI (R2) can be attributed to the measures implemented by the RBI to improve its credibility.

**Table 3.5 MS-VAR Estimation Results of Constant**

Variable	Regime 1 Coeff.	Regime 2 Coeff.	Std. Error (R1)	Std. Error (R2)	z-Statistic (R1)	z-Statistic (R2)
	(Constant)	(Constant)				
WACR	6.29***	6.98***	0.41	0.41	15.33	17.23
CRED	0.09**	0.74***	0.03	0.03	2.54	22.39
GAP	-0.01	0.01	0.01	0.01	-0.85	1.00
FD_USD	0.27	0.07	0.16	0.14	1.68	0.47
FD_OIL	0.51	-0.56	1.07	1	0.48	-0.56

\*\*\*, \*\*, and \* denote significance at 1, 5, and 10 % levels, respectively.

Source: Authors' Calculations

After analysing the regime switches, we present the role of other variables in regime switches. The results are presented in Table 3.6. Results from Column 2 suggest that credibility is positively affected by its own past values, suggesting the presence of the inertia effect. Furthermore, the WACR has a positive (0.01) and significant impact on credibility, indicating that a tighter monetary policy is associated with higher credibility. After the GFC, India experienced high inflation; therefore, a tighter monetary policy was implemented. This had a positive impact on credibility. Therefore, a more disciplined monetary policy made the RBI more credible.

In addition, the study finds that the output gap has no significant impact on credibility, contradicting theoretical expectations. This may be related to the potential growth being close to the actual growth rate. However, the literature suggests that a decline in credibility can increase the output gap; conversely, higher credibility did not have a significant impact on growth (Park, 2023). The changes in foreign exchange rates and oil prices also had no significant impact on influencing the credibility of the RBI. This may be related to the RBI's exchange rate management and the determination of oil prices in the domestic market. The shocks in the growth rate and external factors do not affect the credibility of monetary policy.

**Table 3.6 Common Coefficients**

<b>Variable</b>	<b>WACR (-1)</b>	<b>CRED (-1)</b>	<b>GAP (-1)</b>	<b>FD_USD (-1)</b>	<b>FD_OIL (-1)</b>
<b>WACR</b>	0.82*** (17.54)	0.01** (2.56)	0.00 (1.09)	0.04 (0.77)	-0.75** (-2.85)
<b>CRED</b>	-0.96 (-2.00)	0.75*** (12.55)	0.03 (1.12)	0.13 (0.26)	2.27 (0.85)
<b>GAP</b>	-1.81 (-1.03)	-0.04 (-0.20)	0.15* (1.90)	-2.54 (-1.42)	20.73** (2.11)
<b>FD_USD</b>	0.05 (0.68)	-0.01 (-0.58)	-0.00 (-0.34)	0.23*** (2.98)	-0.47 (-1.09)
<b>FD_OIL</b>	0.01 (1.11)	0.00 (0.85)	0.00 (0.17)	-0.01 (-0.73)	0.35*** (5.13)

Note: z-statistics in parentheses. \*\*\*, \*\*, and \* denote significance at 1, 5, and 10 % levels, respectively.

Source: Authors' Calculations

In addition, the study finds that the output gap has no significant impact on credibility, contradicting theoretical expectations. This may be related to the potential growth being close to the actual growth rate. However, the literature suggests that a decline in credibility can increase the output gap; conversely, higher credibility did not have a significant impact on output (Park, 2023). The changes in foreign exchange rates and oil prices also had no significant impact on influencing the credibility of the RBI. This may be related to the RBI's exchange rate management and the determination of oil prices in the domestic market. The shocks in the growth rate and external factors do not affect the credibility of monetary policy.

Therefore, based on the above analysis, we can conclude that credibility is self-reinforcing, and any slip-ups in monetary policy can have a long-lasting negative impact on credibility. India has a history of experiencing higher inflation, and it has traditionally employed a tighter monetary policy to combat it. This has a positive impact on the credibility. The results further suggest that the RBI should adhere to long-term commitments and refrain from reacting excessively to fluctuations in exchange rates and oil prices. Therefore, the credibility of the RBI largely depends on its past reputation and monetary discipline. The presence of two distinct regimes also signifies that credibility is not static and can shift over time, emphasising the importance of stable, predictable monetary policies.

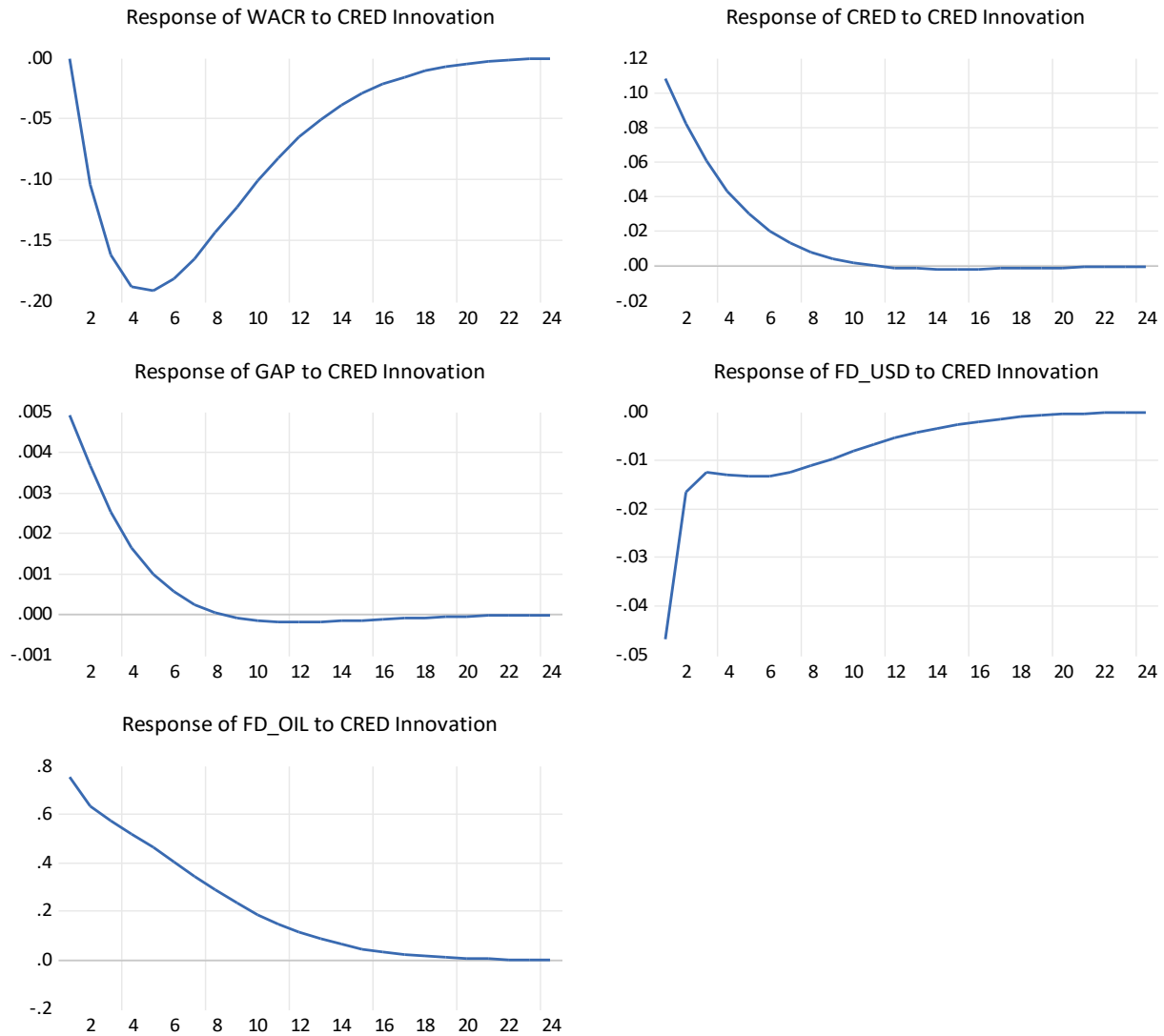
### ***3.4.5 Impulse Response Function (IRF)***

Impulse Response Functions, or IRFs, are used to examine the dynamic relationship among variables. It outlines the impact of one unit or one standard deviation shock to an endogenous variable and its effects on all the endogenous variables, including its own, while keeping everything else constant. Figure 3.7 shows the impulse response function to a standard deviation shock over the time horizon of 24 months. The first graph shows the response of credibility to the interest rate shock. It is observed that a single standard shock to the interest rate initially leads to a decline in credibility. However, after reaching the minimum in period 5, credibility starts to recover, suggesting that a rise in interest rates improves credibility. By moderating the inflationary pressure. Recovery of credibility after period 5 indicates the expectation of appropriate actions by the RBI.

The second graph shows the response credibility to its own shock. As we can see from the graph, our own shock results in a decline in credibility in the initial period, and the shock is eventually neutralised by the end of the 10<sup>th</sup> period. The third graph illustrates the response to a shock in the output gap in terms of credibility. A shock in the output gap induces a fall in credibility, and this process continues till period 8<sup>th</sup>. After that, its impact is neutralised.

The fourth graph shows the credibility response to a standard shock in the exchange rate. Initially, there is a significant decline in credibility during the first period, followed by a rapid recovery in the subsequent period. The recovery process continues till the 4<sup>th</sup> period. After the 4<sup>th</sup> period, the recovery process continues over time. The last graph illustrates the change in credibility in response to a standard shock in oil prices. It is observed that a decisive trend follows an oil price shock. This is due to the expectation that a rise in oil prices may hinder achieving the targeted inflation level.

**Figure 3.7: Impulse Response Function (IRF)**



*Source: Authors Calculations*

Therefore, the impulse response function shows that a shock in interest rate, output gap, oil price, and exchange rate have a negative impact on credibility. Further, the process of recovery is different depending on the shocks to each variable.

### 3.5 Chapter Summary

In the 2014, RBI provided an outline of changes in the monetary policy framework. The framework outlined certain changes at the RBI, including changing the nominal anchor of the RBI, switching

from the WPI to the CPI as the official measure of inflation, and establishing the Monetary Policy Committee to determine interest rates in the economy. In this chapter, we examined the credibility and shift in credibility using the MSVAR model. The results from our study show an improvement in credibility during the FIT period. Further, the credibility of the RBI declined following the GFC, and the RBI was only able to regain its credibility after 2013. This demonstrates that credibility can take time to recover and have a lasting impact. The increase in credibility of the RBI should have led to a more stable economy, thereby encouraging investment and enhancing the economy's growth rate. However, in the case of India, we find evidence that the credibility has led to a reduction in the economy's growth rate. Therefore, to uncover this mystery, we will re-estimate the threshold level of inflation for the country to check if the RBI is having an excessively tight monetary policy or not.

## Chapter 4 : Threshold Inflation in India

### 4.1 Introduction

In Chapter 3, the study examined the credibility of monetary policy, and the results suggest that it has become more credible since 2014. The increase in credibility of the monetary policy ideally should go hand in hand with higher economic growth. However, when we examine the growth rate between the high-credibility regime and the low-credibility regime, we find that the growth rate declined during the high-credibility regime (see Table 4.1). This motivates further investigation into whether a high-credibility regime has a dampening growth effect. Therefore, in this chapter, we investigate the role of monetary policy in promoting economic growth, given that the RBI has a dual mandate of controlling inflation within the targeted range while ensuring the growth rate is maximised.

Public policies in most countries have predominantly aimed to promote high and sustainable GDP growth while maintaining low inflation levels consistent with steady-state economic expansion. Until the late 1960s, the relationship between inflation and growth was either considered negligible or thought to be slightly positive. The sustained period of high inflation, coupled with low economic growth, in the 1970s fundamentally shifted perspectives, leading to empirical studies aimed at understanding the relationship between inflation and economic growth (Blanchard, 2016; Gordon, 2011; Santomero & Seater, 1978). Most empirical studies suggest that inflation has a positive influence on economic growth up to a certain threshold, beyond which it becomes detrimental (Andrés & Hernando, 1999; Azam & Khan, 2022; Khan & Senhadji, 2001; Kremer et al., 2013; Mandeya & Ho, 2022; Rousseau & Wachtel, 2002).

High levels of inflation generate uncertainty that affects real savings, real investments, and exchange rates, leading to a misallocation of resources that hinders economic growth. Generally, the inflation threshold at which growth is maximized is higher for developing nations than for developed and industrialized countries (Ball, 2017; Dash & Kumar, 2018; Deaton, 1983; Fischer & Modigliani, 1978; Ha et al., 2020; Sen et al., 2020). Therefore, calculating the threshold inflation level is crucial for optimizing growth performance. The threshold level of inflation is a dynamic

concept that evolves over time, influenced by various factors such as the structural transformation of the economy, the extent of international openness, financial innovations, shifts in the monetary policy framework, and, most importantly, changes in overall productivity (Bernanke & Mishkin, 1997; Cecchetti et al., 2007; Dholakia, 2020; Koester et al., 2021; Mubarik, 2005). Since the reforms, the Indian economy has transitioned from the Multiple Indicators Approach (MIA) to Flexible Inflation Targeting (FIT), with an inflation target set at 4 per cent and a bandwidth of 2 per cent in either direction.

Since the economic liberalisation of 1991, India has undergone significant changes in its economic landscape. As one of the world's largest developing economies, India's trajectory has been marked by periods of robust growth and inflationary pressures. This has prompted a continuous dialogue among policymakers, economists, and scholars about the optimal balance between growth and inflation (Dash & Kumar, 2018; Dholakia, 2020). While moderate inflation is viewed as conducive to achieving higher growth, high inflation can erode purchasing power and destabilise growth potential. The relationship between these two macroeconomic variables has been linked to the success of monetary policy.

The objective of this chapter is to estimate the threshold level of inflation using the most recent period. To estimate the threshold level of inflation, the study employs Logistic Smoothed Transition Autoregressive (LSTAR) and Threshold Vector Autoregressive (TVAR) models (see Section 4.3). Earlier studies have estimated the threshold level using the Spline regression. However, recent literature has identified spline regression as less effective in capturing the threshold level compared to TVAR, using various simulations. Spline regression is best suited when there is a smooth shift in regime; if the change is abrupt, then TVAR is better suited (Haslbeck et al., 2021). By identifying the critical threshold level of inflation, this study contributes to a deeper understanding of the complex relationship between inflation and growth, providing policymakers and economic planners in India with relevant insights.

This chapter is divided into five sections. Section 4.1 provides the introduction to the chapter. Section 4.2 examines the existing literature on estimating the threshold level of inflation in India. Section 4.3 of this chapter discusses the model specification, data and methodology. Section 4.4 provides results and a discussion on the results. Section 4.5 provides a discussion on the Generalized Impulse Response Functions. Finally, in the section 4.6 we present the summary.

## 4.2 Literature Review

The existing literature on the relationship between inflation and economic growth is extensive, covering a wide range of studies in both developed and developing countries. The results of these studies are mixed and sometimes even contradictory. To navigate this complex landscape, the literature can be classified into four major categories. First, some research finds no significant relationship between inflation and growth (Jha & Dang, 2012; Khan & Senhadji, 2001; Khandelwal et al., 2023). Second, studies have identified a positive relationship in the long run (Ericsson et al., 2001; Geetha et al., 2011; Mwakanemela, 2013). Third, certain studies report a negative short-term relationship (Faria & Carneiro, 2001; Hodge, 2006; Özyılmaz, 2022). Lastly, a considerable portion of the literature suggests a non-linear relationship, where inflation positively influences growth up to a critical threshold or inflexion point, after which the effect turns negative (Mubarik, 2005; Munir et al., 2009; Ndoricimpa, 2017; Thanh, 2015; Vinayagathan, 2013). This categorisation helps in systematically analysing the diverse findings and perspectives presented in previous studies.

Wai (1959) examined the relationship between inflation and economic growth in less developed countries using data from 1938 to 1954. The study found no significant connection between inflation and economic growth. Fountas (2010) explored the relationship between inflation, inflation uncertainty, and their real effects by analysing annual data over more than a century for 22 industrialised countries. The results suggest that inflation uncertainty does not appear to be detrimental to growth. Furthermore, Fountas & Karanasos (2007), using data from the G7 nations, discovered that uncertainty associated with the inflation rate has mixed effects on output growth.

According to Mallik & Chowdhury (2001), a long-term positive relationship exists between GDP growth and inflation in Bangladesh, India, Pakistan, and Sri Lanka, using cointegration and error correction models on data up to 1997. Kryeziu & Durguti (2019) investigated the impact of inflation on GDP growth within the Eurozone, using panel data from 1997 to 2017 and applying multiple linear regression analysis to explore the influence of inflation as an independent variable. Their findings indicated a positive impact of inflation on economic growth rates in the euro area. Complementing this, another empirical analysis across seventy-nine developing countries from 2002 to 2018 employed PMG, FMOLS, and DOLS methods to examine the effects of various factors including inflation on economic growth. The study revealed that while factors such as

corruption and unemployment negatively affected GDP per capita, inflation, alongside governance effectiveness and the rule of law, had a positive impact on GDP per capita (Uddin & Rahman, 2023).

Mubarik (2005) investigated the inflation-growth nexus in Pakistan from 1973 to 2000, discovering that an inflation rate above 9 per cent negatively impacted economic growth. Similarly, Munir & Mansur (2009) examined this relationship in Malaysia from 1970 to 2005, finding that while inflation rates above 3.89 per cent hindered growth, rates below this threshold positively influenced growth. Gillman et al. (2004) explored the inflation-growth dynamics within a panel of OECD and Asia-Pacific Economic Cooperation (APEC) member countries from 1967 to 1997, identifying a consistent negative inflation-growth effect, particularly pronounced at lower levels of inflation. The negative impact of inflation was significant among OECD countries, with similar APEC results observed in countries.

Fischer (1993) first identified a non-linear relationship between inflation and economic growth using data from ninety-three countries, with subsequent studies confirming these findings. Barro (1995) detected a threshold inflation rate of 10 per cent using global data from 1960 to 1990, while Jude & Khan (2014) highlighted multiple thresholds using Panel Smooth Transition Regression (PSTR) and dynamic Generalised Method of Moments (GMM) techniques. Vinayagathan (2013) confirmed a significant non-linear relationship with a critical threshold of about 5.43% for Asian economies from 1980 to 2009. Additionally, Sanga & Gui-Diby (2020) investigated the inflation threshold in Franc zone currency unions, proposing adjustments to the inflation thresholds in African monetary unions based on data from 1970 to 2018. This body of research underscores the increasingly accepted concept of non-linear inflation-growth dynamics and the practical relevance of specific inflation thresholds.

#### ***4.2.1 Historical Trends of Inflation and Economic Growth***

After the liberalisation of the economy in 1991, there was a need to move away from the practice of monetary targeting. Under this framework, the RBI used M3 as the nominal anchor; however, following the reforms, it became impossible for the RBI to control the amount of money flowing into the economy, necessitating an evolution in monetary policy (Rangarajan, 2020). The evolution in monetary policy came through in 1998 when the RBI shifted to a multiple indicator approach

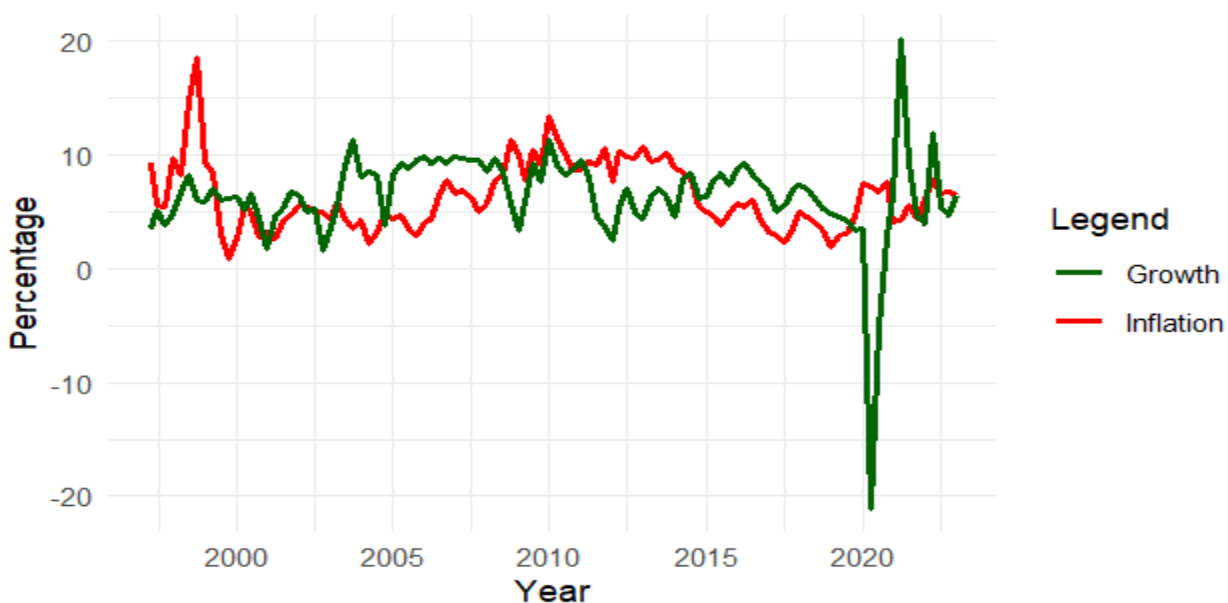
(MIA). There are similarities between monetary targeting and MIA, as both policies aimed for price stability and ensured an adequate flow of credit (Mishra & Mishra, 2012). Later in 2015, the RBI replaced the MIA with flexible inflation targeting (FIT). These changes in the monetary policy affected the relationship between inflation and growth. Figure 4.1 shows the trend in the inflation rate and growth rate for India from April 1997 to January 2023.

**Table 4.1: Comparison between Pre and Post FIT**

	Inflation Rate (in percentage)				Growth Rate (in percentage)			
	Mean	Min	Max	Standard Deviation	Mean	Min	Max	Standard Deviation
<b>Pre FIT (April 1997 to July 2015)</b>	6.89	0.92	18.63	3.12	6.97	1.66	11.37	2.22
<b>Post FIT (October 2015 to January 2023)</b>	4.91	1.97	7.79	1.73	4.93	-21.05	20.25	6.57

*Source: Authors Compilation*

**Figure 4.1 Inflation and Growth in India**



*Source: Authors Compilation*

Figure 4.1 presents the trends in growth and inflation rate from 1997 to 2022. As we can see, the economy's growth rate has been volatile over the period; however, the volatility has been higher during the FIT period compared to the pre-FIT period. The average growth rate achieved during the pre-FIT period was approximately 7 per cent, compared to 5 per cent in the post-FIT period. On the other hand, the inflation rate has been found to be less volatile, particularly in the FIT period. The average inflation rate achieved during the pre-FIT period was approximately 6.9%, compared to 5% in the post-FIT period. This is in contrast to the expectation of a new monetary policy regime, which focuses on stabilising inflation while optimising growth. Therefore, this chapter examines the nexus between the threshold inflation level and growth performances.

### 4.3 Data, Model Specification, and Methodology

#### 4.3.1 Data

To estimate the threshold level of inflation for India, the study uses the quarterly data from April 1997 to December 2022. This study period coincided with the pandemic, which was just another shock that the world had to endure. All the data for this study were extracted from the Handbook of Statistics on the Indian Economy, the Database on Indian Economy (DBIE), except for the growth rates of OECD countries. Data on the growth rate of OECD countries is taken from the OECD's online database. Table 4.2 presents the list of variables, the study period, and the data source.

**Table 4.2: List of Variables**

<b>Variables name</b>	<b>Unit of measurement</b>	<b>Time period</b>	<b>Source</b>
<b>INF</b>	CPI Inflation (%)	April 1997 to December 2022	DBIE (data.rbi.org.in)
<b>GoY</b>	Growth Rate of Output (%)	April 1997 to December 2022	DBIE (data.rbi.org.in)
<b>TBill</b>	91-Day T-bill (%)	April 1997 to December 2022	DBIE (data.rbi.org.in)
<b>G_OECD</b>	Growth Rate of OECD Countries (%)	April 1997 to December 2022	OECD (oecd.org)

*Source: Authors Compilation*

### **4.3.2 Model Specifications**

To estimate the threshold level of inflation, we use the following equation.

$$\text{Output Growth} = f(\text{INF}, \text{TBILL}, \text{G\_OECD}) \quad 4-1$$

In this model, we define the output growth as a function of the country's inflation, interest rates, and the growth rate of OECD countries. In the next section, we describe the variables used in the study to estimate the threshold level of inflation.

### **4.3.3 Independent Variables**

#### **4.3.3.1 CPI Inflation**

The study uses the CPI rate as a proxy for the inflation rate, as it is officially anchored for inflation since the implementation of FIT in 2015. This shift from WPI to CPI was guided by the Urjit Patel Committee Report on Monetary Policy Framework. The CPI data underwent base revisions in 1982, 2010, and 2012. We have spliced the series to create a unified series with a base year of 1982. From this spliced series, we have estimated the inflation rates for the study time period as shown in Figure 4.1.

#### **4.3.3.2 Growth Rate of Output**

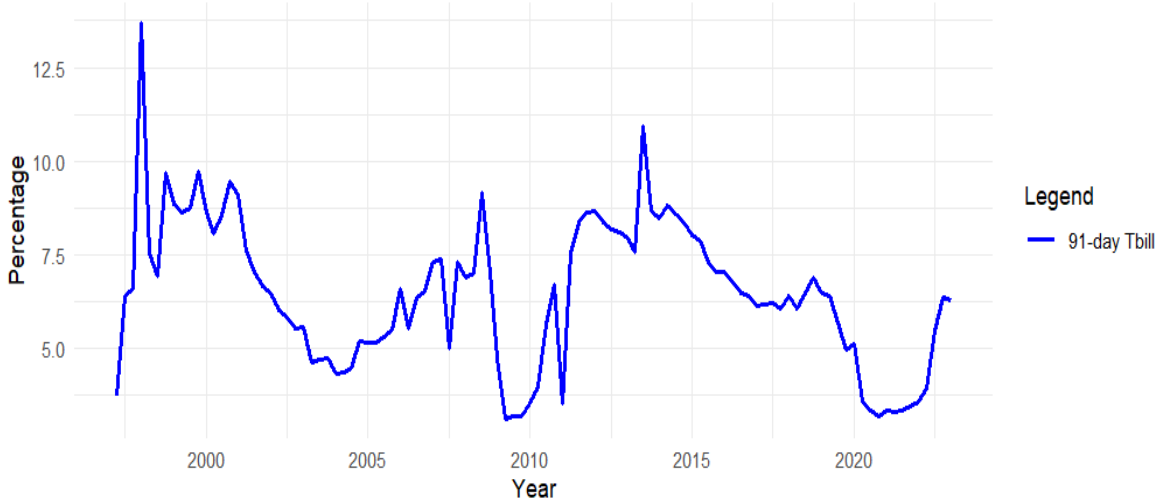
To estimate the growth rate of India over the study period, we used GDP data adjusted for constant prices, based on the base year. Figure 4.3 illustrates the growth rate of India during the study period. The growth rate of India has been affected by global shocks, such as the slowdown in the early 2000s, followed by strong growth until the global financial crisis, and then a slowdown around 2016.

#### **4.3.3.3 Interest Rate (91-Day T-bill)**

The 91 Day Treasury bill rate is used as the proxy for the interest rate. Figure 4.2 shows the 91-Day Treasury bill interest rate for the period of study. The trend in the treasury bill rate indicates a declining trend after the dot.com bubble. The next phase of the decline in interest rates occurred

around 2008, during a global recession, when central banks sought to promote growth by implementing sharp interest rate cuts. Lastly, during the COVID-19 pandemic, which coincided with a period of sharply declining interest rates worldwide.

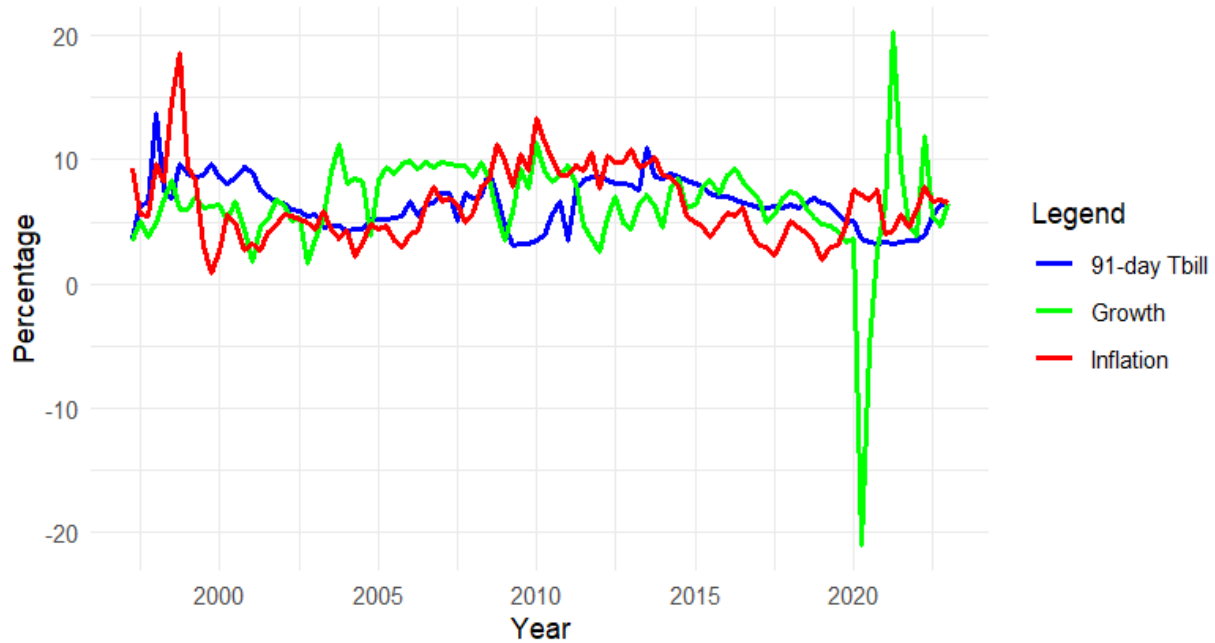
**Figure 4.2: 91 Day-T-Bill**



*Source: Authors Compilation*

Figure 4.3 shows the level of inflation, growth rate and 91-day T-bill data on the same graph. As shown in the graph, interest rates and inflation have fluctuated in tandem. For example, inflation rates had remained low during the early part of the 2000s. This had allowed the interest rate to decline, as shown in Figure 4.3. Furthermore, when the GFC hit the world and growth rates across major economies turned negative, central banks worldwide cut rates to revive growth. We can see similar patterns in India during the GFC and the COVID-19 crisis. Additionally, around 2015, both interest rates and inflation declined. However, the fall in interest rates in the economy is not able to improve the GDP growth rate. This raises an important question: Is there any threshold level of inflation for India? Is the inflation bandwidth ( $4\pm 2$ ) per cent aligned with the threshold level of inflation? We will estimate the threshold level of inflation in the country.

**Figure 4.3 Inflation, Growth and Interest Rate in India**

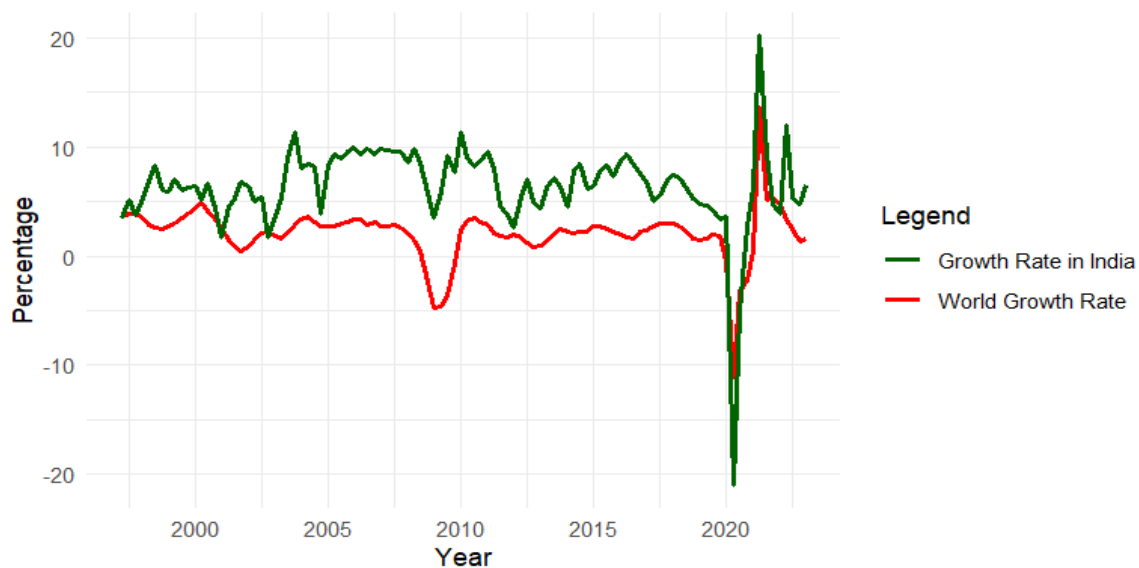


Source: Authors Compilation

#### **4.3.3.4 Growth rate of OECD Countries**

**Figure 4.4** shows the growth rate of output for the OECD (Organisation for Economic Co-operation and Development) countries, which is used as a proxy for the world growth rate. The OECD represents approximately 46 per cent of the world's GDP as of 2021 (OECD, 2024). As we can observe from Figure 4.4, the OECD growth rate shows a relatively stable trend around 2.5 per cent, with major dips in 2007-08 and 2020-21 due to the COVID-19 shock. When we superimpose the growth rate of the world with that of the Indian economy, we first notice that India has grown significantly faster than the world throughout the period of study. This is due to the fact that the OECD countries are mainly a group of developed countries, and India is a developing country. Therefore, to control for the external factors, we use the OECD countries' growth rate as a proxy for the world growth rate.

**Figure 4.4: Growth Rate in India and the World**



*Source: Authors Compilation*

#### **4.3.4 Methodology**

The study used the two methodologies, Logistic Smooth Transition Autoregressive (LSTAR) and Threshold Vector Autoregressive (TVAR), to estimate the threshold level of inflation. Detailed information about the methodologies is given below:

##### **4.3.4.1 Logistic Smooth Transition Autoregressive (LSTAR) Model**

Given the presence of nonlinearities in the inflation and growth rate, linear modelling techniques may not capture the true nature of the relationship. A more realistic approach would be to recognize that the inflationary environment also affects the responses of economic agents. If the inflation rate is below the threshold level, it may boost the growth rate through favorable economic conditions. On the other hand, if the inflation rate is above the threshold level, it may adversely

affect the growth. The LSTAR is a non-linear model that captures gradual shifts between two regimes using a logistic transition function.

Let  $Y_t$  denote the dependent variable (GDP growth rate,  $GoY_t$ ), and  $z_t$  the threshold variable (inflation,  $INF_t$ ). The LSTAR model is specified as:

$$y_t = \underbrace{\left( \phi_0 + \sum_{i=1}^p \phi_i y_{t-i} + \sum_{j=1}^q \beta_j X_{t-j} \right)}_{\text{Low-inflation regime}} \cdot [1 - G(z_t; \gamma, c)] + \underbrace{\left( \theta_0 + \sum_{i=1}^p \theta_i y_{t-i} + \sum_{j=1}^q \eta_j X_{t-j} \right)}_{\text{High-inflation regime}} \cdot c \quad 4-2$$

Transition Function:

$$G(z_t; \gamma, c) = \frac{1}{1 + \exp(-\gamma(z_t - c))} \quad 4-3$$

where:

$X_{t-j}$  Exogenous variables (*such as*  $INF_{t-j}$ , Interest  $_{t-j}$ ).

$\gamma$ : Smoothing parameter ( $\gamma > 0$ ). A larger  $\gamma$  implies a sharper transition.

$c$ : Threshold inflation level where the transition midpoint occurs.

$\epsilon_t \sim N(0, \sigma^2)$ : Gaussian error term.

When  $INF_t$  is far below the threshold  $c$ , ( $G(\gamma, c, INF_t)$ ) approaches zero, and the model reduces to  $y_t \approx \mu_1 + \beta_1 x_t$ . Conversely, when  $INF_t$  is well above  $c$ , the transition function nears one, so  $y_t \approx (\mu_1 + \mu_2) + (\beta_1 + \beta_2)x_t$ . The smooth transition captures gradual shifts in regime behavior as inflation changes.

#### 4.3.4.2 Threshold Vector Autoregression (TVAR)

The VAR methodology has the advantage of measuring simultaneous relationships between the inflation rate and other variables. This methodology has been widely used to examine the nexus between inflation and growth (Chowdhury et al., 2021; Sun & Dimiski, 2024; Yuhan & Sohibien, 2018). The linear VAR method can be adjusted to capture the non-linearity. Therefore, in this study, we use a multivariate Threshold Vector Autoregression (TVAR) model to estimate the threshold level of inflation in India (Afonso et al., 2018). The TVAR model assumes an abrupt switch between two regimes when inflation crosses the threshold. The TVAR model is specified as:

$$Y_t = \begin{cases} \mu_1 + \beta_1 X_t + \epsilon_{1t}, & \text{if } INF_t \leq c, \text{ (Regime 1)} \\ \mu_2 + \beta_2 X_t + \epsilon_{2t}, & \text{if } INF_t > c, \text{ (Regime 2)} \end{cases} \quad 4-4$$

where:

$\mu_1, \beta_1$  are the regime-specific parameters when inflation is below or equal to the threshold.

$\mu_2, \beta_2$  are the parameters when inflation exceeds the threshold.

$c$  is the threshold level derived from the model.

$\epsilon_{1t}, \epsilon_{2t}$  are the regime-specific error terms.

This model splits the sample into two distinct regimes based on the estimated threshold  $c$ . In the low-inflation regime ( $INF_t \leq c$ ), the dynamic relationship between  $Y_t$  and  $X_t$  is governed by one set of coefficients. When inflation exceeds  $c$ , the coefficients change, reflecting an abrupt shift in economic dynamics.

The TVAR model possesses several compelling attributes that make it well-suited for this analysis. Firstly, it offers a straightforward approach to account for nonlinearities, such as asymmetric responses to shocks or the presence of multiple equilibria. Since the effects of shocks are influenced by their magnitude, direction, and initial conditions, the impulse response functions deviate from linearity. Secondly, a notable strength of the TVAR methodology lies in its ability to define regimes using an endogenous variable already included in the VAR framework. This feature allows regime changes to occur in response to shocks affecting each variable (Afonso et al., 2018).

This study leverages both smooth (LSTAR) and abrupt (TVAR) regime-switching frameworks to robustly estimate the inflation threshold in India. By capturing non-linear dynamics and potential regime shifts, our approach provides valuable insights into how inflation interacts with domestic output, interest rates, and external conditions. The estimated threshold not only enhances our understanding of underlying economic relationships but also offers a critical reference point for policymakers monitoring inflationary pressures.

## 4.4 Results and Discussion

### 4.4.1 Lag length Criteria

The first step in our analysis is to identify the appropriate lag length of the VAR. We use the VAR lag length selection criteria to estimate the optimal lag length of the model. Table 4.3 represents the results of lag length selection criteria.

**Table 4.3: Lag Length Selection**

Lag Order (n)	AIC	HQ	SC	FPE
1	3.81	4.03	4.35*	45.34
2	3.81	4.20	4.78	45.10
3	3.90	4.46	5.30	49.52
4	3.46	4.20	5.30	32.26
5	2.94	3.86*	5.22	19.58
6	2.95	4.04	5.66	20.12
7	2.97	4.23	6.11	21.11
8	2.81	4.26	6.38	18.87
9	2.61*	4.23	6.62	16.33*
10	2.70	4.49	7.13	19.03

*Source: Authors' Calculations*

In this study, we have used the Schwarz Criterion (SC), also known as the Bayesian Information Criterion (BIC), over the Final Prediction Error (FPE), Akaike's Information Criterion (AIC), and the Hannan and Quinn (HQ) information criterion. SC criteria are known to apply a stronger penalty on the addition of extra lags compared to other criteria. As a result, SC allows us to select a more parsimonious model. Using a parsimonious model is necessary because overfitting with too many lags may lead to insignificant results. Furthermore, overfitting can lead to poor capturing

of economic relations. The study uses the lag 1 to ensure that the model remains simple, interpretable, and stable.

#### 4.4.2 Unit Root Test

After identifying the appropriate lag length, the study applies the Unit Root test to check for stationarity, as a stationary series is appropriate for the VAR model. For this purpose, we use the ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests. The results are presented in Table 4.4. We first test all variables for stationarity at the level and find that all variables are stationary at this level, as expected. Therefore, we can now proceed to estimate the threshold level of inflation using LSTAR and TVAR further.

**Table 4.4 Unit Root Test**

Variables	ADF Test		PP Test		Results
	t-value	p-value	t-value	p-value	
<b>CPI Inflation (INF)</b>	-3.57**	0.008	-3.67**	0.0058	I (0)
<b>Growth Rate of Output (GoY)</b>	-5.99**	0.00	-5.84**	0.00	I (0)
<b>91-Day T-bill (TBILL)</b>	-4.00**	0.0021	-4.17**	0.0012	I (0)
<b>Growth Rate of OECD Countries (G_OECD)</b>	-2.99*	0.039	-4.29**	0.0008	I (0)

\*\* and \* denote the rejection of the null hypothesis at the 1 and 5 % levels.

Source: Authors' Calculations

#### 4.4.3 Results of the LSTAR Model

To estimate the threshold level of inflation, we first employ the LSTAR model, and the results are presented in Table 4.5. The inflation rate has been divided into linear and non-linear. The linear part of the model indicates a direct relationship between the independent variables (inflation, interest rate, and OECD growth) and the growth rate. On the other hand, nonlinear effects refer to the different responses of the dependent variable when the independent variable reaches its threshold level. According to the linear part of the model, the study finds that inflation has a positive impact on output growth, although the coefficient is not significant. This is expected, and the past results support these findings (Khan & Senhadji, 2001). Further, the coefficient of interest rate is found to be positive but insignificant. This is in contrast to the theoretical expectations. The impact of the world output growth of the rest of the world is positive and significant, as the p-value

is less than 0.05. A rise in the world growth rate leads to a higher growth rate in India through demand factors (Athalage et al., 2025; Bhardwaj, 2017).

However, the linear model does not account for regime changes or non-linear relationships. The results may not be robust in the presence of non-linearity. The non-linear part of the model presented in Table 4.5 indicates a significant presence of a threshold level in inflation, estimated at approximately 7.63%. Furthermore, the nature of the relationship between the growth rate and independent variables changed when non-linearity was taken into account. For example, the coefficients of the inflation rate, interest rate, and OECD growth rate turned negative. However, the coefficient of interest rate and inflation rate remains insignificant, except for the coefficient of OECD growth rate. The impact of world output growth has shifted from positive to negative, indicating that if the inflation rate exceeds the threshold level, the impact of higher world output growth is reduced ( $1.49 + (-1.11) = 0.38$ ).

**Table 4.5: Threshold Level of Inflation from LSTAR Model**

Category	Variable	Coefficient	t-Statistic	Prob.
<b>Linear Part</b>	INF	0.11	0.47	0.64
	TBILL	0.08	0.29	0.77
	G OECD	1.49**	5.52	0.00
	C	1.55	0.64	0.53
<b>Nonlinear Part</b>	INF	-0.14	-0.53	0.6
	TBILL	-0.55	-1.66	0.1
	G OECD	-1.11**	-3.17	0.00
	C	8.45	2.87	0.01
<b>Transition Parameters</b>	SLOPE	21.91	0.77	0.44
	THRESHOLD	7.63**	157.05	0.00

\*\* denotes the rejection of the null hypothesis at the 1% level.

Source: Author's Calculations

Furthermore, the threshold value of inflation is 7.63, which is much higher than the target level of inflation, including bandwidth (4 percent,  $\pm 2$  percent). Given the high threshold of inflation, it could have an adverse growth impact.

Although the LSTAR model estimates the threshold level of inflation, the threshold level is not accurate when there is a regime shift in monetary policy, as observed (see chapter 3). Therefore, we re-estimate the threshold level of inflation using TVAR model.

#### 4.4.4 Results of the TVAR Model

The TVAR model is designed to capture regime changes by allowing different sets of linear relationships in different regimes. This is particularly useful for data with structural breaks. The model can handle multiple breaks simultaneously, making it suitable for analysing the interdependencies among macroeconomic variables. The results are presented in Table 4.6. It is evident from Table 4.6 that the estimated threshold level of inflation is 7.22% which is lower than the estimated threshold level of inflation from LSTAR (7.66%). However, the estimated threshold level in the TVAR model is 7.22%, which is much higher than the targeted level of  $4\% \pm 2\%$ .

**Table 4.6 TVAR Estimates for the threshold level of inflation**

<b>REGIME 1 (INF ≤ 7.22)</b>				
<b>VARIABLE</b>	GoY Equation (Column 1)	INF Equation (Column 2)	TBill Equation (Column 3)	G_OECD Equation (Column 4)
<b>Intercept</b>	5.50 (2.71) *	1.81 (1.46)	-0.18 (0.97)	3.80 (1.47) *
<b>GOY(-1)</b>	0.69 (0.16) ***	-0.07 (0.09)	-0.07 (0.06)	0.09 (0.09)
<b>INF(-1)</b>	0.11 (0.34)	0.79 (0.18) ***	0.14 (0.12)	-0.23 (0.18)
<b>TBILL(-1)</b>	-0.36 (0.28)	-0.09 (0.15)	0.92 (0.10) ***	-0.22 (0.15)
<b>G_OECD(-1)</b>	-0.52 (0.29).	0.14 (0.16)	0.18 (0.10).	0.26 (0.16)
<b>REGIME 2 (INF &gt; 7.22)</b>				
<b>VARIABLE</b>	GoY Equation	INF Equation	TBill Equation	G_OECD Equation
<b>Intercept</b>	-1.85 (3.73)	2.45* (2.01)	2.92 (1.33) *	-1.84 (2.01)
<b>GOY(-1)</b>	0.83 (0.28) **	0.24 (0.15)	-0.02 (0.10)	0.10 (0.15)
<b>INF(-1)</b>	0.13 (0.27)	0.49** (0.14)	0.05 (0.10)	0.16 (0.14)
<b>TBILL(-1)</b>	0.14 (0.28)	0.09 (0.15)	0.46 (0.10) ***	-0.07 (0.15)
<b>G_OECD(-1)</b>	-0.05 (0.31)	-0.18 (0.17)	0.38 (0.11) ***	0.93 (0.17) ***

Note: Standard errors are reported in parentheses below the coefficient estimates. Significance levels are denoted as follows: \*\*\* indicates significance at the 1% level ( $p < 0.01$ ), \*\* indicates significance at the 5% level ( $p < 0.05$ ), and \* indicates significance at the 10% level ( $p < 0.10$ ).

Source: Author's Calculations

Based on the threshold level inflation rate, the model has been divided into two regimes (see column 1). The first regime reflects low inflation, i.e., where inflation is less than the threshold

level of 7.22 per cent, and the second regime, where inflation is higher than the threshold level. The growth impact of other variables, such as interest rate, world growth rate, and inflation rate, remained insignificant. This is in contrast to the result of LSTAR, where the world growth rate had a positive effect. In regime 2 (high inflation), the baseline growth is lower, as the intercept is negative (-1.85), although it is insignificant. However, positive inertia effect pushes the growth momentum upward as the lag effect is positive and significant, which is higher than in regime 1. The growth impact of other variables, such as interest rate, world growth rate, and inflation rate, remained insignificant as found in the LSTAR model, except for the world growth rate.

More importantly, the study finds no direct impact of inflation on growth in either regime. This suggests that inflation may be significantly below the threshold level. According to Khan & Senhadji (2001), when inflation is significantly below the threshold level, it may not have a significant impact on growth. Inflation may indirectly influence the growth rate through other factors. Results suggest that inflation is stickier in regime 1, as the lag effect of inflation is significantly larger in regime 1 than in regime 2, indicating a longer-lasting impact of inflation in the low-inflation regime (Regime 1), as shown in column 2. Furthermore, interest rates have exhibited strong inertia in both regimes, as evidenced by the positive and significant lag effect. The coefficient of intercept is positive and significant in regime 1, indicating the inertia effect, as shown in column 3. In the case of regime 2, the inertia effect is negative, indicating a cycle of lower growth rate.

#### **4.5 Generalized Impulse Response Functions**

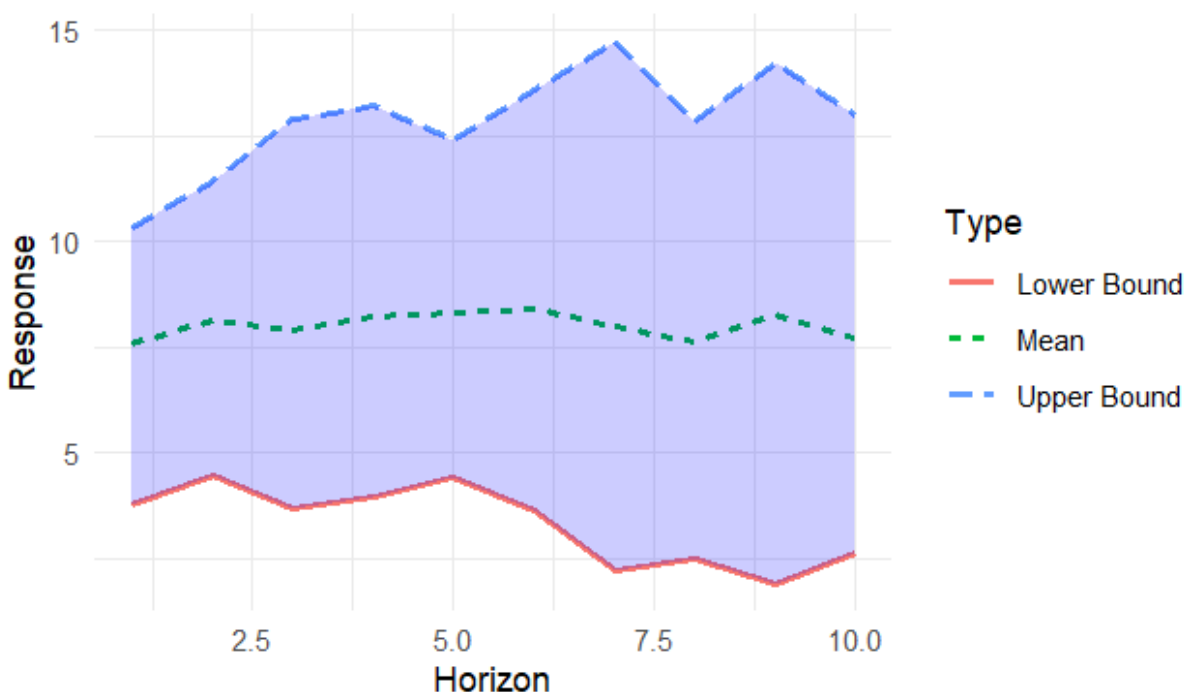
To infer the causality relationship among variables, the study derives the Generalised Impulse Response Functions (GIRFs) from the TVAR model. The results are presented in Figures 4.5-4.8.

##### ***4.5.1 Response of Growth Rate to Inflation Shock***

Figure 4.5 shows the reaction of the growth rate to a one-standard-deviation shock in the inflation rate. The shaded region reflects the 5% lower and upper confidence bandwidth. The green dashed line shows the mean response to the shock. We find that the growth rate responds positively to a one-standard-deviation shock in inflation. The positive response continues till the 8th period, and the growth rate returns to the original level after the 10<sup>th</sup> period. Therefore, we conclude that an

inflation shock has a positive impact on economic growth. In the long run, the uncertainty band increases, thereby indicating prolonged positive effects, and the lower bound has mostly remained positive only.

**Figure 4.5: GRIF for Growth rate**

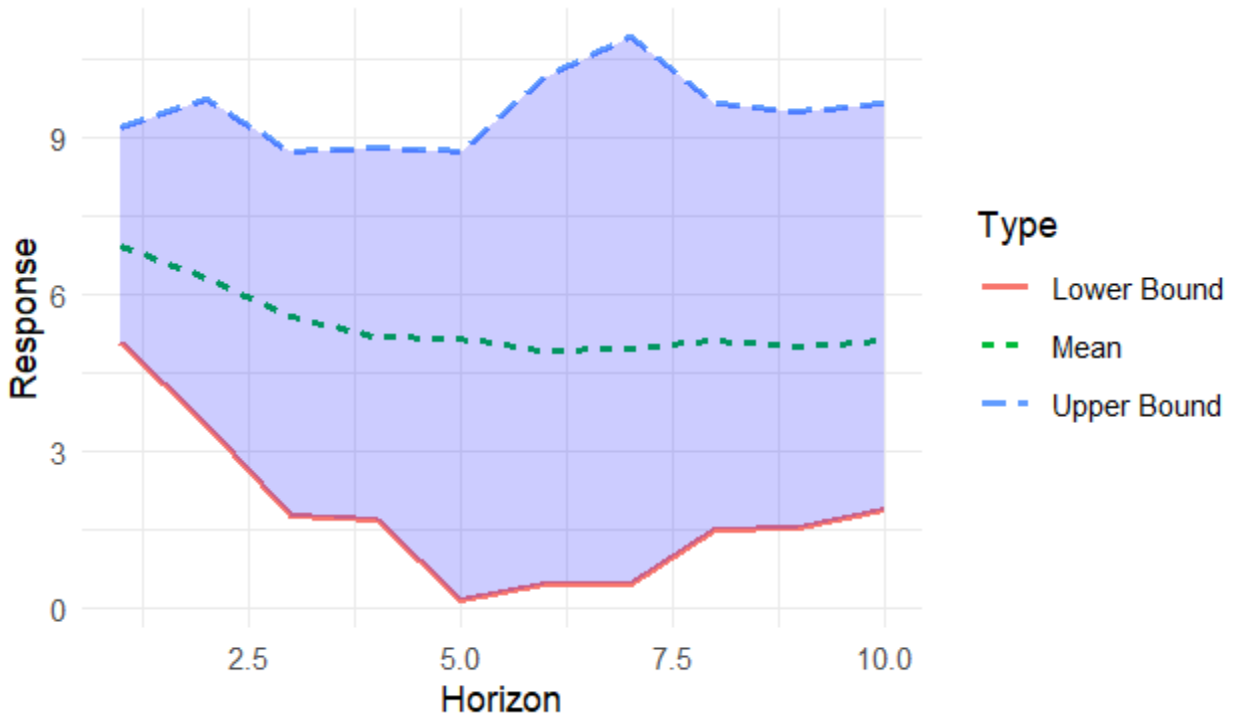


*Source: Authors Compilation*

#### **4.5.2 Response of Inflation to Own Shock**

Figure 4.6 shows the generalized impulse response of the inflation rate to its own shock. Results indicate that the inflation rate initially declines, and this process continues in the 5<sup>th</sup> period. After the 5th period, the inflation rate stabilizes but stays above the initial level. The lower bound keeps on declining till the 5th period, indicating dampening inflation expectations. Another important aspect that the model shows is that the shock never turns to a negative region, showing persistence of inflation to remain positive, and the economy is not falling into the trap of deflation. The initial decline in the inflation rate indicates lower price pressure in the short run, which can be the result of improvements in the supply side. These improvements in the supply side can arise from productivity increases, global supply, or trade liberalization (Atabay, 2016).

**Figure 4.6 GRIF for Inflation**

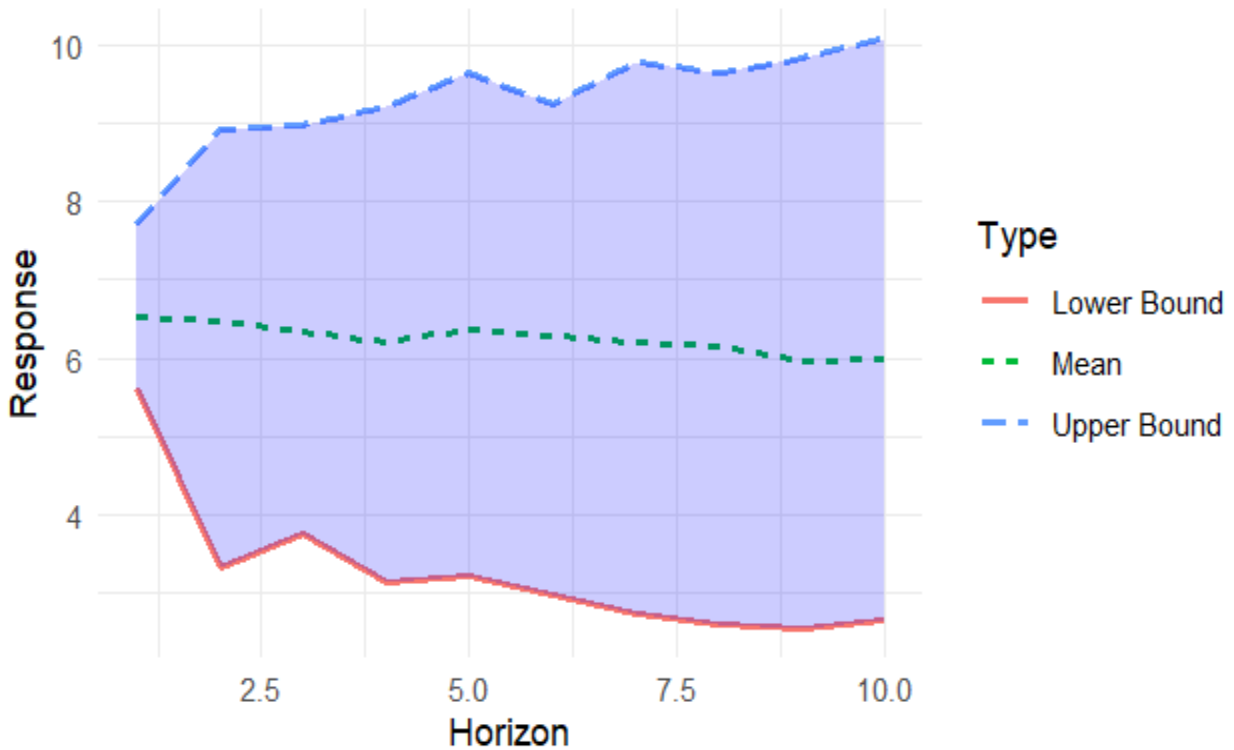


*Source: Authors Compilation*

### ***4.5.3 Response of Interest Rate to Inflation Shock***

Figure 4.7 shows the generalised impulse response of the interest rate to an inflation shock. In response to the inflation shock, the interest rate declines gradually until the 4th period, indicating an expectation of a tight monetary policy. From the 5th period, the interest rate again increases and returns to the original level. This indicates the high credibility of India's monetary policy following the FIT. In Chapter 3, we also showed that monetary policy has become more credible. In the long run, uncertainty remains high, leaving room open for adjustments as represented by the large bandwidth of the response.

**Figure 4.7 GRIF for Interest Rate captured by 91-Day T-Bills**

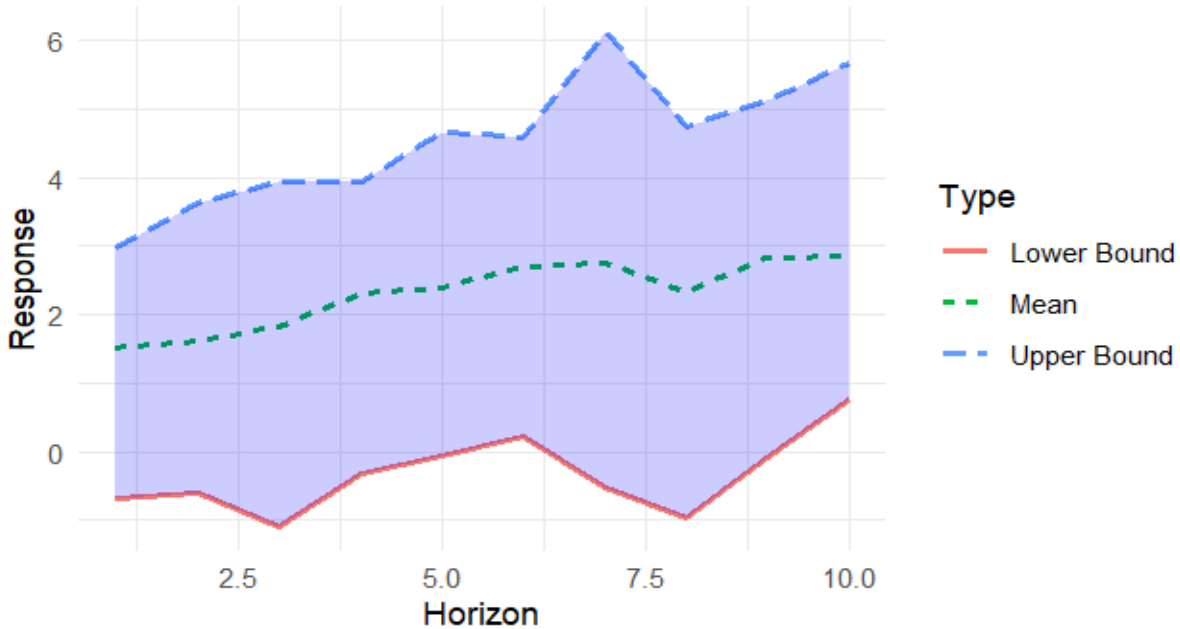


*Source: Authors Compilation*

#### ***4.5.4 Response of OECD Growth to Inflation Shock***

Figure 4.8 shows the response of inflation to a standard shock in OECD growth rate. The inflation rate in India positively responds to the OECD growth rate, driven by higher demand and increased exports. The positive response of inflation to growth shocks in OECD countries continues till the 8<sup>th</sup> period. This indicates inflationary pressure originating from growth shocks in OECD countries.

**Figure 4.8: GRIF for World Growth captured by OECD countries**



*Source: Authors Compilation*

#### **4.6 Chapter Summary**

The linkages between growth and inflation have been debated for a long time, both in the context of developing and developed countries. In India, several papers have attempted to estimate the threshold level of inflation, considering its implications for growth. Therefore, this chapter re-estimates the threshold level of inflation using non-linear models (LSTAR and TVAR) and quarterly data from 1997 to 2022. Results of this study suggest that the threshold level of inflation is higher than the targeted level. Furthermore, the results of this study corroborate the previous findings. This suggests that growth can be improved by fine-tuning the inflation targeting.

The key additions we make in this study are the domination of the indirect impact of inflation on growth. Most studies in the past have focused solely on the direct impact of inflation on the growth rate; however, this study finds that the indirect impact is more significant in the current time period. The reason for the indirect impact dominating can be attributed to the delay in revising the CPI basket for the economy, and therefore, the CPI is not fully able to capture the actual inflation. The structure of the Indian economy has undergone significant evolution during the study period. However, since the CPI base has not been revised, it may not fully capture it.



## Chapter 5 : Conclusion and Policy Implications

### 5.1 Background

The Indian economy has undergone significant change since 1991. One major reform includes changes to monetary policy. Prior to the reforms, India had a monetary policy focused on monetary targeting, based on the recommendations of the Chakravarty Committee (1985). However, the monetary policy was found to be inadequate and ineffective following post-liberalization due to the integration of the Indian economy with the rest of the world. Hence, India had to adopt a new monetary framework to adjust to the new changing environment. In 1998, India shifted its monetary policy target from monetary targeting to a multiple indicator approach. The multiple indicator approach enabled the RBI to focus on a list of indicators, including interest rates on sovereign bonds, asset prices, exchange rates, growth rates, and various inflation rates. However, by focusing on the list of indicators, the monetary policy deviated from its core objectives. As a result, by the end of the first decade of the twenty-first century, inflation had reached an intolerable level (double-digit), and the growth rate had tumbled to below desirable levels. This further paved the way for the adoption of a new monetary policy framework. With these objectives, a committee (Patel Committee, 2014) was appointed to recommend a new framework to reform the monetary policy framework. The new monetary policy framework also included other recommendations, such as setting inflation as the nominal anchor for monetary policy, and the calculation of inflation was based on the CPI. Even the decision to alter the interest rate was shifted from the Governor of the RBI to the Monetary Policy Committee (MPC).

In 2016, India adopted a flexible inflation targeting approach, where the inflation target was set at 4 per cent per annum for the next four years. This new framework also provided a bandwidth of 2 percent in either direction to allow RBI to also focus on maximizing the growth in the economy.

There is vivid literature that exists examining the growth and inflation trade-off in the monetary policy. However, the regime switches in monetary policy have remained a niche area with very limited research. Hutchison et al., (2013), analyzed the monetary policy regimes in two categories namely, dovish and hawkish using the MS-VAR using the Taylor rule. The results showed the existence of both regimes. However, the study period was limited to 2008. Similarly, another study using MS-VAR estimated the regime switches in monetary policy with respect to changes in the

RBI Governor, mapping the inflation growth trade-off between RBI Governors using data from 1998 to 2017. Neither study has been able to map the changes in the monetary policy since the implementation of FIT. Hence, in Chapter 2 of the thesis, we investigated the regime changes in RBI regimes before and after the implementation of the FIT.

Furthermore, one of the reasons for implementing the FIT was to increase transparency and thereby enhance the credibility of the RBI. The credibility of the RBI has been relatively underexplored in the past. Recently, a study has shown improvements in credibility between January 2010 and February 2020, utilising the financial market expectation channel. Authors have found improvements credibility of RBI since the implementation of FIT. Another study, using quarterly data from 2014 to 2022, also found that credibility has improved after the implementation of the FIT. However, the study used a list of indicators to measure the performance of the RBI, assigning less than 20 per cent weight to the current performance of the RBI with respect to the inflation target. Therefore, in this thesis, we examine the credibility switches of the RBI with respect to its inflation-targeting performance.

The estimation of a threshold level of inflation has been widely explored in the literature due to its consequences for growth dynamics. In the Indian context, most studies have estimated the threshold level of inflation using the WPI only. Using the WPI, estimates of the threshold level of inflation have ranged mainly between 4 and 6 per cent in the twenty-first century. (Pattanaik & Nadhanael, 2013) estimated the threshold level of inflation at 6 per cent using the WPI and annual data from 1972 to 2011. Also, the threshold level of inflation from 1966 to 2011 was estimated using the quarterly data. However, according to their estimates, the threshold level of inflation was between 4.5% and 5%. However, the RBI has shifted from WPI to CPI as a measure of inflation. Therefore, studies based on WPI are no longer effective in terms of policy discourse. Recently, Dholakia (2020) estimated the threshold level of inflation to be between 5.4% and 6% using the CPI data from 1996 to 2019. Most authors have used the spline or Logistic Smooth Transition Regression (LSTR) model to estimate the threshold level of inflation. Although spline regression does provide the estimates of the threshold level, the literature suggests that the TVAR model can better capture the threshold phenomena of inflation dynamics. Therefore, this study examines the threshold level of inflation by applying the TVAR model.

The FIT introduced in 2016 emphasised the objectives of inflation control and growth maximisation. The implementation of FIT was also motivated by some of its implicit objectives, such as making the monetary policy more transparent and improving its credibility. Therefore, this study investigates the regime changes in monetary policy in terms of the inflation-growth trade-off and switches in the credibility of the RBI. Studies suggest that an improvement in the credibility of the central bank improves the growth effect. Therefore, to expand our understanding of the changes in monetary policy, we also examine the inflation targets. As a result, there is a need to re-estimate the threshold level of inflation. Therefore, the objectives of the study are as follows: -

1. To analyze the impact of the Flexible Inflation Targeting (FIT) framework on monetary policy regime changes in India.
2. To investigate the shifts in monetary policy credibility before and after the implementation of the new FIT framework in India.
3. To examine the existence, time variation, and relationship between threshold inflation levels and economic growth dynamics in India.

## **5.2 Methodology of the Study**

The study applies advanced time series techniques using multi-stage procedures. First, the variables are examined for stationary properties using the unit root test. In addition, the seasonality issues have been addressed. In the second stage, we run the Markov-Switching VAR to examine the regime-switching behaviour of the model. MS VAR models offer several compelling advantages for analysing multivariate time series characterised by regime shifts, making them a powerful tool in empirical macroeconomics. A significant advantage of the MS VAR framework is its ability to model regime changes that arise endogenously from the system's dynamics, driven by the probabilistic transitions of the latent Markov chain. This contrasts sharply with traditional structural break models that treat shifts as exogenous, deterministic events. MS-VAR provides a rigorous, model-based approach for inferring the unobserved historical path of regimes from the observed data. The estimation process yields a time series of probabilities indicating the likelihood that the system was in each specific regime ( $j$ ) at each time point ( $t$ ). Estimating MS VAR models presents a considerable challenge compared to their linear counterparts. The presence of the latent state variable necessitates specialized estimation techniques. Maximum Likelihood Estimation

(MLE) typically relies on iterative procedures, such as the Expectation-Maximization (EM) algorithm, to maximise the likelihood function. Third, we estimate the impulse response function and forecast error variance decomposition. The impulse response function enables the examination of the impact of various endogenous shocks on the model.

To study the threshold level of inflation, we employ Logistic Smooth Transition Autoregressive (LSTAR) and Threshold Vector Autoregressive (TVAR) models. Thresholds represent critical points or levels of a variable where the underlying relationship or dynamic behaviour of a system changes fundamentally. The prevalence of such threshold phenomena highlights a significant limitation of linear models. In this thesis, we have used Logistic Smooth Transition Autoregression (LSTAR) models, which allow gradual, smooth shifts between regimes and Threshold Vector Autoregression (TVAR) models, which extend the standard VAR framework by allowing model parameters to switch abruptly between a finite number of regimes based on the value of an observed threshold variable relative to specific threshold levels. It is particularly suited for modelling sharp, discrete changes in system dynamics. In the third step, we further estimate the generalized impulse response functions to estimate the impact of the shocks on the model.

### **5.3 Findings of the Study**

To estimate the regime changes, we employed the MS-VAR model with two states. The result of the model showed two states (S-1 and S-2). The transition probabilities of switching from S1 to S2 were 22 per cent, and while staying within S1 were 78 per cent. The S2 state had a transition probability of the transiting from S2 to S1 was 56 percent while staying in S2 state had a probability of the barely 44 percent. Therefore, results suggest that state S1 is stable and significant. Therefore, study does not find any regime changes in the RBI before and after implementation of the FIT. This is because the transition probability of staying in the S1 (no change in regime) 78 percent or transition from S1 to S1 is 78 percent. Furthermore, if the model, transits from S1 to S2, the model quickly returns to the original state S1 as the transition probability of switching from S2 to S1 is 56 percent which is significantly higher than the critical value of the 50 percent. Study also found the evidence of the RBI managing the exchange rates. The results further suggest that monetary policy did not have any significant impact on the economic growth, indicating the failure of the

transmission mechanism. The study results are in line with previous findings (Acharya, 2017; Das, 2015; Pandey et al., 2024).

After examining the regime change in monetary policy, the study next investigated the shifts in the RBI's credibility in Chapter 3. To study the credibility of the RBI's switches, we employ a model with two regimes. The two regimes are defined as: Low Credibility Regime (R1) and High Credibility Regime (R2). The study finds both regimes are stable in India, as the transition probability of staying in the same regime is higher than 50 per cent. For example, the probability of transitioning from regime R1 to R2 was 91 per cent, and similarly, from R2 to R2 was 93 per cent, indicating both regimes are very stable. We further find that the regime R1 was prevalent between 2007 to the beginning of 2014. Prior to 2007 and after 2014, the credibility of the RBI was in R2, which is also a high credibility regime. Therefore, the study finds that the credibility and transparency of monetary policy have improved post-2014, achieving the FIT objectives. The period of 2007 is the beginning of the GFC, which was followed by the Euro Debt Crisis. This study also provides evidence for the impact of these crises in India. According to estimates provided in this study, India regained the credibility of its monetary policy after 2014. The improvement in credibility has been supported by recent literature (Garga et al., 2022; Patnaik, 2023). Contrary to theoretical expectations, the study finds that the improvement in the credibility of the central bank has not led to an improvement in growth performance.

The perplexing outcome of Chapter 3 prompted us to investigate the reasons behind the declining growth rate, despite an improvement in credibility. Therefore, Chapter 4 of the thesis estimated the threshold level of inflation by applying the LSTAR and TVAR methods using the quarterly data from 1997 to 2022. Results of LSTAR estimations indicate that the threshold level of inflation for India is over 7.5 per cent. On the other hand, the threshold inflation level estimated using TVAR is 7.22 per cent. This suggests that the growth rate is maximised when the inflation is around 7 per cent. However, the threshold inflation level suggested by the study is outside the range of the threshold level of FIT (upper limit is 6 per cent, i.e.  $4 \pm 2$  per cent). This suggests that the FIT threshold level should be revised upward as suggested by past literature (Bhoi & Tabasum, 2024; Dholakia, 2020). The study also finds a weak link between inflation and growth. This may be related to the CPI basket which has not been revised since 2014. According to Khan & Senhadji (2001), if the actual inflation is significantly lower than the threshold level of inflation, then the

relation between inflation and growth may disappear. The estimation of the threshold level of inflation has enabled us to understand the lack of link between growth and inflation level in India.

#### **5.4 Implications of the study**

Monetary policy plays a crucial role in economic management, contributing to macroeconomic stability and promoting economic growth. This depends on the credibility of the monetary policy. To improve credibility, the monetary policy framework has undergone several changes.

The findings of this study have significant implications and critical insights regarding the monetary policy framework. First, the study found that there was no regime change in India's monetary policy between 2013 and 2020, despite the adoption of a new framework. The monetary policy during the study period has been hawkish, with a bias towards inflation management, and the primary objective has been price stability. This has an implication for economic growth. India is a lower-middle-income country with the largest population, and growth should be given priority. Therefore, the monetary policy should be dovish. There is a need to improve the transmission mechanism so that monetary policy can be effectively leveraged to promote economic growth while maintaining stable prices. To enhance the effectiveness of monetary policy in driving economic growth, it is necessary to refine the risk management framework, particularly for Non-Banking Financial Companies (NBFCs). By 2019, NBFCs represented around 50 per cent of the real estate loans. The failure of the NBFC's further compounded the problem of the slowdown in the growth (Gupta & Tyagi, 2022; Subramanian & Felman, 2019). Furthermore, to promote growth, RBI can focus Small and Medium Enterprises (SMEs) for to ensure maximize the impact of monetary policy. However, the during this era, RBI has focused only on the inflation control, and this has resulted in the financing gaps for SMEs (Baker et al., 2020; Rao et al., 2017).

There is also a need for the better coordination of fiscal and monetary policy through a formal mechanism. This would allow the both fiscal and monetary policy to complement each other and thereby improving the impact.

Second, the study showed the evidence of improvements in the credibility of RBI after 2013. Credibility of the central bank plays a decisive role in setting expectations for wages, price, in consumption and in investment decisions. Once the expectations are anchored the cost of disinflation also decreases in the economy. Other major benefits of credibility include improved

transmission mechanisms for monetary policy and economic stability during shocks. Furthermore, improved credibility can also lead to stable inflation, which can elevate investment and consumption in the economy (Bernanke, 2004; Carballo, 2025). However, this did not improve the growth dynamics for the country. This suggests a central bank priority is not aligned with economic growth. Furthermore, various studies have suggested that the implementation of inflation targeting in developed and developing economies has resulted in improved credibility of the central bank (Capistrán & Ramos-Francia, 2010; Mishkin & Posen, 1998; Mishkin, 2000; Mishkin & Schmidt-Hebbel, 2007; Svensson, 2010; Walsh, 2009). Therefore, the focus has shifted from controlling current inflation to promoting growth more explicitly. Furthermore, this can be improved by including goals for employment (Epstein, 2007, 2008). The RBI has been publishing inflation forecasts and policy rationales regularly; however, growth targets can also help central banks meet their objectives. Furthermore, there is a need to improve the awareness about the trade-off between growth and inflation control. This awareness will enable the public to anticipate higher inflation during periods of lower growth.

Third, the estimated threshold level of inflation is approximately 7 per cent, which falls outside the bandwidth of the FIT targets. Hence, there is a need for revisiting the inflation bandwidth. According to the estimation in this thesis, the bandwidth of FIT can be increased by 1 per cent in both directions, thereby maximising economic growth. The new bandwidth can be between 3% and 7%. To further enhance the growth rate, the RBI can develop a mechanism to periodically update the inflation bandwidth by incorporating GDP growth, employment, and global inflation rates. Such a framework will dynamically adjust to the changing economic conditions. Furthermore, there needs to be a more formal inclusion of the dual mandate of inflation control and economic growth. This will enable the RBI to shift its focus between inflation and growth in more dynamic and explicit ways.

## **5.5 Limitations and Future Prospects**

The scope of study is focused on the monetary policy to promote growth with stable inflation, but it ignored other factors that may have a significant effect on growth. The study period has included the period of various global shocks to the economy, in terms of volatile crude oil prices and GFC and others. One of the key highlights that we found was the weak link between inflation and growth

in India. This can be attributed to the outdated CPI basket used to measure inflation. The monetary policy framework, which was proposed by the Patel Committee (2014), has provided the new CPI base year; since then, there has not been any revision in the CPI basket. The lack of revision of the CPI basket has diluted the accuracy of the inflation estimates provided by the CPI and the actual inflation faced by households in the economy.

This study has focused solely on the monetary policy framework; it has not examined fiscal policy. The study period has witnessed various fiscal policy reforms, such as the GST reforms. The growth promotion has mainly been attributed to the role of fiscal policies. The tax reforms that have happened have been beyond the scope of the study. Furthermore, another limitation of the study is the COVID-induced lockdowns, which have been both a domestic and global issue. There is a strong need to enhance the quality of data, which would enable the RBI to monitor real-time changes in inflation, growth, employment, and other economic indicators. This lack of high-frequency data has been another important limitation for the study. For example, to understand the nexus between growth and inflation, the study relied on the IIP data. The IIP truly does not reflect the growth dynamics, as it accounts for less than 20 per cent of GDP. Nevertheless, it remains the only proxy for capturing growth on a monthly basis.

## Bibliography

Acharya, V. V. (2017). Monetary Transmission in India: Why is it important and why hasn't it worked well. *Reserve Bank of India Bulletin*, 71(12), 7–16.

Addo, S. (2017). *Regime Changes in Monetary Policy* [University of Cape Town].  
<http://hdl.handle.net/11427/29311>

Afonso, A., Baxa, J., & Slavík, M. (2018). Fiscal developments and financial stress: a threshold VAR analysis. *Empirical Economics*, 54(2), 395–423. <https://doi.org/10.1007/s00181-016-1210-5>

Ahmed, F., Binici, M., & Turunen, J. (2022). Monetary Policy Communication and Financial Markets in India. *IMF Working Papers*, 2022(209), 1.  
<https://doi.org/10.5089/9798400224430.001>

Albrizio, S., Bluedorn, J., Dizioli, A., Koch, C., & Wingender, P. (2023). „Managing Expectations: Inflation and Monetary Policy”. *World Economic Outlook, Navigating Global Divergences*.

Amisano, G., & Tronzano, M. (2010). Assessing European Central Bank's Credibility During the First Years of The Eurosystem: A Bayesian Empirical Investigation. *The Manchester School*, 78(5), 437–459. <https://doi.org/10.1111/j.1467-9957.2010.02203.x>

Andrés, J., & Hernando, I. (1999). Does inflation harm economic growth? Evidence from the OECD. In *The costs and benefits of price stability* (pp. 315–348). University of Chicago Press.

- Atabay, R. (2016). The Relationship between Trade Openness and Inflation in Turkey. *International Journal of Research in Business and Social Science (2147- 4478)*, 5(3), 137–145. <https://doi.org/10.20525/ijrbs.v5i3.464>
- Athalage, D., Wijesuriya, P., Sandanayaka, I., Rathnayake, D., & Jayathilaka, R. (2025). The Interplay Between Globalisation and Economic Growth: a Multi-Regional Analysis. *Discover Sustainability*, 6(1), 525. <https://doi.org/10.1007/s43621-025-01403-6>
- Azam, M., & Khan, S. (2022). Threshold effects in the relationship between inflation and economic growth: Further empirical evidence from the developed and developing world. *International Journal of Finance & Economics*, 27(4), 4224–4243. <https://doi.org/10.1002/ijfe.2368>
- Bajpai, N. (2011). *Global financial crisis, its impact on India and the policy response*. <https://doi.org/https://doi.org/10.7916/D85T3TQB>
- Ball, L. (1994). Credible Disinflation with Staggered Price-Setting. *The American Economic Review*, 84(1), 282–289.
- Ball, L., Sheridan, N., & Sharma, S. (2003). *Does inflation targeting matter?* National Bureau of economic research Cambridge, MA.
- Ball, R. J. (2017). *Inflation and the Theory of Money*. Routledge. <https://doi.org/10.4324/9780203788585>
- Barro, R. (1995). *Inflation and Economic Growth*. <https://doi.org/10.3386/w5326>
- Benchimol, J., & Fourçans, A. (2019). Central bank losses and monetary policy rules: A DSGE investigation. *International Review of Economics & Finance*, 61, 289–303. <https://doi.org/10.1016/j.iref.2019.01.010>

- Bernanke, B. (2004). *The Great Moderation*. Washington, DC.  
<https://www.federalreserve.gov/boarddocs/speeches/2004/20040220/>
- Bernanke, B. S. (2019). Monetary Policy in a New Era. In *Evolution or Revolution?* (pp. 3–48). The MIT Press. <https://doi.org/10.7551/mitpress/11734.003.0004>
- Bernanke, B. S., & Mishkin, F. S. (1997). Inflation targeting: a new framework for monetary policy? *Journal of Economic Perspectives*, 11(2), 97–116.
- Beyer, A., & Reichlin, L. (2006). The role of money—money and monetary policy in the twenty-first century. *Fourth ECB Central Banking Conference*, 9–10.
- Bhardwaj, R. (2017). Impacts of Globalization on Indian Economy-An Overview. *Research Journal of Humanities and Social Sciences*, 8(3), 351. <https://doi.org/10.5958/2321-5828.2017.00052.3>
- Bhattacharya, K., & Bhattacharyya, I. (2001). Impact of increase in oil prices on inflation and output in India. *Economic and Political Weekly*, 4735–4741.  
<https://www.jstor.org/stable/4411508>
- Bhoi, B. K., & Tabasum, G. (2024). Inflation-Growth Relationship: New Evidence for India. *Journal of Quantitative Economics*, 22(1), 223–239. <https://doi.org/10.1007/s40953-024-00388-9>
- Bhuyan, B., & Sethi, D. (2016). *An Augmented Taylor rule for India's Monetary Policy: Does Governor Regime Matters?* <https://mpira.ub.uni-muenchen.de/75287/>
- Blanchard, O. (2016). The Phillips Curve: Back to the '60s? *American Economic Review*, 106(5), 31–34. <https://doi.org/10.1257/aer.p20161003>
- Blinder, A. (1999). *Central Bank Credibility: Why Do We Care? How Do We Build It?*  
<https://doi.org/10.3386/w7161>

- Blinder, A. S. (1999). *Central banking in theory and practice*. Mit press.
- Blinder, A. S. (2000). Central-Bank Credibility: Why Do We Care? How Do We Build It? *American Economic Review*, 90(5), 1421–1431. <https://doi.org/10.1257/aer.90.5.1421>
- Bomfim, A. N., & Rudebusch, G. D. (2000). Opportunistic and Deliberate Disinflation under Imperfect Credibility. *Journal of Money, Credit and Banking*, 32(4), 707. <https://doi.org/10.2307/2601179>
- Bordo, M., & Siklos, P. (2014). *Central bank credibility, reputation and inflation targeting in historical perspective*. National Bureau of Economic Research.
- Bordo, M., & Siklos, P. (2015). *Central Bank Credibility: An Historical and Quantitative Exploration*. <https://doi.org/10.3386/w20824>
- Bordo, M., & Siklos, P. (2019). *The Transformation and Performance of Emerging Market Economies Across the Great Divide of the Global Financial Crisis*. <https://doi.org/10.3386/w26342>
- Çakmaklı, C., & Demiralp, S. (2020). *A dynamic evaluation of central bank credibility* (Issue 2015). Koç University-TÜSIAD Economic Research Forum (ERF). <https://hdl.handle.net/10419/242999>
- Capistrán, C., & Ramos-Francia, M. (2010). Does Inflation Targeting Affect the Dispersion of Inflation Expectations? *Journal of Money, Credit and Banking*, 42(1), 113–134. <https://doi.org/10.1111/j.1538-4616.2009.00280.x>
- Carballo, P. (2025). Exploring Monetary Policy with Imperfect Credibility: The Case of Uruguay. *Latin American Journal of Central Banking*, 100164. <https://doi.org/10.1016/j.latcb.2025.100164>

- Cecchetti, S. G., Hooper, P., Kasman, B. C., Schoenholtz, K. L., & Watson, M. W. (2007). Understanding the evolving inflation process. *US Monetary Policy Forum*, 8, 5–23.
- Cecchetti, S. G., & Krause, S. (2002). Central bank structure, policy efficiency, and macroeconomic performance: exploring empirical relationships. *Review-Federal Reserve Bank of Saint Louis*, 84(4), 47–60.
- Chakravarty, S. (1985). *Report of the Committee to Review the Working of the Monetary System*.
- Choudhri, E., & Malik, H. (2012). Monetary policy in Pakistan: confronting fiscal dominance and imperfect credibility. *Carleton University and State Bank of Pakistan*, 1.
- Chowdhury, K. B., Sarkar, K. K., & Kundu, S. (2021). Nonlinear relationships between inflation, output growth and uncertainty in India: New evidence from a bivariate threshold model. *Bulletin of Economic Research*, 73(3), 469–493. <https://doi.org/10.1111/boer.12260>
- Claessens, S., Glaessner, T., & Klingebiel, D. (2025). *Strengthening central bank financial resilience in a changing world*. <https://cepr.org/voxeu/columns/strengthening-central-bank-financial-resilience-changing-world>
- Cukierman, A. (1986). Central bank behavior and credibility: some recent theoretical developments. *Federal Reserve Bank of St. Louis Review*, 68(5), 5–17.
- Cukierman, A. (2013). Monetary policy and institutions before, during, and after the global financial crisis. *Journal of Financial Stability*, 9(3), 373–384. <https://doi.org/10.1016/j.jfs.2013.02.002>
- Darby, M., & Lothian, J. (1986). *Economic Events and Keynesian Ideas: The 1930s and the 1970s*. <https://doi.org/10.3386/w1987>
- Das, M. S. (2015). *Monetary policy in India: Transmission to bank interest rates*. International Monetary Fund.

- Das, S. (2020). Seven ages of India's monetary policy. *Reserve Bank of India Governor's*.
- Das, S. (2022). *Governor's Statement*.
- Dash, S. K., & Kumar, L. (2018). Does inflation affect savings non-linearly? Evidence from India. *Margin: The Journal of Applied Economic Research*, 12(4), 431–457.
- de Mendonça, H. F., & de Guimarães e Souza, G. J. (2009). Inflation targeting credibility and reputation: The consequences for the interest rate. *Economic Modelling*, 26(6), 1228–1238. <https://doi.org/10.1016/j.econmod.2009.05.010>
- Deaton, A. (1983). Savings and inflation: Theory and British evidence. *The Determinants of National Saving and Wealth: Proceedings of a Conference Held by the International Economic Association at Bergamo, Italy*, 125–139.
- Demertzis, M., Marcellino, M. G., & Viegli, N. (2008). *A measure for credibility: tracking US monetary developments*.
- Dholakia, R. H. (2020). A Theory of Growth and Threshold Inflation with Estimates. *Journal of Quantitative Economics*, 18(3), 471–493.
- Drakos, A. A., & Kouretas, G. P. (2015). The conduct of monetary policy in the Eurozone before and after the financial crisis. *Economic Modelling*, 48, 83–92. <https://doi.org/10.1016/j.econmod.2014.11.010>
- Droumaguet, M. (2012). *Markov-Switching Vector Autoregressive Models: Monte Carlo Experiment, Impulse Response Analysis, and Granger-Causal Analysis* [European University Institute]. <https://doi.org/https://doi.org/10.2870/63610>
- Dua, P. (2020). Monetary policy framework in India. *Indian Economic Review*, 55(1), 117–154.

- Dua, P. (2023). Monetary Policy Framework in India. In *Macroeconometric Methods* (Vol. 55, Issue 1, pp. 39–72). Springer Nature Singapore. [https://doi.org/10.1007/978-981-19-7592-9\\_3](https://doi.org/10.1007/978-981-19-7592-9_3)
- Eichengreen, B., Gupta, P., & Choudhary, R. (2020). *Inflation Targeting in India : An Interim Assessment*. World Bank, Washington, DC. <https://doi.org/10.1596/1813-9450-9422>
- Eijffinger, S. C. W., & Hoeberichts, M. (2002). Central Bank Accountability and Transparency: Theory and Some Evidence. *International Finance*, 5(1), 73–96. <https://doi.org/10.1111/1468-2362.00088>
- English, W. B. (1999). Inflation and financial sector size. *Journal of Monetary Economics*, 44(3), 379–400. [https://doi.org/10.1016/S0304-3932\(99\)00033-1](https://doi.org/10.1016/S0304-3932(99)00033-1)
- Epstein, G. (2007). *Central banks, inflation targeting and employment creation* (Vol. 2). International Labour Office. [https://d1wqtxts1xzle7.cloudfront.net/38402004/elm07-2-libre.pdf?1438876975=&response-content-disposition=inline%3B+filename%3DCentral\\_banks\\_inflation\\_targeting\\_and\\_em.pdf&Expires=1759731845&Signature=ZyCXNHCoC3cH4~K9MxcnxlnnZ-Gab99EEM0~NtCw6Q2aNLJQ~pVvaTo0~X862Lg9tbtrzGisR.JkQ7hCXLc6HXMM3a4sqOzml dgTKVMK1i~xY366MQp91Wq1SJnEdVi9k8e3R5Pek10FYuETPv9vXGWRniQSKqF0Nv5vH4ppiJ4d6d69FcQHYSUcn96bewlBvG5AhOzjTNS8~K8qzw6yGPbjO2PwMvUD3TP19oyZXIbs7Zx8yxJ10rZDlxP76Y2PdKhGaX~sNpjEDUzE7JNU12POvja8R5bdVHnGckHENB77PUKiu8KNyBXt6CecSKCrC0C-X3Y4zSJDuuk9N8-KPw\\_\\_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA](https://d1wqtxts1xzle7.cloudfront.net/38402004/elm07-2-libre.pdf?1438876975=&response-content-disposition=inline%3B+filename%3DCentral_banks_inflation_targeting_and_em.pdf&Expires=1759731845&Signature=ZyCXNHCoC3cH4~K9MxcnxlnnZ-Gab99EEM0~NtCw6Q2aNLJQ~pVvaTo0~X862Lg9tbtrzGisR.JkQ7hCXLc6HXMM3a4sqOzml dgTKVMK1i~xY366MQp91Wq1SJnEdVi9k8e3R5Pek10FYuETPv9vXGWRniQSKqF0Nv5vH4ppiJ4d6d69FcQHYSUcn96bewlBvG5AhOzjTNS8~K8qzw6yGPbjO2PwMvUD3TP19oyZXIbs7Zx8yxJ10rZDlxP76Y2PdKhGaX~sNpjEDUzE7JNU12POvja8R5bdVHnGckHENB77PUKiu8KNyBXt6CecSKCrC0C-X3Y4zSJDuuk9N8-KPw__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA)
- Epstein, G. (2008). An employment targeting framework for central bank policy in South Africa. *International Review of Applied Economics*, 22(2), 243–258. <https://doi.org/10.1080/02692170701880775>
- Ericsson, N. R., Irons, J. S., & Tryon, R. W. (2001). Output and inflation in the long run. *Journal of Applied Econometrics*, 16(3), 241–253.

- Erken, H. (2017). *India: getting inside the head of the RBI*. Coöperatieve Rabobank U.A.
- Faria, J. R., & Carneiro, F. G. (2001). Does high inflation affect growth in the long and short run? *Journal of Applied Economics*, 4(1), 89–105.
- Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics*, 32(3), 485–512. [https://doi.org/10.1016/0304-3932\(93\)90027-D](https://doi.org/10.1016/0304-3932(93)90027-D)
- Fischer, S. (2021). *Comparing the Monetary Policy Responses of Major Central Banks to the Great Financial Crisis and the COVID-19 Pandemic*. Working Paper. MA, USA: MIT Management Sloan School, Cambridge.
- Fischer, S., & Modigliani, F. (1978). Towards an understanding of the real effects and costs of inflation. *Review of World Economics*, 114(4), 810–833.
- Fountas, S. (2010). Inflation, inflation uncertainty and growth: Are they related? *Economic Modelling*, 27(5), 896–899. <https://doi.org/10.1016/j.econmod.2010.06.001>
- Fountas, S., & Karanasos, M. (2007). Inflation, output growth, and nominal and real uncertainty: Empirical evidence for the G7. *Journal of International Money and Finance*, 26(2), 229–250. <https://doi.org/10.1016/j.jimonfin.2006.10.006>
- Friedman, M. (1968). The Role of Monetary Policy. *The American Economic Review*, 58(1), 1–17. <http://www.jstor.org/stable/1831652>
- Friedman, M. (1977). Nobel lecture: inflation and unemployment. *Journal of Political Economy*, 85(3), 451–472.
- Froyen, R. T. (2013). *Macroeconomics: Theories and Policies* (10th ed.). Pearson Education Limited England.

- Garga, V., Lakdawala, A., & Sengupta, R. (2022). *Assessing Central Bank Commitment to Inflation Targeting: Evidence from Financial Market Expectations in India* (Federal Reserve Bank of Boston Research Department Working Papers). Federal Reserve Bank of Boston. <https://doi.org/10.29412/res.wp.2022.19>
- Geetha, C., Mohidin, R., Chandran, V. V., & Chong, V. (2011). The relationship between inflation and stock market: Evidence from Malaysia, United States and China. *International Journal of Economics and Management Sciences*, 1(2), 1–16.
- Gelos, G., & Ustyugova, Y. (2017). Inflation responses to commodity price shocks – How and why do countries differ? *Journal of International Money and Finance*, 72, 28–47. <https://doi.org/10.1016/j.jimonfin.2016.10.001>
- Geraats, P. M. (2014). Monetary policy transparency. *The Oxford Handbook of Economic and Institutional Transparency*, 68–97.
- Gillman, M., Harris, M. N., & Mátyás, L. (2004). Inflation and growth: Explaining a negative effect. *Empirical Economics*, 29(1), 149–167. <https://doi.org/10.1007/s00181-003-0186-0>
- Gordon, R. J. (2011). The History of the Phillips Curve: Consensus and Bifurcation. *Economica*, 78(309), 10–50. <https://doi.org/10.1111/j.1468-0335.2009.00815.x>
- Goyal, A. (2022). Flexible Inflation Targeting: Concepts and application in India. *Indian Public Policy Review*, 3(5 (Sep-Oct)), 1–21. <https://doi.org/10.55763/ippr.2022.03.05.001>
- Güler, A. (2021). Does Monetary Policy Credibility Help in Anchoring Inflation Expectations? Evidence from Six Inflation Targeting Emerging Economies. *Journal of Central Banking Theory and Practice*, 10(1), 93–111. <https://doi.org/10.2478/jcbtp-2021-0005>
- Guler, M. H. (2013). A Literature Overview of the Central Bank’s Knowledge Transparency. *Available at SSRN 2230301*.

- Gupta, P., & Tyagi, A. (2022). *Slowdown of the Indian economy during 2019-20: An enigma or an anomaly*. <https://mpira.ub.uni-muenchen.de/112704/>
- Gupta, A. Sen, & Sengupta, R. (2013). *Management of capital flows in India*.
- Gürkaynak, R. S., Levin, A., & Swanson, E. (2010). Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence From the U.S., U.K, and Sweden. *Journal of the European Economic Association*, 8(6), 1208–1242. <https://doi.org/10.1111/j.1542-4774.2010.tb00553.x>
- Ha, J., Stocker, M. M., & Yilmazkuday, H. (2020). Inflation and exchange rate pass-through. *Journal of International Money and Finance*, 105, 102187.
- Hamilton, J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica*, 57(2), 357. <https://doi.org/10.2307/1912559>
- Hamilton, J. D. (1996). Specification testing in Markov-switching time-series models. *Journal of Econometrics*, 70(1), 127–157. [https://doi.org/10.1016/0304-4076\(99\)00168-9](https://doi.org/10.1016/0304-4076(99)00168-9)
- Haslbeck, J. M. B., Bringmann, L. F., & Waldorp, L. J. (2021). A Tutorial on Estimating Time-Varying Vector Autoregressive Models. *Multivariate Behavioral Research*, 56(1), 120–149. <https://doi.org/10.1080/00273171.2020.1743630>
- Hodge, D. (2006). Inflation and growth in South Africa. *Cambridge Journal of Economics*, 30(2), 163–180.
- Hutchison, M. M., Sengupta, R., & Singh, N. (2013). Dove or Hawk? Characterizing monetary policy regime switches in India. *Emerging Markets Review*, 16, 183–202.
- Jha, R. (2008). Inflation targeting in India: issues and prospects. *International Review of Applied Economics*, 22(2), 259–270. <https://doi.org/10.1080/02692170701880783>

- Jha, R., & Dang, T. N. (2012). Inflation variability and the relationship between inflation and growth. *Macroeconomics and Finance in Emerging Market Economies*, 5(1), 3–17.
- Kabundi, A., Schaling, E., & Some, M. (2015). Monetary Policy and Heterogeneous Inflation Expectations in South Africa. *Economic Modelling*, 45, 109–117.  
<https://doi.org/10.1016/j.econmod.2014.11.002>
- Kannan, R., & Joshi, H. (1998). Growth-Inflation Trade-Off: Empirical Estimation of Threshold Rate of Inflation for India. *Economic and Political Weekly*, 33(42/43), 2724–2728.  
<http://www.jstor.org/stable/4407296>
- Kapur, M., & Mohan, R. (2014). *India's Recent Macroeconomic Performance: An Assessment and Way Forward*.
- Karmakar, A. K., & Jana, S. K. (2019). An Investigation into India's Move Toward Emerging Contours of New Monetary Policy Framework. In *The Impacts of Monetary Policy in the 21st Century: Perspectives from Emerging Economies* (pp. 211–221). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-78973-319-820191022>
- Kaseeram, I. (2012). *Essays on the impact of inflation targeting in South Africa*. University of Zululand.
- Kent Baker, H., Kumar, S., & Rao, P. (2020). Financing preferences and practices of Indian SMEs. *Global Finance Journal*, 43, 100388. <https://doi.org/10.1016/j.gfj.2017.10.003>
- Khan, M. S., & Senhadji, A. S. (2001). Threshold Effects in the Relationship between Inflation and Growth. *IMF Staff Papers*, 48(1), 1–21. <https://doi.org/10.2307/4621658>
- Khandelwal, T., Hari, K. S., & Dash, R. K. (2023). Determinants of Monetary Policy: An Application of Regime Switching Model. *Indian Journal of Economics and Development*, 880–886. <https://doi.org/10.35716/IJED-23324>

- Khundrakpam, J. K. (2011). *RBI WORKING PAPER SERIES Credit Channel of Monetary Transmission in India - How Effective and Long is the Lag ? November*.
- Koester, G., Lis, E., Nickel, C., Osbat, C., & Smets, F. (2021). Understanding low inflation in the euro area from 2013 to 2019: cyclical and structural drivers. *ECB Occasional Paper*, 2021280.
- Kose, M. A., Matsuoka, H., Panizza, U., & Vorisek, D. (2019). *Inflation expectations: review and evidence*.
- Kozicki, S., & Tinsley, P. A. (2008). Term structure transmission of monetary policy. *The North American Journal of Economics and Finance*, 19(1), 71–92.
- Kremer, S., Bick, A., & Nautz, D. (2013). Inflation and Growth: New Evidence from a Dynamic Panel Threshold Analysis. *Empirical Economics*, 44(2), 861–878.  
<https://doi.org/10.1007/s00181-012-0553-9>
- Krolzig, H.-M. (1997). *Markov-Switching Vector Autoregressions* (Vol. 454). Springer Berlin Heidelberg. <https://doi.org/10.1007/978-3-642-51684-9>
- Kryeziu, N., & Durguti, E. A. (2019). The Impact of Inflation on Economic Growth. *International Journal of Finance & Banking Studies* (2147-4486), 8(1), 01–09.  
<https://doi.org/10.20525/ijfbs.v8i1.297>
- Kumhof, M., Nunes, R., & Yakadina, I. (2010). Simple Monetary Rules under Fiscal Dominance. *Journal of Money, Credit and Banking*, 42(1), 63–92.  
<https://doi.org/10.1111/j.1538-4616.2009.00278.x>
- Kupfer, A. (2015). Revisiting Svensson’s test of inflation target credibility. *Applied Economics Letters*, 22(5), 343–348. <https://doi.org/10.1080/13504851.2014.943876>

- Kydland, F. E., & Prescott, E. C. (1977). Rules Rather than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy*, 85(3), 473–491.  
<https://doi.org/10.1086/260580>
- Lucas Jr, R. E. (1972). Expectations and the Neutrality of Money. *Journal of Economic Theory*, 4(2), 103–124.
- Mallik, G., & Chowdhury, A. (2001). Inflation and economic growth: evidence from four south Asian countries. *Asia-Pacific Development Journal*, 8(1), 123–135.
- Mandeya, S. M. T., & Ho, S.-Y. (2022). Inflation, Inflation Uncertainty and the Economic Growth Nexus: A Review of the Literature. *Folia Oeconomica Stetinensia*, 22(1), 172–190.  
<https://doi.org/10.2478/fofi-2022-0009>
- Mariscal, I. B.-F., Wong, W., & Howells, P. (2011). Measuring the Policymaker’s Credibility: The Bank of England in ‘nice’ and ‘not-so-nice’ times. *Alman Yur Https://Www2. Uwe. Ac. Uk/Faculties/BBS/BUS/Research/Economics/1110\_Measuring\_credibility\_v10. Pdf*.
- Mathur, A., & Sengupta, R. (2019). Analysing Monetary Policy Statements of the Reserve Bank of India. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3383869>
- Mayandy, K. (2019). Monetary Policy Rules and Macroeconomic Stability: Evidence from Sri Lanka. *Buletin Ekonomi Moneter Dan Perbankan*, 22(4), 485–506.  
<https://doi.org/10.21098/bemp.v22i4.1191>
- McCarten, W. J. (2003). The challenge of fiscal discipline in the Indian states. *Fiscal Decentralization and the Challenge of Hard Budget Constraints*, 249–286.
- Meltzer, A. H. (2002). A History of the Federal Reserve Volume 1: 1913–1951. In *Business History Review* (Vol. 1, Issue 1). The University of Chicago Press.
- Meltzer, A. H. (2009). *A History of the Federal Reserve, Volume 2, 1951-1969*.

- Mertens, T. M., & Williams, J. C. (2019). Tying down the anchor: monetary policy rules and the lower bound on interest rates. *FRB of New York Staff Report*, 887.
- Mishkin, F., & Posen, A. (1998). *Inflation Targeting: Lessons from Four Countries*.  
<https://doi.org/10.3386/w6126>
- Mishkin, F. S. (2000). Inflation Targeting for Emerging-Market Countries. *American Economic Review*, 90(2), 105–109. <https://doi.org/10.1257/aer.90.2.105>
- Mishkin, F., & Schmidt-Hebbel, K. (2007). *Does Inflation Targeting Make a Difference?*  
<https://doi.org/10.3386/w12876>
- Mishra, A., & Mishra, V. (2012). Inflation targeting in India: A comparison with the multiple indicator approach. *Journal of Asian Economics*, 23(1), 86–98.  
<https://doi.org/10.1016/j.asieco.2011.10.003>
- Mishra, P., Montiel, P., & Sengupta, R. (2016). Monetary Transmission in Developing Countries: Evidence from India. *IMF Working Papers*, 16(167), 1.  
<https://doi.org/10.5089/9781475523966.001>
- Misra, S. N. (2019). Repo Rate, Inflation and Growth: The Way Forward. *Indian Journal of Economics and Development*, 15(2), 327–330.
- Modigliani, F., & Papademos, L. (1975). Targets for Monetary Policy in the Coming Year. *Brookings Papers on Economic Activity*, 1975(1), 141. <https://doi.org/10.2307/2534063>
- Mohan, R. (2005a). Financial sector reforms in India: policies and performance analysis. *Economic and Political Weekly*, 1106–1121.
- Mohan, R. (2005b). Globalisation, financial markets and the operation of monetary policy in India. In *Globalisation and monetary policy in emerging markets* (pp. 161–170).

- Mohan, R., & Patra, M. (2009). Monetary Policy Transmission in India. In *Monetary Policy Frameworks for Emerging Markets*. Edward Elgar Publishing.  
<https://doi.org/10.4337/9781848449190.00015>
- Mohan, R., & Ray, P. (2019). Indian Monetary Policy in the Time of Inflation Targeting and Demonetization. *Asian Economic Policy Review*, 14(1), 67–92.  
<https://doi.org/10.1111/aepr.12242>
- Mohanty, D. (2010). Implementation of Monetary Policy in India. *Speech Delivered at the Banker's Club, Bhubaneswar*.
- Mohanty, D. (2011). Changing contours of monetary policy in India. *Speech by Shri Deepak Mohanty, Executive Director, Reserve Bank of India, Delivered at the Royal Monetary Authority of Bhutan, Thimpu on 1st December*.
- Mohanty, D. (2012). Evidence of interest rate channel of monetary policy transmission in India. *Second International Research Conference at the Reserve Bank of India, February, 1–2*.
- Mohanty, D. (2013, March 25). *Efficacy of monetary policy rules in India*. Speech Delivered at Delhi School of Economics, Delhi, India, March 25th.  
<https://www.bis.org/review/r130327a.pdf>
- Mohanty, D., & Mitra, A. K. (1999). Experience with monetary targeting in India. *Economic and Political Weekly*, 123–132.
- Mohanty, M. S., & Klau, M. (2005). Monetary Policy Rules in Emerging Market Economies: Issues and Evidence. In *Monetary Policy and Macroeconomic Stabilization in Latin America* (pp. 205–245). Springer Berlin Heidelberg. [https://doi.org/10.1007/3-540-28201-7\\_13](https://doi.org/10.1007/3-540-28201-7_13)
- Montes, G. C. (2009). Reputation, credibility and monetary policy effectiveness. *Estudos Econômicos (São Paulo)*, 39, 673–698.

- Mubarik, Y. A. (2005). *Inflation and growth: An estimate of the threshold level of inflation in Pakistan* (1; 08). State Bank of Pakistan Karachi.  
<https://ideas.repec.org/p/sbp/wpaper/08.html>
- Mundell, R. A. (2000). A Reconsideration of the Twentieth Century. *American Economic Review*, 90(3), 327–340. <https://doi.org/10.1257/aer.90.3.327>
- Munir, Q., & Mansur, K. (2009). Non-Linearity Between Inflation Rate and GDP Growth in Malaysia. *Economics Bulletin*, 29(3), 1555–1569.  
<http://www.accessecon.com/pubs/eb/2009/volume29/eb-09-v29-i3-p4.pdf>
- Munir, Q., Mansur, K., & Furuoka, F. (2009). Inflation and Economic Growth in Malaysia — A Threshold Regression Approach. *ASEAN Economic Bulletin*, 26(2), 180.  
<https://doi.org/10.1355/ae26-2d>
- Mustafi, U. P., & Sengupta, R. (2020). *Regime changes in Indias monetary policy and Tenures of RBI governors*. Indira Gandhi Institute of Development Research, Mumbai, India.
- Mwakanemela, K. (2013). *Impact of inflation on economic growth: A case study of Tanzania*.
- Nair, A. R., & Anand, B. (2020). Monetary policy and financial stability: Should central bank lean against the wind? *Central Bank Review*, 20(3), 133–142.  
<https://doi.org/10.1016/j.cbrev.2020.03.006>
- Nazlioglu, S., Gupta, R., & Bouri, E. (2020). Movements in international bond markets: The role of oil prices. *International Review of Economics & Finance*, 68, 47–58.
- Ndoricimpa, A. (2017). Threshold Effects of Inflation on Economic Growth: Is Africa Different? *International Economic Journal*, 31(4), 599–620.  
<https://doi.org/10.1080/10168737.2017.1380679>

- Nogueira, R. P. (2009). Testing credibility with time-varying coefficients. *Applied Economics Letters*, 16(18), 1813–1817. <https://doi.org/10.1080/13504850701719611>
- OECD. (2024, May 30). *Share of OECD economies in global GDP broadly stable at 46% in 2021 compared to 2017*. <https://www.oecd.org/en/data/insights/statistical-releases/2024/05/share-of-oecd-economies-in-global-gdp-broadly-stable-at-46-in-2021-compared-to-2017.html>
- Omay, T., & Öznur Kan, E. (2010). Re-examining the threshold effects in the inflation–growth nexus with cross-sectionally dependent non-linear panel: Evidence from six industrialized economies. *Economic Modelling*, 27(5), 996–1005. <https://doi.org/10.1016/j.econmod.2010.04.011>
- Orphanides, A. (2003). Historical monetary policy analysis and the Taylor rule. *Journal of Monetary Economics*, 50(5), 983–1022. [https://doi.org/10.1016/S0304-3932\(03\)00065-5](https://doi.org/10.1016/S0304-3932(03)00065-5)
- Özyılmaz, A. (2022). Relationship Between Inflation and Economic Growth in EU Countries. *Journal of Economic Policy Researches / İktisat Politikası Araştırmaları Dergisi*, 9(2), 425–438. <https://doi.org/10.26650/JEPR1132170>
- Pandey, R., Patnaik, I., & Sengupta, R. (2024). *The journey of inflation targeting in India*. Indira Gandhi Institute of Development Research.
- Pandey, R., Patnaik, I., & Sengupta, R. (2025). The Journey of Inflation Targeting in India. *Indian Public Policy Review*, 6(4), 01–34. <https://doi.org/10.55763/ippr.2025.06.04.001>
- Park, K. (2023). Central Bank Credibility and Monetary Policy. *International Journal of Central Banking*, 19(2). <https://www.ijcb.org/journal/ijcb23q2a3.pdf>
- Patel, U. R., Nayak, P. J., Nitsure, R., Ghate, C., Darbha, G., Montiel, P. J., Mohanty, D., Chinoy, S., & Patra, M. D. (2014). *Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework*.

- Patnaik, A. (2023). Central Bank Credibility: A Case Study of RBI. *Available at SSRN 4491188*.
- Pattanaik, S., & Nadhanael, G. V. (2013). Why Persistent High Inflation Impedes Growth? An Empirical Assessment of Threshold Level of Inflation for India. *Macroeconomics and Finance in Emerging Market Economies*, 6(2), 204–220.  
<https://doi.org/10.1080/17520843.2012.735248>
- Petroleum Planning & Analysis Cell. (2023). *RSP of Petrol and Diesel at Delhi up to 15.6.2017*. Ministry of Petroleum & Natural Gas, Government of India. <https://ppac.gov.in/retail-selling-price-rsp-of-petrol-diesel-and-domestic-lpg/rsp-of-petrol-and-diesel-at-delhi-up-to-15-6-2017>
- Phelps, E. S. (1967). Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time. *Economica*, 34(135), 254. <https://doi.org/10.2307/2552025>
- Phillips, A. W. (1958). The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957. *Economica*, 25(100), 283.  
<https://doi.org/10.2307/2550759>
- Pierdzioch, C., Reid, M. B., & Gupta, R. (2016). Forecasting the South African inflation rate: On asymmetric loss and forecast rationality. *Economic Systems*, 40(1), 82–92.  
<https://doi.org/10.1016/j.ecosys.2015.08.004>
- Pleša, G. (2025). State-Dependent and Time-Varying Effects of Monetary Policy. *Eastern European Economics*, 1–24. <https://doi.org/10.1080/00128775.2025.2456281>
- Pollin, R., & Zhu, A. (2009). Inflation and Economic Growth: A Cross-Country Non-Linear Analysis. In *Beyond Inflation Targeting*. Edward Elgar Publishing.  
<https://doi.org/10.4337/9781849801980.00014>

- Primiceri, G. E. (2005). Time Varying Structural Vector Autoregressions and Monetary Policy. *The Review of Economic Studies*, 72(3), 821–852. <https://doi.org/10.1111/j.1467-937X.2005.00353.x>
- Rangarajan, C. (1998). Development, inflation and monetary policy. *India's Economic Reforms and Development (Oxford University Press: New Delhi)*, 48–72.
- Rangarajan, C. (2001). Some Critical Issues in Monetary Policy. *Economic and Political Weekly*, 36(24), 2139–2146.
- Rangarajan, C. (2020). The New Monetary Policy Framework: What it Means. *Journal of Quantitative Economics*, 18(2), 457–470. <https://doi.org/10.1007/s40953-020-00210-2>
- Rangarajan, C. (2021). Evolving Contours of Monetary Policy. *Economic & Political Weekly*, 56(20), 35.
- Rao, P., Kumar, S., Gaur, V., & Verma, D. (2017). What constitutes financing gap in Indian SMEs – owners' perspective? *Qualitative Research in Financial Markets*, 9(2), 117–131. <https://doi.org/10.1108/QRFM-01-2017-0001>
- Ray, P., Joshi, H., & Saggiar, M. (1998). New monetary transmission channels: Role of interest rates and exchange rate in conduct of Indian monetary policy. *Economic and Political Weekly*, 2787–2794.
- Rechard, K., & Regmi, N. R. (2023). Greenspan's adherence to the Taylor rule: examining Federal Reserve chairmen policy regimes and deviations from the Taylor rule. *Cogent Economics & Finance*, 11(1), 2209951. <https://doi.org/10.1080/23322039.2023.2209951>
- Reid, M. (2009). Isolating a Measure of Inflation Expectations for the South African Financial Market Using Forward Interest Rates. *South African Journal of Economics*, 77(3), 399–413. <https://doi.org/10.1111/j.1813-6982.2009.01218.x>

- Rigobon, R. (2007). Through the Pass-Through: Measuring Central Bank Credibility. *Journal of Policy Analysis and Management*, 5(3), 657–664.
- Romero, J. (2013). Treasury-Fed Accord. *Federal Reserve History*.
- Rousseau, P. L., & Wachtel, P. (2002). Inflation Thresholds and the Finance–Growth Nexus. *Journal of International Money and Finance*, 21(6), 777–793.  
[https://doi.org/10.1016/S0261-5606\(02\)00022-0](https://doi.org/10.1016/S0261-5606(02)00022-0)
- Samuelson, P. A. (1960). Reflections on Monetary Policy. *The Review of Economics and Statistics*, 42(3), 263. <https://doi.org/10.2307/1926371>
- Sanga, D., & Gui-Diby, S. L. (2020). *Inflation Threshold Levels and Economic Growth in the Franc Zone Countries* (9405). <https://ideas.repec.org/p/wbk/wbrwps/9405.html>
- Santomero, A. M., & Seater, J. J. (1978). The inflation-unemployment trade-off: A critique of the literature. *Journal of Economic Literature*, 16(2), 499–544.
- Sarmah, A., & Bal, D. P. (2021). Does Crude Oil Price Affect the Inflation Rate and Economic Growth in India? A New Insight Based on Structural VAR Framework. *The Indian Economic Journal*, 69(1), 123–139. <https://doi.org/10.1177/0019466221998838>
- Sawhney, B., Kulkarni, K. G., & Cachanosky, N. (2017). Monetary policy in India and the US: Is the Taylor rule irrelevant? *International Review of Business and Economics*, 1(1), 75.
- Şen, H., Kaya, A., Kaptan, S., & Cömert, M. (2020). Interest Rates, Inflation, and Exchange Rates in Fragile EMEs: A Fresh Look at the Long-Run Interrelationships. *The Journal of International Trade & Economic Development*, 29(3), 289–318.  
<https://doi.org/10.1080/09638199.2019.1663441>

- Sharma, A., & Nurudeen, I. (2019). Monetary Policy Disturbance in India: The Relationships Among Money, Output and Prices. *The Indian Economic Journal*, 67(3–4), 246–257. <https://doi.org/10.1177/0019466220947699>
- Siekmann, H. (2023). *Inflation, Price Stability, and Monetary Policy: On the Legality of Inflation Targeting by the Eurosystem* (pp. 125–146). [https://doi.org/10.1007/978-3-031-27949-2\\_8](https://doi.org/10.1007/978-3-031-27949-2_8)
- Singh, K., & Kalirajan, K. (2003). The inflation-growth nexus in India: an empirical analysis. *Journal of Policy Modeling*, 25(4), 377–396. [https://doi.org/10.1016/S0161-8938\(03\)00011-5](https://doi.org/10.1016/S0161-8938(03)00011-5)
- Singh, P. (2010). Searching threshold inflation for India. *Economics Bulletin*, 30(4), 3209–3220.
- Subbarao, D. (2022). *Fiscal Dominance of Monetary Policy: Global and Indian Experience* (pp. 31–50). [https://doi.org/10.1007/978-981-19-0185-0\\_3](https://doi.org/10.1007/978-981-19-0185-0_3)
- Subramanian, A., & Felman, J. (2019). India’s great slowdown: what happened? What’s the way out? *CID Working Paper Series*.
- Sun, Y., & Dimiski, A. (2024). Exploring inflation dynamics in Canada: A threshold vector autoregressive approach. *The Journal of Economic Asymmetries*, 30, e00364. <https://doi.org/10.1016/j.jeca.2024.e00364>
- Svensson, L. E. O. (2010). *Inflation Targeting* (pp. 1237–1302). <https://doi.org/10.1016/B978-0-444-53454-5.00010-4>
- Takeshi, I., & Shigeyuki, H. (2009). An Empirical Analysis of the Monetary Policy Reaction Function in India. In *IDE Discussion Papers* (IDE Discussion Papers 200; Vol. 200).

- Tan, C.-T., & Mohamed, A. (2020). MONETARY POLICY RULES IN MALAYSIA, SINGAPORE AND THAILAND. *Buletin Ekonomi Moneter Dan Perbankan*, 23(4), 565–596. <https://doi.org/10.21098/bemp.v23i4.1112>
- Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39, 195–214. [https://doi.org/10.1016/0167-2231\(93\)90009-L](https://doi.org/10.1016/0167-2231(93)90009-L)
- Taylor, J. B. (1994). The inflation/output trade-off revisited. *Goals, Guidelines and Constraints Facing Monetary Policymakers, Federal Reserve Bank of Boston, Boston, Massachusetts*, 21–38.
- Taylor, J. B. (2000). Using monetary policy rules in emerging market economies. *75th Anniversary Conference, "Stabilization and Monetary Policy: The International Experience", Bank of Mexico*.
- Taylor, J. B. (2001). The Role of the Exchange Rate in Monetary-Policy Rules. *American Economic Review*, 91(2), 263–267. <https://doi.org/10.1257/aer.91.2.263>
- Taylor, J. B. (2019). Inflation targeting in high inflation emerging economies: lessons about rules and instruments. *Journal of Applied Economics*, 22(1), 103–116. <https://doi.org/10.1080/15140326.2019.1565396>
- Thanh, S. D. (2015). Threshold effects of inflation on growth in the ASEAN-5 countries: A Panel Smooth Transition Regression approach. *Journal of Economics, Finance and Administrative Science*, 20(38), 41–48. <https://doi.org/10.1016/j.jefas.2015.01.003>
- Tronzano, M. (2005). Inflation Targeting and Credibility: a note on the recent empirical literature. *Economia Internazionale/International Economics*, 58(4), 489–506.
- Twinoburyo, E. N., & Odhiambo, N. M. (2018). Monetary Policy and Economic Growth: A Review of International Literature. *Journal of Central Banking Theory and Practice*, 7(2), 123–137. <https://doi.org/10.2478/jcbtp-2018-0015>

- Uddin, I., & Rahman, K. U. (2023). Impact of corruption, unemployment and inflation on economic growth evidence from developing countries. *Quality & Quantity*, 57(3), 2759–2779. <https://doi.org/10.1007/s11135-022-01481-y>
- Vinayagathan, T. (2013). Inflation and economic growth: A dynamic panel threshold analysis for Asian economies. *Journal of Asian Economics*, 26, 31–41. <https://doi.org/10.1016/j.asieco.2013.04.001>
- Virmani, V. (2004). *Operationalising Taylor-Type Rules for the Indian Economy: Issues and Some Results (1992Q3 2001Q4)*. Indian Institute of Management Ahmedabad, Research and Publication Department. <https://web.iima.ac.in/publications/data/2004-07-04vineet.pdf>
- Wai, U. T. (1959). The relation between inflation and economic development: a statistical inductive study. *Staff Papers (International Monetary Fund)*, 7(2), 302–317.
- Walsh, C. E. (2009). Inflation Targeting: What Have We Learned? *International Finance*, 12(2), 195–233. <https://doi.org/10.1111/j.1468-2362.2009.01236.x>
- Yanamandra, V. (2015). Exchange rate changes and inflation in India: What is the extent of exchange rate pass-through to imports? *Economic Analysis and Policy*, 47, 57–68. <https://doi.org/10.1016/j.eap.2015.07.004>
- Yuhan, R. J., & Sohibien, G. P. D. (2018). *Relationship between inflation, exchange rate and money supply in Indonesia using threshold vector autoregressive (TVAR)*. 020128. <https://doi.org/10.1063/1.5054532>
- Zakaria, M., Khiam, S., & Mahmood, H. (2021). Influence of oil prices on inflation in South Asia: Some new evidence. *Resources Policy*, 71, 102014.
- Zeng, N. (2018). Time-varying Inflation Dynamics and Monetary Policy Credibility: A Bivariate Approach with Stochastic Uncertainty. *2018 International Conference on Management and Education, Humanities and Social Sciences (MEHSS 2018)*, 290–293.

