TRANSMISSION MECHANISM AND OPERATING PROCEDURE OF MONETARY POLICY IN INDIA: AN ECONOMETRIC ANALYSIS

A THESIS SUBMITTED TO THE
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FOR A WARD OF THE DEGREE OF
DOCTOR OF PHILOSOPHY IN ECONOMICS

By

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Dedicated to ...

My

Parents & Teachers

DECLARATION

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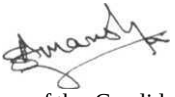
I hereby declare that the work embodied in this thesis entitled **"Transmission Mechanism and Operating Procedure of Monetary Policy in India: An Econometric Analysis"** submitted to the Department of Economics, University of Hyderabad for award of the degree of Doctor of Philosophy in Economics is original work carried by me under the supervision of Dr. Naresh Kumar Sharma and Prof B. Kamaiah, Department of Economics, University of Hyderabad.

I declare to the best of my knowledge that no part of this thesis previously formed the basis for award of any degree, diploma, fellowship or any other similar title of recognition of any other University.



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This is to certify that, the thesis entitled **"Transmission Mechanism and Operating Procedure of Monetary Policy in India: An Econometric Analysis"** submitted by Mr. Amaresh Samantaraya to fulfill the requirement for award of the degree of Doctor of Philosophy in Economics has been carried out under our supervision and no part of the thesis has been submitted for any other degree or diploma of any other University.

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Amaresh Samantaraya

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A. List of Tables

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LIST of ABBREVIATIONS

ADF Test: Augmented Dickey-Fuller Test for Unit Root

ADs: Authorised Dealers

AGGDEP: Aggregate Deposits

AGFI: Adjusted Goodness of Fit Index

AIC: Akaike Information Criterion

AL: Autonomous Liquidity

BBOW: Borrowings of Banks from RBI

BSE: Bombay Stock Exchange

CAS: Credit Authorisation Scheme

CD: Certificate of Deposit

CLF: Collateralised Lending Facility

CP: Commercial Paper

CRR: Cash Reserve Ratio

DFHI: Discount and Finance House of India

DL: Discretionary Liquidity

DvP: Delivery *versus* Payment

FOMC: Federal Open Market Committee

FRD: Forward Premia

GDP: Gross Domestic Product

GFI: Goodness of Fit Index

GNP: Gross National Product

GoI: Government of India

GSEC: Government Securities

IIP: Index of Industrial Production

ILAF: Interim Liquidity Adjustment Facility

LAF: Liquidity Adjustment Facility

M3: Broad Money

MoU: Memorandum of Understanding

NFA: Net Foreign Assets

NFCREDIT: Non-food Credit

NNP: Net National Product

NLP: Net Liquidity Position

OLS: Ordinary Least Squares

OMO: Open Market Operations

PDBOW: Borrowings of PDs from RBI

PDs: Primary Dealers

PLRs: Prime Lending Rates

PP Test: Phillips-Perron Test for Unit Root

QTM: Quantity Theory of Money

RBI: Reserve Bank of India

RBICG: RBI Credit to Government

RM or RESM: Reserve Money

SBC: Schwarz Bayesian Criterion

SDs: Satellite Dealers

SLR: Statutory Liquidity Ratio

TBs: Treasury Bills

VAR: Vector Auto Regressions

WMA: Ways & Means Advances

WPI: Wholesale Price Index

Chapter 1

Introduction

Chapter – I

INTRODUCTION

"The first and most important lesson that history teaches about what monetary policy can do - and it is a lesson of most profound importance - is that monetary policy can prevent itself from being a major source of economic disturbance ... provide a stable background for the economy ...and contribute to offsetting major disturbances in the economic system arising from other sources. "

- Milton Friedman, 1968.

1.1- Introduction

In the perspective of enhancing social welfare, the science of economics guides in optimisation of production and consumption of goods and services through efficient allocation of available productive resources as well as through redistribution of benefits of production across various strata of the society. In the same spirit, the branch of monetary economics studies the relationship between monetary aggregates, interest rates, output and prices, and the technique of monetary policy is found to be an essential and sound instrument of overall economic policy in the endeavour of output stabilisation and inflation control. The origin of monetary thinking in terms of linking money and prices can be traced back to the rudimentary work of French writer Jean Budin (Pierce and Tysome, 1985). He attempted to explain the price revolution that swept Europe for almost a century through import of large quantities of gold and silver from American colonies in the sixteenth century. Subsequently, this idea was refined and formalised in the classical tradition in the form of quantity theory of money (QTM) proposing a direct relationship between money supply and general prices, and laid down the formal foundation of monetary policy. However, the ideology of 'classical dichotomy' ignored any sort of influences from monetary variables to real variables.

Notwithstanding his emphasis on fiscal measures, Keynes had highlighted the ability of monetary expansion to raise investment spending through decline in real

interest rate and repudiated the concept of 'money neutrality'. However, a special twist in terms of 'liquidity trap' in the Keynesian literature implied impotence of monetary policy to promote economic activity at low rates of interest. The monetarist school of thought that followed under the leadership of Milton Friedman viewed fluctuations in monetary growth leading to fluctuations in growth of output and thought stabilisation of money supply will eliminate the sources of fluctuation in real output and hence advocated 'rule' based monetary growth as against 'discretionary' practice. The basic thrust of monetarist school lies in its faith on long-run money neutrality without ignoring the ability of money to influence output in the short-run.

The broad analytical aspect of current international practices of monetary policy has evolved as a nice blend of synthesis incorporating elements of classical, Keynesian and monetarist thinking. Presently, there is a broad consensus with the view - 'monetary policy also matters' (Rangarajan, 1997b). The question is not whether monetary policy affects output and prices, but how to use it for economic stabilisation. Over the years, monetary policy has been increasingly receiving considerable attention in the overall economic policy. Usually, the formulation and implementation of monetary policy lies in the hands of the central bank of a country with either active or implicit guidance of the government. The formulation of monetary policy mainly involves preparing a precise plan aimed at pursuing various objectives, namely, price stability, output expansion, maintaining orderly conditions in the financial markets, etc. and setting appropriate intermediate and operating targets. The implementation of this plan is undertaken by using various direct and indirect operating instruments such as reserve requirements, open market operations, refinance facilities, etc. to regulate the operating and intermediate targets.

In India, the responsibility of conducting monetary policy is entrusted to the Reserve Bank of India (RBI). In the Annual Monetary and Credit Policy of RBI, the Governor publicly announces the medium to long-term stance of the monetary policy and changes in the relevant policy measures in the month of April every year. This is followed by a mid-term review in the month of October. In the planning era,

consistent with the overall economic policy framework, monetary policy in India was characterised by credit planning. The basic objective of monetary policy was to ensure flow of credit to the particular sectors as desired in the planning exercise and provide credit to government to undertake development activities. The constitution of a high level committee to review the working of monetary system in India and to shape the future monetary policy framework under the chairmanship of Prof. Sukhamoy Chakravarty in 1982 was an important landmark in the history of monetary policy in India. Chakravarty Committee (RBI, 1985) recommendations have significant influence in guiding the subsequent transformation in conduct of monetary policy in India. Finally, the process of economic reforms initiated in India in the early 1990s and the following institutional changes towards creation of a conducive atmosphere for operation of market forces have effected radical changes in the overall monetary policy framework in India. In view of the changing parameters of monetary policy in India, correct understanding and clarity on the interlinkages amongst the policy instruments, targets and objectives is a necessary prerequisite for monetary policy operations. In this backdrop, the present work attempts to study the transmission mechanism and operating procedure of monetary policy in India to aid monetary policy operations.

1.2 –Overall Framework of Monetary Policy and its Basic Parameters in India

To provide a brief introduction to the transmission mechanism and operating procedure of monetary policy, we shall delineate the overall monetary policy framework as depicted in Exhibit I.1. The overall framework can be broadly distinguished into two parts (i) Implementations / Tactics and (ii) Strategy. In monetary policy formulation, the ball starts rolling with preparing the set of final objectives desirable to be achieved through monetary policy actions. World over, the set of final objectives of monetary policy include price stability, output expansion or employment augmentation, maintaining orderly conditions in the financial markets including foreign exchange market, comfortable balance of payment, etc. However,

emphasis on a subset of the above is assigned depending on country specific conditions.

In most cases, the above final objectives are not under the direct control of the monetary authority. Hence, it relies on appropriate intermediate target(s) having close and predictable link with final objectives and upon which it exercises reasonable control. Since long various monetary aggregates such as broad or narrow money, monetary base have been widely used as intermediate targets. But, targeting broad money has been abandoned in many industrial countries, because of signs of instability in the money demand function and money multipliers in the light of financial deepening and emergence of innovative financial instruments. Credit targets for specific sectors and for the whole economy constituted another important intermediate target in developing countries. Presently, many industrial countries use interest rates as intermediate targets. Some small open economies opt for focusing on foreign exchange rate as the intermediate target in view of high importance of foreign trade in determining the real income and prices. Further, there are a few industrial countries, which do not have any intermediate targets as they attempt to control the general price level directly in the 'inflation targeting' framework. The above tasks of drawing up the set of final objectives and selecting the desired levels of intermediate targets constitute the strategy of monetary policy.

In the implementation part, the operating procedure characterises the detailed description of policy tools and operations. The operating procedure tactically decides the appropriate operating target and the set of policy instruments, the mode and frequency of their use, the list of counterparties, etc. to achieve the desired level of intermediate target. At first, the desired level of operating target is arrived at based on estimates of the desired level of intermediate target. World over, reserve money, particularly bank reserves and short-term interest rates are used as the operating targets. Finally, the task at hand boils down to select the appropriate set of direct and indirect policy instruments to be employed to achieve the desired operating target. Traditional policy tools related to standing facilities such as refinance rates and

statutory reserve requirements have been very useful instruments of monetary management. In recent times, an array of indirect instruments such as open market operation (OMO) in domestic securities, foreign exchange swaps, issue of short term paper, interbank market transactions, etc. find wide application.

As discussed above, the basic parameters such as objectives, targets, instruments and operating procedure characterise the overall framework of monetary policy in an economy. All the above parameters vary depending on the structure of the economy, particularly its financial sector and institutional arrangements. These parameters have experienced steady transformation and modification with changing economic environment in India. Starting with the final targets or objectives of monetary policy in India, the preamble to the Reserve Bank of India Act, 1934, sets out the objectives as, "to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage". The objective of price stability can be derived from the phrase 'securing monetary stability' and 'operating credit system to its advantage' can be interpreted as the objective of supporting output growth through credit expansion (Vasudevan, 2002). The RBI has spelt out, many times, price stability and adequate credit expansion to support economic growth as the dominant objectives of monetary policy (RBI Annual Report, 1996-97, Rangarajan (1994), Reddy (2002)). However, depending on the specific circumstances in a particular year, emphasis is placed on either of the two. Gradual opening up of the economy and development of key segments of the financial market with close interlinkages in recent years has attributed high emphasis on the objective of financial stability in India.

Coming to intermediate targets, in the era of credit planning in India, there was greater reliance on credit aggregates to achieve output growth and regulating agricultural prices for inflation control. Subsequently, India had adopted 'monetary targeting with feedback' since mid-1980s as per the recommendations of Chakravarty Committee. However, with increasing concern for financial stability in the context of

greater openness of the economy and close interlinkages among different segments of financial market, there has been a tilt towards multiple indicator approach in recent years, which adopts monitoring and using a whole range of monetary and financial indicators instead of any explicit intermediate target.

In the pre-reform period, direct instruments such as priority sector lending obligations, variations in statutory liquidity ratio (SLR) and cash reserve ratio (CRR), food credit, refinances related to priority sector lending commitments, etc. constituted major tools of monetary management in India. With recommendations of Chakravarty Committee (RBI, 1985) and Narasimham Committee (RBI, 1991), there has been a gradual shift from direct to indirect instruments in the post-reform period. Presently, OMO - both outright and repo, Bank Rate, refinance facilities to banks and primary dealers (PDs) are commonly used monetary policy instruments in India. 'Reserve money' serves as the main operating target and 'call money rate' is used as the supplementary one. Now, there is greater emphasis on the process of liquidity management. The use of policy instruments mainly influences the conditions that equilibrate supply of and demand for liquidity in the market.

1.3 – Issues and Motivation of the Study

On the dimensions of channels of monetary transmission to influence real activity, currently, there is a widespread debate regarding the dominance of 'money view' *versus* 'credit view'. Works by Bernanke and Blinder (1988), Burnner and Meltzer (1988), Romer and Romer (1990), Kashyap, Stein and Wilcox (1993), Kashyap and Stein (1994), Bernanke and Gertler (1995), Cecchetti (1995), Taylor (1995), Kim (1999), Sellon (2002), etc. are some of the prominent contributions in this debate. Mishkin (1996) schematically depicts the original and extended versions of various channels of both money and credit view. Each of the individual channel C_i is derived by putting some restriction ψ_i on the way in which monetary policy influences real output. For example, traditional interest rate channel (IRC) depicts the particular path in which monetary shocks affect real output by putting restriction ψ_{IRC}

which ignores the rest of the channels. Such a partial view of the individual channel is far from reality where all possible channels operate simultaneously.

In our view, an individual channel of monetary transmission does not operate in isolation but all the channels coexist and complement each other. We hypothesise that all possible channels operate simultaneously and combined together transmit the monetary shocks to the final target. Without imposing any restriction, we attempt to analyse the combined effect through all possible channels with aid of 'path analysis'

Secondly, as discussed in the previous section, basic parameters of monetary policy in India experienced radical transformation in the post-reform period with policy initiatives to activate key segments of the financial market such as money market, government securities market, capital market, foreign exchange market. Now a conducive atmosphere for operation of market forces is created and in the changed environment various new channels of monetary policy have emerged and a new array of policy instruments are added to the armory of the monetary authority. The operating procedure of monetary policy, *inter alia,* has witnessed significant transformation. In view of this, it is essential to analyse and establish various interlinkages among the policy instruments, targets and objectives of monetary policy in India to aid monetary policy operation. In this backdrop, the present work envisages to empirically study the transmission mechanism and operating procedure of monetary policy in India, which will draw useful implications for the conduct of monetary policy.

1.4 - Objectives

The broad objectives of the current study can be enlisted as:

(i) To analytically review the evolutionary process of monetary policy framework in India since Independence.

(ii) To explore and examine the effectiveness and relative strength of different channels of monetary transmission in India and their combined effect on real activity.

(iii) To study the lag structure of monetary impulses on various real and financial variables.

(iv) To delineate the detailed operating procedure and highlight the interactions between instruments and targets of monetary policy in India

(v) To assess the desirability of shifting to the regime of 'interest rate targeting' and its feasibility in the near future.

1.5– Methodology

In this study, we have employed 'Path Analysis' and 'VAR Analysis' as the major techniques to empirically study the transmission mechanism of monetary policy in India. The technique of path analysis is nothing but an extension of standard regression analysis, which is capable of capturing the indirect effects of the exogenous or explanatory variable on the final dependent variable, through the intervening variables. It is particularly suitable to estimate the relationship in which the independent variable affects the final dependent variable in various ways. In the path analyses, the path model encompasses various dependent, intermediary and independent variables and their interlinkages, which can be depicted in a path diagram. The path coefficients are standardised regression weights, which measure the effect of causal variable on the effect variable using standardised data or a correlation matrix as input. After the path coefficients are estimated, the direct, indirect and total effect of the exogenous variable on the final dependent variable can be ascertained. The detailed description of this technique is discussed in the Appendix A. We have used path analysis to study various channels through which monetary policy affects real activity.

The technique of VAR Analysis is quite popular in modern day macro-monetary research. The standard VAR analysis due to Sims (1980) is very useful in the analysis of the dynamic interrelationship amongst the variables without any theoretical restrictions. Particularly, the tools of innovation accounting through

impulse response function and variance decomposition in VAR are widely used to study the impact of policy shock on the other endogenous variables. In standard VAR, exact identification is achieved thorough Choleski decomposition. However, Choleski decomposition restrictions are accused to be 'atheoretical' and to overcome this limitation structural VAR models (Bernanke (1986), Sims (1986), Blanchard and Quah (1989)) were introduced. In structural VAR, the identification restrictions are derived from economic reasoning. We have employed both standard VAR analysis with Choleski decomposition and structural VAR analysis to analyse the impact of monetary shocks on economic variables such as real output, prices and interest rates in India. These techniques are discussed in detail in the Appendix A and Chapter 4. In Chapter 5, we have used simple regression analysis to study the operating procedure of monetary policy.

It can be noted that, we have used both annual and monthly data for the estimations in our study. Particularly, the monthly data is subject to the problem of seasonality. We have used well-known 'X12' - method for deseasonalising monthly data before using it for estimations. Further, to get rid of spurious regression, the variables used in the model need to be stationary. We have employed Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for unit root to confirm stationarity of the variables. The details of the above techniques are provided in Appendix A.

1.6– Organisation of the Study

In the thesis, the following Chapter 2 provides a succinct picture of the transformation process of monetary policy in India since Independence. It discusses the basic characteristics of monetary policy in India in different phases in terms of objectives, instruments, targets and policy framework. It also highlights the role of existing economic conditions, overall economic policy regime and institutional arrangements in shaping the framework of monetary policy. This discussion on the emergence of present mode of monetary policy through numerous modifications since

Independence serves as a useful guide on empirical realities for the econometric analysis in the following chapters.

Looking beyond the current debate of superiority of money *versus* credit view, Chapter 3 analyses various channels of monetary transmission in India adopting a synthetic approach. Instead of emphasising on the operation of any particular channel, this chapter constructs a hybrid channel combining all individual channels, which is very close to the reality. To realise the above objective we have employed the technique of 'path analysis', which encompasses operation of all possible channels, simultaneously. In a single path model we study the effect of monetary policy on the final objective of real activity through all possible channels. Different models are considered for the pre-reform and post-reform period separately keeping in mind the prevailing empirical realities.

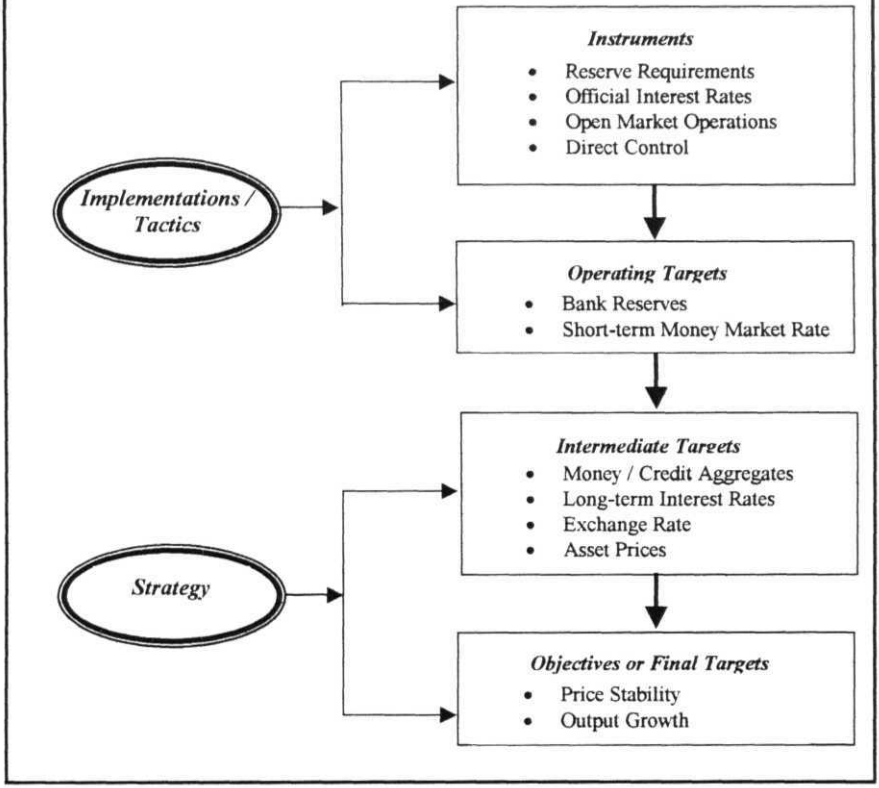
The following Chapter 4 employs VAR analysis to study the influence of monetary policy shocks on various economic variables such as real output, interest rates and prices. It supplements the analysis of Chapter 3 in terms of taking care of the feedback from real output to money and introducing the price variable explicitly in the system. In this chapter, we examine the strength of monetary policy impact on the economic variables in terms of explaining the forecast variance and trace the lag structure of monetary policy effects through the impulse response function. In this chapter also, we have constructed different VAR models based on annual and monthly data, mainly guided by the number of observations available and the existing economic realities.

The task of delineating the operating procedure of monetary policy in India is undertaken in Chapter 5. In this chapter, we have started with highlighting the international practices of monetary policy operating procedure in selected industrial and emerging economies. It is followed by a brief account of operating procedure of monetary policy in India in the post-reform period. Subsequently, we have empirically examined the relative role of various instruments and analysed the

interlinkages amongst the policy instruments, operating targets and intermediate targets in India.

Finally, Chapter 6 provides a broad overview of the study and draws up important policy implications. The details of the methodology adopted in the study and data issues are separately presented in Appendix A and Appendix B, respectively towards end of the thesis.

Exhibit I.1
Framework of Monetary Policy



Chapter 2

Analytics of Monetary (Policy in India since Independence

Chapter-II

ANALYTICS OF MONETARY POLICY IN INDIA SINCE INDEPENDENCE

2.1 - Introduction

Very useful insights on the causes and events that shaped the direction and pace of an event can be gained by studying its evolutionary process. It is also useful in guiding the current actions and future plans. This logic tempts to undertake a purposeful analytical review of policy trends in the sphere of monetary policy in India, since Independence. Over the last five decades, the conduct of monetary policy in India has undergone sharp transformation and the present mode of monetary policy has evolved over time with numerous modifications. In this chapter, we shall trace the evolution of institutional arrangements, changes in the policy framework, objectives, targets and instruments of monetary policy in India in the light of shifts in theoretical underpinnings and empirical realities. This will serve as a useful guide for the empirical analysis in the following chapters.

The discussion on the historical developments of monetary policy in India can be carried out with different ways of periodisation. Our method of periodisation is primarily based on the policy environment. Based on the policy framework, broadly two distinct regimes can be delineated in the monetary policy history of India, since Independence. The first regime refers to the credit-planning era followed since the beginning upto the mid-1980s. The second is the regime started with adoption of 'money-multiplier' framework, implemented as per recommendations of Chakravarty Committee (RBI 1985). However, both the regimes command appropriateness under the circumstances and institutional structure existed during the respective periods. In the first regime, there was a shift towards a tightly regulated regime for bank credit and interest rates since the mid-1960s with emergence of a differential and regulated interest rate regime since 1964, adoption of the philosophy of social control in

December 1967, the event 'bank nationalisation' in 1969, increasing deficit financing by the government, etc. Similarly, The post-Chakravarty Committee regime also can be separated into two sub-periods distinguished by the event of economic reforms of 1991-92. There was a radical shift from direct to indirect instruments and emergence of a broad, deep and diversified financial market, with prevalence of greater autonomy, in the post-reform period.

Thus, the whole period since Independence can be divided into four sub-periods in our discussion on the historical development of monetary policy in India. They are (i) Initial Formative Period, which extends since Independence upto 1963, (ii) Period of High Intervention (Regulation) and Banking Expansion with social control since 1964 to 1984, (iii) New Regime of Monetary Targeting with Partial Reforms, from 1985 to 1991, and (iv) Post-Reform Period with Financial Deepening, since 1992.

2.2 - Initial Formative Period (1947-1963)

Prior to the Independence, the broad objectives of monetary policy in India could be classified as (a) issue of notes, acting in national interest by curtailing excessive money supply and to overcome stringency where it mitigated production activities, (b) public debt management, and (c) maintaining exchange value of the Rupee. In the initial days of Independence, there were some challenges for monetary operations due to the event of partition and consequent division of assets of RBI, and its responsibility of currency and banking management in the transitory phase in the two new Dominions. In Independent India, the advent of planning era with establishment of Planning Commission in 1950 brought a directional change in all parameters in the economic management. As bulk of the actions and responsibilities pertaining to the economic policy rested with the Planning Commission, other entities of policymaking including the monetary authority had a supplementary role.

However, setting the tone of monetary policy, the First Five Year Plan envisaged, "judicious credit creation somewhat in anticipation of the increase in

production and availability of genuine savings" (GOI, 1951). During the First Five Year Plan, monetary management witnessed a distinguished order with effective co-ordination between the then Finance Minister Chintaman Deshmukh, a former Governor of RBI and the then Governor of RBI Benegal Rama Rau. The RBI decided to withdraw support to the gilt-edged market signifying the proof of an independent monetary policy (da Costa, 1985). The initiatives of the Finance Minister to control government expenditure with emphasis to enhance revenue and capital receipts facilitated such a move. A mere 10.3 percent growth of money supply in the whole First Plan reflects restrictive monetary policy during this period.

In the next two five year plans, conduct of monetary policy faced unprecedented challenges due to the new initiatives in the planning regime and the degree of independence enjoyed by the RBI was heavily curtailed. At the beginning of the Second Five Year Plan, both foreign exchange reserves and India's external credit were very high for easy availability of required investments. In this backdrop, under the able leadership of Prof. P. C. Mahalanobis the plan exercise emphasised on heavy industries. Although, there were notable success in the front of output expansion mainly lead by industrialisation during the Second Five Year Plan, there were some setbacks for monetary policy operations. Firstly, finance minister T. T. Krishnamachari emphasised on transforming sterling balances into investment goods since 1956-57. The foreign exchange assets depleted to the extent of Rs. 664 crores during a decade since then. There was increasing pressure on the RBI to provide credit to the government. Thus, when the real income (NNP) increased by 21.5 per cent in Second Five Year Plan, money supply (M1) increased by 29.4 per cent (da Costa, 1985). During this period, the prices increased by 35.0 per cent contrary to the magnificent control on it in the First Five Year Plan.

'Selective Credit Control' was followed during this period as a remedy to overcome the dilemma of controlling inflationary pressure and need for financing developmental expenditure (Iengar, 1958). Much needed expenditure on infrastructure projects, which was not immediately productive exerted upward pressure on the prices

of consumer goods. On the other hand, the private sector was to be provided credit for complementary expansion of investment. Hence, monetary policy did not adopt general tightening or relaxation of credit but some sectors were provided preferential credit and for some others the credit was made expensive.

In the Third Five Year Plan, the 1962 hostilities with China further added pressure on monetary policy operations. This was mainly due to the credit requirement of the government for the increasing defence and developmental expenditure. Thus, money supply (Ml) during this period increased by as high as 57.9 percent. With only 11.8 percent growth of NNP in the Third Plan, prices rose by close to 32 percent.

Thus, the conduct of monetary policy became a process of passive accommodation of budget deficits, by early 1960s. The decade of 1960s witnessed a gradual shift of priority from price stability to greater concerns for economic growth and accompanying credit control. A new differential interest rates regime emerged with a view to influence the demand for credit and imparting an element of discipline in the use of credit. Under the 'quota-cum-slab' introduced in October 1960, minimum lending rates were stipulated. This was the beginning of a move towards regulated regime of interest rates.

2.3- Period of High Regulation and Bank Expansion (1964 - 1984)

This period witnessed radical changes in the conduct of monetary policy predominantly caused by interventionist character of credit policy and external developments. The process of monetary planning was severely constrained by heavily regulated regime consisting of priority sector lending, administered interest rates, refinance to the banks at concessional rates to enable them to lend at cheaper rates to priority sectors, high level of deficit financing, external oil price shocks, etc. Inflation was thought to be primarily caused by supply factors and not emanating from monetary causes. Hence, output expansion was thought to be anti-inflationary and emphasis was attributed on the credit expansion to step up output. In the process, the

government occupied the pivotal role in monetary management and the RBI was pushed down to the secondary position.

Since the mid-1960s, regulation of the domestic interest rates became ubiquitous in India. In September 1964 a more stringent system for bank credit based on net liquidity position was introduced and both deposit and credit rates were regulated. The introduction of Credit Authorisation Scheme (CAS) in 1965 initiated rationing of bank credit (RBI, 1999). With implementation of CAS, prior permission of RBI was required for sanctioning of large credit or its augmentation. It served the twin objectives of mobilising financial resources for the Plans and imparting better credit discipline. The degree of constraints on the monetary authority started mounting up with the measures of 'social control' introduced by the Government of India in December 1967, which envisaged a purposive distribution of credit with a view to enhance the flow of credit to priority sectors like agriculture, small sector industries and exports coupled with mobilisation of savings. Accordingly, National Credit Council was set up to provide a forum for discussing and assessing the credit priorities. Credit to certain economic activities like exports was provided with concessional rates since 1968. The transfer of financing of public procurement and distribution and fertliser operations from government to banks in 1975-76 further constrained the banking operations. The rationalisation of CAS guided by recommendations of Tandon Committee (1975), Chore Committee (1979) and Marathe Committee (1983) subsequently refined the process of credit rationing.

The event of nationalisation of major commercial banks in July 1969 constitutes an important landmark in the monetary history of India, which had significant bearings on the banking expansion and social control of bank credit. The nationalisation of banks led to use of bank credit as an instrument to meet socio-economic needs for development. The RBI began to implement credit planning with the basic objective of regulating the quantum and distribution of credit to ensure credit flow to various sectors of the economy in consonance with national priorities and targets. There was massive branch expansion in the aftermath of bank

nationalisation with the spread of banking facilities reaching to every nook and corner of the country. The number of bank branches rapidly increased from 8,262 in 1969 to 13,622 in 1972, which subsequently increased to 45,332 by 1984.

These developments had significant implications for financial deepening of the economy. During this period the growth of financial assets was faster as compared to the growth of output. The volume of aggregate deposit of scheduled commercial banks increased from Rs 4,338 crore in March 1969 to Rs 60,596 crore in March 1984 and the volume of bank credit increased from Rs 3,396 crore to Rs 41,294 crore in between the same period (Table II. 1). Particularly, non-food credit increased from Rs 3,915 crore in March 1970 to Rs 37,272 crore in March 1984. The average annual growth rate of aggregate deposits markedly increased from 9.5 per cent for the period 1951-52 to 1968-69 to 19.3 per cent for the period 1969-70 to 1983-84. In between the same period, bank credit increased from annual average of 10.9 per cent to 18.2 per cent. This period also witnessed growing volume of priority sector lending, which had not received sufficient attention by the commercial banks prior to nationalisation. The share of priority sector advances in the total bank credit of scheduled commercial banks rose from 14 per cent in 1969 to 36 per cent in 1982. The share of medium and large industries in the bank credit had come down from 60.6 per cent in 1968 to 37.6 per cent in 1982.

During this period, monetary policy of the RBI mainly focused on bank credit, particularly non-food credit, as the policy indicator. Basically, the attention was limited to the scheduled commercial banks, as they had high proportion of bank deposits and timely available data. Emphasis on demand management through control of money supply was not in much evidence upto mid-1980s. Reserve money was not considered for operational purposes as the major source of reserve money creation - RBI's credit to the government - was beyond its control. Due to lack of control on the reserve money and establishment of direct link between bank credit and output, credit aggregates were accorded greater importance as indicators of the stance of monetary policy and also as intermediate targets.

Among the policy instruments, SLR was mainly used to serve the purpose of raising resources for the government plan expenditure from the banks. The level of SLR had progressively increased from the statutory minimum of 25 per cent in February 1970 to 36 per cent in September 1984 (Table II.2). Banks were provided funds through standing facilities such as 'general refinance' and 'export refinance' to facilitate developmental financing as per credit plans. The instrument of CRR was mainly used to neutralise the inflationary impact of deficit financing. The CRR was raised from its statutory minimum of 3 per cent since September 1962 to 5 per cent in June 1973 (Table II.2). Gradually it was hiked to 9 per cent by February 1984. During this period, the Bank Rate had a limited role in monetary policy operations.

The year 1976 constitutes one of the most eventful period in the monetary thinking in India, when a heated debate surfaced on the issue of validity of the then prevailing monetary policy procedure. The first dissenting note came from S.B. Gupta with his seminal article advocating in favour of 'money-multiplier' approach. Gupta (1976a) argued that, the then practice of RBI's money supply analysis simply sums up its various components, and hence merely an accounting or *ex post* analysis. It was accused of being tautological in nature. He suggested, money supply analysis based on some theory of money supply like money multiplier approach could provide better understanding of the determinants of money supply. He also highlighted the difference in monetary impact of financing government expenditure through credit from RBI *versus* investment of the banks in government securities.

However, RBI economists rejected Gupta's analysis as mechanistic and unsatisfactory in theory and useless in practice (Mujumdar, 1976) and claimed that, RBI's analysis provides an economic explanation of money supply in India. Mujumdar (1976) questioned the basic ingredients of 'money-multiplier approach' such as stability of the relationship between money supply and reserve money, controllability of reserve money and endogeneity of money-multiplier, and stated that, "... in certain years if the expansion in M does not confirm to the postulated relationship, one has to explain away the situation by saying that the multiplier itself

has changed". He also claimed that, RBI analysis takes into account both primary money supply through the RBI and secondary expansion through commercial banks and provides a total explanation of variations in money supply. As against this, multiplier approach explains only the secondary expansion through the money-multiplier.

Shetty, Avadhani and Menon (1976) supplemented Mujumdar in defending RBI's money supply analysis. They argued that, money supply is both an economic and a policy controlled variable. As an economic variable it may be determined by the behaviour of the public to hold currency and bank deposits, but as a policy controlled variable it depends on the monetary authority's perception about the appropriate level of primary and secondary money. Thus, they refuted any simple and mechanical relationship between reserve money and money supply. They completely rejected the appropriateness of projecting monetary aggregates based on money-multiplier in the short-term due to erratical behaviour of related coefficients, but they do not rule out usefulness of long-term projections. On the issue of the relationship between reserve money and money supply, Shetty *et al* (1976) asserted that, "it is incorrect of Gupta to state that the RBI is ignorant of the significance of reserve money in monetary analysis. The RBI, however, does not consider it as the single element for explanation of the sources of changes in money supply."

At this point a reconciliatory note came from Khatkhate (1976). He emphasised the usefulness of 'money-multiplier framework' as suggested by Gupta (1976a), but was critical of him for accusing the RBI being not aware of it. According to Khatkhate (1976), "Gupta is quite right in suggesting this line, but the difficulty is that it has no connection with the RBI presentation of monetary data. And what is even worse is that Gupta does no better than the RBI in proposing his alternative." Towards end of 1970s, there were resentments regarding the way monetary management is operated in the policy circle. With large part of the monetary reserve outside the control of monetary authority, the channel of credit allocation to few pockets of the commercial sector could transmit very limited influence to the real

economic variables. The neglect of issues related to monetary targeting viewed as an unnecessary byproduct of the preoccupation with credit targeting.

The period 1979-82 witnessed a turbulent phase for Indian economy. During 1979-80 adverse weather conditions caused record downfall in foodgrains production. It was accompanied by a setback in industrial production. The budget nonetheless continued to be expansionary. The budgetary deficit as percentage of GDP was 2.13 per cent in 1979-80 and 1.82 per cent in 1980-81. The external sector added to further deterioration of the situation with hike in prices of petroleum products and fertilisers. All these contributed together towards prevalence of a widespread general inflation. Reserve money growth was explosive and financial crowding out threatened long run prospects of stable growth. These macroeconomic developments made the conduct of monetary policy extremely difficult and progressively brought a sharp shift in monetary policy.

2.4– New Regime of Monetary Targeting (1985 - 1991)

In the backdrop of intellectual debate as discussed above and prevailing economic conditions, it was imperative to comprehensively review the functioning of the monetary system and carry out necessary changes in the institutional set up and policy framework of the monetary policy. This was materialised by setting up a high level committee in 1982, under the chairmanship of Prof. Sukhamoy Chakravarty. The major recommendations of the Chakravarty Committee include, *inter alia*, shifting to 'monetary targeting' as the basic framework of monetary policy, emphasis on the objectives of price stability and economic growth, coordination between monetary and fiscal policy to reduce the fiscal burden on the former and suggestion of a scheme of interest rates in accordance with some valid economic criteria. Clarifying the stand on monetary targeting with feedback, Rangarajan (2002) asserts that, "the scheme of fixing monetary targets based on expected increase in output and the tolerable level of inflation is far removed from the Friedmanite or any other version of monetarism." The Committee endorsed the use of bank reserves as the main operating

target of monetary policy and laid down guidelines relating to the optimal order of the growth of money supply in view of stability in demand for money.

The recommendations of Chakravarty Committee guided far-reaching transformation in the conduct of monetary policy in India. There was a shift to a new policy framework in the conduct of monetary policy by introducing monetary targeting. In addition, recommendations of the Report of the Working Group on Money Market, 1987 (Chairman: Vaghul) and subsequent move to activate the money market by introducing new financial instruments such as 182-day Treasury Bills (TBs), Certificates of Deposit (CDs), Commercial Paper (CP) and Participation Certificates, and, establishment of Discount and Finance House of India (DFHI) in April 1988 created new institutional arrangements to support the process of monetary targeting.

It was felt that, the complex structure of administered interest rate and cross-subsidisation resulted in higher lending rates for the non-concessional commercial sector. The concessional rates charged to the priority sector necessitated maintaining the cost of funds i.e. deposit rates at a low level. Nevertheless, there was a move to activate money market with new instruments to serve as a transmission channel of monetary policy, within this administered regime. Gradually, the complex lending rate structure in the banking sector was simplified in 1990. By linking the interest rate charged to the size of loan, the revised structure prescribed only six slabs (Rangarajan, 2002). However, credit rationing continued with its due importance in the new framework to support the growth process. The share of priority sectors in total non-food credit rose from 36.9 per cent in 1980-81 to the peak of 43.6 per cent in 1986-87. But, inadequacy of this system slowly emerged due to problems in the monitoring of credit thereby causing delays in the sanctioning of bank credit. With the strengthening of the credit appraisal systems in banks, the CAS lost its relevance through the 1980s, eventually leading to its abolition in 1988.

During this period, the primitive structure of the financial markets impeded their effective functioning. The money market lacked depth, with only the overnight interbank call money market in place. The interest rates in the government securities market and credit market were tightly regulated. The dispensation of credit to the government took place via SLR stipulations, where commercial banks were made to set aside a substantial portion of their liabilities for investments in government securities at below market rates, known in the literature as 'financial repression'. The SLR had touched the peak of 38.5 by September 1990 (Table II.2). As increasing SLR was not adequate, the RBI was forced to be a residual subscriber. The process of financing the government deficit involved 'automatic monetisation', in terms of providing short-term credit to the government that slipped into the practice of rolling over the facility. The situation was aggravated as the government's fiscal balance rapidly deteriorated. The process of creating 91-day *ad hoc* TBs and subsequently funding them into non-marketable special securities at a very low interest rate emerged as the principal source of monetary expansion. In addition, RBI had to subscribe dated securities those not taken up by the market. As a result, the net RBI credit to the Central Government which constituted about 77 per cent of the monetary base during the 1970s, accentuated to over 92 per cent during the 1980s (Table II. 1). In such an environment, monetary policy had to address itself to the task of neutralising the inflationary impact of the growing deficit by raising CRR from time to time. CRR was mainly being used to neutralise the financial impact of the government's budgetary operations rather than an independent monetary instrument.

2.5- Post-Reform Period with Financial Deepening (1992 Onwards)

Indian economy experienced severe economic crisis in mid-1991, mainly triggered by a balance of payment difficulty. This crisis was converted to an opportunity by introducing far-reaching reforms in terms of twin programs of stabilisation and structural adjustment. The financial sector received its due share of attention in the reform process mainly guided by the influential recommendations of Narasimham Committee - I (1991) and - II (1998). To curtail the excessive fiscal dominance on the monetary policy in the spirit of the recommendations of the

Chakravarty Committee (RBI, 1985) and Narasimham Committee (RBI, 1991), the memorandum of understanding (MoU) was signed between the Government of India and the RBI in 1994. Consequently, the issuance *of ad hoc* TBs was eliminated with effect from April 1, 1997. Instead, Ways and Means Advances (WMA) was introduced to cope with temporary mismatches. This was a momentous step and necessary condition towards greater autonomy in the conduct of monetary policy. As a result, the proportion of net RBI credit to government to reserve money has substantially come down to close to 50 per cent in recent years (Table II. 1).

Interestingly, this period witnessed the new problem of coping with increasing inflow of foreign capital due to opening up of the economy for foreign investment. Foreign exchange reserves increased from mere US $ 5.83 billion in March 1991 to US $ 25.18 billion in March 1995. Presently, foreign exchange reserves with RBI stand at close to US $ 82 billion. Hence, increase in foreign exchange assets had a sizeable contribution to raise reserve money in this period. As a proportion of reserve money, the share of net foreign assets is increased from 9.1 per cent in 1990-91 to 38.1 per cent in 1995-96 and subsequently reached 78.1 per cent in 2001-02 (Table II. 1). To negate the effect of large and persistent capital inflows, RBI absorbed excess liquidity through outright OMO and repos under liquidity adjustment facility (RBI, 2003a).

In the post reforms era, emphasis was placed to develop and deepen various components of the financial market such as money market, government securities market, forex market, which has significant implication for the monetary policy to shift from direct to indirect instruments of monetary control. To widen the money market in terms of improving short term liquidity and its efficient management, new instruments such as inter-bank Participation Certificates, CDs and CP were further activated and new instruments in the form of TBs of varying maturities (14-, 91- and 364-day) were introduced. The DFHI was instrumental to activate the secondary market in a range of money market instruments, and the interest rates in money market instruments left to be market determined.

The government securities market witnessed radical transformation towards broadening its base and making the yields market determined. Major initiatives in this direction include introducing the system of auctions to impart greater transparency in the operations, setting up a system of Primary Dealers (PDs) and Satellite Dealers (SDs) to trade in Gilts, introducing a delivery versus payment (DvP) system for settlement, adopting new techniques of flotation, introducing new instruments with special features like zero coupon bonds, partly paid stock and capital-indexed bonds, etc. All these measures have helped in creating a new treasury culture in the country, and today, the demand for the government securities is not governed by solely SLR requirements but by considerations of treasury management. Now, the SLR is at the statutory minimum of 25 per cent since October 1997, far below than its peak of 38.5 per cent in February 1992 (Table II.2). Also, the CRR has been gradually brought down to the current level of 4.5 per cent (effective from June 2003) from 10 per cent in January 1997 and 15 per cent in October 1992. Certain initiatives to reform the foreign exchange market include, *inter alia,* moving to full convertibility of Rupee in the current account since August 1994, greater freedom to Authorised Dealers (ADs) to manage their foreign exchanges, activation of the forward market and setting up a High Level Committee (Chairman: S.S. Tarapore) to provide a roadmap for capital account convertibility. All these measures acted towards making the foreign exchange rate market-determined and linking it to the domestic interest rates.

In the process of reforms, the interest rate structure was rationalised in the banking sector and there is greater emphasis on prudential norms. Banks are given freedom to determine their domestic term deposit rates and prime lending rates (PLRs), except certain categories of export credit and small loans below 2 lakh Rupees. All money market rates were set free. The 'Bank Rate' was reactivated in 1997 by linking it to various refinance rates.

Because of all these reforms, we find today, interest rates in various segments of the financial market are determined by the market and there is close association in their movement, as discussed in detail in Chapter 5. The developments in all the

segments have led to gradual broadening and deepening of the financial market. This has created the enabling conditions for a smooth move towards use of indirect instruments of monetary policy such as open market operations (OMO) including repos and reverse repos. The operation of LAF has been used as an effective mechanism to withdraw or inject liquidity on day-to-day basis and providing a corridor for call money rate. In June 2002, RBI has come out with its Short Term Liquidity Forecasting Model to evaluate the short term interaction between the monetary policy measures and the financial markets, which will be immensely helpful for imparting discipline once started operation. Because of reforms in the financial market, new interest rate based transmission channels have opened up. Importantly, this period has witnessed emergence of monetary policy as an independent instrument of economic policy (Rangarajan, 2002).

To sum up, this chapter undertakes an analytical survey of evolution of monetary policy in India. We observed that, the existing policy regime and institutional arrangements constrained monetary management in the pre-reform period. Monetary policy during this period was limited to credit rationing. The key segments of the financial market in India are developed only in the post-reform period and the interest rates were deregulated. Recently, there has been greater emphasis in short-term liquidity management in monetary policy operation with emergence of a broad-based and developed financial market. In the new environment, the operating procedure and monetary transmission mechanism are completely transformed. These observations will guide our econometric analysis of monetary policy in India in the following chapters.

Table II.l

Selected Macro-monetary Aggregates in India

(Amount in Rs. Crore)

Year	GDP	M3	AGGDEP	CREDIT	NFCREDIT	RESM	RBICG	NFA	(8/7*100)	(9/7-100)
I	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*//*
1950-51	140466	2287	882	547		1489	461	878	30.9	59.0
1951-52	143745	2137	852	522		1353				
1952-53	147824	2121	832	529		1327				
1953-54	156822	2200	848	538		1381				
1954-55	163479	2379	943	623		1469				
1955-56	167667	2683	1043	761		1675	707	782	42.2	46.7
1956-57	177211	2869	1175	900		1728	1038	504	60.0	29.2
1957-58	175068	3163	1452	963		1800	1459	209	81.0	11.6
1958-59	188354	3476	1635	1014		1922	1615	153	84.0	8.0
1959-60	192476	3883	1902	1128		2108	1761	159	83.5	7.5
1960-61	206103	3964	1736	1336		2232	1897	107	85.0	4.8
1961-62	212499	4244	1917	1408		2344	2057	41	87.7	1.7
1962-63	216994	4553	2042	1588		2534	2264	14	89.3	0.5
1963-64	227980	5037	2285	1817		2777	2459	45	88.5	1.6
1964-65	245270	5498	2583	2035		2959	2587	95	87.4	3.2
1965-66	236306	6134	2950	2287		3231	2957	59	91.5	1.8
1966-67	238710	6817	3425	2692		3463	3077	125	88.9	3.6
1967-68	258137	7460	3856	3032		3662	3243	151	88.6	4.1
1968-69	264873	8306	4338	3396		4069	3590	302	88.2	7.4
1969-70	282134	9337	5028	3971	3915	4390	3500	566	79.7	12.9
1970-71	296278	11020	5906	4684	4469	4822	4000	530	83.0	11.0
1971-72	299269	12693	7106	5263	4918	5382	4870	608	90.5	11.3
1972-73	298316	15013	8643	6115	5775	6033	5696	569	94.4	9.4
1973-74	311894	17624	10139	7399	7032	7273	6460	661	88.8	9.1
1974-75	315514	19549	11827	8762	8149	7604	7121	369	93.6	4.9
1975-76	343924	22480	14155	10877	9356	7808	6924	924	88.7	11.8
1976-77	348223	27781	17566	13173	10982	9798	7762	2599	79.2	26.5
1977-78	374235	32906	22211	14939	12955	10941	7644	4532	69.9	41.4
1978-79	394828	40112	27016	17795	15585	14082	9416	5431	66.9	38.6
1979-80	374291	47226	31759	21537	19437	16573	12405	5388	74.9	32.5
1980-81	401128	55774	37988	25371	23612	19452	16443	4775	84.5	24.5

(Continued)

Table II.1
Selected Macro-monetary Aggregates in India

(Amount in Rs. Crore)

Year	GDP	M3	AGGDEP	CREDIT	NFCREDIT	RESM	RBICG	NFA	(8/7*100)	(9/7*100)
1	2	3	4	5	6	7	8	9	10	11
1981-82	425073	62752	43733	29682	27555	20998	20440	2706	97.3	12.9
1982-83	438079	73184	51358	35493	32528	23110	22823	1729	98.8	7.5
1983-84	471742	86525	60596	41294	37272	28994	26810	1624	92.5	5.6
1984-85	492077	102933	72244	48953	43287	35216	34350	2899	97.5	8.2
1985-86	513990	119394	85404	56067	50533	38165	38678	3741	101.3	9.8
1986-87	536257	141632	102724	63308	58204	44808	46285	4621	103.3	10.3
1987-88	556778	164275	118045	70536	68346	53489	52687	5416	98.5	10.1
1988-89	615098	193493	140150	84719	83950	62958	59615	6201	94.7	9.8
1989-90	656331	230950	166959	101453	99446	77591	73683	6068	95.0	7.8
1990-91	692871	265828	192541	116301	111795	87779	88848	7983	101.2	9.1
1991-92	701863	317049	230758	125592	120922	99505	94016	18838	94.5	18.9
1992-93	737792	364016	268572	151982	145239	110779	98449	22647	88.9	20.4
1993-94	781345	431084	315132	164418	153510	138672	99300	51422	71.6	37.1
1994-95	838031	527596	386859	211560	199286	169283	101478	74720	59.9	44.1
1995-96	899563	599191	433819	254015	244224	194457	121349	74092	62.4	38.1
1996-97	970083	696012	505599	278401	270805	199985	124181	94817	62.1	47.4
1997-98	1016266	821332	598485	324079	311594	226402	135160	115890	59.7	51.2
1998-99	1083047	980960	714025	368837	352021	259286	152539	137954	58.8	53.2
1999-00	1151991	1124174	813345	435958	410267	280555	148264	165880	52.8	59.1
2000-01	1198685	1311583	962618	511434	471443	303311	153877	197175	50.7	65.0
2001-02	1265429	1500003	1103360	589723	535745	337970	152178	263969	45.0	78.1

Note: 1. Figures in columns 4, 5 and 6 pertain to scheduled banks (cooperative and commercial) from 1950-51 to 1965-66 and to scheduled commercial banks from 1966-67 onwards. Upto 1984-85, these data are as on last Friday of March and from 1985-86 onwards relate to last reporting Friday of March

2. Monetary data till 1969-70 pertain to the old series and are as on last Friday of the year basis and since 1970-71 pertain to the new seris and are as on end-March basis

3. Data on GDP pertains to GDP at factor cost at constant prices (1993-94=100)

Sources: 1. Handbook of Statistics on Indian Economy, 2001, RBI, Mumbai

2. Mohanty, *et al* (1997)

Table II.2
Key RBI Policy Instruments

(Per cent)

Eff. Date	CRR	Eff. Date	CRR	Eff. Date	Bank Rate	Eff. Date	SLR
	2	3	4	5	6	7	8
05-07-1935	5.0 (DL)	014)7-1989	15.00 @	054)7-1935	3.50	164)3-1949	20.00
	2.0 (TL)	044)5-1991	15.00 @	28-11-1935	3.00	164)9-1964	25.00
06-03-1960	5.0 (DL)	114)1-1992	15.00 @	15-11-1951	3.50	054)2-1970	26.00
	2 (TL) @	21-04-1992	15.00 (5)	16-05-1957	4.00	24-04-1970	27.00
06-05-1960	5.0 (DL)	08-10-1992	15.00 @	034)1-1963	4.50	28-08-1970	28.00
	2 (TL) @	174)4-1993	14.50	26-09-1964	5.00	044)8-1972	29.00
11-11-1960	5.0 (DL)	154)5-1993	14.00	17-02-1965	6.00	17-11-1972	30.00
	2.0 (TL)	11-06-1994	14.50	02-03-1968	5.00	08-12-1973	32.00
16-09-1962	3.00	09-07-1994	14.75	094)1-1971	6.00	014)7-1974	33.00
29-06-1973	5.00	064)8-1994	15.00	314)5-1973	7.00	01-12-1978	34.00
08-09-1973	6.00	11-11-1995	14.50	234)7-1974	9.00	254)9-1981	34.50
22-09-1973	7.00	09-12-1995	14.00	124)7-1981	10.00	30-10-1981	35.00
014)7-1974	5.00	27-04-1996	13.50	044)7-1991	11.00	284)7-1984	35.50
14-12-1974	4.50	11-05-1996	13.00	09-10-1991	12.00	014)9-1984	36.00
28-12-1974	4.00	06-07-1996	12.00	164)4-1997	11.00	084)6-1985	36.50
04-09-1976	5.00	26-10-1996	11.50	26-06-1997	10.00	06-07-1985	37.00
13-11-1976	6.00	09-11-1996	11.00	22-10-1997	9.00	25-04-1987	37.50
14-01-1977	6.00 @	044)1-1997	10.50	174)1-1998	11.00	02-01-1988	38.00
01-07-1978	6.00 @	184)1-1997	10.00	194)3-1998	10.50	224)9-1990	38.50
05-06-1979	6.00 @	25-10-1997	9.75	03-04-1998	10.00	29-02-1992	38.50
31-07-1981	6.50	22-11-1997	9.50	29-04-1998	9.00	094)1-1993	38.25
21-08-1981	7.00	06-12-1997	10.00	02-03-1999	8.00	06-02-1993	38.00
27-11-1981	7.25	174)1-1998	10.50	02-04-2000	7.00	06-03-1993	37.75
25-12-1981	7.50	284)3-1998	10.25	224)7-2000	8.00	21-08-1993	37.50
29-01-1982	7.75	11-04-1998	10.00	17-02-2001	7.50	18-09-1993	3725
09-04-1982	7.25	29-08-1998	11.00	024)3-2001	7.00	16-10-1993	34.75
11-06-1982	7.00	134)3-1999	10.50	23-10-2001	6.50	204)8-1994	34.25
27-05-1983	7.50	084)5-1999	10.00	30-10-2002	6.25	174)9-1994	33.75
29-07-1983	8.00	06-11-1999	9.50	30-04-2003	6.00	29-10-1994	31.50
27-08-1983	8.50	20-11-1999	9.00			25-10-1997	
12-11-1983	8.50 @	08-04-2000	8.50				
04-02-1984	9.00 @	22-04-2000	8.00				
27-10-1984	9.00 @	294)7-2000	8.25				
01-12-1984	9.00 @	124)8-2000	8.50				
26-10-1985	9.00 @	244)2-2001	8.25				
22-11-1986	9.00 @	03-10-2001	8.00				
284)2-1987	9.50 @	19-05-2001	7.50				
234)5-1987	9.50 @	03-11-2001	5.75				
24-10-1987	10.00 @	29-12-2001	5.50				
23-04-1988	10.00 @	064)6-2002	5.00				
024)7-1988	10.50 @	16-11-2002	4.75				
304)7-1988	11.00 @	14-06-2003	4.50				

Note: @: Additional reserve requirements of CRR on incremental NDTL

Sources: 1. Handbook of Statistics on Indian Economy, 2001, RBI, Mumbai
2. RBI Bulletin, Various Issues, RBI, Mumbai

Chapter 3

An Analysis of Channels of Monetary Transmission in India

Chapter – III

AN ANALYSIS OF CHANNELS OF MONETARY TRANSMISSION IN INDIA

3.1 - Introduction

the channels through which money affects output and prices have been subject to intense debate and widespread research since long. The theoretical underpinnings of direct influence of money supply on the general prices can be traced back to the quantity theory of money (QTM) and there is no denying of this fact except adding structural factors as additional arguments in the price determination. On the influences of money supply on real output, while the 'classical dichotomy' does not recognise any such influence, the Keynesian 'money non-neutrality proposition' highlights the capability of monetary expansion to augment real output through lowering interest rate and increasing investment demand. Notwithstanding their faith in long run neutrality of monetary impulses on output, the monetarist school emphasises the short run influences mainly due to inability of households and business to anticipate or perceive the implications of past and present policy actions.

Currently, there is little dispute on the ability of monetary expansion to influence the general level of prices and economic growth. However, a clear understanding of the monetary transmission mechanism in terms of describing the exact channels through which monetary policy affects output and prices is essential for a proper assessment of the timing and effect of policy measures on the economy, for the monetary authority to inject policy shocks in the relevant segment of the financial market and choosing the appropriate operating and intermediate targets. This underscores the need for a detailed and rigorous analysis of various channels of monetary policy.

Monetary policy affects real activity through various channels. All the channels may be divided into two broad categories, namely 'money view' and 'credit view'. There has been a heated debate since the late 1980s focusing on establishing the superiority of one channel over the other. Although the debate on the relative importance still continues, it may be pertinent to note that individual channels of monetary transmission considered in isolation may not be appropriate as in the real world all possible channels operate simultaneously. Hence, testing the effectiveness of individual channels may not lead us to any meaningful destination, as each channel in isolation however forceful may be the theoretical underpinnings, has the inbuilt limitation of partial explanation. Therefore, it would be a rewarding attempt to synthesise all the channels and evolve a methodology to test the transmission mechanism of the combined channels.

The rest of this chapter is planned as below. Section 3.2 undertakes a review of literature on channels of monetary transmission and highlights the theoretical underpinnings. The basic framework encompassing various competing channels is developed in Section 3.3. Using the technique of path analysis, Section 3.4 presents the empirical evidences on operation of various channels of monetary transmission in India. Finally, Section 3.5 concludes with policy implications.

3.2 - Theoretical Underpinnings and Review of Literature

In the literature, theoretical discussion on monetary transmission channels can be broadly divided into two lines of thought such as (i) money view, and (ii) credit view. 'Money view' can be traced back to Keynesian IS-LM analysis, which basically operates through the liabilities side of banks' balance sheet. In this world, consisting of money and bonds, monetary contraction by the central bank squeezes the demand for bonds. As a result, the real interest rate on bonds accentuates. Higher real interest rate squeezes investment demand as fewer profitable projects will be available at higher required rates of return. This assumes movements along a fixed marginal efficiency of investment schedule. Thus, in the 'money view' monetary contraction leads to decline in investment spending, and hence, real output.

On the other hand, the 'credit view' concentrates on assets side of the banks' balance sheet in explaining monetary transmission. Assuming existence of three assets in the economy such as money, bonds and bank loans, exponents of 'credit view' conceive that, monetary contraction by restricting the banks to issue deposits impedes their capacity to extend loans. Given the special nature of relationship between banks and small firms, this leads to cut down in investment spending of small firms. Even the large firms also face higher interest rates on bank loans, so reducing their investment expenditure. Thus, monetary contraction leads to lower investment and aggregate demand through bank lending. The effectiveness of credit channel rests on two crucial assumptions. First, in the assets side of the banks, loans and securities are imperfect substitutes. So, banks cannot substitute securities for loans keeping bank lending unchanged in response to monetary shocks. Second, the firms treat bank loans and other sources of finances as imperfect substitutes. Otherwise, firms can completely offset the changes in bank loans by corresponding changes in other sources of funding. The institutional arrangements for maintaining reserves and other sources of funds for the banks also play a critical role in effectiveness of bank lending channel.

It is to be noted that, the 'money view' may not rule out decline in bank lending in the aftermath of monetary contraction but it conceives it as a consequence of lower aggregate demand. In other words, 'credit view' highlights the impact of lower supply of bank credit on the aggregate demand, but on the contrary the 'money view' sees decline in demand for bank loans as a consequence of lower aggregate demand. This is a case of reversing the cause and effect in the two competing approaches.

Most of the literature on monetary transmission mechanism has been carried out with reference to the United States. Leeuw and Gramlich (1969) had provided the theoretical framework of three important channels of monetary transmission such as cost of capital, consumption through wealth effects and credit rationing. Their

empirical evidences highlight the complicated response of final demand to monetary shocks through above three channels. The simulation exercise using Federal Reserve - MIT econometric model indicates that, the credit-rationing channel alone comprises of about 17 per cent of the total direct monetary effect on output by the end of first year. But gradually its strength diminishes as the sluggish deposit rates adjust completely to the market interest rates. They find the cost of capital channel operating strongly throughout the four-year simulation period. The wealth effect accounted for the 35 per cent of the total effect by the end of the first year and builds up gradually to 45 per cent by the end of four years.

King (1986) supports credit view from high degree of correlation between output and loans as compared to the degree correlation between money and output. Bernanke and Blinder (1988) have developed a modified version of IS-LM framework to capture the distinguishing role of money and credit channels. In this model, the IS-curve is replaced by the CC-curve (for commodities-credit). An upward shift in the credit supply leads to outward shifting of CC-curve along a fixed LM-curve, raising both interest rate and output. Empirically, they have compared the simple correlation between growth rate of GNP with those of money and credit, separately. They found that, the correlation between growth rates of GNP and money was stronger for the period 1953 through 1973. However, for the period 1979 to 1985, the correlation between growth rates of GNP and Credit found to be stronger giving a clear edge to credit. The correlations between VAR residuals also supported similar findings. However, the correlation-based analysis is plagued by the constraint of not distinguishing the shifts in loan supply from that of loan demand.

Brunner and Meltzer (1988) provide a good theoretical account of interaction between money, credit and output as a response to monetary shocks in an extended IS-LM framework by explicitly incorporating a second asset market. The major policy implications of the extended framework include, *inter alia*, the differences of the impact of changes in reserve requirements and open market operations on real activity through modifying conditions in the credit market, high sensitivity of asset multiplier

as against monetary multiplier to variations in the currency-deposit ratio and refutation of Stiglitz's loan rationing as the solely reliable channel of policy transmission rather finding it complementary to interest rationing.

Kashyap, Stein and Wilcox (1993) and Kashyap and Stein (1994) have developed a broad theoretical framework to analyse the credit channel of monetary transmission for aggregated and disaggregated data, respectively. According to Kashyap, Stein and Wilcox (1993), the impact of monetary shock operating through interest rate channel of 'money view' will reduce the demand for all type of finances, but that operating through credit channel will lower only bank loans vis-a-vis other types of financing. Based on the aggregate time series data, the behaviour of the ratio of bank debt to the sum of bank debt and commercial paper, denoted as 'mix' is studied under monetary shocks characterised by Romer shocks (Romer and Romer, 1990) and federal funds rate (Bernanke and Blinder, 1992). The empirical findings validate the impact of monetary shocks on the mix and the influence of induced changes in the mix on investment, supporting the credit view.

On the other hand, given the lock-in factor due to the special relationship between small firms and the banks, inability of smaller firms to access other sources of finance and lesser dependence of large firms on bank loans, it seems appropriate to analyse credit channel based on disaggregated data across firm size. Kashyap and Stein (1994) develop a model to capture this lock-in effect and their empirical results supported the presence of credit channel. Further, analysing the disaggregated form of credit Gertler and Gilchrist (1993) find a fall in bank loans to households as a response to restrictive monetary policy, whereas the bank loans to businesses register a marginal rise. From the evidences from the manufacturing sector, they find a relative decline in credit to small firms vis-a-vis lending to large firms as a result of monetary tightening. The evidences lead them to validate the view that credit market imperfections help propagate the impact of monetary policy.

Among the recent studies, Kim (1999) finds evidence of practical importance of the bank lending channel in the aftermath of financial crisis of December 1997 in Korea. It is derived from the marked decline in loan supply largely attributable to a pervasive and stringent bank capital regulation rather than by a weak demand for loans. Kryshko (2001) empirically validates the hypothesis supporting the operation of bank lending channel in Ukraine. The summary VAR estimated by Morsink and Bayoumi (2001) to examine the monetary transmission mechanism in Japan supports dominance of bank lending both as an important source of shocks and an important conduit for transmission of interest rate and broad money shocks to real activity. They find that, "after two years, about two-thirds of the direct impact of a change in the overnight call rate on private demand comes through bank loans."

There is another set of studies, which cast suspicion on the effectiveness of credit channels. The doubt mainly arises because of impediments to transmission of monetary shocks to bank credit either due to flexibilities of the liability management of the banks by switching to those liabilities subject to lesser or no reserve requirement or because of compensating the fall in deposits by selling securities instead of cutting down bank loans. Romer and Romer (1990) found no evidence of independent bank lending channel in the major episodes of restrictive monetary policy in the post-World War II period. Their evidence is based on banks' response to shift to alternative sources of funds such as Certificates of Deposit (CDs) at the time of tight monetary policy inspite of shrink in transaction deposits subject to reserve requirements. However, they assert that, "in a changing economy, the channels of monetary transmission are unlikely to be constant over time." It is also pointed out that, in view of deregulation of interest rates on transaction deposits in the 1980s, there will be more pressure on bank loans in the adjustment process in response to variation in the quantity of reserves in the future.

In another interesting paper, Bernanke and Blinder (1992) have empirically analysed the channels of money and credit in a VAR framework. They found that, monetary policy shocks captured by the federal funds rate has immediate impact on

the deposits of the banks and the maximum effect is felt in 9 months, which remains permanent. Due to quasi-contractual nature, the maximum effect of monetary shocks on the bank loans is noticed after about 2 years. The nature of impact on the unemployment rate is similar to that on loans. These findings may lead to the interpretation that monetary policy works entirely through the conventional money demand mechanism and fall in the credit is due to demand constraints with fall in real output.

In an analysis of four periods of restrictive monetary policy in between mid-1970s and mid-1990s in the US, Morris and Sellon (1995) found that, "banks have been able to offset a decline in core deposits by selling securities and issuing managed liabilities so as to maintain their business lending. In addition, an analysis of the terms of bank business lending finds little support for the view that banks reduce loan supply or ration credit in periods of monetary tightening." However, because of bank credit dependence of some firms, they do not completely rule out the impact of sudden disruptions in bank lending in spending decisions of these firms and the resulting influence on the level of economic activity. Further, Friedman and Knutter (1993), Oliner and Rudebusch (1996) and Cecchetti (1995) had certain objections on the methodology used by Kashyap, Stein and Wilcox (1993) to validate effectiveness of credit channel. To underscore the increasing importance of interest rate channels in view of changing financial system in the US, Sellon (2002) asserts that, "changes in the financial structure appear to have strengthened the interest rate channel of monetary policy ... monetary policy now works through capital markets as well as through the banking system." The debate on the greater effectiveness of credit or monetary channel still remains an unsettled issue.

In a historical perspective, Miron, Romer and Weil (1993) analyse changes in the importance of lending channel in the transmission of monetary shocks to the real economy for the period 1890 to 1990 by using a simple extension of Bernanke-Blinder (1988) model. They attempted to capture the changes in financial market institutions in terms of the structure of reserve requirements and the composition of

external firm finance and its relationship with effectiveness of bank lending channel. From this analysis they showed that, "the lending channel should have played a much greater role in the pre-1929 era than during the post-World War II period, especially the early part of this period ... The lending channel may have been stronger in the second half of the post-World War II era than the first half, but whether it should be as strong the pre-Depression era is not clear." On the other hand, they have used measures such as spread between the interest rate on bank loans and that on the commercial paper, the ratios of bank loans to other sources of credit and the relation between bank loans and output after monetary contractions in ordinary times. Here, they do not find any evidence of change in the importance of lending channel across the period. This contradiction leads them to conclude that, either the traditional indicators of importance of lending channel are not useful or the lending channel has not been important in any sample period. Both the possibilities question the relevance of lending channel.

There are certain extensions of the traditional money and credit view. The Keynesian interest rate channel can be extended by treating expenditure on housing and consumer durables as investment spending. Empirically it is shown that, in the final demand the earliest and sharpest response is noticed in spending on residential investment and consumer goods (Bernanke and Gertler, 1995). Secondly, by extending the interest channel to other asset prices, exchange rate and equity price channels emerge as important channels of monetary transmission. The exchange rate channel works through impact of monetary expansion on the foreign exchange rate and is growing in importance in view of increasing openness of the economies world over. With increasing openness and freer capital mobility across geographical boundaries, the interest rate parity conditions establish a very simple relationship between short-run interest rates and the foreign exchange rate. Precisely, a positive association should exist between the exchange rate and the differential between domestic and foreign interest rates (Taylor, 1995). The expansion of money supply reduces the attractiveness of the financial assets denominated in the domestic currency with fall in domestic real interest rate and results in a tendency to shift to

foreign currency denominated financial assets. Without restrictions on capital flows across the boundary, this may lead to net outflow of capital and depreciation of foreign exchange rate. This may augment net exports, and hence, real output Bryant, Hooper and Mann (1993) and Taylor (1993) provide empirical evidence in support of importance of exchange rate channel in the monetary transmission mechanism.

The transmission mechanism through equity price channel is explained mainly through Tobin's 'Q' theory of investment (Tobin, 1969) and wealth effects on consumption (Franco Modigliani, 1971). Simply, Tobin's 'Q' is defined as the ratio of market value of a firm to its replacement cost. When 'Q' is high the firm can sell a lesser amount of equity to install new plant and machinery implying positive relationship between 'Q' and investment spending of the firms. With increase in money supply, the asset prices of the firms will rise in view of shifting of preferences from money to other financial assets. As rise in asset prices raise the market value of the firms, there is increase in Tobin's 'Q' and hence, rise in investment and real output. Further, following Modigliani's life-cycle hypothesis, the consumption expenditure of an individual is determined by his lifetime resources raised from human and physical capital, and wealth. Monetary expansion increases asset prices and with increase in financial wealth, there is a positive effect on the consumption expenditure. Thus, wealth effect on consumption provides another channel of monetary influence on real output.

Similarly, introducing information asymmetry we can extend the broad contour of the traditional bank credit channel. Changes in money supply have certain effects on the asset prices and the cash flow of the firm through its effects on interest rates and prices. Changes in asset prices and cash flow of the firms through adverse selection and moral hazard influences bank lending and economic activity. Increase in the problems of adverse selection and moral hazards discourage the incentive for lending activities, and hence, reduce investment including spendings on housing and consumer durables. In other words, with lower net worth, a firm is less creditworthy as it has a higher incentive to provide a manipulated information on the riskiness of

potential projects. Because of this asymmetry of information, the potential lenders will be provoked to charge a higher risk premium for the lending (Cecchetti, 1995). These extensions of credit channel are known as bank balance sheet channels.

The above summarises all possible individual channels through which monetary policy influences real output. In an economy, the importance of each of the channels or a combination of them depends on country specific issues such as spread of banking, development of financial sector, degree of openness and institutional arrangements. In an economy, where key segments of the financial market are not in prominence and interest rates are highly regulated like the pre-reform India, credit channels may be more relevant than interest rate channels. Similarly, where the degree of substitution between bank loans and other sources of funding is high and where bank lending remains unaffected by the contraction of banks' reserves by the monetary authority, there is greater role for the interest rate channels. However, the evidences supporting operation of a particular channel do not rule out the existence of other channels. In fact, the analysis of the transmission process is incomplete without assigning due emphasis on both the money and credit markets and their interaction (Brunner and Meltzer, 1988).

3.3 - A Synthetic Framework delineating Channels of Monetary Transmission in Path Diagram

The schematic presentation of channels of monetary transmission discussed in the previous section could be very handy for easy grasping of the process of their working. In this section we shall start with schematically depicting the individual channels following Mishkin (1996) and then, construct the synthetic channel by combining them. The traditional interest rate channel can be presented in the schematic:

$$M\uparrow \Rightarrow r\downarrow \Rightarrow I\uparrow \Rightarrow Y\uparrow \quad \text{----------} \quad (C-1)$$

where, M = Money, r = Real Interest Rate, I = Real Investment and Y = Real Output

By extending the traditional interest rate channel to foreign exchange and equity markets, the exchange rate channel and the asset prices channels of monetary transmission as discussed in the previous section can be presented in following schematic presentation:

$$M\ t \Rightarrow r\ i \Rightarrow \text{Depreciation} \Rightarrow \text{Net Exports } t \Rightarrow Y\ t \qquad \text{(C - 2)}$$

and,

$$M \uparrow \Rightarrow Pe \uparrow \Rightarrow Q \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow \qquad \text{(C - 3)}$$

where, P_e = Equity Price, Q=Tobin's Q

The monetary transmission channel through wealth effect can be depicted schematically as,

$$M \uparrow \Rightarrow Pe \uparrow \Rightarrow \text{Wealth} \uparrow \Rightarrow \text{Consumption Spending } t \Rightarrow Y\ T \qquad \text{(C - 4)}$$

Both Tobin's 'Q' and wealth effect arguments can be extended to properties like houses and land by treating them similar to financial assets.

As discussed in the previous section, the credit channels are broadly categorised as bank lending channel and bank balance sheet channel. The bank lending channel can be presented schematically as,

$$M \uparrow \Rightarrow \text{Bank Deposits } t \Rightarrow \text{Bank Lending} \uparrow \Rightarrow I \uparrow \Rightarrow Y\ t \qquad \text{(C - 5)}$$

The alternate bank balance sheet channel operates through information asymmetry in the form of adverse selection and moral hazard. Monetary policy shocks affect financial position, and hence, net worth of the firms both directly and indirectly

(Bernanke and Gertler, 1995). Expansionary monetary policy reduces problems of adverse selection and moral hazard mainly in three ways. Firstly, increase in money supply raises the asset prices leading to increase in net worth of firms, and hence, enhancing the value of collateral. Secondly, as expansionary monetary policy reduces nominal interest rate in the economy, it improves banks balance sheet in terms of cash flow, which in turn reduces problem of adverse selection and moral hazard. The above two factors affect net worth of the firms directly. Thirdly, increase in money supply results in unanticipated price inflation and reduces the real value of liabilities of the firms. Further, there is possibility of narrowing down of the 'financial gap' of the firms, when the prices of the products to the downstream customers increase at a faster rate as a response to monetary expansion than the fixed and quasi-fixed costs such as interest and wage payments. Thus, monetary expansion indirectly improves the firms net worth and credit worthiness or reduces the problem of adverse selection and moral hazard leading to higher lending and investment. All the above three can be put schematically as

$$M\ t \Rightarrow Pe\ t \Rightarrow \text{Adverse Selection \& Moral Hazard} \downarrow \Rightarrow \text{Lending } t \Rightarrow I \uparrow \Rightarrow Y\ t \qquad \text{(C – 6)}$$

$$M\ t \Rightarrow i \downarrow \Rightarrow \text{Cash Flow } t \Rightarrow \text{Adverse Selection and Moral Hazard} \downarrow \Rightarrow \text{Lending} \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow \qquad \text{(C – 7)}$$

$$M\ t \Rightarrow \text{Inflation } t \Rightarrow \text{Adverse Selection and Moral Hazard} \downarrow \Rightarrow \text{Lending } t \Rightarrow I \uparrow \Rightarrow Yt \qquad \text{(C - 8)}$$

where, i = Nominal Interest Rate

Each of the individual channel C_i as schematically presented above is derived by putting some restriction ψ_i on the way in which monetary policy influences real output. For example, traditional interest rate channel C–1 depicts the particular path in which monetary shocks affect real output by putting restriction ψ_1 which ignores the

rest of the channels. This type of partial view of the individual channel is far from reality where none of the channels works in isolation but all possible channels operate, simultaneously. In fact, all possible channels coexist and complement each other, and the combined effect of monetary policy is felt on the final targets. This is basic philosophy that differentiates the current study from the earlier ones.

We therefore, hypothesise that, all possible channels of monetary transmission operate simultaneously and combined together transmit monetary shocks to the real output. Without imposing any restrictions, we shall attempt to analyse the combined effect by constructing a hybrid channel incorporating all individual channels. The present study overcomes the isolated view of the existing studies by emphasising the operation of a particular channel of monetary transmission and completely ignoring the role of other channels. It integrates all possible channels and formulates a synthetic framework to study the transmission of monetary impulses to real output in India.

In this exercise, the technique of 'path analysis' is found to be the most suitable tool, which can be best used for this purpose. The methodology of the path analysis is briefly discussed in Appendix A. Our path diagram as depicted in Exhibit III.1 presents the combined paths of monetary transmission by incorporating all individual channels as discussed above. This constitutes our basic framework for analysis of channels of monetary transmission in India.

3.4 – Empirical Evidences from Path Analysis

As discussed in Chapter 2, in the pre-reform period, the financial sector in India was limited to banking sector and other key segments of the financial market, namely, government securities market, money market, capital market existed in very rudimentary form. The interest rates, which play a crucial role in the 'money view', were highly regulated. The phenomenon of priority sector lending had been impeding the role of market mechanism in credit allocation. All these factors constrained the potent of interest rate and related channels of monetary policy and deemphasise the

effectiveness of 'money view' in India in the pre-reform period. On the other hand, during this period, credit planning was the main form of monetary policy in India and hence credit channel is expected to be effective. However, in the post-reform period sincere policy attempts developed a deep and broad-based financial market in India. Gradual deregulation of various interest rates, effective working of money, government securities and capital markets, move to market determined foreign exchange rate coupled with opening up of the economy with 'outward orientation' have brought radical changes in the institutional structure of the economy. All these factors have due implications for effectiveness of interest rate and related channels of monetary transmission. We believe that, both interest rate and credit channel carry their due importance in the 1990s. In this backdrop, we have constructed different models for the pre-reform and post-reform periods.

Our empirical analysis is based on both annual and monthly data. For estimations based on annual data the period covers from 1951-52 to 2001-02. For estimations based on monthly data the period of coverage is from March 1992 to May 2002, which coincides with the post-reform period. The selection of period for monthly data is mainly constrained by data availability. The details on data issues and data sources are discussed in 'Appendix B' towards end of the thesis, separately.

3.4.1 - Evidences from Annual Data

Our estimations of path analysis for annual data are based on the path model graphically depicted in the path diagram Exhibit III.2. In this model, the credit channel operates through the normal Money→ Deposit→ Credit→ Investment—• Output route. We have alternatively included and excluded post-reform period in our estimations to get a comparative picture. However, due to availability of few data points in the post-reform period, we may not get very different results. We are constrained to construct a small model due to limited observations. As discussed above, we think bank credit channel as the only appropriate channel for the pre-reform period. As bulk of our annual data include pre-reform period, we shall examine this channel only. Although, it is possible to test the strength of interest rate

and other related channels, which are thought to be ineffective in our above discussion, but limited time points do not permit this.

In our estimations, money is represented by 'reserve money'. We prefer 'reserve money' to 'broad money' as the path analysis assumes no feedback from the dependent variable to the exogenous variable. Ultimately, the basic objective is to capture the impact of monetary policy, where reserve money can serve the best purpose as monetary indicator. However, for comparative purpose we have also used broad money (M3) as indicator of monetary stance, alternatively. Among the rest of the variables, the variable credit refers to total bank credit prior to 1970-71 and non-food credit afterwards. The component of food credit in total bank credit has little relevance in our discussion. It can be noted that, all the variables are in terms of growth rates.

In time series econometrics, the variables used for regression analysis are supposed to be stationary to get rid of spurious regressions (Granger and Newbold, 1974). It holds true for the path analysis, also. The results of unit root tests checking for stationarity of the variables used in the annual path model are reported in Table III.1. Both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests of unit root reveal that all the variables used in the model are stationary at 1 percent level of significance.

The estimation results of the path analysis for annual data are presented in Tables III.3 through III.6. These estimations are based on the path model depicted in Exhibit III.2. It can be noted that, the estimated path coefficients are standardised regression weights estimated by maximum likelihood method.

For the period, 1951-52 to 1991-92 (Tables III.3), taking reserve money as an indicator of monetary stance, we find that in the credit channel Money—• Deposit→ Credit→ Investment→ Output, first three relevant path coefficients i.e. a, b and c are found to be statistically significant at 5 per cent level of significance and bear

appropriate sign. However, the fourth path coefficient estimated for the path from investment to real output is not statistically significant although bears appropriate positive sign. The indirect effect of money on real output through the credit channel *(a.b.c.d)* is estimated to be 0.017. The direct effect from money to real output is estimated to be 0.029, which is statistically not significant. Thus, our estimates found evidence of weak influence of money on real output in the pre-reform period.

However, our estimates showed strong influence of money on investment through credit channel. The indirect effect of money on real investment *(a.b.c)* is estimated to be 0.08. This implies that, with one standard deviation increase in the growth of money, the standard deviation of growth of real investment increases by 0.08 through credit channel. The indirect effect of money on credit is 0.28. With statistical evidence in support of monetary influence on credit and real investment, we cannot ignore operation of credit channel, completely. The goodness of fit index (GFI) and adjusted GFI are estimated at 0.88 and 0.63, respectively. Both these indicators support good fit of the model.

Now by including the post-reform period, the same model as above is re-estimated for the period 1951-52 to 2001-02. The estimation results are presented in Table III.5. There is no significant change in the path coefficients and their statistical significance as compared to the results based on exclusively pre-reform period. However, the goodness of fit indices have shown marginal improvement. In this case the indirect effect through credit channel of monetary transmission is estimated to be 0.019. The direct effect of money on real output is estimated to be 0.049, but not statistically significant. However, money is found to having statistically significant effect on bank credit and investment. The indirect effect of money on bank credit and real investment are estimated to be 0.25 and 0.09, respectively. In other words, with one standard deviation increase in the growth of reserve money, the bank credit growth increases by 0.25 standard deviations and real investment growth increases by 0.09 standard deviations. Thus, our path results for the full period also found evidence

of weak influence of money on real output. We found statistical evidence of significant monetary influence on bank credit and real investment.

Using M3 as a measure of money the estimation results for the periods 1951-52 to 1991-92 and 1951-52 to 2001-02 are presented in the Tables III.4 and III.6, respectively. The results are very much similar as the previous case of using reserve money. Thus, irrespective of using reserve money or M3 as indicator of monetary stance and irrespective of including or omitting post-reform period, our results remain unchanged. Our findings are in line with monetarist long run money neutrality proposition.

3.4.2 — Evidences from Monthly Data

Various initiatives to develop a diversified and broad-based financial market and suitable changes in the institutional arrangements in the post-reform period in India have created a conducive environment to enable the market forces to transmit the monetary impulses to real output, effectively. In view of this, we construct a new model for post-reform period based on monthly data, which is depicted in Exhibit III.3. This comprises mainly four channels of policy transmission as discussed in the previous section. They are interest rate channel, asset prices channel, exchange rate channel and credit channel. It can be noted that, in this model, we have not considered possible interactions amongst the individual channels. It is because, with available 111 observations, we can estimate at most 10 path coefficients. This compelled us to estimate the crucial path coefficients of the above four channels ignoring the interactions. Nevertheless, our path model encompasses four important channels of monetary transmission, simultaneously and estimated the combined effects in the synthetic framework.

Before using variables for path analysis, we have undertaken seasonal adjustment of the variables using 'X12 - method'. Other than the interest rates all other variables are in terms of growth rates. The growth rates for a particular month in a year are estimated as percentage change over the corresponding month in the

previous year. We have also tested the stationarity condition of the variables used in the model using ADF and PP tests of unit root. The results are presented in Table III.2. Both the ADF and PP tests found all the variables to be stationary.

In the model, 'call money rate' is used as an indicator of monetary policy stance. From policy point of view, increasing emphasis on maintaining orderly conditions in a multiple indicator approach since 1997-98 makes call rate a better candidate to capture the policy changes. Further, the assumption of no feedback as discussed earlier assigns preference to call money rate over M3. However, just to present a comparative view, we have also used growth rates of M3 as an alternative to capture stance of monetary policy. Real interest rate is represented by 91-day treasury bills rate adjusted for inflation based on WPI. However, a major hindrance is the absence of a monthly real output data series. Even the quarterly GDP series starts only from 1996-97. Inspite of its limitations, Index of Industrial Production (IIP) is widely used in India to represent monthly real output. We have also used IIP as a proxy for real output for our monthly estimations in absence of any other better option. BSE Sensex represents asset prices in our estimations. Other variables are self-explaining and do not need further discussion.

Estimated results using growth rate of M3 as an indicator of monetary policy are presented in Tables III.7A and III.7B. Let us start with the exchange rate channel. All the three path coefficients of this channel (a, *b* and *c)* are found to be statistically not significant. The first coefficient bears appropriate sign as expected, but the second and third coefficients *(b* and *c)* bear incorrect sign. For the first coefficient, limited openness in the capital account might have mitigated the relationships. May be external factors like world demand for Indian exports and domestic supply factors play a dominant role mitigating the influence of exchange rate on net exports.

Coming to the second channel of asset prices, the coefficients for the paths from M3 to asset prices (d) and from asset prices to real output (e) are estimated to be 0.259 and 0.396, respectively. Both are statistically significant and have expected

positive sign. The indirect effect of money on real output through this channel is estimated to be 0.103. It implies that, with one standard deviation increase in growth rate of M3, there is 0.1 standard deviation increase in growth rate of real output through asset prices channel.

In the interest rate channel both the path coefficients (*f* and *g)* are found to be statistically significant and bear appropriate sign. The path coefficient for the path from M3 to real interest rate is estimated to be - 0 460 and the coefficient for the path from real interest rate to real output is estimated to be - 0.123. The indirect effect through this channel is found to be 0.057.

Now let us take up the credit channel of monetary transmission. In this channel, all the three path coefficients (*h, i* and/) are statistically significant. However the path coefficient from aggregate deposit to credit has inappropriate negative sign. This underscores the role of demand factors, which dominated credit expansion in the post-reform period. The indirect effect of monetary policy though credit channel is estimated to be - 0.092. However, its sign is not as per the theoretical perception. The GFI and adjusted GF1 are estimated to be 0.74 and 0.48, respectively.

One serious limitation of the above model is the possible feedback from real output to M3. To overcome this problem we have substituted 'call money rate' as the indicator of monetary policy stance instead of growth rate of M3, keeping all other variables intact. The model is also estimated for the same period as above. We have already discussed the appropriateness of using call rate as indicator of monetary policy in the post-reform period. The estimation results are presented in Tables III.8A, and III.8B

Similar to the previous one, in this case also the estimated results support effective operation of asset prices and interest rate channels to transmit monetary impulses to the real activity in the post-reform period. In the asset price channel, the path coefficient from call rate to asset prices is estimated to be - 0.202, and that from

asset prices to real output is estimated to be 0.393. Both the coefficients are statistically significant at 5 percent level of significance and bear appropriate sign. The indirect effect of monetary policy on real output through this channel is estimated to be - 0.079. Similarly, in the interest rate channel both the path coefficients bear the appropriate signs. Here, the path coefficient relating call rate to real interest rate is significant at 5 per cent level of significance, but the coefficient for the path from real interest rate to real output is significant at 8 per cent level. The indirect effect of monetary policy on real output through interest rate channel is estimated to be - 0.027.

The results also could not support operation of foreign exchange rate channel. We found the coefficients for the path from exchange rate to net exports and from net exports to real output as not significant statistically. However, we found the path coefficient from call rate to exchange rate to be statistically significant supporting the link between call money rate and foreign exchange rate in the post-reform period in India. Similar to the previous case, here also we found all the coefficients of the credit channel to be statistically significant but the coefficient for the path from bank deposits to credit bears inappropriate negative sign.

The total effect of monetary policy on real output consists of sum of all the indirect effects through the respective channels. In the above analysis of using call rate to capture the stance of monetary policy, the indirect effect through the exchange rate channel is statistically not significant. Thus, we can estimate the total effect as the sum of indirect effects through asset price channel, interest channel and credit channel. It is found to be - 0.073. It indicates that with one standard deviation increase in the call rate, the growth rate of IIP decreases by 0.07 standard deviations. This captures the total effects of monetary policy on real output through combined operation of all the channels. Our findings support significant influence of monetary policy on real output in the post-reform period in India. Monetary influences are mainly transmitted by the market based rate channels during this period.

3.5 - Summary of Results and Concluding Remarks

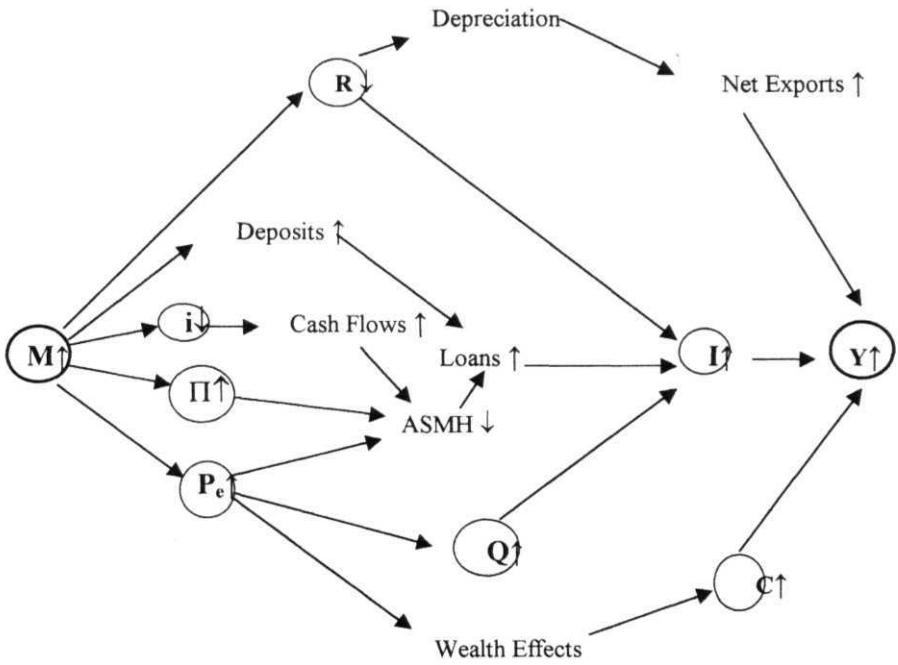
The above estimation results have some significant implications for the ongoing debate on superiority of money *versus* credit view regarding monetary transmission mechanism. Given the structure of the economy and the institutional arrangements as discussed before we cannot conceive the possibility of operation of market based rate channels in India in the pre-reform period. We can think of operation of only the credit channel during this period. From the estimation results based on annual data bulk of which represents the pre-reform period, we found statistically weak evidence of influence of monetary policy on real output in India. This finding supports monetarist long run money-neutrality proposition. In the path chain, particularly, the influence of real investment on real output was found to be statistically weak. Irrespective of including or excluding the post-reform period, we found the influence of monetary policy on bank credit and real investment to be statistically significant. Hence, we may not ignore the potent of credit channel in India, completely.

Our monthly estimations, exclusively focusing on the post-reform period, revealed some interesting features. Particularly, radical reforms in various segments of the financial market had played as catalyst to activate market based rate channel in India in the post-reform period. We found statistical evidences in support of market based interest rate and asset prices channels as effective channels of monetary transmission in the post-reform period. Amongst the two, the strength of asset price channel is stronger. We do not find statistical evidence of operation of exchange rate channel. In the post-reform period, the working of credit channel is impeded due to inappropriate relationship between bank deposits and bank credit. Overall, there is strong evidence supporting influence of monetary shocks on the real output through combined channels in the post-reform period in India.

Amongst the competing policy targets, both 'M3' and 'call money rate' have exhibited close relationship with intermediary variables of real interest rate, asset price and bank credit. With foreign exchange rate, only call rate seems to have a

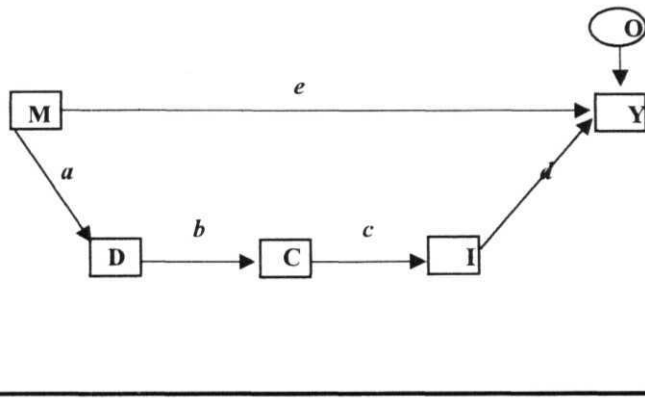
statistically significant relationship. This adds advantage to the use of 'call money rate' as the policy target in view of increasing emphasis on maintaining orderly conditions in the financial market. Overall, empirical support on the ability of monetary shocks to influence real output, particularly, in the post-reform period underscores the role of monetary policy in augmenting economic growth.

Exhibit: III.1
Path Diagram of Channels of Monetary Transmission



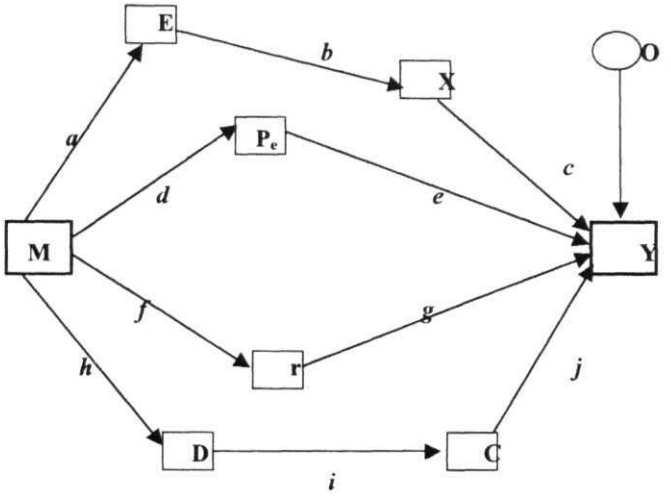
Note: **M** : Money,
I : Real Investment,
$\mathbf{P_e}$: Asset Prices,
r : Real Interest Rate
C : Private Consumption Expenditure, and
ASMH : Information Asymmetry and Moral Hazards,
Y : Real Output,
$\prod$: Price Inflation,
Q : Tobin's **'q',**
i : Nominal Interest Rate

Exhibit III.2
Path Diagram – Annual Data



Note: M: Money (either Reserve Money or Broad money) ,
Y: GDP at factor cost (1993-94=100),
D: Bank Deposit
I: Gross Domestic Capital Formation,
C: Bank Credit,
and O: Others

Exhibit III.3
Path Diagram – Monthly Data



Note: M: Money (either M3 or Call Money Rate),
Y: Index of Industrial Production (IIP),
D: Aggregate Deposit of the Scheduled Commercial Banks
C: Non-food Credit,
r: 91-day TBs Rate (real),
P_e :BSE Sensex
E : Rupee-US Dollar Exchange Rate
X : Exports over Imports, and
O: Others

Table III.1
Results of Unit Root Tests: Annual Data

Variables	*ADF Test*	*PP Test*
M3	-3.56	-4.25
Reserve Money	-4.09	-5.15
Deposit	-3.73	-4.41
Credit	-5.00	-5.69
Investment	-6.00	-8.44
GDP	-5.56	-8.34

Note: Critical Values: - 2.89 at 5 per cent level of significance
- 2.58 at 10 per cent level of significance

Table III.2
Results of Unit Root Tests: Monthly Data

Variables	*ADF Test*	*PP Test*
M3	-2.69	-3.32
Call Money Rate	-2.97	-5.71
Deposit	-2.96	-3.76
Credit	-3.29	-2.93
Rs/US $ Exchange Rate	-2.60	-2.62
Net Exports	-2.63	-6.18
BSE Sensex	-3.54	-2.59
Real 91 TBs Rate	-2.65	-2.61
IIP	-3.58	-3.43

Note: Critical Values: - 2.89 at 5 per cent level of significance
- 2.58 at 10 per cent level of significance

Table IU.3
Results of Path Analysis - Annual
(1951-52 to 1991-92)

Path	*Path Coeff.*	*Standd. Reg. Coeff.*	*SE*	*CR*	*P*
	a	0.590	0.120	4.619	0.000
D → C	***b***	0.477	0.117	3.431	0.001
C → I	***c***	0.295	0.295	1.952	0.051
I → Y	***d***	0.210	0.042	1.353	0.176
Direct Effect M → Y	***e***	0.029	0.066	0.990	0.849
Indirect Effect	***a . b . c . d***	0.017			
Total Effects	***(e) + (a. b. c. d)***	0.047			

***Goodness** of Fit Indices.* GFI = 0.88, AGFI = 0.63

Note: M: Reserve Money, Y: GDP at factor cost (1993-94=100)
D: Bank Deposits, C: Bank Credit

Table IH.4
Results of Path Analysis - Annual
(1951-52 to 1991-92)

Path	*Path Coeff.*	*Standd. Reg. Coeff.*	*SE*	*CR*	*P*
M → D	***a***	0.873	0.090	11.297	0.000
D → C	***b***	0.477	0.117	3.431	0.001
C → I	***c***	0.295	0.295	1.952	0.051
I → Y	***d***	0.214	0.043	1.376	0.169
Direct Effect M → Y	***e***	0026	0.082	.165	0.869
Indirect Effect	***a . b . c . d***	0.026			
Total Effects	***(e) + (a. b. c. d)***	0.052			

***Goodness of Fit Indices*: GFI = 0.85, AGFI = 0.56**

Note: M: M3, Y: GDP at factor cost **(1993-94=100)**
D: Bank Deposits, C: Bank Credit

Table III.5
Results of Path Analysis - Annual
(1951-52 to 2001-02)

Path	*Path Coeff.*	*Standd. Reg. Coeff.*	*SE*	*CR*	*P*
M → D	***a***	0.570	0.104	4.907	0.000
D → C	***b***	0.440	0.118	3.501	0.000
C → I	***c***	0.353	0.237	2.665	0.008
I → Y	***d***	0.209	0.038	1.509	0.131
Direct Effect M → Y	***e***	0.046	0.057	0.330	0.742
Indirect Effect	***a . b . c . d***	0.019			
Total Effects	***(e) + (a. b. c. d)***	0.065			

Goodness of Fit Indices. **GFI = 0.90, AGFI = 0.71**

Note: M: Reserve Money, Y: GDP at factor cost (1993-94=100)
D: Bank Deposits, C: Bank Credit

Table III.6
Results of Path Analysis --Annual
(1951-52 to 2001-02)

Path	*Path Coeff*	*StandiL Reg. Coeff.*	*SE*	*CR*	*P*
M → D	***a***	0.872	0.079	12.625	0.000
D → C	***b***	0.444	0.118	3.501	0.000
C → I	***c***	0.353	0.237	2.665	0.008
I → Y	***d***	0.216	0.038	1.558	0.119
Direct Effect M → Y	***e***	0.089	0.073	0.645	0.519
Indirect Effect	***a . b . c . d***	0.029			
Total Effects	*(e) + (a. b. c. d)*	0.119			

***Goodness of Fit Indices:* GFI = 0.88, AGFI = 0.63**

Note: M: M3, Y: GDP at factor cost (1993-94=100)
D: Bank Deposits, C: Bank Credit

Table I1L7A
Results of Path Analysis –Monthly

Path	*Path Coeff.*	*Standd. Reg. Coeff.*	*SE*	*CR*	*P*
M → E	*a*	0.019	0.232	0.204	0.838
E → X	*b*	- 0.023	0.270	- 0.246	0.806
X → Y	*c*	- 0.094	0.020	-1.341	0.180
M → P_e	*d*	0.259	1.453	2.809	0.005
P_e → Y	*e*	0.396	0.009	5.598	0.000
M → r	*f*	- 0.460	0.131	- 5.436	0.000
r → Y	*g*	-0.123	0.088	- 1.737	0.082
M → D	*h*	0.856	0.065	17.373	0.000
D → C	*i*	-0.197	0.214	-2.108	0.035
C → Y	*J*	0.543	0.044	7.706	0.000
O → Y	*k*	0.736			

(March 1993 to May 2002)

Goodness of Fit Indices. GFI = **0.74,** AGFI = **0.48**
IFI = 0.60, CFI = 0.59

Note: M: M3, r = Real 91-day Treasury Bills Rate
E: Rupee-US Dollar Exdiange Rate,
X: Net Exports, P = BSE Sensex
Y: IIP (1993-94=100), D: Bank Deposit,
C: Non-food Credit, and O: Others

Table III.7B
Direct, Indirect and Total Effects

Path	*Ind. coeff*	*ID. Effect*	*D. Effect*	*T. Effect*
M→ E→ X→ Y	*a * b *c*	0.000041	0.00	DE+IDE=
M → P_e→ Y	*d * e*	0.102564		
M → r→ Y	*f * g*	0.056580		- 0.068
M → C → I → Y	*h * i *j*	-0.091567		

Table III.8A

Results of Path Analysis - Monthly

Path	*Path*	*Standd. Reg. Coeff.*	*SE*	*CR*	*P*
	a	-0.213	0.097	2.287	**0.022**
E → X	***b***	- 0.023	0.270	- 0.246	**0.806**
X → Y	***c***	- 0.093	0.020	- 1.341	**0.180**
M → P_e	***d***	- 0.202	0.663	-2.158	0.031
P_e → Y	***e***	0.393	0.009	5.636	**0.000**
M → r	***f***	0.225	0.062	2.426	**0.015**
r → Y	***Z***	-0.122	0.087	-1.752	**0.080**
M → D	***h***	-0.318	0.052	-3.521	0.000
D → C	***j***	-0.197	0.214	-2.108	0.035
C → Y	***J***	0.539	0.044	7.732	0.000
O → Y	***k***	0.731			

(April 1997 to May 2002)

Goodness of Fit Indices. **GFI = 0.77, AGF1 = 0.54**
IFI = 0.36, **CF1** =0.33

Note: M: Call Money Rate, r = Real 91-day Treasury Bills Rate
E: Rupee-US Dollar Exdiange Rate,
X: Net Exports, P = BSE Sensex
Y: IIP (1993-94=100), D: Bank Deposit,
C: Non-food Credit, and O: Others

Table III.8B

Direct, Indirect and Total Effects

Path	***Ind.*** *Coeff*	*ID. Effect*	*D. Effect*	*T. Effect*
M→ E→ X→ Y	*a * b * c*	0.00046		DE+IDE=
M → P_e→ Y	*d * e*	- 0.07939		
M → r → Y	*f*Z*	- 0.02745		- 0.073
M → C→ I → Y	*h * ı *j*	0.03377	0.00	

Chapter 4

Analysing Monetary Impact on Real Output and Prices in India: A VAR Approach

Chapter – IV

ANALYSING MONETARY IMPACT ON REAL OUTPUT AND PRICES IN INDIA: A VAR APPROACH

4.1 - Introduction

In the previous chapter, we have examined various competing channels of monetary transmission defining the paths of influence of monetary shocks upon real output, with the aid of 'path analysis'. Over there, one of the basic assumption was absence of any feedback from real output to money. In the interrelationship between money and output, it may not be appropriate to completely ignore the influence of real activity on money. Secondly, in any discussion on the association between money and real output, inclusion of prices is important. Addressing these issues, we shall study the interrelationship between money, output and prices in India, in this chapter.

The first formal framework to study the interactions amongst money, output and prices was established by the Pigouvian Cash Balance Equation 'M = k.P.Y' of quantity theory of money (QTM) in the classical era. This proposes a direct and proportional influence of monetary growth on price inflation assuming full employment condition. Since then, innumerable research works pertaining to this relationship and many heated debates have revealed the sheer complexity in the association between money, output and prices. Some of the divergent views include money non-neutrality proposition of Keynes vis-a-vis long run money neutrality proposition of the monetarist school; Philips curve philosophy of *trade off* between output growth and price stability, and its subsequent refutation in the long run by Phelps (1967) and Friedman (1968). In the context of developing countries there was a debate on emphasising the role of monetary *versus* structural factors. There was another issue of addressing the fiscal-monetary nexus (Dutton (1971), Aghveli and Khan (1978) and Rangarajan and Arif (1990)).

Some recent studies (Barro (1995), Sarel (1996), Khan and Senhadji (2000) Samantaraya and Prasad (2001)) established the non-linearity in the association between output growth and inflation highlighting the negative impact of inflation on real output beyond the threshold level of inflation. However, in this chapter, we shall not indulge into addressing the broad interrelationship between money, output and prices. Rather, we shall narrow down our focus to examine the nature of influence of money on real output and prices.

At present, there is some convergence of the conflicting views on the impact of monetary regulation on real output and price. Inspite of prevalence of uncertainty about the strength and lags of monetary policy on real output and prices, recent studies in many industrial and emerging economies largely infer that, a contractionary monetary shock immediately raises interest rates and temporarily squeezes real activity as well as results in a gradual decline in prices (Fung, 2002). A large part of these empirical works are based on the United States. However, only a limited amount of similar research work has been conducted in India to the date, particularly with sizeable data from the post-reform period. Our analysis in this chapter is an attempt to fill this gap. Particularly, we shall examine the nature and strength of effects of monetary policy shocks on real output, interest rate and price, and detect the lag structure of policy effects employing the technique of Vector Auto-Regressions (VAR). The technique of VAR analysis is widely used in the macro-monetary literature, which treats all the endogenous variables in the system symmetrically without imposing any *a priori* restriction. It also takes into account the feedback effects.

In rest of this chapter, Section 4.2 discusses the theoretical underpinnings on the interrelationships amongst money, output and prices and undertakes a brief review of the literature. Section 4.3 presents the methodology of the VAR estimations as undertaken in this chapter. The estimation results are provided in Section 4.4 and Section 4.5 draws up concluding remarks.

4.2 - Theoretical Underpinnings and Review of Literature

There is quite a bit of literature available examining the interrelationships between money, output and prices. The theoretical discussion on the influence of money on real output is already presented in the previous chapter. To avoid repetitions, we do not discuss this aspect any further. On the relationship between money and prices, the first formalised statement on influence of money on prices can be attributed to the French writer Jean Budin (Pierce and Tysome, 1985). He established the link from money to price in an attempt to explain the price revolution which swept Europe for almost a century after the Spanish introduced great quantities of gold and silver into Europe from their American colonies in the sixteenth century.

Budin's rudimentary work was subsequently refined and made more rigorous in the classical tradition. The classical QTM provided the theoretical foundation for the direct relationship between money supply and general prices. The QTM was modified in the Keynesian and monetarist literature with addition of interest rate in bonds and returns in other assets, respectively as additional explanatory variables to real activity. The demand for money derived from the above is mainly determined by factors like level of real output and opportunity cost of holding money. Any additional amount of money supply above the money demand as determined by the money demand function shall exert pressure on the general prices and push up inflation.

It is important to note that, in the context of developing countries, domestic and external supply shocks affecting the cost of production are expected to influence the prices. This had led to emergence of structuralist theory of inflation. However, the domestic supply shocks mainly affect the relative prices and not necessarily the general prices. Any of these supply shocks cannot sustain consistent rise in prices in long run without accommodating rise in money supply. As asserted by Rangarajan (1997a), "a continuous pressure on prices, which is what inflation is all about, cannot be sustained, if there is no accommodating increase in money supply" The growth of money supply dominates in determining the general price level in a monetary

economy in which every transaction is invoiced in terms of unit of the domestic currency.

In the literature, the monetarist model due to Cagan (1956) influenced major studies looking at monetary version of inflationary process in developing countries upto late 1970s. Basically, these studies treated money supply as exogenous policy action and inflation was attributed entirely to monetary variation. In the aftermath, studies on monetary-fiscal nexus (Dutton (1971), Aghevli and Khan (1977), Aghevli and Khan (1978)) dominated the thinking to study the interlinkages between money, output and prices. The above studies highlighted the money-inflation-fiscal deficit-money spiral relation. In this spiral, the semi-circle from inflation to money is explained through the higher elasticity of government expenditure vis-a-vis government revenue with respect to inflation, and the consequent expansion of fiscal deficit and higher monetisation. In Indian case, Sarma (1982), Jadhav-Singh (1990) and Rangarajan-Arif (1990) are noteworthy contributions in this literature. Most of the above studies incorporating the fiscal-monetary nexus have employed the tool of macro-econometric model.

Subsequently, Sims (1980) introduced the technique of VAR, which does not impose *a priori* restrictions as in multi-equation macro-econometric models rather allows the data to specify the dynamic structure. It was suitable to estimate large scale macro-models treating all variables as endogenous and taking care of the feedback effects. Sims (1980) estimated VAR models for the postwar time series data (quarterly) upto mid-1970s for the US and West Germany, separately. The variables included in the model were money, real output, unemployment rate, wages, prices and import price index. In the US, monetary innovations were found to explain 35 per cent of forecast variance in real output after 3 quarters of occurrence of policy shock, which slowly declined to 28 per cent at 33-quarters ahead forecast. On the other hand, monetary innovations in West Germany were found to explain merely 15 per cent of forecast variance of real output at the peak. Coming to the impact on the prices, in the US the monetary shocks explain a meager 4 per cent of the forecast variance of prices

at 3-quarters ahead forecast. However, the impact slowly increases and 60 per cent of variation in prices is explained by monetary shocks at 33-quarters ahead forecast. But, in West Germany, monetary shocks were found to be negligible to explain variation in prices.

VAR methodology had significant influence on the subsequent studies examining the interactions between money, output and prices in the following days. In the literature, King (1986), Sims (1986), Bernanke (1986), Bernanke and Blinder (1992), Leeper, Sims and Zha (1996), Morsink and Bayoumi (2001), Fung (2002), etc. have used different versions of VAR technique.

Bernanke and Blinder (1992) decompose the set of endogenous variables in the VAR model into sub-sets of policy and non-policy variables. The sub-set of non-policy variables includes economic variables such as output, interest rate and price, etc. and the sub-set of policy variable includes federal funds rate to capture the overall stance of monetary policy. By imposing contemporaneous identification restrictions, they analyse the impact of monetary shocks on real activity and price. Based on US monthly data covering the period 1961:7 to 1989:12, they find that the effects of shocks to funds rate on the output are essentially zero during first two to three quarters after the shock. The effect begins to rise at about 9-months ahead and reaches the peak after two years before returning back to zero.

Leeper, Sims and Zha (1996) use a single time frame (from January 1960 to March 1996) and data set (for the US) to test the robustness of results of several studies in the literature examining the effects of monetary policy. They found that, the strength of the monetary policy effects on output and price differs across specifications of economic behaviour by different studies. Most of the specifications indicated modest effect of monetary policy on real output and price in terms of explaining their variance since 1960 in the US. They also found that, in most of the specifications feedback from the state of the economy influence variation in monetary policy instruments.

Morsink and Bayoumi (2001) use VAR analysis with Choleski decomposition to examine the monetary transmission mechanism in Japan and trace the influence of monetary shocks on economic activity, interest rates and prices. The estimations are based on quarterly data covering from the first quarter of 1980 to third quarter of 1998. In the basic model, real private demand (real GDP minus total government spending) representing real activity significantly decline with monetary tightening and bottoms out after 8 to 10 quarters. The price level responds positively to contractionary monetary shocks, which is known as 'price puzzle' in the empirical literature in the US implying monetary contraction producing inflation. They find interest rate rising with tightening monetary shocks.

Fung (2002) attempts to analyse the impact of monetary shocks on output, interest rate and price in East Asian economies, namely Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, China and Thailand by generating dynamic responses employing VAR analysis. In his analysis, contemporaneous identification restrictions are imposed in a 'semi-structural VAR' approach followed by Bernanke and Mihov (1998) and the estimations are based on monthly data. Although the period of coverage varies across countries, roughly it covers since early 1980s to June 2001. From the estimated impulse response function, it is found that following a contractionary monetary policy shock, output falls immediately in all economies except Korea and Taiwan. This fall in output is significant for about a year in Indonesian, Malaysia and the Philippines and the same is short-lived in Thailand and Singapore falling significantly for the first few months. With monetary tightening, price declines initially only in Korea and Singapore and in all other economies there is increase in price, contrary to the expectation. Interest rates in all economies rise immediately and significantly after contractionary monetary shocks. However, it can be noted that, the results for most economies are more in line with the theoretical predictions, when data for estimations are restricted to the pre-Asian Crisis (upto mid-1997) period.

In the Indian context, using standard VAR approach RBI (1998) analyses the effects of monetary shocks on real output and price based on monthly data for the period April 1993 to March 1997. Although the details of estimation results are not reported, broadly it concludes that, an expansionary monetary policy reduces interest rate, raises price inflation and tends to improve output. On the other hand, Srimany and Samanta (1998) have studied the impact of monetary shocks on output and prices employing VAR analysis with both Choleski and structural decomposition for the post-reform period in India. The period of coverage for their study is from August 1991 to March 1997. They found that, monetary shocks explain 17 per cent forecast variance of output and close to 31 per cent of forecast variance of price at 24-months ahead forecast. The impulse response function revealed that, the effect of money on output is found to be important till 24 months and that on price is very significant till the 8th months. They also infer that, standard VAR analysis using Choleski decomposition may produce sub-optimal results as compared to structural VAR analysis. However, short period of coverage of both the studies which does not cover even a single business cycle weakens the reliability of the inferences.

4.3 – Methodology

The technique of standard VAR as developed by Sims (1980) and its modifications in form of structural VAR are discussed separately in the Appendix A. In this section, we shall briefly outline our VAR models for India based on both annual and monthly data. Starting with our annual VAR model, it contains only three variables, namely money, real output and prices. Selection of such a small model with just three crucial variables is mainly guided by limited annual observations available. Now, denoting the variables money, real output and price by M_t, Y_t and P_t, the column matrix X_t can be written as,

$$X_t' = [M_t \quad Y_t \quad P_t]$$

Now, the standard first-order VAR (order '1' chosen for simplicity) model representing the true economy can be written in matrix notation as

$$B X_t = A_0 + A_1 X_{t-1} + U_t \qquad \text{(IV.1)}$$

where,

$$B = \begin{pmatrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ a_{31} & a_{32} & 1 \end{pmatrix}, \quad A_0 = \begin{pmatrix} a_{10} \\ a_{20} \\ a_{30} \end{pmatrix}, \quad A_1 = \begin{pmatrix} a_{14} & a_{15} & a_{16} \\ a_{24} & a_{25} & a_{26} \\ a_{34} & a_{35} & a_{36} \end{pmatrix} \text{ and } U_t = \begin{pmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{pmatrix}$$

Pre-multiplying both sides of System IV.1 by B^{-1}, we get the reduced form model which can be written as,

$$X_t = C_0 + C_1 X_{t-1} + E_t \qquad \text{-----} \qquad \text{(IV.2)}$$

where,

$$C_0 = B^{-1} A_0 , \quad C_1 = B^{-1} A_1 \quad \text{and} \quad E_t = B^{-1} U_t$$

This reduced form model as presented in System IV.2 can be appropriately estimated by OLS method. However, for innovation accounting through variance decomposition and impulse response function, the next task is to achieve identification in estimations of the System IV.2. One possible option for identification is through Choleski decomposition, which is a common method of identifying a VAR as discussed in Appendix A. Choleski decomposition converts matrix B into a lower triangular matrix as given below

$$B^* = \begin{pmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{pmatrix}$$

It can be noted that, in the above VAR model our variables follow the ordering pattern: money, output and price. Here, we shall discuss the logic behind adopting this

ordering pattern. Putting money at first in the ordering is mainly guided by our motive to capture the impact of monetary shocks on real output and prices. In such an ordering, Choleski decomposition will capture only pure shocks to money and no feedback from output or price in the current period. But, such a structure never rules out lagged feedback from output or price on money. We have placed price at last in the ordering to emphasise the role of both output and monetary variation in price determination in India similar to other developing countries. By putting price in the last equation, Choleski decomposition captures the contemporaneous impact of both money and output on price. Also, with this ordering pattern, imposition of Choleski decomposition will be similar to contemporaneous restrictions of Bernanke and Blinder (1992).

However, Choleski decomposition may not produce a theoretically consistent system as discussed in Appendix A. We attempt to formulate a different system imposing restrictions derived from economic theory and construct the structural VAR following Bernanke (1986), and Srimany and Samanta (1998). In our structural VAR, we add the new restriction of no contemporaneous effect from money to output to the set of restrictions of Choleski decomposition. This restriction is supported by our finding of weak influence of monetary shocks on real output in the previous chapter. This additional restriction can be denoted mathematically as, '$a_{21}=0$'. With this over-identifying restriction, the matrix B is modified as,

$$B^{**} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ a_{31} & a_{32} & 1 \end{pmatrix}$$

Thus, in our structural VAR, we assume no contemporaneous effect of output and prices on money and no contemporaneous effect of money and prices on output. However, we do not rule out the lagged effects. The above restrictions allow both contemporaneous and lagged effects of money and output on the prices.

We have constructed a different VAR model for our analysis based on monthly data. It contains four variables in the order money, real interest rate, real output and prices. We have the liberty of adding the 4th variable interest rate with the advantage of availing large number of monthly observations. The logic of putting money at first in the ordering and prices at last remains the same as in the annual VAR model. Real interest rate precedes real output in the ordering with the assumptions of no contemporaneous impact of output on interest rate but existence of contemporaneous effect of real interest rate on real output.

Both the Choleski and structural decompositions can be modified analogously in this case for innovation accounting through variance decomposition and impulse response function. Choleski decomposition being straight forward, we need not discuss it any further, but we need to specify structural decomposition. In the structural VAR model based on monthly data, we assume no contemporaneous effect of real interest rate on prices. Unlike our annual VAR model, we allow for contemporaneous effect of money on output guided by our finding in the previous chapter. The matrix B for the structural VAR model based on monthly data thus can be modified as,

$$B^{***} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & 0 & a_{43} & 1 \end{pmatrix}$$

4.4 – Empirical Evidences in India from VAR Analysis

As mentioned above, our VAR models for India are estimated based on both annual and monthly data. The period of coverage for annual data is from 1951-52 to 2001-02 and that for monthly data is from March 1992 through May 2002. It can be noted that, as our annual dataset contains just 51 observations, we are constrained to construct a small VAR model with just three variables money, output and prices.

Secondly, prevalence of administered interest rate coupled with fixed exchange rate regime in the pre-reform period, which constitutes bulk of the annual data do not encourage inclusion of variables like interest rate or exchange rate in the VAR. In these estimations GDP (1993-94=100) at factor cost, broad money (M3) and Wholesale Price Index (WPI) represent real output, money and price, respectively. All the variables are in terms of growth rate.

Our monthly data broadly coincides with the post-reform period since early 1990s in India. In absence of sufficient data points from the post-reform period based on either annual or quarterly frequency, the only option left is to solely rely on monthly data. Our monthly VAR model includes four variables, namely real output, real interest rate, money and price. Inspite of the limitations, as discussed in the previous chapter, we have used IIP as a proxy for real output in absence of any other better option. We have used 91-day TBs rate adjusted for WPI inflation as a proxy for real interest rate. WPI represents price and monetary stance is alternately represented by growth rate of M3 and call money rate. The variables IIP, M3 and WPI are in terms of growth rates, and call money rate is in terms of weighted average as estimated by the Reserve Bank of India.

As monthly data are subject to the problem of seasonality, each of the data series is deseasonalised by using 'X12 method'. The deseasonalised data series are used for estimations.

Brief descriptions of all the data series both for annual and monthly frequency are presented in Appendix B.

4,4.1 - *Evidences* ***from Annual Data***

Before estimating the model, we have attempted to verify the stationarity condition of the variables. As shown in Table III.1 in the previous chapter, growth rates of GDP and M3 were found to be stationary. The ADF and PP tests for unit root estimate the test statistics for growth rate of WPI (inflation) to be 4.47 and 4.32,

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respectively, rejecting the null hypothesis of unit root. Thus, all the variables used in our annual VAR models are confirmed to be stationary.

The next step is determination of lag structure of the VAR. We have chosen first-order VAR supported by both A1C and SBC. Estimating the first order VAR as given in the System IV.2, we present the results of innovation accounting, below. The results of variance decomposition of standard VAR model using Choleski decomposition for exact identification are presented in Table IV.4. From this table it can be noticed that, monetary variable is having very modest impact on real output. The effect of monetary shocks on forecast variance of real output in the current year is less than 0.1 per cent and it gradually increases to reach 1.15 per cent in the fourth year. Afterwards upto the 10-years ahead forecast, a meagerly 1.2 per cent of the variance of real output can be attributed to money.

On the other hand, 2.68 per cent of the forecast variance of price inflation in the current period is explained by money, which substantially increases to 14.22 per cent in the next year. The effect of monetary shocks on variance of price inflation gradually increases to 21 per cent in the 5-years ahead forecast after which it remains closely at the same level. Thus, the results of the standard VAR analysis imply that, money has marginal influence on real output whereas it explains close to one-fifth of forecast variance of inflation since 2-years ahead upto 10-years ahead forecasts.

The impulse responses of real output and price due to shocks to money derived from the standard VAR are depicted in Graph IV.1. It can be observed from this graph that, the effect of monetary shocks on real output is negligible in the first year (less than 0.1 in absolute value). In the second year, the growth rate of output increases from that of the initial level and reaches maximum level of 0.25. After that, it gradually diminishes and becomes negligible by the fifth year.

Similar to the impact on real output, as a result of monetary shock price inflation fall from the initial level in the first year. But, it reaches the maximum of 2.0

above the initial level in the second year. Afterwards the effect of monetary shocks on inflation gradually diminishes but remains important upto the ninth year. Thus, from this impulse response analysis of the standard VAR, we found evidence of strong influence of monetary shocks on price inflation, whereas its impact on real output is weaker. However, initial negative impact both on real output and price is puzzling.

The results of variance decomposition of the structural VAR analysis are presented in Table IV. 5. The results are very similar to that of previous VAR analysis with Choleski decomposition. The effect of monetary shocks on variance of real output at 2-years ahead forecast is close to 0.6. Afterwards the contribution of monetary shocks on real output remains close to 1 per cent in terms of explaining the forecast variance. Similar to the case of standard VAR, from the structural VAR also we can infer that, only about 3 per cent of forecast variance of price inflation can be attributed to monetary shocks in the first year. With gradual increase, monetary shocks account for close to 21 per cent of forecast variance of price inflation since 5-years ahead upto 10-years ahead forecast.

The impulse response function derived from the structural VAR is presented in Graph IV.2. From this graph, we can observe that, real output reaches maximum of 0.23 above the initial level in the next year as a result of monetary policy shock in the current year. The effect of monetary shock on the real output slowly dies down and after the fourth year its effect becomes negligible.

From Graph IV.2, it can also be noticed that, price inflation reaches 0.84 below the initial level (negative) due to monetary shock in the current year. Contrary to theoretical expectation, it suggests that monetary expansion causes price deflation. This phenomenon is commonly found in the literature on the monetary transmission mechanism in the US and has been widely known as the 'price puzzle' (Morsink and Bayoumi, 2001). However, in the second period we found the price inflation reaching the pick of 1.93 above the initial level and the positive effect of monetary shock on price inflation slowly decays down. Nevertheless, the effect of monetary shocks on

inflation remains very significant upto the fifth year. Its importance becomes negligible only after the ninth year.

To sum up, our VAR analysis examining the impact of monetary shocks on output and prices in India based on annual data extending over five decades imposing either Choleski or structural decomposition found very similar results. Similar to our analysis in the previous chapter, we found the impact of monetary shocks on real output to be weak. But we found strong impact of monetary shocks on inflation which remains consistent for close to nine years.

4.4.2- Evidences from Monthly Data

Similar to the case of estimations based on annual data, we shall start with verifying the stationarity condition for all the variables used in our estimations based on monthly data to overcome the problem of 'spurious regression'. The results of unit root tests as presented in the Table III.2 confirm that all variables except WPI-inflation are I(0). We have estimated the test statistics for WPI-inflation by using ADF and PP tests for unit root to be 2.91 and 3.12, respectively rejecting the null hypothesis of unit root. Thus, we confirm that, all the variables used in our monthly VAR models are stationary.

As mentioned earlier we have used call money rate and monthly growth rate of M3 to capture the stance of monetary policy, alternatively. Let us first consider the VAR model in which we are using call money rate. In this model, the order of the variables is money (call rate), real interest rate, real output and price. We have chosen first order VAR guided by both AIC and SBC criteria. With just 111 observations and 4 endogenous variables, lag length of 1 seems to be ideal.

Let us now discuss the results of innovation accounting from the estimated model. The results of variance decomposition of real interest rate, real output and price inflation due to shocks in money (call rate) based on Choleski decomposition are presented in Table IV.6. The effect of monetary shocks on forecast variance of

real output in the current month is lower at close to 2 per cent which slowly increases to 4.1 percent at 9-months ahead forecast. Monetary shocks explain close to 3.9 per cent variance of real output at 12-months ahead forecast which slowly declines to 3.4 per cent at 24-months ahead forecast. On the impact of monetary shocks on the price inflation, we can observe from Table IV.6 that, the contribution of monetary shock is negligible to explain forecast variance of price inflation in the first year. However, its strength slowly increases afterwards and monetary shocks explain 3.5 per cent variance of price inflation in 6-months ahead forecast and 8.2 per cent of variance in 24-months ahead forecast.

The impact of monetary policy shocks on real interest rate is very encouraging. As can be observed from Table IV.6, monetary shocks contribute towards 2.7 per cent of variation of real interest rate in the first year. The impact of monetary shocks substantially increases to 10.8 per cent in explaining forecast variance of real interest rate at 3-months ahead forecast. Since 12-months ahead forecast, monetary shocks explain nearly one-fifth of variation in real interest rate.

Table IV.7 presents the results of variance decomposition of output, interest rate and price due to monetary shocks (call rate) based on structural decomposition as discussed in the previous section. The results are very much similar to that of the above case of imposing Choleski decomposition. However, with structural decomposition the strength of monetary shocks seems to be marginally lower in explaining forecast variance of real output and interest rate, and marginally higher in explaining forecast variance of price inflation. To avoid repetitions, we do not discuss these results any further.

As discussed above, with either Choleski or structural decomposition, we found weak influence of monetary shocks on real output. But, from Table IV. 8, it can be observed that, real interest rate explains sizeable portion of variance of real output since 18-months ahead forecast. With structural decomposition, real interest rate accounts for 15.2 per cent of forecast variance at 6-months ahead which remains

almost close to 15 per cent upto 24-months ahead forecast. With Choleski decomposition, real interest shocks explain 10.5 per cent variance of real output at 15-months ahead forecast, which slowly increases to 21 per cent at 24-months ahead forecast.

To sum up, with establishment of sizeable impact of monetary shocks on real interest rate and that of real interest rate on real output, we have evidences supporting activation of interest rate channel of monetary transmission. However, our results failed to support significant influence of monetary shocks on price inflation in the post-reform period.

The impulse response functions of output, interest rate and price due to monetary shocks (call rate) with Choleski and structural decomposition are presented in Graph IV.3 and Graph IV.4, respectively. Both the graphs are very much similar. From both the graphs it can be observed that, with monetary shocks real output increases from the initial level in the current year and slowly declines. The expected negative impact is detected only after 14 months. However, this negative impact remains negligible upto 20 months. The expected negative impact of tight monetary policy on real output becomes important since the 21st month.

The real interest rate accentuates significantly in the current period itself with monetary tightening. The maximum effect on real interest rate is realised in third month. Afterwards, the effect of monetary shocks on real interest rate slowly declines but remains significant upto 24 months. On the other hand, monetary shocks have negligible effect on price inflation in the first period. From the second period onwards effect of monetary shocks on price inflation becomes important. With slow increase maximum effect of monetary shocks on price inflation is detected after 12 months. Afterwards, there is a slow decline in the impact of monetary shocks on inflation.

Let us now discuss the estimation results for our second model based on monthly data in which growth rate of M3 replaces call money rate to capture the

stance of monetary policy. The results of variance decomposition for this model due to monetary policy shocks with Choleski decomposition are presented in Table IV.9. It can be observed from this table that, monetary shocks (growth rate of M3) explains roughly 2 per cent of variance of real output since the first period upto 24-months ahead forecast. Monetary shocks explain merely 1 per cent of forecast variance of price inflation for the first three months and its strength slowly declines to 0.4 per cent at 24-months ahead forecast. The impact of monetary shocks on real interest rate is also found to be negligible. The results of variance decomposition due to shocks in growth rate of M3 with structural decomposition are presented in Table IV. 10. These results are also very similar to the results presented in Table IV.9. Thus, with growth rate of M3 representing the stance of monetary policy, we found little evidence of impact of monetary shocks on output, interest rate and prices.

The impulse response functions of economic variables due to shocks in growth rate of M3 employing Choleski and structural decompositions are presented in Graph IV. 5 and Graph IV.6, respectively. Here also, both the graphs are very similar. Due to monetary shocks, real output falls immediately from the initial level in the first period. The expected positive impact of expansionary monetary policy is realised since the fifth month. The maximum positive effect of monetary shocks on real output is felt in the tenth month. Since the thirteenth month, the impact of monetary shocks on real output became negligible. The price inflation rises above the initial level in the first period due to expansionary monetary shock. On the other hand, expansionary monetary policy shock squeezes interest rate immediately. However, in both cases the impact slowly decays and becomes negligible since the third month.

4.5 - Summary of Results and Concluding Remarks

The findings from our VAR analysis of monetary policy in India are quite consistent with that of international experience. Our data series, both for annual and monthly frequencies, cover maximum observations compared to any study on this area to the date. Based on annual observations for the period 1951-52 to 2001-02, we observed that monetary shocks have negligible influence on output. Monetary shocks

can explain merely one percent of forecast variance in real output. This finding supports monetarist long run money neutrality proposition. On the other hand, the effect of monetary shock on the prices is sizeable and persistent. Since the third year upto 10-years ahead forecast, monetary shocks explain close to one-fifth of variation in inflation. The impulse response function of price inflation due to monetary policy shocks reveals that, the maximum effect of the shock is felt in the second year. The effect remains significant atleast upto the fifth year.

Our VAR analyses based on monthly data for the post-reform period in India have some interesting findings with useful policy implications. We had used growth rate of M3 and call money rate as the policy variables capturing the stance of monetary policy, alternatively. The estimation results based on M3 as the policy variable are not very encouraging. Particularly, from the results of variance decomposition, we found little evidence in support of monetary shocks to influence output, interest rate and price.

However, monthly growth rates of M3 is not the appropriate measure to capture the monetary policy stance in the post-reform period in India. M3 targets are set by the Reserve Bank of India in the annual Monetary and Credit Policy announced in the month of April every year consistent with projections on economic growth and inflation scenario with a mid-term review in the month of October. Thus, M3 targets are set with a medium-term perspective and there is no practice of setting up or revising monthly M3 targets. On the other hand, with financial deepening and opening up of the economy, there is greater emphasis on maintaining orderly conditions in the financial market on day-to-day basis. There is greater emphasis on monitoring interest rates in various segments and foreign exchange rate. This assigns pivotal role to short-term interest rates as useful policy targets in the short run. In this backdrop, call money rate has slowly emerged as the effective operating target of monetary policy in India in recent years. The above logic underscores superiority of call money rate vis-a-vis growth rate of M3 to capture the overall stance of monetary policy atleast in the short run in the post-reform period in India.

Replacing M3 by call money rate, we observed from the VAR analysis that, the impact of monetary policy shocks on real interest rate and that of real interest rate on real output are sizeable. Monetary shocks explain close to one-tenth of variation in inflation since 15-months onwards forecast. The impulse response functions reveal that, similar to international experiences, with monetary tightening the real interest rate hardens up immediately, output experiences a mild setback after a lag of 15 months and prices witness a gradual decline.

To sum up, the inferences drawn from our VAR analysis on the impact of monetary shocks on real output are consistent with the inferences drawn from the path analysis in the previous chapter. From the results based on annual data, we found negligible monetary influence on the real output. On the other hand, from the results based on monthly data there are evidences supporting activation of interest rate channel. As an important policy implication from our VAR analysis, call money rate emerges as a better alternative to M3 as intermediate target, atleast in the short-run due to its closer link with final targets such as interest rate, output and price.

Table IV.1
Covariance\Correlation Matrix of Residuals - I
(Annual 1951-52 to 2001-02)

	M3	*GDP*	*WPI*
M3	11.01	-0.03	-0.16
GDP	-0.31	8.93	-0.30
WPl	-2.64	-4.30	23.72

Table IV.2
Covariance\Correlation Matrix of Residuals - II
(Monthly 1992:3 to 2002:5)

	Call Rate	***R91TB Rate***	***IIP***	***WPI***
Call Rate	12.86	0.16	0.14	0.02
R91TB Rate	0.59	1.01	0.15	-0.88
IIP	1.02	0.31	4.14	-0.14
WPI	0.06	-0.79	-0.25	0.78

Table IV.3
Covariance\Correlation Matrix of Residuals - III
(Monthly 1992:3 to 2002:5)

	M3	***R91TB Rate***	***IIP***	***WPI***
M3	1.30	-0.12	-0.15	0.11
R91TB Rate	-0.14	1.05	0.15	-0.89
IIP	-0.35	0.32	4.14	-0.14
WPI	0.11	-0.81	-0.25	0.80

Table IV.4
Decomposition of Variance of GDP & WPI Due to M3:
Choleski Decomposition
(Annual 1951-52 to 2001-02)

Step	*GDP*	*WPI*
1	0.099	***2.611***
2	0.783	14.219
3	1.032	18.439
4	1.147	20.231
5	1.195	20.966
6	1.216	21.279
7	1.225	21.413
8	1.229	21.470
9	1.231	21.495
10	1.232	21.505

Table IV.5
Decomposition of Variance of GDP & WPI Due to M3:
Structural Decomposition
(Annual 1951-52 to 2001-02)

Step	*GDP*	*WPI*
1	0.000	2.987
2	0.590	13.709
3	0.854	18.123
4	0.971	19.960
5	1.020	20.716
6	1.042	21.037
7	1.051	21.175
8	1.055	21.234
9	1.057	21.259
10	1.058	21.270

Table IV.6
Decomposition of Variance of R91TB Rate, IIP and WPI Due to Call Rate: Choleski Decomposition
(Monthly 1992:3 to 2002:5)

Step	*R91TB Rate*	*UP*	*WPI*
1	2.700	1.957	0.041
3	10.825	3.270	1.818
6	14.975	4.100	3.514
9	16.876	4 119	4.659
12	18.095	3.857	5.599
15	18.956	3.587	6.408
18	19.567	3.415	7.105
21	19.976	3.365	7.702
24	20.221	3.419	8.203

Table IV.7
Decomposition of Variance of R91TB Rate, IIP and WPI Due to Call Rate: Structural Decomposition
(Monthly 1992:3 to 2002:5)

Step	*R91TB Rate*	*IIP*	*WPI*
1	2.700	1.957	0.041
3	10.816	2.952	1.961
6	14.059	2.957	4.232
9	14.696	2.586	6.068
12	14.634	2.281	7.664
15	14.326	2.093	9.006
18	13.936	2.016	10.074
21	13.538	2.033	10.876
24	13.168	2.121	11.437

Table IV.8
Decomposition of Variance of IIP Due to R91TB Rate
Choleski and Structural Decomposition
(Monthly 1992:3 to 2002:5)

Step	*Choleski*	*Structural*
1	1.721	1.721
3	1.290	8.215
6	1.718	15.198
9	3.698	17.253
12	6.809	17.253
15	10.486	16.602
18	14.253	15.872
21	17.786	15.300
24	20.904	14.973

Table IV.9

Decomposition of Variance of R91TB Rate, IIP and WPI
Due to M3: Choleski Decomposition

(Monthly 1992:3 to 2002:5)

Step	*R91TB Rate*	*IIP*	*WPI*
1	1.358	2.253	1.172
3	0.683	.862	0.924
6	0.432	.674	0.675
9	0.506	.789	0.516
12	0.676	.913	0.418
15	0.865	.958	0.364
18	1.045	.932	0.342
21	1.201	.869	0.343
24	1.330	.793	0.359

Table IV. 10
Decomposition of Variance of R91TB Rate, IIP and WPI
Due to M3: Structural Decomposition

(Monthly 1992:3 to 2002:5)

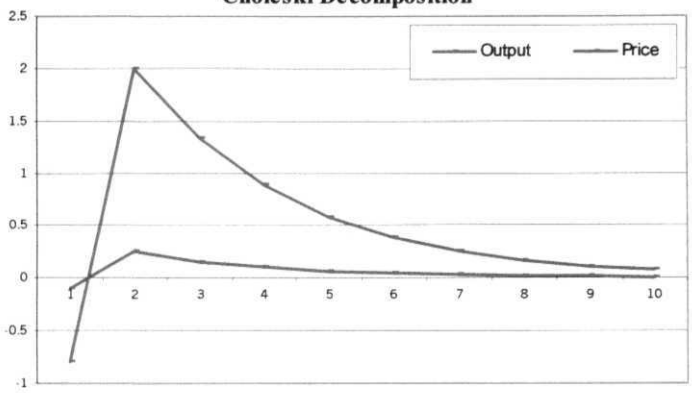
Step	*R91TB Rate*	*IIP*	*WPI*
1	1.358	2.253	1.172
3	0.621	.663	1.085
6	0.349	.183	0.923
9	0.370	.110	0.766
12	0.453	.135	0.641
15	0.539	.165	0.557
18	0.613	.180	0.512
21	0.673	.180	0.497
24	0.719	.170	0.502

Table IV.11
Decomposition of Variance of IIP Due to R91TB Rate
Choleski and Structural Decomposition

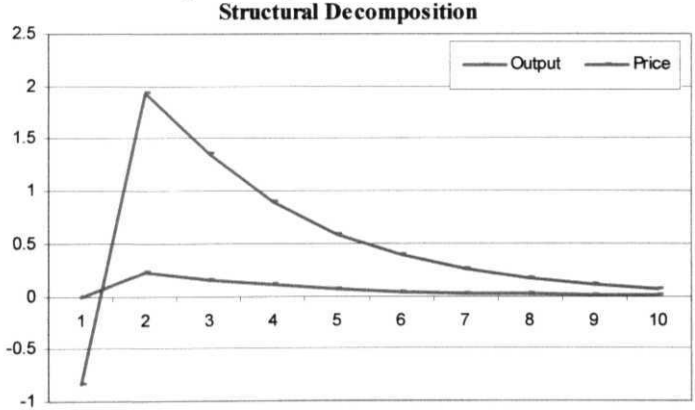
(Monthly 1992:3 to 2002:5)

Step	*Choleski*	*Structural*
1	1.828	1.828
3	1.522	9.417
6	1.609	17.087
9	3.092	18.967
12	5.934	18.631
15	9.667	17.755
18	13.738	17.020
21	17.701	16.688
24	21.276	16.810

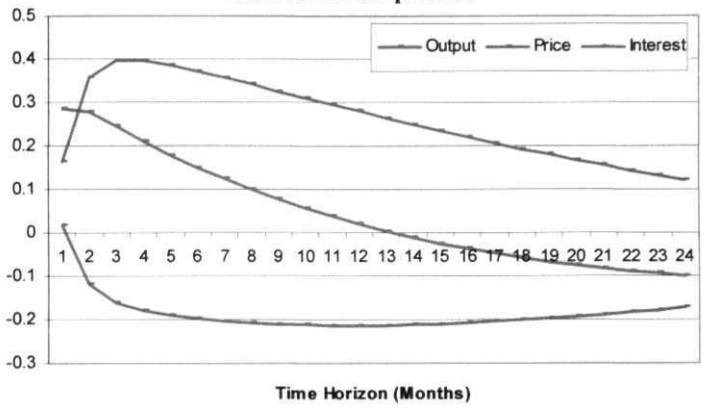
Graph IV.1
Impulse Responses to Shocks in M3:
Choleski Decomposition



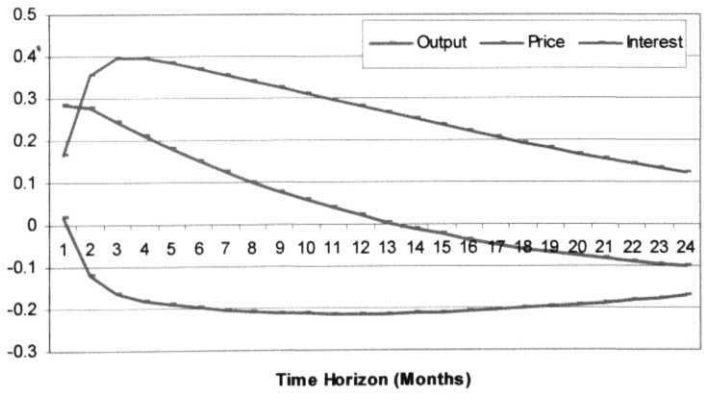
Graph IV.2
Impulse Responses to Shocks in M3:
Structural Decomposition



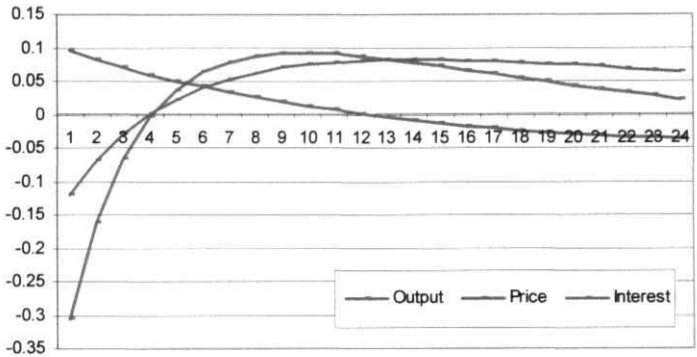
Graph IV.3
Impulse Responses to Shocks in Call Rate:
Choleski Decomposition



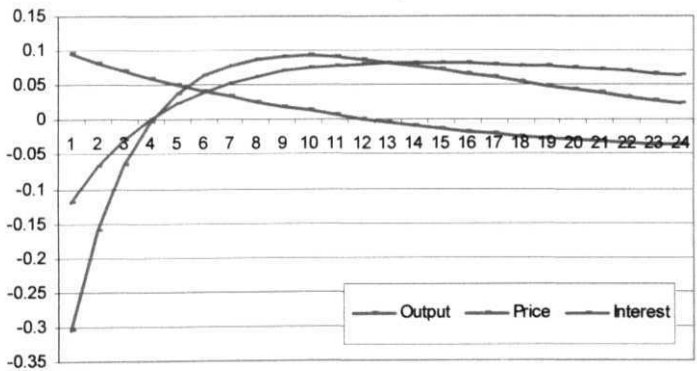
Graph IV.4
Impulse Responses to Shocks in Call Rate:
Structural Decomposition



Graph IV.5
Impulse Responses to Shocks in M3:
Choleski Decomposition



Graph IV.6
Impulse Responses to Shocks in M3:
Structural Decomposition



Chapter 5

Operating Procedure of Monetary Policy in India

Chapter - V

OPERATING PROCEDURE OF MONETARY POLICY IN INDIA

5.1 – Introduction

In monetary policy implementation, operating procedure serves the purpose of the 'nuts and bolts' in the overall policy framework. It encompasses, basically, a set of tactics such as choice of the operating target and policy instruments, the nature and frequency of use of policy instruments, market interventions, the width of corridor for market interest rates and the manner of policy signals to effect desired changes in the intermediate target. In other words, the operating procedure in monetary policy refers to its implementation in very short run, including the day-to-day operations. The efficacy of the operating procedure lies in its ability to unambiguously convey the policy signal of the central bank to the market and its effectiveness to influence the operating target with precision and accuracy.

As discussed in Chapter 2, upto mid-1980s monetary policy in India was mainly characterised by credit planning. Firstly, the Plan exercise had been determining the amount of credit to be allocated to different projects, sectors, etc. and the monetary authority was given the responsibility to achieve these targets. Operationally, the exercise of credit targeting involves residual estimation after deducting reserve requirements from forecasts of aggregate deposit growth and after providing for monetisation of budgetary deficit. Refinances were intended to meet the difference between the residual estimates and the independent estimates of sectoral credit requirements. Sectoral flow of credit was assigned greater emphasis and credit growth targets thought to be operationally more relevant. Secondly, provision of food credit for procurement, storage and distribution of foodgrains and selective credit control measures to prohibit speculative holdings of agricultural commodities were used to control inflation. Thus, policy measures such as CAS, refinance policy, a

complex structure of administered lending and deposit rates, various provisions of concessions and cross subsidisation, etc. regulated bank credit in a view to support economic growth and control prices, particularly that of agricultural products. Bank credit served the purpose of both the operating and intermediate targets. Other important role of monetary policy in India had been providing credit to the government to finance its expenditure over its own resources. As discussed in detail in Chakravarty Committee Report (RBI, 1985), most of the instruments of monetary policy such as CRR, SLR, refinance facilities, OMO, etc. were ineffective during this period.

Following Chakravarty Committee recommendations, the Reserve Bank of India apparently followed a monetary targeting framework, with feedback. In this framework, based on the expected rate of output growth and allowing for a tolerable level of inflation, the growth rate of indicative broad money (M3) target is determined assuming stable money demand function. In accordance with the targeted level of M3 expansion, the desired level of reserve money is estimated. However, the order of expansion of reserve money has to align with the likely outcomes in the fiscal and external payment spheres.

Notwithstanding shifting to a new policy framework, the structural and institutional bottlenecks impeded the smooth operation of monetary policy prior to the economic reforms of early 1990s. High fiscal dominance, rudimentary structure of key segments of the financial market, interest rate and exchange rate regulations and stringent credit control heavily constrained the effectiveness of policy instruments. In the post-reform period, there has been a serious and concerted effort to develop a broad-based, deep and vibrant financial market in India. Consequently, there are radical changes in all the segments namely, money market, government securities market, foreign exchange market and capital market. Gradually, the emphasis on direct instruments has been reduced and liquidity management through open market operations, both outright and repo operations is the order of the day. According to Kanagasabapathy (2001), "In recent times, due to the emergence of interest rate as an

efficient variable in the transmission mechanism, the RBI has begun placing greater reliance on indirect instruments such as repo, Bank Rate, OMO, etc. rather than the earlier practice of greater dependence on CRR alone." In the post-reform period, with continuation of 'reserve money' as the main operating target, short-term interest rate proxied by 'overnight call money rate' has emerged as the supplementary operating target. We shall confine our discussion on operating procedure of monetary policy in India to the post-reform period of the 1990s guided by the above empirical realities.

The efficacy of the present operating procedure rests on certain empirical conditions. Firstly, the two-stage links, (a) from the policy instruments to operating targets, and (b) from the operating targets to the intermediate targets are to be established as stable and predictable. There has to be certain degree of integration between interest rates across various maturities and the foreign exchange rate, so that there is predictable spread of policy impulses to different segments of the financial market in the desired direction. These issues are empirically verified in this chapter.

In rest of this chapter, Section 5.1 presents a brief discussion of international practices of operating procedure. The task of delineating the broad contour of operating procedure in India in the post-reform period is undertaken in Section 5.2. In Section 5.3, the empirical relations amongst monetary policy instruments and targets in India are examined. Finally, Section 5.4 draws up concluding remarks.

5.2 – International Practices

From international perspective, countries are placed differently on the scale of economic development. Across the countries, there is considerable variation in terms of institutional arrangements, the structure of the financial market, autonomy of the monetary authority and overall framework of monetary policy. Based on these country specific characteristics, there are differences in **the mode** of operating procedure of monetary policy. Nevertheless, there is a tendency towards convergence, with increasing reliance on the indirect instruments. In this section we shall briefly

summarise recent practices of operating procedure in monetary policy implementation in selected industrially advanced and developing economies.

We shall start with discussing the operating procedure adopted in industrially advanced countries enjoying the privilege of possessing well developed financial markets, sound balance of payment conditions, well defined role and objectives of different policy making bodies and a coherent relationship among the various institutions. Most often, the dominant objective of monetary policy in these countries is that of price stability. We shall briefly sketch the operating procedure in the US, Japan, South Korea and Singapore amongst industrially advanced countries. The practices in newly industrialised countries like South Korea and Singapore will guide the developing countries like India in the transition period.

In the US, the Federal Reserve pursues the objective of price stability in the form of 'covert inflation targeting' by making interest rates more responsive to inflation, in normal times. However, in view of signs of economic slowdown experienced in 2001, the Fed had aggressively cut federal funds rate to prop up output growth. Unlike Paul Volcker, Alan Greenspan deemphasised the role of monetary aggregates as intermediate target by stating that these aggregates "do not appear to be giving reliable indications of economic developments and price pressures" (Financial Times, 1993). On the other hand, there is greater reliance on the overnight federal funds rate, which plays both the role of operating and intermediate target. The Federal Open Market Committee (FOMC) undertakes open market operations in treasury securities and debt obligations of government agencies and government sponsored enterprises to regulate it consistent with the desired final objectives. The method of multiple price auctions is used for all these transactions. In OMO, repurchase agreements are used to regulate the reserve balances on a temporary basis. Although the maturity of repurchase transaction varies from overnight to 3-month period, in actual practice overnight repo is most commonly used. In the US, the instrument of statutory reserve requirement is less effective because of its overall lower level, eligibility of vault cash to fulfill the reserve requirements and smaller averaging

period of two weeks. A well-defined group of primary dealers, mainly commercial banking organisations and registered security dealers in good standing with their regulator and complying with minimum capital standards constitute the set of counterparties.

The new Bank of Japan Law (1997) asserts the objective of monetary policy as, "to contribute to the sound development of the national economy through the pursuit of price stability." As policy instruments, the Bank of Japan uses standard instruments such as official discount rate, OMO and capital requirements, etc. There has been less frequent use of reserve requirement and greater reliance on OMO, over time. This was in line with several reform measures introduced in 1990s, such as abolition of window guidance in 1991 and completion of deregulation of interest rates in 1994, adopting overnight call rate as the operational target since 1995, etc. In OMO, temporary liquidity is provided mainly through repurchase agreements in short-term government bills or commercial paper JGB repos. Outright purchases of government bonds are used for providing permanent funds. All these operations are conducted through American type - multiple auction method. Depending on the type of operations the set of counterparties differs and in most cases it includes banks, securities companies, securities finance companies and money market brokers and all of them must have a current account with the Bank of Japan. In Japan the standing facilities in the form of Complementary Lending Facility extends loans against eligible collateral. Maturity of this credit is overnight and rate of interest charged is official discount rate. This discount rate serves as the ceiling for the overnight call rate.

In South Korea, the Bank of Korea sets annual and quarterly target range of M3 estimated from a modified Fisherian equation based on the projections of GDP growth, target inflation and variations in the velocity of money. Then, target ranges for annual and quarterly reserve money are set up consistent with the corresponding M3 targets by using M3 multiplier. Bank reserves had been used as operating target until the financial and currency crisis of late 1997. Consequently, the reforms

introduced in the financial market in terms of reducing the average reserve requirements from 9.4 per cent in March 1996 to 3.1 per cent in February 1997, lowering the aggregate credit limit on the discount window, interest rate deregulations, revamping the structure of call market, streamlining the payment and settlement system have paved the way for effective use of market related instruments. There was a gradual move to employ overnight call rate as the key operating target along with bank reserves. With the introduction of policy reforms since the early 1990 ranging from deregulation of interest rate in four stages, opening up of the capital and money markets and shift towards floating exchange rate regime, etc. which reached near completion by end of 1997, there was a gradual shift of emphasis from direct instruments of monetary policy to indirect ones. In recent years there is greater reliance on liquidity management through OMO, lending and rediscount facilities and **reserve** requirements. Amongst them, the repo operations involving government and government guaranteed bonds, MSBs have evolved as the main policy tool. These operations follow American type auction method and the set of counterparties include banks, trust accounts of banks, merchant banks, securities investment and trust companies, and life insurance companies.

Monetary policy operations in Singapore have very limited dimensions. The small size of the economy and huge external sector dominance makes monetary policy play a second fiddle to exchange rate management. The Monetary Authority of Singapore uses exchange rate policy with the primary objective of maintaining sustainable non-inflationary economic growth. In view of greater reliance on foreign sources of funds and high dependence on exports, both interest rates and domestic prices are determined by combination of factors such as foreign interest rates, market expectations on the performance of the domestic economy, economic conditions in export destinations and future strength of Singapore dollar. As money supply **and** domestic interest rates have a relatively modest impact on the prices, the monetary authority does not set any specific targets for them, but attempts to maintain long-term money market conditions consistent with exchange rate policy. For this purpose, there was greater emphasis on statutory reserve requirements during the 1970s as the

financial markets in Singapore were immature. However, since the 1980s, the foreign exchange swaps are largely used to influence the level of liquidity in the system supported by uncollateralised borrowing from and lending to banks.

Coming to the developing countries, we shall take up the case of Brazil, first. Experiencing hyperinflation in the 1980s and following ineffective stabilisation attempts through government intervention and price freezes, Brazil initiated financial reforms in the early 1990s. The Brazilian Real Plan (Piano Real) saw a reduction of annual inflation from as high as 5,000 per cent in June 1994 to under 4 per cent in mid-1998. Currently, the monetary programming of the Central Bank of Brazil uses monetary targets such as Ml and M3 as the intermediate targets and publishes quarterly targets for the monetary base and amplified monetary base consistent with the desired level of intermediate target. The effective monthly interest rate on federal securities transactions (SELIC) serves the purpose of the operating target. The Monetary Policy Committee provides a corridor for SELIC rate by setting TBC rate as the lower bound and TBAN rate as the upper bound. Contrary to the trend in emerging markets, there is greater emphasis on the standing facilities and use of OMO and repo operations are gradually reduced since the mid-1996. Auction in central bank debt are conducted to fine-tune bank liquidity through discount window and providing additional signal on the desired short-term interest rate.

Consistent with the primary objective of price stability, monetary policy in Columbia uses monetary base as the intermediate target and overnight interbank rate as the main operational variable. Understanding the difficulty of controlling monetary aggregates, interest rates and exchange rates simultaneously in a regime of liberalised international capital flows, mutually consistent targets are set for the three variables. Based on the existing equilibrium between the three, monetary, exchange rate and interest bands condition each other. Reserve requirements were used as active policy instrument upto 1993, but presently lost its importance. Currently, the Banco de la Republica employs OMO as the main policy instrument. The OMO Committee assesses the liquidity position of the economy on a weekly basis and monitors the

weekly behaviour of the interbank interest rate. Accordingly, it conducts the OMO so as to put the monetary base at the midpoint of its band. It had been using its own securities varying from one to ninety days of maturities in OMO through auctions. Since 1999, these transactions are carried out with government paper negotiated on the secondary market. Repo in its own securities is frequently used as a measure of short-term liquidity management. The list of counterparties include banks, finance corporations, savings and loan corporations, commercial finance companies, trust companies, pension funds and stock brokers.

The evolution of monetary policy and its operating procedure in Peru strikes high resemblance with that of India. Up to 1990, Peruvian monetary policy was largely dominated by expansionary fiscal stance with highly regulated interest rate regime, stringent controls on international capital flows and fixed exchange rate regime. The financial market was restricted to the banking sector only. Mostly, monetary policy was limited to neutralise the inflationary pressure of fiscal policy through direct instruments such as reserve requirements, selective credit controls along with exchange rate and interest rate regulations. Peru witnessed economic depression in the 1990 with hyperinflation of around 7,000 per cent. As a remedy, radical reform measures were introduced since 1992. The Central Bank of Peru was given greater autonomy and inflation control was assigned as the prime objective. Now, the monetary authority sets annual inflation target range and uses monetary aggregates as intermediate target. The liquidity management exercise injects or withdraws liquidity from the market to regulate the monetary base. OMO and short-term (usually overnight) collateralised credit are increasingly used to regulate market liquidity. The role of reserve requirements is deemphasised and use of foreign exchange swaps is limited due to absence of a well-developed forward market.

The monetary policy in Mexico also pursues price stability as the most important objective. Since adopting floating exchange rate regime in December 1994, the Bank of Mexico achieved the liberty to use growth of monetary base as the intermediate target. It typically uses average level of settlement balances on banks'

accounts as the primary operating target. Daily fluctuations in the public's demand for bills and coins are met through operations in the money market by creating or destroying monetary base. The Bank of Mexico does not convey to the market its desired levels of interest rates and does not intervene when these rates change in accordance to its expectations. In Mexico, the 'zero-average reserve requirement system' and removal of liquidity coefficient have left OMO as the main policy tool.

In Saudi Arabia monetary policy plays a subordinate role to exchange rate policy like that of Singapore in view of high degree of openness. It also assists to fine-tune the adverse effects of fiscal policy. As the foreign exchange rate plays a crucial role to influence domestic prices and for Balance of Payment adjustment, it receives utmost attention. Consistent with the desired exchange rate and fiscal policy, the Saudi Arabian Monetary Agency formulates monetary policy by using reserve requirements, statutory liquidity ratio, repo, foreign exchange swaps as policy instruments. Banks' reserve accounts with it serve the purpose of operational instrument. Interest rates are predominantly influenced by the US dollar interest rates, and hence, not useful as policy instruments.

In South Africa, the country's Constitution assigns the South African Reserve Bank the specific objective of protecting the value of the domestic currency in the interest of balanced and sustainable growth of the economy. South African Reserve Bank treats money supply (M3) as the intermediate target, but does not use rigid or overriding monetary rule. As policy instruments, refinance rate (Bank Rate) and cash reserve requirements were mainly used prior to March 1998. Since then, there is greater reliance on active liquidity management, and OMO, particularly repurchase transactions have emerged as the main monetary policy instruments.

5.3 - An Outline of the Operating Procedure in India

As discussed in the introduction of this chapter, it is appropriate to limit to the post-reform period of the 1990s in our discussion of monetary policy operating procedure in India. The working estimates of indicative money supply (M3) growth

consistent with projected economic growth and inflation guide the medium stance of monetary policy in India but the day-to-day operations are mainly guided by the developments in the financial market. The inter-departmental Financial Markets Committee (FMC) of the Reserve Bank of India (since 1997) assesses the liquidity conditions of the domestic market by closely monitoring the movements in different segments and watching closely the developments in the international market. It undertakes liquidity management operation tracking movement of various components of the RBI balance sheet and determines the appropriate level of 'net liquidity position' (NLP) consistent with desired level of call money rate in day-to-day operations and that of reserve money in the medium term perspective. On the other hand, based on the projections of the demand for and supply of banks' reserves and autonomous liquidity (AL) due to government transactions and changes in net foreign assets, the discretionary liquidity (DL) to be injected or withdrawn is estimated consistent with desired NLP. Now, various policy tools such as outright and repo operations, refinances to banks and PDs, CRR variation, etc. are used accordingly, either to inject or withdraw liquidity as per estimated DL.

Amongst policy instruments, there is diminishing emphasis on CRR variation as a policy tool in the 1990s. Firstly, in line with recommendations of Chakravarty Committee (RBI, 1985) and Narasimham Committee (RBI, 1991), there has been policy driven downward revision of CRR except for the periods of disturbances in the foreign exchange market as experienced during 1994, 1998 and 2000. Secondly, CRR changes result in very large variation in liquidity in the market, which may be undesirable in the normal short-term liquidity management. The traditional instrument of refinance facility carried high importance during the 1990s until slowly phasing it out recently. RBI had been providing credit to banks through its refinance window in the form of formula based export credit refinance and general refinance. The facility of general refinance was basically provided to smoothen liquidity at times of temporary liquidity shortages of the banks. However, since April 1999, the general refinance facility to banks was replaced by a collateralised lending facility (CLF) as a part of overall Interim Liquidity Adjustment Facility (ILAF) (RBI Annual Report,

1998-99). The volume of CLF was related to outstanding aggregate deposits and the interest rate charged was linked to the Bank Rate. The CLF was further refined in May 2001 with satisfactory functioning of Liquidity Adjustment Facility (LAF) and finally abandoned since October 2002.

During March 1999, a facility of liquidity support to the primary dealers (PDs) against collateral of government securities based on parameters such as bidding commitments, success ratio, etc. was introduced to deepen the government securities market, Here also, the interest rate charged was linked to the Bank Rate. This measure of liquidity support to the PDs facilitated smoothening of call rate at tight liquidity situations.

With activation of key segments of the financial market and changing institutional factors, OMO, both outright and repos have emerged as the dominant tool of liquidity management (Reddy, 2000b). In the outright OMO, RBI uses both dated government securities and treasury bills (TBs). The sale of government securities is now auction based and multiple auction method is commonly used except for 91-TBs, which is uniform price based. As the outright OMO effects large-scale liquidity variation, it is used judiciously by studying the market liquidity conditions. The process of auction for TBs is fixed calendar based but that of dated securities is carried out depending on market liquidity conditions and status of government finances. However, the system of releasing the calendar for issuance of dated for every half year was introduced in 2002-03 (RBI, 2003b). The calendars were roughly adhered to with slight variation from the scheduled issuances in amounts raised, tenor of the security and timing of the auctions. The set of counterparties include commercial banks, cooperative banks, insurance companies, provident funds, mutual funds, financial institutions, PDs, satellite dealers (SDs), non-bank finance companies and corporate entities.

The introduction of ILAF in April 1999 envisaged a procedure of absorbing liquidity from the market at the fixed repo rate and injecting liquidity through CLF

and ACLF to the banks and liquidity support to the PDs at interest rates related to the Bank Rate providing an informal corridor for overnight call money rate. The fixed rate repo was thought to provide the floor whereas the Bank Rate was thought to provide the ceiling (Table V.1, Graph V.1 A). With introduction of full-fledged LAF in June 2000, repo and reverse repo are providing an effective corridor for overnight call money rate (Table V.1, Graph V.1B). On daily basis, liquidity is injected and absorbed through reverse repo and repo, respectively by uniform price auctions. These operations are conducted on all working days, except on Saturdays. The counterparties for repo and reverse operations are mainly the banks and the PDs.

5.4 - Empirical Analysis

In this section, we shall examine the relationship between the policy instruments, operating and intermediate targets of monetary policy in India in the post-reform period. Let us start with analysing the impact of policy instruments on the discretionary liquidity (DL), which in turn get transmitted to the principal operating target of 'bank reserves' and supplementary operating target of 'call rate'. Our period of coverage extends from January 1993 through May 2002. A close look at the instruments of monetary policy in India during this period reveals that, prior to March 1995, mainly the RBI credit to the banks and CRR variation determined the variation in the DL. But since April 1995, OMO both outright and repo slowly emerged as the effective policy instruments. Further, since March 1999 credit support to PDs emerged as an additional instrument. Accordingly, we shall analyse the effect of the individual instruments on the DL dividing the whole period into three sub-periods. The first sub-period covers from January 1993 through March 1995 and examines the influence of CRR variation and RBI credit to banks on the variation of DL. Similarly, the second and third sub-periods cover the periods from April 1995 to February 1999 and from March 1999 to May 2002, respectively.

Coming to data issues, DL is estimated as the sum of net liquidity injection due to CRR variation, RBI credit to banks and PDs and net OMO. Variation in DL, denoted as IDL is estimated as the change in DL in a particular month over the

corresponding figure in the same month of the previous year. The effect of CRR variation is captured by the dummy variable 'CRR-DUM' taking the value '1 *, for the month when there is a change in liquidity due to CRR variation and '0' otherwise. The effect of RBI credit to banks and PDs are captured by the explanatory variables 'BBOW' and 'PDBOW', respectively, which are nothing but the variation of RBI credit to banks and PDs in that particular month over the corresponding figure in the same month of the previous year. Finally, the explanatory variable OMO represents net OMO of both dated securities and TBs. The details of the data issues are presented in Appendix B towards the end of the thesis.

As we are dealing with monthly data, all the individual series are deseasonalised by applying 'X12' method before being used for estimations. As there were not sufficient observations to employ 'X12' method in the first sub-sample, we have used seasonal dummy for regression estimations in this case. Further, to avoid the problem of spurious regression we have employed Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for unit root to confirm that, the variables used in our estimations are stationary. The unit root test results are presented in Table V.2. The results confirm all the variables to be stationary. It was quite expected as they are in the variation form.

The regression results capturing the impact of various policy instruments on IDL are presented in Table V.3. All the estimations are based on OLS. As shown in Table V.3, there is almost one-to-one relationship between variation in RBI credit to banks and IDL in the first sub-period. In this sub-period, with one crore increase in the RBI credit to banks, IDL increases by 0.99 crore. The CRR dummy is found to be statistically significant and bears a negative sign. The negative relation is due to hike of CRR in 4 out of 5 times of CRR variation in this sub-period. The coefficient of determination is very high at 0.99 and the results remain almost unchanged with or without seasonal dummies.

For the second sub-period, OMO is included as an additional explanatory variable. The results as presented in Table V.3 show that, all the individual explanatory variables are statistically significant. The estimated coefficients imply that, during this period, one crore increase in RBI credit to banks results in 0.93 crore increase in IDL. Similarly, one crore increase in net OMO increases DDL by 1.24 crore. During this sub-period, the IDL increases by 1751.3 crore with each CRR variation. This positive relation can be attributed to the gradual downward movement of CRR. The results clearly support greater relative strength of OMO in this sub-sample.

In the third sub-period, all the policy instruments are found to be statistically significant in influencing IDL, also. As per the results, with one crore increase in RBI credit to banks and RBI credit to PDs, IDL increase by 0.90 crores and 0.78 crore, respectively. One crore increase in net OMO raises IDL by 0.83 crore. This clearly indicates that, in this sub-period all the three above instruments have roughly similar effect on IDL.

The above estimates basically depict the strength of different policy instruments to effect variation of the DL. Comparison of the results over the three sub-periods indicates that, in the second period OMO found to exert greater impact on IDL vis-a-vis RBI credit to banks. However, in the most recent period, RBI credit to banks and PDs, and OMO exhibit similar strength.

After establishing the link between policy instruments and DL, the next step would be to examine the relationship between DL and operating targets. The sum of DL and AL constitute NLP. AL being outside the control of the monetary authority, any policy driven changes in NLP is largely due to policy driven changes in DL. In other words, the policy effect on operating targets can be captured by the impact of NLP on them. We have presented the estimation results of impact of NLP on the operating targets in Table V.4. As the OLS estimations detected presence of serial correlation, we have employed Cochrane-Orcutt procedure.

On the influence of NLP on the principal operating target of reserve money, our results support its statistical significance. We may infer that, one crore increase in NLP can increase reserve money by about 0.2 crore. Coming to the supplementary operating target of call money, it is nothing but the price for liquidity, and hence, should be negatively related to the NLP. Our estimation results, as presented in Table V.4, reveal that for the full period October 1999 to May 2002, there is inappropriate relationship between NLP and call rate. However, the estimations for the recent periods clearly indicate the negative relationship. The estimation results merely reflect the empirical reality. Since 1997-98, the Reserve Bank of India assigns greater emphasis on maintaining orderly conditions in the financial market in the multiple indicator approach. The call money rate moves within a narrow band since February 1998. Now, through liquidity management the RBI attempts to smoothen the call money rate by changing discretionary liquidity (DL), taking into account both the demand for and supply of net liquidity and the autonomous liquidity (AL) position. It can be noted that, since June 1999, the components of AL and DL are distinctly inverse but complementary to each other (Graph V.2). This is also the same period, which witnessed considerably smooth call money rate (Graphs V. 1A and 1B) within the designed corridors.

Finally, we have to verify the link between the operating and intermediate targets. To examine the relationship between reserve money and broad money, Graph V.3 plots the 12-period moving averages of growth rates of reserve money and M3. It can be observed that, throughout the period there is positive association between them, but there is a distinct change in the ratio of growth rates of M3 and reserve money in late 1995. This ratio termed as 'money multiplier' seems to be varying since late 1995 upto late 1997. Since then, there is greater consistency in the relationship.

Next, we shall look at the interlinkages between the supplementary operating target of call money rate and other market interest rates. As shown in Graphs V.4A and V.4B, there is very close movement of call money rate with other money market

rates such as interest rates on CP, CDs, and TBs. Similarly, the close relationship between call money rate with forward premia as depicted in Graph V.5 highlights the link between call money market and foreign exchange market. Now, Graph V.6 shows close movement amongst yields on government securities of various maturity and 364-days TBs. Thus, Graphs V.4 through V.6 summarise close link between call money and interest rates of various maturity in the economy including the foreign exchange market. This sort of close association between call money rate and interest rates across different maturity is very encouraging to satisfy feasibility condition for 'interest rate targeting'.

5.5 – Concluding Remarks

We have examined the operating procedure of monetary policy in India in the post-reform period to gain insights on the influence of various policy instruments on the desired targets. We observed that, in this period the role of traditional instruments such as CRR and refinance facilities is gradually deemphasised. Over the time, OMO and repo operations have emerged as dominant policy instruments with development of a broad-based and diversified financial market. The liquidity management procedure has effectively served the purpose of maintaining orderly conditions in the market. Our empirical analysis establishes the link between the policy instruments and operating targets of 'reserve money' and 'call money rate'.

However, there are some signs of inconsistency in the relationship between M3 and reserve money growth rates in the post-reform period. Also, as observed by Mohanty and Mitra (1998), many a times there are deviations in the actual growth rate of M3 from that of the targeted growth. Further, as observed in many industrial countries, with financial development and emergence of financial instruments with innovative features there are signs of instability in money demand functions. In this backdrop, it may be prudent to think of some alternative to the practice of solely depending on 'monetary targeting'. On the other hand, there are evidences of close movement amongst the call money rate and rates of returns in other segments of the

financial market. Combining the above factors, it may be desirable to shift to 'interest rate targeting'.

However, some rigorous analysis has to be undertaken to establish the formal integration amongst various segments of the financial market as a prerequisite for shifting to the new regime. An ideal 'interest rate' with close relationship with the operating target and final objectives is to be identified. It seems the present practice of monitoring a selected range of economic variable in the 'multiple indicators approach' adopted by the RBI forms the transition phase.

Table V.1
Monthly Call, Repo, Reverse Repo and Bank Rate

Month-Year	Call Rate	Repo Rate	Reverse Repo Rate	Bank rate
Dec-97	8.2	7.00		9.0
Jan-98	28.7	7.00		11.0
Feb-98	9.7	9.00		11.0
Mar-98	8.8	9.00		10.5
Apr-98	6.7	7.00		10.0
May-98	6.8	6.00		9.0
Jun-98	6.4	5.00		9.0
Jul-98	6.0	5.00		9.0
Aug-98	7.6	5.00		9.0
Sep-98	8.4	8.00		9.0
Oct-98	8.4	8.00		9.0
Nov-98	8.0	8.00		9.0
Dec-98	8.3	8.00		9.0
Jan-99	10.0	8.00		9.0
Feb-99	8.9	8.00		9.0
Mar-99	8.5	6.00		8.0
Apr-99	8.0	6.00		8.0
May-99	8.8	6.00		8.0
Jun-99	8.1	6.00		8.0
Jul-99	8.2			8.0
Aug-99	9.4	6.00		8.0
Sep-99	9.7			8.0
Oct-99	11.0	6.00		8.0
Nov-99	8.1			8.0
Dec-99	7.7	6.00		8.0
Jan-00	7.9	6.00		8.0
Feb-00	10.3			8.0
Mar-00	9.4			8.0
Apr-00	6.8	5.00		7.0
May-00	7.5	5.00		7.0
Jun-00	11.1		13.50	7.0
Jul-00	7.8	8.00	10.00	7.0
Aug-00	13.1	14.50	16.00	8.0
Sep-00	10.3	10.00	13.50	8.0
Oct-00	9.1	8.50	10.25	8.0
Nov-00	9.3	8.00	10.00	8.0
Dec-00	8.8	8.00	10.00	8.0
Jan-01	9.9		10.00	8.0
Feb-01	8.5	8.00	10.00	7.5
Mar-01	7.8	7.00	9.00	7.0
Apr-01	7.5	7.00	8.75	7.0
May-01	8.0	6.75	8.75	7.0
Jun-01	7.2	6.50	8.50	7.0
Jul-01	7.2	6.50	8.50	7.0
Aug-01	6.9	6.50		7.0
Sep-01	7.3	6.50	8.50	7.0
Oct-01	7.4	6.50	8.50	7.0
Nov-01	7.0	6.50	8.50	6.5
Dec-01	7.1	6.50	8.50	6.5
Jan-02	6.6	6.50		6.5
Feb-02	6.7	6.50	8.50	6.5
Mar-02	7.0	6.00	8.00	6.5
Apr-02	6.6	6.00	8.00	6.5
May-02	6.9	6.00		6.5
Jun-02	6.0	5.75		6.5

Source: 1. Handbook of Statistics on Indian Eoonomy, 2001, RBI
2. RBI Bulletin, Various Issues

Table V.2

Results of Unit Root Tests

Variables	***ADF Test***	***PP Test***
Period: October 1993 to May 2002		
NLP	-2.90	-3.73.
BD	-3.09	-3.39
RM	-2.60	-2.11
CALL	-2.82	-5.53
M3	-2.64	-3.35
Period: April 1999 to May 2002		
BBOW	-2.64	-2.79
DL	-3.49	-4.02
PDBOW	-3.48	-5.97
OMO	-4.22	-6.86

Note: For the first set, the critical values are

- 2.89 at 5 per cent level of significance
- 2.58 at 10 per cent level of significance

For the second set, the critical values are

- 2.94 at 5 per cent level of significance
- 2.61 at 10 per cent level of significance

Table V.3

Results of Regression 1
Relative Strength of Policy Instruments

Independent Variables	***Dependent Variable: IDL***			
	1993:1 to 1995:3 Method: OLS		*1995:4 to 1999:2 Method: OLS*	*1999:3 to 2002:5 Method: OLS*
CONSTANT	2.31 (0.06)	23.19 (0-77)	-71.18 (- 0.20)	62.97 (0.12)
BBOW	0.99 (56.83)	0.99 (74.08)	0.93 (14.12)	0.90 (5.03)
CRR-DUM	- 1075.4 (- 11.97)	- 1005.4 (- 14.25)	1679.83 (3.35)	2289.84 (2.93)
OMO			1.24 (7.76)	0.83 (6.96)
PDBOW	-	-	--	0.78 (4.22)
SEASONAL -BUM	--	-443.86 (-4.26)	-	-
Adjusted R^2	*0.99*	*0.99*	*0.85*	*0.85*
DW Statistics	*2.21*	*2.18*	*2.26*	*1.87*

Note: Figures in brackets are t-statistic

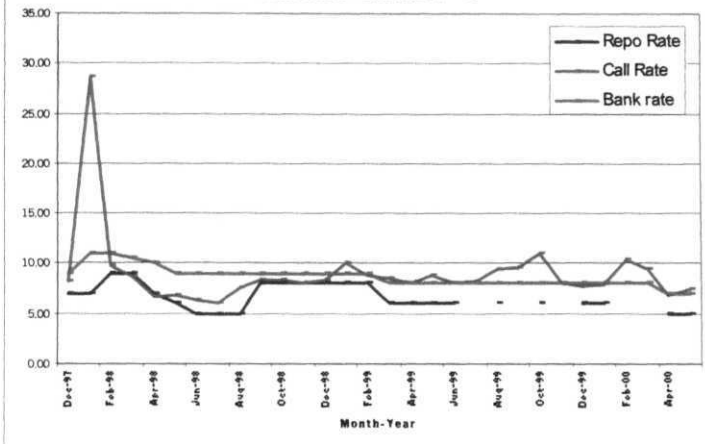
Table V.4

Results of Regression II
Impact of NLP on Operating Targets

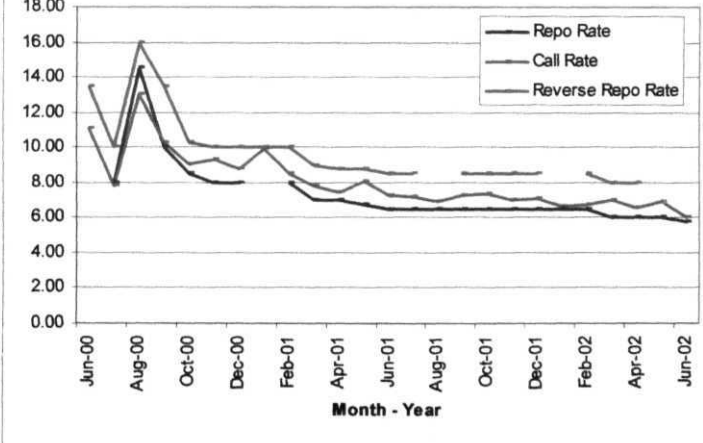
Independent Variables	***Dependent Variable: RM***	***Dependent Variable: Call Rate***		
	October 1993 to May 2002 Method: ARJ	*October 1993 to May 2002 Method: AR1*	*April 1999 to May 2002 Method: AR1*	*April 2000 to May 2002 Method: AR1*
CONSTANT	11.25	9.12	8.32	8.29
	(7.40)	(10.01)	(20.05)	(14.65)
NLP	0.17	0.003	-0.01	-0.04
	(7.14)	(0.08)	(-0.43)	(-1.16)
Adjusted R^2	*0.85*	*0.30*	*0.25*	*0.31*
DW-Statistic	*2.24*	*2.12*	*2.30*	*2.34*

Note: Figures in brackets are t-statistic

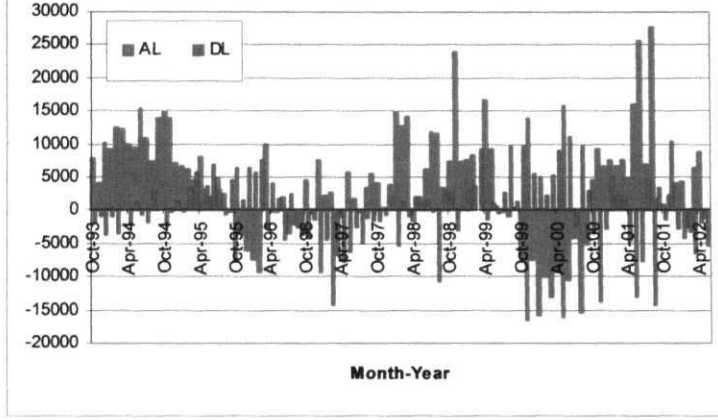
Graph V.1A
Call Rate Corridor - I



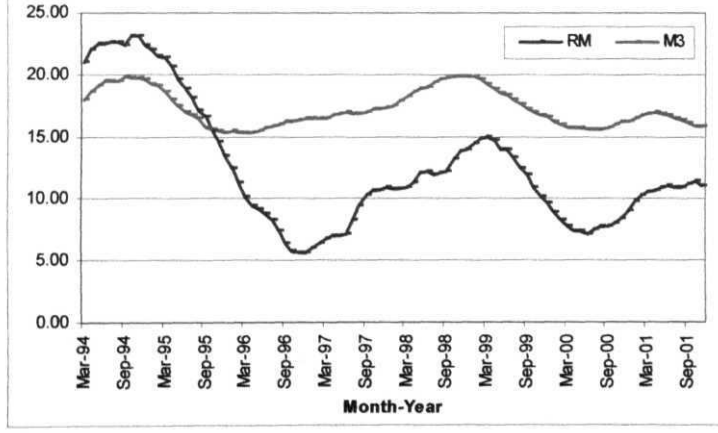
Graph V.1B
Call Rate Corridor - II



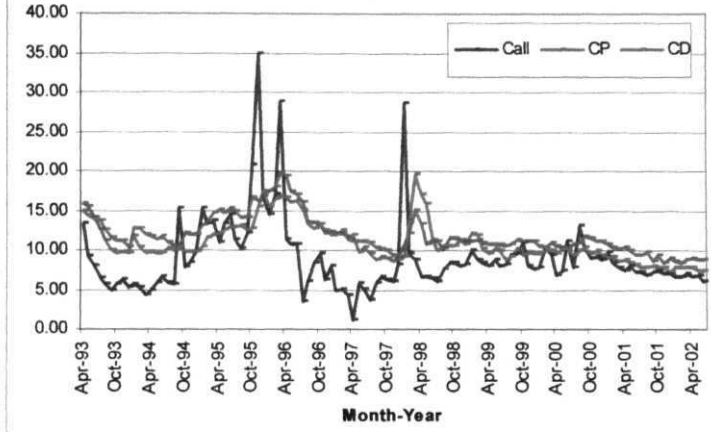
Graph V.2
Monthly Variation in Autonomous and Discretionary Liquidity



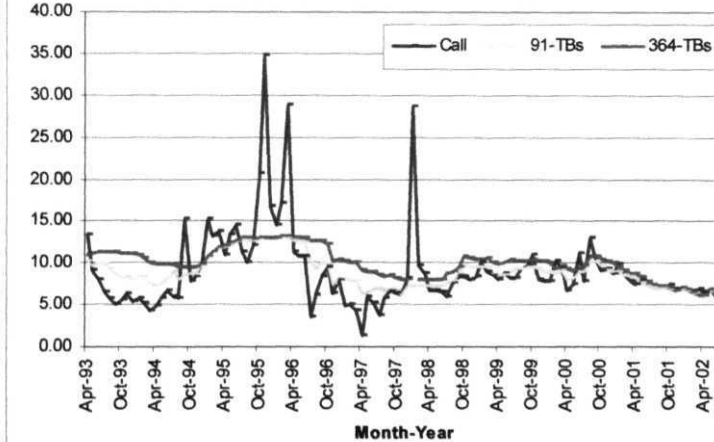
Graph V.3
Growth Rates of Reserve Money and M3 - 12Pd Moving Averages



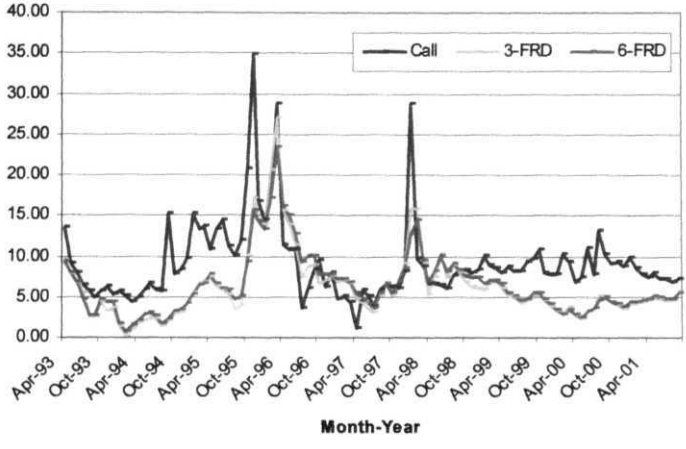
Graph V.4A
Monthly Call Money, CP and CD Rates



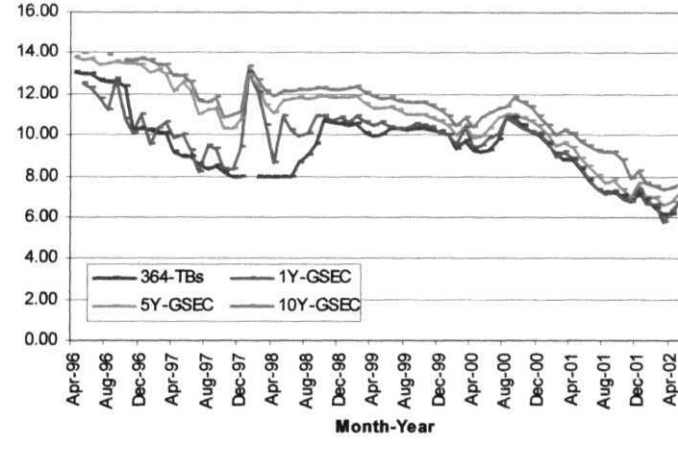
Graph V.4B
Monthly Call Money, 91-TBs and 364-TBs Rates



Graph V.5
Monthly Call Money Rate and Forward Premia



Graph V.6
Long-term Interest Rates



Chapter 6

Overview and Policy Implications of the Study

Chapter - VI

OVERVIEW AND POLICY IMPLICATIONS OF THE STUDY

The present study attempts to study the interlinkages amongst the final objectives, targets and instruments of monetary policy in India by tracing its transmission mechanism and the operating procedure with the aid of latest econometric techniques. Before undertaking the econometric exercise, as a prerequisite a clear understanding of the empirical realities in terms of the existing economic environment, institutional arrangements and the basic parameters of monetary policy in India is essential. To satisfy this, Chapter 2 of our thesis provided a useful description of the empirical realities in India since Independence and briefly described the process of gradual transformation of basic parameters of monetary policy. From this discussion of historical developments we observed that, upto mid-1980s the monetary policy in India was mainly characterised by credit planning. During this period, the Reserve Bank of India (RBI) was entrusted the responsibility to ensure credit flows to different sectors and for the economy as a whole as decided by the planning authority. The financial requirements of the government to undertake developmental activities were also to be satisfied. Highly regulated regime encompassing priority sector lending commitments, cross-subsidisation coupled with adoption of the philosophy of 'social control' culminating in the event of 'bank nationalisation' which heavily constrained the banking operations.

During this regime, there was limited scope for conduct of monetary policy. There was an imperative need to shift from the existing practice and configure a new policy framework to enable monetary policy serve its best purpose. This was materialised with constitution of a high level committee to review the working of monetary system in India and to delineate the appropriate framework of monetary policy under the chairmanship of Professor Sukhamoy Chakravarty in 1982.

With implementation of recommendations of Chakravarty Committee Report **(RBI,** 1985) there was a directional change in the conduct of monetary policy, mainly drawing up the list of important objectives with emphasis on price stability and economic growth, adopting monetary targeting with feedback as the basic framework, initiation of a process of coordination between monetary and fiscal policy to reduce the fiscal burden on the former, attempt to activate money market to operationalise indirect instruments, etc. The process of reforms in key segments of the financial market and gradual opening up of the economy as a part of overall economic reforms since 1991-92 further expanded the scope of monetary policy in India. This process has slowly created the conducive atmosphere for operation of market forces by liberalising interest rates, introducing auction system in government securities, making foreign exchange rate flexible guided by Marshallian scissors of demand and supply, introducing liquidity management for day-to-day monetary policy operations, etc. Thus, Chapter 2 traces the transition of monetary policy in India from a highly regulated credit planning exercise to a new regime operating through market forces with greater transparency in a well-defined framework. The discussion in this chapter is very useful in understanding various dynamics of monetary policy operations in India in the last five decades and guides the econometric analysis with a strong foundation on the empirical realities.

In Chapter 3, we have undertaken the analysis of channels of monetary transmission in India with the aid of 'path analysis'. Basically, we have focused on the influence of monetary policy on real output. We have examined the channels of monetary transmission for pre-reform and post-reform period separately with different path models. We presume that, based on the empirical realities there is little role of market related channels such as interest rate channel, exchange rate channel, asset prices channel in the pre-reform period. During this period, only credit channel can be thought of being in operation in transmitting monetary policy shocks to real output. We have used a simple path model with only credit channel for our path analysis of channels of monetary transmission in India based on annual data covering the period from 1951-52 to 1991-92. From our estimation results, we can infer that, monetary

impulses have statistically significant influence on the bank credit and real investment. With monetary contraction, the growth of bank credit and real investments shrink. But due to weak influence of real investment on real output, we could not find statistically significant influence of monetary impulses on real output. Thus, our estimation results support monetarist long run money neutrality proposition. Extending our annual data series upto 2001-02 and estimating the above path model do not alter our inferences.

As discussed above, greater play of market forces in the post-reform period has opened up avenues for operation of market related channels of monetary transmission. Rangarajan (1997a) asserts that, "Under this new environment monetary policy is expected to work through the interest rate channel in promoting the expansion of credit and overall investment activity in the economy." Thus, post-reform period constitutes the right set up to analyse the operation of various channels of monetary transmission and examine their relative importance and interlinkages. But the major hindrance we face in this endeavour is inadequacy of observations. Availability of limited data points on annual or quarterly frequency constrains us to depend on monthly data for our path analysis in the post-reform period, exclusively.

The new path model to study the channels of monetary transmission for the post-reform period encompasses four important paths such as interest rate channel, foreign exchange rate channel, asset prices channel and credit channel. Although it is possible to analyse the interactions amongst various individual channels in path analysis, limited data points do not permit this. With 111 monthly data points, we can estimate only 10 path coefficients, appropriately. Hence, we focused only on individual channels in a combined set up without the interlinkages.

From the estimation results of monthly path model, we found evidences of effectiveness of interest rate and asset prices channel in transmitting monetary influences to real output. Both the channels were statistically significant. The exchange rate channel was not found to be statistically significant, but monetary

shocks are found to have statistically significant influence on foreign exchange rate. There are evidences of operation of credit channel supported by statistical significance. However, inappropriate relation between the growth of deposits and credits distort monetary influence on real output through this channel. To sum up, we found statistically significant influence of monetary shocks on real output, mainly through interest rate and asset prices channels. Secondly, there are clear evidences of transmission of monetary policy shocks to key segments of financial market. Both the findings underscore the role of monetary policy in enhancing growth of real output and maintaining orderly condition in the financial market in the post-reform period in India.

The path analysis of Chapter 3 assumes no feedback from the final dependent variable to the causal variable. The assumptions of no feedback from output to money may sound restrictive. Secondly, in any discussion on monetary influence on real output, the role of prices should not be ignored. Addressing the above issues, we have attempted to study the impact of monetary shocks on final objectives of price stability and economic growth in a VAR framework in Chapter 4. Our VAR analysis takes care of the endogenity issue and includes price in the system. From the innovation accounting exercise in VAR analysis, we have analysed the impact of monetary policy shocks on output and prices at different time horizons. Our VAR models are estimated based on both annual and monthly data, alternatively. Similar to the previous chapter our annual data covers the period from 1950-51 to 2001-02 and monthly data extends from March 1992 through May 2002. The models are identified imposing both Choleski and structural decompositions.

From the estimation results of VAR analysis based on annual data it is observed that, monetary shocks can explain only a meager 1 per cent of forecast variance of real output, and hence, monetary influences on real output is negligible. This supports monetarist long run money neutrality proposition similar to the inference drawn from the path analysis. Interestingly, we found evidences of significant influence of monetary shocks on price inflation supporting Rangarajan

(1997a) emphasising the role of monetary factor in determining inflation in the long run. The results of variance decomposition reveals that, close to one-fifth of forecast variance of inflation can be attributed to monetary shocks. As derived from the impulse response function, the impact of monetary shocks on inflation remains very significant upto 5-years after the policy shock and remains important atleast upto the ninth year. Our results were similar irrespective of using Choleski or structural decompositions.

For monthly VAR models we have used monthly growth rate of M3 and call money rate to capture the stance of monetary policy, alternatively. Other variables in the model include real interest rate, growth rates of real output and price inflation. From the estimation results of our VAR model with growth rate of M3 capturing the **stance** of monetary policy, we found little evidence of influence of monetary shocks on real output, price and real interest rate. However, monthly growth rates of M3 may not be the appropriate variable to capture the stance of monetary policy in India in the post-reform period. Firstly, indicative targets of M3 are set in the annual Monetary and Credit Policy of the RBI in the medium term perspective consistent with projections of output growth and inflation scenario. There is no practice of setting or revising monthly M3 targets. Secondly, with greater emphasis on maintaining orderly conditions in the financial market call money rate has emerged as a better indicator of monetary policy stance in day-to-day practice.

In the **VAR** model consisting of call rate, real interest rate, real output and price, we found similar results imposing Choleski and structural decompositions. The impact of monetary shocks on real output was found to be negligible. Even the impact of monetary shocks on price inflation was not very significant. Monetary shocks could explain close to 10 per cent of variation in inflation since 15-months ahead upto 24-months ahead forecast. However, monetary shocks could explain close to 15 per cent variation in real interest rate since 6-months ahead to 24-months ahead forecast. Similarly, we found real interest rate shocks explaining more than 15 per cent

variation in real output since 6-months upto 21-months ahead forecast. Thus, there are evidences of activation of interest rate channel in the post-reform period.

The impulse response function for the above model revealed that, similar to the international evidence, tightening monetary shocks immediately pushes up the real interest rate. The prices experience a gradual decline and real output suffers a mild setback with one year lag.

In Chapter 5, the task of delineating the broad outline of monetary policy operating procedure in India was undertaken and linkages between policy instruments and targets were empirically examined. In this chapter, we have first discussed the international practices of operating procedure of monetary policy across selected industrial and emerging economies. This discussion implied convergence of monetary policy operation towards shifting from use of direct to indirect instruments worldwide. In India in the highly regulated regime of the pre-reform period, the flow of credit was directed to the desired sectors in consonance with the plan exercise and the administered interest rate regime impeded the functioning of market mechanism. Efforts towards reforming the monetary system and introducing a new monetary policy framework with recommendations of Chakravarty Committee Report (RBI, 1985) marked the beginning of the process to transform monetary policy operations. Development of key segments of financial market and opening up of the economy in the post-reform period further activated the financial system and effected radical changes in operation of monetary policy in India. As a consequence, *inter alia,* the operating procedure became transparent and well-defined.

It is observed that, there is gradual shift of emphasis from direct to indirect instruments such as OMO and repo operations in the post-reform period of 1990s in India. In the recent years, there is heavy reliance on liquidity management in monetary policy operations. Based on expected movements of various components of RBI balance sheet, liquidity is injected in or withdrawn from the market consistent

with medium term objectives of price stability and credit creation coupled with maintaining orderly conditions in the market on day-to-day basis.

We have empirically examined the relative role of policy instruments to regulate liquidity in the market. Prior to activation of OMO in March 1995, credit to banks through refinances and CRR variation largely regulated the operating target of 'reserve money'. However, high fiscal dominance during this period constrained policy operations where autonomous liquidity mainly determined the direction of overall liquidity and was largely responsible for the variation of reserve money. Since 1997, the movement of discretionary liquidity was effective in regulating the overall liquidity consistent with desired objectives taking into account expected changes in the autonomous liquidity. During this period, policy instruments such as OMO and repo operations have emerged as dominating policy tools. Recently, the general refinances facility is completely phased out. The liquidity adjustment facility (LAF) serves the purpose of regulating liquidity on day-to-day basis to maintain orderly conditions in the market.

From our econometric analysis, we observed that, the policy instruments are quite capable of regulating discretionary liquidity consistent with desired net liquidity position (NLP). Policy shocks as reflected in NLP influence operating targets of reserve money and call money rate in the desired direction. Particularly, recent liquidity management procedure of RBI has been quite capable of exercising reasonable control on the operating target of call money rate. We found evidences of close movements of call money rate and other market rates. However, some signs of inconsistency between the association of reserve money and M3 could be traced in the post-reform period.

To sum up, there is increasing emphasis on monetary policy in the overall economic policy in India with broad objective of output expansion and price stability. In the recent times, there is greater emphasis on ensuring orderly conditions in the financial market in view of close interlinkages amongst various segments of the

domestic financial market and increasing openness of the economy. From our econometric exercise examining the influence of monetary shocks on real output, it is confirmed that in the long run money neutrality proposition holds for India. But, in the short run, particularly in the post-reform period there are evidences of positive influence of monetary policy on real output, mainly through the rate channels. We have found sound evidences of monetary influences on price inflation in the long run. Monetary shocks have sizeable impact on the real interest rate in the post-reform period.

The most important policy implication of the study is the emergence of the 'call money rate' as the most suitable operating and intermediate target atleast in the post-reform period due to its close and predictable link with the final objectives coupled with reasonable control of the monetary authority on it. Our econometric analysis in Chapter 5 has established the influence of policy instruments on the 'call money rate'. We have observed close movements of 'call money rate' with other interest rate in the market. From our path analysis in Chapter 3, there are evidences supporting the link between 'call money rate' and real output. We have also found convincing evidences of transmission of monetary policy shocks through call rate to other segments of the financial market. In view of increasing emphasis on maintaining orderly conditions in the financial market in the post-reform period, these are very encouraging developments. Further, evidences supporting dominance of rate channels of monetary transmission in the recent days and close association of various market rates with call rate underscores the role of 'call money rate' in recent monetary policy practices in India.

On the other hand, there are signs of inconsistency in the association between growth rates of reserve money and M3 in the post-reform period. Secondly, our VAR analysis in Chapter 4 could not find any evidence of influence of M3 on the economic variable like real output, interest rate and prices during this period.

In this backdrop, it may be prudent to think of shifting emphasis from targeting M3 to 'call money rate'. It may be desirable to shift to 'interest rate targeting'. However, the feasibility of shifting to 'interest rate targeting' regime rests on establishing the formal integration amongst various segments of the financial market and identifying the particular rate of interest to be targeted. In the transition phase, the present 'multiple-indicators approach' seems to be appropriate. In the choice of rate of interest rate to be targeted in the interest rate targeting, 'call money rate' emerges as a convincing candidate from our study.

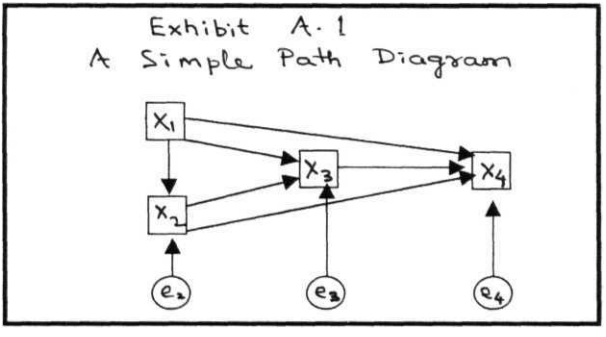
Appendices

Appendix - A

DESCRIPTION OF METHODS USED

A.1: Path Analysis

The technique of 'path analysis' is an extension of the regression analysis most suitable to analyse the causal relationships where the causal variable influences the response variable not only directly but through other intervening variables. The path analysis can be interpreted as an application of multiple regression analysis to a complex causal model. In path analysis, the path model encompasses various dependent, intermediary and independent variables and their interlinkages in a rectangle-circle-arrow figure, which is called the 'path diagram'. In the following, Exhibit A.1 provides an example of a simple path diagram. In this graphical presentation, the coefficients measure the relative size and direction (positive or negative) of various net effects between variables. The net effects are seen within a network of hypothesised causal mechanisms.



In the path diagram, a single-headed arrow pointing from the cause to the effect indicates assumed causal relations. Single-headed arrows also connect the error terms with their respective endogenous variables. The exogenous variables in the path

model do not have any explicit causes and endogenous variables are caused by other variables in the model and have incoming arrows. Generally, the observed variables (both exogenous and endogenous) in the model are depicted in rectangles and unobserved variables such as random error terms are depicted in circles and ellipses.

A 'path coefficient' denoted by PYX measures the direct effect of a variable X assumed to be the cause on the variable Y assumed to be the effect. The path coefficients are standardised regression coefficients (beta), which measure the extent of effect of independent variable on the dependent variable in the path model controlling for other prior variables using standardised data or a correlation matrix as input. It measures the variation in dependent variable Y in terms of standard deviation due to one standard deviation change in the independent variable X. The use of standard deviation improves the comparability between two variables, which are measured in different units.

The technique of path analysis is based on some key assumptions, which can be listed as follows:

1. All the causal relations are linear and additive.
2. The residual error terms (e's) are uncorrelated with the variables in the model and with each other.
3. The causal flow is one way without any feedback
4. The variables are measured on interval scales and use of dummy variables is ruled out.
5. The variables are measured without error.

However, some of these assumptions can be relaxed in more advanced models, which are used to cope with less restrictive sets of assumptions.

Now, let us enlist the set of equations that constitute the model as depicted in the above path diagram (Exhibit A. 1).

$$X2 = P_{21}\, X1 + e_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad .-- \qquad (A.1)$$

$$X3 = P_{31}\, X1 + P_{32}\, X2 + e_3 \qquad (A.2)$$

$$X4 = P_{41}\, X1 + P_{42}\, X2 + P43\, X3 + e_4 \qquad (A.3)$$

It can be observed that, the first variable 'X1' is not explained by any other variable in the model. In path analysis, residual error term 'e' means stray causes or causes outside the model. It does not stand for measurement error as measurement error is assumed to be zero. In our model, the second variable 'X2' is partly explained by 'X1' and partly due to error term 'e_2'. Comparing with the path diagram as given in Exhibit A.1, each variable in our model is determined by the path leading to it but not by the indirect paths which does not lead to it. It can be noted that, all the variables $X_{i's}$ are in standardised form.

To calculate the path coefficients, we can use the observed correlations. Let us discuss the method of derivation of path coefficients from the correlation coefficients. The coefficient of correlation between X1 and X2, denoted by 'r_{12}' can be given as

$$r_{12} = 1 / N \sum X1 * X2 \qquad (A.4)$$

Substituting X2 in terms of X1 from the Equation A.1 in Equation A.4, we get,

$$r_{12} = 1 / N \sum X1 * (P21\, X1 + e_2) \qquad (A.5)$$

or, $$r_{12} = P_{21} * (\sum X1 * X1) / N + (\sum X1 * e_2) / N \qquad (A.6)$$

In Equation A.6, the first term on the right is nothing but the path coefficient (P21) times the variance of X1. The variance of X1 is 'one' as it is in standardised form. The second term on the right is nothing but the correlation between X1 and e_2, which is equal to 'zero' as per our assumptions. Hence, the path coefficient is equal to the correlation coefficient if the dependent variable is a function of a single independent variable.

Now, we can see that variable X3 is a function of both X1 and X2. We can compute the path based correlations between variables X1, X2 and X3. Things become simpler with the assumption of no correlation of error terms and we can leave them out. Thus,

$$r_{13} = 1 / N \sum X1 * X3 \quad \text{(A.7)}$$

or, $$r_{13} = 1 / N \sum X1 (P31\ X1 + P_{32}\ X2) \quad \text{(A.8)}$$

or, $$r_{13} = P_{31} * (Z\ X1^2) / N + P_{32} * (\sum X1X2) / N \quad \text{(A.9)}$$

Simplifying the terms on the right side, we get,

$$r_{13} = P_{31} + P_{32} * r_{12} \quad \text{(A. 10)}$$

In a similar way we can derive,

$$r_{23} = 1 / N \sum X2 * X3 \quad \text{(A. 11)}$$

or, $$r_{23} = 1 / N \sum X2 (P31\ X1 + P_{32}\ X2) \quad \text{(A. 12)}$$

or, $$r_{23} = P31 * (I\ X1X2) / N + P_{32} * (\sum X2^2) / N \quad \text{(A. 13)}$$

or, $$r_{23} = P31 * r_{21} + P32 \quad \text{(A. 14)}$$

Now, we have two equations (A. 10) and (A. 14), which we can solve to **get two** unknowns, P_{31} and P_{32}.

By simple manipulation and substitution, we can derive that,

$$P_{32} = (r_{23} - r_{13} * r_{12}) / (1 - r_{12}^2) \quad \text{(A. 15)}$$

It can be noticed that, the Equation (A. 15) is identical to formula for 'beta weight' in simple regression analysis with X3 as the dependent variable and X1 and X2 as independent variables. This is also true analogously for other path coefficients. In other words, the standardised regression weights (betas) can nicely solve the problem of the path coefficients. Needless to mention, the first path coefficient P21 is also a beta weight as it is simply equal to the correlation coefficient when there is only one variable.

Now, coming to the fourth variable X4, it is a function of X1, X2 and X3, and hence, there are three paths coming to it. We need the following three equations to solve for these paths derived in the same fashion as above.

$$r_{14} = P_{41} + P42 * r_{12} + P43 * r_{13} \quad \text{(A. 16)}$$

$$r_{24} = P_{41} * r_{21} + P_{42} + P43 * r_{23} \quad \text{(A. 17)}$$

$$r_{34} = P41 * r_{31} + P42 * r_{32} + P43 \quad \text{(A.18)}$$

The path coefficients P41, P42 and P43 can be derived from the above equations. Treating X4 as the dependent variable and X1, X2 and X3 as the independent variables in a simultaneous regression model, we can derive **the path** coefficients which are nothing but the beta weights.

Thus, each set of path coefficients is derived from the respective set of multiple regressions. In the simple regression analysis the analysis of interrelations amongst the independent variables is ignored, which is captured in path analysis. After estimating the path coefficients, we attempt to decompose the effects from the exogenous variable to the final dependent variable, which is the best advantage of path analysis. As can be seen in Exhibit A. 1, variable X1 affects variable X4 in a very

complex way. For example, there is a 'direct effect' from X1 to X4, which is captured by the path coefficient 'P_{41}'. But, X1 also influences X4 through X2 and X3. These 'indirect effects' are captured by the intervening paths. The indirect effect of X1 on X4 through X3 is estimated as the product of P_{31} and P43. Similarly, indirect effect of X1 on X4 through X2 is captured by P_{21} * P42 + P21 * P32 * P43. Now the total effect of X1 on X4 is the sum of the direct and indirect effects. Thus, the total effect of X1 on X4 is equal to P41 + P31 * P43 + P21 * P42 + P21 * P32 * P43. Simple regression analysis like OLS does not capture the indirect effect which in the present case is equal to P31 * P43 + P21 * P_{42} + P21 * P_{32} * P43.

The fit of the model can be ascertained by various measures of goodness fit index. The goodness of fit index (GFI) devised by Jorekog and Sorbom (1984) is based on minimum value of the discrepancy function. GFI always lies between '0' and '1', where unity indicates a perfect fit. The measure of adjusted GFI takes into account the degrees of freedom available for testing the model. The adjusted GFI is bounded from the above by '1' but not bounded below by '0'. When it is closer to 'one', it implies a better fit.

A.2: Unit Root Tests

Inclusion of non-stationary variables in regression analysis may lead to spurious inferences (Granger and Newbold, 1974), and hence, verifying the stationarity of the time series used in a regression analysis is very common in any econometric exercise, today. The test of unit root is the simplest tool used to examine the stationarity of a time series. Unit root test is based on the random walk process, which can be presented as,

$$X_t = X_{t-1} + e_t \quad \text{---} \quad (A.19)$$

where, e_t is a discrete, purely random process with mean ξ and variance σ_e^2.

It can be observed that, both mean and variance of X_t are not independent of time, and hence, the series X_t is non-stationary. In the Equation (A. 19) the coefficient of X_{t-1} is equal to unity and the terminology of unit root is derived from this. We have used Augmented Dickey-Fuller (ADF) and Phillips-Perron tests of unit root in our study.

A. 2.1: Augmented Dickey-Fuller (ADF) Test:

Augmented Dickey-Fuller unit root test procedure requires the estimation of the following equation

$$AXt = \mu_0 + \alpha X_{t-1} + \sum_{i=2}^{k} \gamma_i \Delta X_{t-i+1} + e_t \quad — \quad (A.20)$$

where, A is the difference operator,

$$\alpha = -\left\{1 - \sum_{i=1}^{k} \mu_i\right\}, \qquad \gamma_i = \sum_{j=1}^{k} \mu_j$$

and $\mu_{i's}$ are regression coefficients.

The t-statistics of a is the Dickey-Fuller test statistic (τ_α) under the null hypothesis $(H_0 : X_t \text{ is } I(1))$. It does not follow the usual t-distribution. The test rejects the null hypothesis against its alternative $(H_1: X_t \text{ is } I(0))$ if the a is significantly negative. The selected percentiles for the distribution of a are available in Dickey et al. (1986).

A.2.2: Phillips-Perron (PP) Test:

Phillips and Perron (1988) have suggested an alternative test of unit root. The advantage of this test is that it is neutral to selection of lag-length in the ADF equation. Further, it overcomes the problem of serial correlation and heteroscedasticity of the stochastic error term. Let us consider the equation:

The test statistic for a viz., τ_α is modified in this case to form Z_α statistic which is given by:

$$Z_\alpha = \tau_\alpha(\delta_e / \delta_{\tau 1}) - 1/2(\delta_{\tau 1}^2 - \delta_e^2) \{ \delta_{\tau 1} T^{-1/2} \sum_{t=2}^{T} (X_{t-1} - X^*_{t-1})^2 \}^{1/2} \quad \text{---} \quad \text{(A.22)}$$

where, δ_e^2 is sample variance of e_t, T is sample size.

$$X^*_{t-1} = \sum_{t=1}^{T-1} X_t,$$

$$\text{and } \delta_{\tau 1}^2 = T^{-1} \sum_{t=1}^{T} e_t^2 + 2T^{-1} \sum_{j=1}^{p} w_{j1} \sum_{t=j+1}^{T} e_t \, e_{t-j}$$

The weights $w_{j1} = (1-j) / (p+1)$ ensure that the variance estimate $\delta_{\tau 1}$ is positive.

The remaining procedure is the same as in ADF test. The calculated value of Z_α may be compared to τ_α tables.

A.3; **VAR Analysis**

In the structural single-equation or multi-equation models, the specific relationships between the variables are derived from the economic theory. The choice of explanatory variables, their lag structure and functional form in the models are guided by economic reasoning. However, as noted by Pindyck and Rubinfeld (1998), sometimes it may be felt that economic theory is not sufficient to determine the right specification. Economic theory may imply several alternate lag structures but different lag structures may produce models with very different dynamic behaviour. Further, different theories may imply contradictory relationship between variables. To overcome these difficulties it is felt to develop models in which the data specify the dynamic structure rather than the econometrician. The seminal work by Sims (1980) filled this vacuum and introduced Vector Auto-Regressions (VAR) analysis as an

alternative to multi-equation structural modeling. Enders (1995), Pindyck and Rubinfeld (1998), etc. have discussed this methodology extensively from which large part of the discussion in this section is borrowed.

Let us consider a simple bivariate system with variables Y and Z. Let us assume that, the variable Y is affected by its own past realisations, and current and past realisations of the variable Z. Similarly, Z is assumed to be influenced by current and past realisations of Y and its own past realisations. Permitting for only first order lag for simplicity, the system can be presented, mathematically, as,

$$Y_t = b_{10} - b_{12} Z_t + c_{11} Y_{t-1} + c_{12} Z_{t-1} + u_{yt} \qquad \text{(A.23)}$$

$$Z_t = b_{20} - b_{21} Y_t + c_{21} Y_{t-1} + c_{22} Z_{t-1} + u_{zt} \qquad \text{(A.24)}$$

where, endogenous variables Y and Z are assumed to be stationary, and random error terms u_{yt} and u_{zt} are uncorrelated white noise disturbances with standard deviations σ_y and σ_z, respectively. The equations A.23 and A.24 represent a first order VAR, the analysis of which can be extended to higher order VAR.

However, the above system cannot be estimated by OLS method as the current realisation of the dependent variable Z_t and u_{yt} may be correlated in Equation A.23 and the current realisation of the dependent variable Y_t and u_{zt} may be correlated in Equation A.24. With small manipulation, we can derive the reduced form VAR which can be appropriately estimated by OLS. Using matrix algebra, equations A.23 and A.24 can be written as,

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} Y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

(A.25)

Let us denote, $B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$, $X_t = \begin{bmatrix} Y_t \\ Z_t \end{bmatrix}$, $B_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$, $C = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}$ and $u_t = \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$

Then, System A.25 can be rewritten as

$$B X_t = B_0 + C . X_{t-1} + u_t \quad \text{------} \quad (A.26)$$

Pre-multiplying both sides of System A.25 by B^{-1}, we get,

$$X_t = A_0 + A . X_{t-1} + e_t \quad \text{-----} \quad (A.27)$$

where, $A_0 = B^{-1} B_0$, $A = B^{-1} C$ and $e_t = B^{-1}$

System A.27 gives us the standard VAR model. In higher order VAR the right hand side will include higher lags of X_t only. It can be noted that, for determination of appropriate lag length in a VAR model, log likelihood ratio, Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) can be used. In System A.27, all the right hand variables are in lagged term and are uncorrelated with the stochastic disturbance term. Here, OLS method can be suitably applied for estimation.

In VAR analysis, Impulse Response Function (IRF) and Variance Decomposition (VD) are used as very useful tools to illustrate the dynamic behaviour of the system. The IRF exhibits how shocks to any one variable transmits through the model to influence all other variables and eventually feedback to the original variable itself. It produces dynamics from which the strength and length of impact of the shocks to endogenous variables in the system can be derived. Variance decomposition of a variable in the system reveals the relative strength of other variables in the system in explaining the forecast variance of the former variable at various time horizons.

The major issue before deriving impulse response function and variance decomposition is the problem of identification. In OLS estimations of the System A.27, we get two elements of A_0 and four elements of A_1, variances of e_{yt} and e_{zt}, and covariance of e_{yt} and e_{zt}. In the primitive system presented in the system of Equations A.23 and A.24, we have to estimate eight regression coefficients, variances and covariance of residuals. The problem of identification deals with the derivation of these estimates in the primitive system from the estimated reduced form VAR. One of the methods for achieving identification is through Choleski decomposition. This method decomposes the estimated residuals in a triangular fashion by imposing zero restrictions for all elements above principal diagonal of matrix B. This assumes a recursive system in which both u_{yt} and u_{zt} shocks affect the contemporaneous values of Z_t, but only u_{yt} shocks affect the contemporaneous value of Y_t.

However, the recursive contemporaneous model derived by imposing Choleski decomposition may not conform to the true economic structure. This method involves selection of a particular economic structure with a given ordering of variables which is difficult to reconcile with economic theory (Cooley and LeRoy, 1985). The structural VAR models developed by Bernanke (1986), Sims (1986), Blanchard and Quah (1989) overcome this limitation and attempt to impose some restrictions consistent with economic theory. While Bernanke (1986) imposed covariance restrictions, Blanchard and Quah (1989) utilised long-run restrictions to identify the economic structure. Structural VAR yields impulse responses and variance decompositions that can be given structural interpretations (Srimany and Samanta, 1998). On the other hand, Bernanke and Blinder (1992), Bernanke and Mihov (1998) separate the set of variables into policy and non-policy variables and impose contemporaneous identification restrictions on policy variable.

Appendix - B
DESCRIPTION AND SOURCES OF DATA

Time series data on all the variables used in the empirical analysis are of annual or monthly frequency. The series for annual observations mostly cover the period from 1950-51 to 2001-02. For monthly data the period of coverage is from March 1992 to May 2002, in general. If the period of coverage is different in any case, it is explicitly mentioned. The data on monetary aggregates, banking aggregates, real output (GDP), real investment, etc. are originally measured in crores of rupees. In our study, we have used these series in terms of growth rates in all estimations. The annual growth rates are calculated as percentage variation in the current year over the previous year and the monthly growth rates are estimated as percentage variation in a particular month over the corresponding month of the previous year. The interest rate and inflation rate are in terms of percentages. In addition, the economic activity for monthly data measured by index of industrial production. The details of various data series are presented below.

B.1: Monetary Aggregates

We have used two measures of monetary aggregates such as broad money (M3) and reserve money (M0) in our study. For annual data, both the series pertain to the old series and are as on last Friday of the year upto 1969-70. Since 1970-71 both of them pertain to the new series and are as on end-March basis. It can be noted that, average monetary aggregates are published in the *Handbook of Statistics on Indian Economy*, Reserve Bank of India, Mumbai only since 1970-71. As our data covers the earlier period, we have used year-end figures. However, monetary aggregates being stock in nature, there is no harm using year-end figures.

For data based on monthly frequency, the figures refer to last reporting Friday for all the months except for March. They are as on March 31 for data relating to the

Reserve Bank of India and as on the last reporting Friday of the year for data relating to scheduled commercial banks.

B.2: Banking Aggregates

In our study we have used two types of banking aggregates. They are (i) bank deposits, and (ii) bank credit. For annual data, both the series pertain to scheduled commercial and cooperative banks for the period 1950-51 to 1965-66. Since 1966-67, these banking aggregates pertain to scheduled commercial banks only. Both the series refers to as on last Friday of March upto 1984-85 and from 1985-86 onwards refers to as on last reporting Friday on March. Further, bank credit refers to non-food credit only since 1970-71, prior to which it refers to total credit.

B.3: Real Output

For annual data, Gross Domestic Product (GDP) at factor cost with base: 1993-94=100 represents the measure of real output. For monthly observations, index of industrial production (IIP) has been used as a proxy for real output. The growth rate of IIP upto March 1995 refers to the base: 1980-81=100 and April 1995 onwards refers to the base 1993-94=100. It can be noted that, as IIP covers only a particular segment of real output, using it as the proxy for real output has its own limitations. Nevertheless, we are compelled to do so in absence of other better option.

B.4: Interest Rate Variables

Interest rate variables are many and choosing from the alternatives may be sometimes arbitrary. In many of the empirical literature in India in the post-reform period 91-day treasury bills rate is used as the representative interest rate. We have used interest rates in our study mainly in the analysis based on monthly data. We have used 91-day treasury bills rate adjusted for WPI inflation as a proxy for real interest rate. We have also used call money rate in Mumbai in terms of its weighted averages as compiled by the Reserve Bank of India. The call money rate upto 1997-98 is the weighted arithmetic average of the rate at which money is accepted and reported by select scheduled commercial banks at Mumbai, the weights being proportional to the

amounts accepted during the period by the respective banks. The data for the period since 1998-99 till April 2001 refer to those reported by scheduled commercial banks, primary dealers (PDs) and select financial institutions. Since May 2001, data refer to those of commercial banks, PDs, financial institutions, insurance companies and mutual funds.

B.5: Discretionary and Autonomous Liquidity

Discretionary liquidity (DL) in a month is estimated as the sum of net liquidity injected through CRR variation, RBI credit to banks and PDs, and net OMO. Firstly, net liquidity injected or withdrawn through each of the four components as given above in a particular month is estimated. Then, the individual estimates are added up to get DL. In the regression estimations in Chapter 5, we have used variation of DL, denoted by IDL, which is estimated as the change in DL in a particular month over the DL in the corresponding month of the previous year.

Autonomous liquidity (AL) is nothing but the sum of net liquidity injected or withdrawn through RBI credit to the government and net foreign assets.

B.6: Price Variables

The price variable is represented by the wholesale price index (WPI) in terms of average of weeks both for annual and monthly data. Based on annual frequency, WPI-inflation data refer to the base 1981-82=100 upto 1993-94. Since 1994-95, data refer to the base: 1993-94=100. Based on monthly frequency, data upto March 1994 relate to the base 1981-82=100 and data since April 1994 relate to the base 1993-94=100.

B.7: Others

In our study, the foreign exchange rate is expressed as Rupees per US dollar. This data series is in term of monthly averages and based on Foreign Exchange Dealers' Association of India (FEDAI) indicative rates. In Chapter 3, we have used

BSE Sensex as a proxy for equity price. This series is also in terms of monthly averages and related to base 1978-79=100.

DATA SOURCES:

The major sources of data used in our study are:

1. *Handbook of Statistics on Indian Economy, 2001* published by the Reserve Bank of India, Mumbai.
2. Various Issues of monthly *RBI Bulletin* published by the Reserve Bank of India, Mumbai.
3. Various Issues of *Report on Currency and Finance* published by the Reserve Bank of India, Mumbai.
4. *RBI Annual Report, 2001-02* published by the Reserve Bank of India, Mumbai.
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