A MACROECONOMETRIC MODEL FOR INDIA WITH FOCUS ON CHANGES IN PUBLIC INVESTMENT AND ITS EFFECT ON MACROECONOMY

Thesis submitted in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy in Economics

Doctor of Philosophy in Economics

By

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CERTIFICATE

This is to certify that **Mrs. A. Soumya** has carried out the research embodied in the present thesis entitled ***"A MACROECONOMETRIC MODEL FOR INDIA WITH FOCUS ON CHANGES IN PUBLIC INVESTMENT AND ITS EFFECT ON MACROECONOMY"*** for the full period prescribed under Ph.D. ordinances of the University of Hyderabad. This thesis is an independent work and does not constitute part of any material submitted for any research degree or diploma here or elsewhere.

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DECLARATION

I hereby declare that the work embodied in this thesis entitled ***"A MACROECONOMETRIC MODEL FOR INDIA WITH FOCUS ON CHANGES IN PUBLIC INVESTMENT AND ITS EFFECT ON MACROECONOMY"*** carried out under the supervision of Prof. K. N. Murty is an original work of mine and has not been submitted for the award of any research degree or diploma of any other university.

Place: Hyderabad **Signature of the Candidate**

Date: (A. Soumya)

DEDICATED TO

To my parents for letting me pursue my dream for so long so far away from home

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CHAPTER I

Introduction

1.1 Introduction to Macroeconometric Models:

There has been a growing interest in developing macroeconometric models with transparent theoretical foundations and flexible dynamics that fit the historical time series data well in the context of achieving comprehensive economic growth (Pandit, 2000). Macroeconometric modelling is generally motivated by two objectives: forecasting and more significantly, policy analysis. A Macroeconometric model can be defined as a quantitative analysis of an economy via the estimation or computation of an interrelated system of equations using economic theory, data and a good knowledge of econometrics to achieve three objectives, *viz.*, structural analysis, forecasting and policy evaluation (Valadkhani, 2004). In the words of Hendry and Wallis (1993), "Econometric modelling is a science of what is established and an art when the frontier is reached." Economic theory plays an important guiding role in the specification and validation of the model. The primary aim of macroeconometric modelling is to develop a comprehensive model to understand the way the economy functions and its reaction to specific policies and the wide variety of demand and supply shocks which can cause instability. Economy-wide macroeconometric models can help to a better understanding of main macroeconomic problems of large-scale and aimed directly to obtain quantitative answers for fiscal, monetary and other kinds of policy questions (Taylor, 1993).

A macroeconometric model can be stated as a system of simultaneous equations, which relates the variables, and seeks to explain the behaviour of the economy at an aggregate level, based on the received theories of macroeconomics. In the words of Wallis (2000), "Macroeconometric models mean economy-wide systems of dynamic equations, based around the internationally accepted national accounting framework, with parameters estimated from aggregate time series data at quarterly to annual frequencies, various descriptions are used to differentiate this style of quantitative analysis form others available in macroeconomics." The macroeconometric models so produced can be used for the purpose of forecasting economic variables and also for policy simulations i.e. for studying the effect of alternative policies and strategies for economic variables. Macroeconometric modelling involves several distinct steps like specification, identification, estimation, validation and finally application in the same inferential fashion, usually *ex ante* forecasting or the comparative analysis of alternative policy proposals. Experience shows that models that can deal with policy issues need to be assorted rather than exclusively pure in their structure.

From the first macroeconometric model built for the Dutch economy in 1940's by Tinbergen, macro models have come a long way since then; models currently in use are vastly more complicated and have a wider scope than their predecessors. More comprehensive models are emerging because of the increase in degree of disaggregation in model blocks. There is an increasing trend in building large-scale models. Theoretical sophistication, refined econometric methodology and team approaches are leading to large-scale macroeconometric models. Now-a-days macroeconometric systems are virtually in use in every country around the

world. Today macro models have come a long way from prototype stage to large, more sophisticated and useful ones for forecasting and policy purposes.

1.2 Theoretical Basis of Macroeconometric Models:

Macroeconometric models are built on the basis of certain theoretical underpinnings in macroeconomics, which lend credence to empirically observed results. Importantly, macroeconometric models are specified and validated on the basis of macroeconomic theory. The relationships among the different variables in the equations of a macroeconometric model depend on the prevailing theoretical framework and according to the objectives of the model.

It is important to mention that the structure of the macroeconometric models depends on how the modeller introduces such things as information, expectations and contracts along with choosing a theoretical framework of classical/ neoclassical, Keynesian or monetarist. One may indeed assert that it is these factors that a good deal of macroeconomic theory today is all about.

The new developments in macroeconomic theory have implications both for policy formulation as well as modelling methodology. It is interesting to note that the macroeconometric research tied up with the Keynesian theory across both time and space (Klein, 1986). The early seventies witnessed the decline of Keynesian paradigm both among the policy makers as well as among academics in the US. In contrast, Keynesian theory still remains as a serious subject in the UK and the rest of Europe. In developing countries, Keynesian theory, which talks about the demand side of the economy, is of greater emphasis even now.

The supply side of the macroeconometric models determines its long run or steady state properties, which is essential for the developing economies. The forecasting failures of the demand-oriented models of the 1970s in the face of supply side shocks stimulated extensions to the specification of the models. The theoretical criticism of their lack of internal consistency is partly prompted by the same forecast experience and the new classical revolution in economic thought. Developing countries require macro models of steady-state properties of a system of dynamic equations, designed for short-term forecasting and policy analysis. The nature of the long-run equilibrium is the steady growth path for the aggregate variables in both real and nominal terms (Wallis, 2000).

One recent development in macroeconomic theory is the acceptance of micro theoretic foundations to the various building blocks of an overall macroeconomic model rather than the reliance on stylised facts. However, macroeconometric modelling has been progressing on the basis of revised theories of macro economics, structural shifts and changes in policy regimes occurring in international and national economies, advanced econometric methodology and strengthened database. In the words of Pandit (2000), “modelling an economy has to be continuous on-going activity not merely because of the need for forecasting but also more importantly because it is only a live model that can incorporate new information by way of data, reflect changes in the perception of contemporary economic issues and new developments in theory and in quantitative methodology”.

Macroeconometric modelling in general pursues two objectives: forecasting and policy analysis. As mentioned above, policy analysis is for the short run

determination of output and prices. Optimality and simplicity are the two key factors in policy making. Fiscal and monetary policies are the foremost policies that are virtually in use from the beginning. Fiscal policy instrument, in developed economies, relates to the direct taxes, but in the developing economies it relates to govt. expenditure especially public investment and indirect taxes, which is of some theoretical significance. The impact of direct taxes is more on economic activity where as the impact of indirect taxes is on the price level. Given the predominance of public sector, govt. current or capital expenditure simulation is the traditional policy instrument practiced in developing economies.

In most less developed countries, the public sector's role in the planning and implementation of development projects has been considerable. The rising level of public expenditure has been fueled by capital inflows from public and private sources abroad, and by the mobilization of domestic resources through taxation and local borrowing. Recently the imperative role of public investment in achieving inclusive economic growth seems to be in sharp focus in India. In light of this it would be worthwhile to analyse the impact of increase in public investment and its allocation in favour of infrastructure sector on growth and poverty by using a macroeconometric model for India.

1.3 The Nexus of Public Investment and Economic Growth:

There has been a lot of academic debate in India, about the need for achieving inclusive growth and its feasibility, the role and potential of public investment especially in infrastructure sector in achieving the desired GDP growth and the ways and means of raising resources for public investment. Public investment is vital role in improving the growth of the economy. Economic development and

poverty reduction depend on sustained growth, which in turn depends on productive activities supported by roads, railways, seaports and airports, power generation and transmission and other infrastructure services. In most developing countries, the public sector's role in the planning and implementation of development projects has been considerable. The rising level of public expenditure has been financed by capital inflows from public and private sources abroad, and by the mobilization of domestic resources through taxation and local borrowing. Public sector investment especially in infrastructure sector (which consists of highways, airports, mass transit, etc.) contributes to private sector productivity growth. Increasing public investment in an appropriate policy framework, gives the private sector adequate poise and incentives to invest on a massive scale in the infrastructure sector, provided government simultaneously keeps adequate checks and balances through transparency, competition and regulation (Krishnamurty, 2000). It is important to draw attention here to the phenomenon of crowding-in or crowding-out associated with public and private investments in India.

The role of public expenditure has been widely debated in the literature. The classical/neo classical theory postulates that public investment may displace private investment or more generally expenditure. The impact works through the rate of interest. It may also work through movements in the price level depending on how such investment is financed and the extent of capacity utilization in the economy. Public expenditure increases aggregate consumption in the economy which leads to reduction in the aggregate savings resulting in higher interest rates which in turn discourages the private investment and overall economic activity in

a closed economy. In open economy higher public investment leads to higher capital flows and a real appreciation which results in lower net exports and again a reduction in the economic activity. In either case higher public investment leads to reduction in overall economic activity. An implicit assumption in the above approach is the economy works at full capacity level.

An opposite view in Keynes approach is, in conditions of less than full employment higher public investment doesn't crowd-out private investment. According to Keynesian the public investment gives adequate push to private investment through multiplier if the economy is operating under below capacity (Krishnamurty, 2000). Given sticky wages and prices rise in public investment increases the utilisation of factors of production resulting in more output.

Another view contrasting both classical/neo classical and Keynes approaches comes from Ricardian approach which argues that the impact of increase in public investment on the economy is neutral. The rational agents in the economy try to adjust their expenditure in relation to movements in public expenditure. Hence no effect on the economy with overall savings remaining unchanged. The empirical support in favour of the Ricardian view seems to be weak (Ball and Mankiw, 1995; Elmendorf and Mankiw, 1998). However there are empirical studies supporting both classical and Keynes views for India.

Nevertheless, endogenous growth theories suggest that public investment especially in infrastructure activities like irrigation, power, transport etc. should help in stimulating and facilitating private investment by creating new capacities (Romer, 1994). Unlike the classical/neo classical growth theory, the endogenous

growth theories supports the view that the fiscal policy related to public investment can affect long-run growth performance (Tanzi and Zee, 1997).

Following Wagner (1890), the public finance studies generally postulate that growth in public expenditure over time is caused by growth in national income. Here public expenditure works as a behavioral variable, similar to private consumption expenditure. Most macroeconometric models have tended to take the opposite view. The divergent views following Keynes (1936) treats public expenditure as an exogenous policy instrument designed to correct short-term cyclical fluctuations in aggregate expenditures**.** Causal relation between these two variables, in turn, rest on more basic differences in assumptions. **(**Balvir Singh; Balbir S. Sahni, 1984).

Recent studies show that there has been a crowding-in effect between public and private investments in manufacturing, infrastructure and services sectors (Krishnamurty, and Pandit, 1985; Murty and Soumya, 2006), which in turn will have an impact on the economic growth of a country. Public investment adds to real capital stock, which in turn increases the real output. (e.g. Krishnamurty and Pandit, 1985). This phenomenon has attracted attention in a proper understanding of the tradeoff between growth and inflation. A Contrary view is that public investment can exert a negative influence on private investment as both the sectors compete for scarce physical and financial resources by the very nature of its role in developing countries. It can draw off resources to itself by a non-price rationing mechanism such as licensing and other controls. A few studies concluded on the basis of empirical analysis that the crowding out effect dominates in India (Sundararajan and Thakur 1980).

However, public investment not only provides supply of crucial inputs such as irrigation, power and transport, but also augments aggregate demand. It may encourage private investment from the supply as well as demand side. A few studies ascribe the deceleration in industrial growth in India since the mid-sixties to slowing down of public investment (Srinivasan and Narayana, 1977, and Ahulwalia 1982). This view projects the complementarity between public and private investments.

1.4 The Objectives of the Study:

The research objective emerges from the observed facts and formed goals to accelerate growth as well as reduction of poverty. In India investment in infrastructure is dominated by public sector because of externalities, high capital intensity and long gestation periods. Many developing countries suffer from resource constraint. Public investment is needed for promoting growth which necessitates active government participation in development and regulation (Krishnamurty, 1984).

The objectives of the study are:

- To build a comprehensive macroeconometric model for India and seek quantitative answers for above discussed issues in a macroeconomic theoretical framework. The tool of counter factual policy simulations will be used for this purpose.
    - The focus will be on modelling various sectoral blocks. The disaggregation of sectors permits incorporating interdependency between sectors.

- To analyse the factors determining output, government fiscal operations, money supply, prices and external activities in a macroeconometric framework.

- To analyse the crowding-in or crowding-out effect between public and private investments in each sector and also to analyse the importance of public investment in infrastructure sector.

- To take up important policy scenarios related to public investment especially in infrastructure and analyse the effects of such simulations on important macro economic variables.

- To analyse the mode of financing of the increased public investment in favour of infrastructure.

1.5 Methodology and Data Sources:

The focus will be on utilizing the tool of an aggregate, structural, macroeconometric model to analyze macroeconomic relations and to address a few policy questions. The economy will be disaggregated into different sectoral blocks to capture the growth process. We will focus on sectoral disaggregation into agriculture, manufacturing, infrastructure and service sectors. The model will have 4 blocks like real, fiscal, monetary and external sectors. In order to link the economic growth with poverty reduction, we may postulate a simple relationship between head count ratio and the per capita real income, separately in rural and urban areas. Simultaneous system of equations may be estimated by using 3SLS for accurate and consistent forecast. Historical simulations will be analysed to

assess the performance of the model in capturing the behaviour of the economy. A few deterministic and dynamic policy simulations against the historical (base) simulation will be experimented to assess the effect of specific policies relating to important macro variables.

Data Sources:

Annual time series data are collected at all India level for all the variables, from 1979-80 to 2005-06. All variables were measured in crores of rupees.

The data sources are:

a) National Accounts Statistics published by Central Statistical Organization (CSO)

b) Handbook of Statistics on Indian Economy published by Reserve Bank of India (RBI)

c) International Financial Statistics published by International Monetary Fund (IMF)

d) World Bank reports (various issues)

1.6 Scheme of the Thesis:

CHAPTER II of the study provides a detailed overview of selective macroeconometric models for India. CHAPTER III contains the outline of the proposed model, and trends and patterns in data necessary for estimating the proposed model. CHAPTER IV contains the empirical results of the study. CHAPTER V discusses the policy simulations. CHPTER VI gives the summary and conclusions.

CHAPTER II

Review of Literature

2.1 The Genesis of Macroeconometric Modelling:

The origin of macroeconometric modelling dates back to 1940's when Marschak organised a special team at the Cowles Commission by inviting luminaries such as Tjalling Koopmans, Kenneth Arrow, Trygve Haavelmo, T.W. Anderson, Lawrence Klein, G. Debreu, Leonid Hurwitz, Harry Markowitz, and Franco Modigliani (Diebold 1998, Christ 1994). The Cowles committee was intended to combine economic theory, statistical theory and observed data to construct and estimate a system of simultaneous equations that could describe the structure of the macroeconomy. The estimated system of simultaneous equations can be used for forecasting and policy evaluations. (Christ, 1994).

Tinbergen's (1939) pioneering work, 'Business cycles in the United States of America from 1919-1932', hoisted the interest in the field of macroeconometric modelling. The attempt of Tinbergen to construct large-scale models by providing new tools for economic analysis in the direction of application of mathematical techniques coupled with the rudiments of statistical analysis has its genesis in the evolution of macroeconometric modelling. Tinbergen published a 24-equation model for the Netherlands economy around 1935.

Klein's early efforts in the field of macroeconometric modelling is in his 1950 volume, 'Economic Fluctuations in the US 1921-1941', but they were not large compared to Tinbergen's model. The Brookings model said to be the first large-scale model contains nearly 400 equations. The models emerged in the second

half of 1960s gave a new impetus to the macro modelling. According to Klein (1971), four issues given below that should be kept in mind while constructing a macroeconometric model.

i. Specification and identification of analytical models keeping in mind the objectives of the model and many other structural features relevant to the economy under consideration.

ii. Estimation of the model as best as one could with the available data base and diagnostics as per the state of the art.

iii. Validation of the estimated structural model by examining its ability to reproduce observed movements in key variables within and outside the sample period.

iv. Application of the model for forecasting and policy analysis by means of simulation techniques.

2.2 Evolution of Macroeconometric Modelling in India[1]

Macroeconometric modelling in India has relatively a long history. The first macroeconometric model for India was constructed and estimated by Narasimham (1956) under the supervision of Professor Jan Tinbergen. Since then, a large number of models have been constructed focusing on different aspects of the Indian economy and the work continues till date. The earliest models for India

[1]See Krishnamurty (2001) for elaborate discussion on macroeconometric modelling in India.

were small versions of the KK model[2] capturing the demand side of the economy (Valadkhani, 2004, Krishnamurty 2001).

The research in macro modelling has followed the evolution of the economy both in terms of the policy thrust as well as the changing economic structure. According to Bhide (2001), the empirical models of the Indian economy can be broadly classified into three categories namely Plan models, Macroeconometric models and the Computable General Equilibrium (CGE) models. The triple categorization reflects the concern that the modellers have with different objectives in terms of policy analysis and the evaluation of the performance of Indian economy. The 'plan' models intend to provide estimates of investment requirements to meet the targeted economic growth. Generally macroeconometric models were essentially meant to track the evolution of an economy and to provide estimates of the impact of alternative policy scenarios. The more recent CGE models are meant to provide insight into more detailed working of the economy as a general equilibrium system.

According to Krishnamurty (2001)[3], the present macroeconometric models come under the fifth generation. The first generation models were small and simple. They suffered from limitations like inadequate database and absence of comprehensive and empirically feasible theoretical framework. Apart from the practical difficulties in building macroeconometric models, first generation models were quite rudimentary and could focus very little on the sectoral linkages.

[2]Keynesian-Klien (KK) demand-oriented model deals with the problems of short-run instability of output and employment using mainly fiscal policy.
[3] See Presidential address to the Indian Econometric Society. It is also published in Economic and Political Weekly, Oct 19-24, 2002.

The major aspects that were explored in these first generation models include price behaviour (Choudhry, 1963, Marwah, 1963, 1972, Chakrabarty, 1977), investment behaviour and endogenous population expansion in a two sector model focused on growth (Krishnamurty, 1964), integration of real, monetary and foreign trade sectors with endogenous capacity utilization (Choudhry and Krishnamurty, 1968), role of food grain output in growth and price stability (Pandit, 1973), interaction between monetary and real variables in the monetised component of the economy (Bhattacharya,1975), the structure of monetary and financial markets (Gupta,1973, Mammen,1973), external trade (Choudhry,1963) and growth in a dualistic economy (Agarwala,1971).

The second-generation models, which mostly belonged to the seventies, encompass models by Pani (1977), Ahulwalia (1979), Bhattacharya (1982), Pandit (1982), Srivastava (1987) and Rangarajan (1982). The 1970s witnessed flowering a surge in the large scale macroeconometric modelling. Comparatively, these models were larger in size, and more disaggregated, mainly concentrating on policy analysis. Second generation models were concentrated more on allowing for lagged, more varied and somewhat more complex adjustment processes. Unlike the first generation models, these models had the advantage of a considerably improved database and rigorous micro and sectoral empirical studies.

Third generation models came in the eighties, notably those of Ghose, Lahiri et. al. (1983), Pani (1984), Bhattacharya (1984), Krishnamurty (1984), Pandit (1984,1985,1986), Sinha (1986), Krishnamurty, Pandit and Sharma (1989). Some of these models were important sectoral studies of significance and they provided

impetus to macro modelling endeavour. To be specific, Krishnamurty and Sastry (1975) focused on investment and financing in the corporate sector; Rangarajan, Basu and Jadhav (1989) on dynamic interaction between government deficit and domestic debt; Kannan (1985) providing analysis of foreign trade sector; Marwah (1987) modelling the exchange rate, Ghose, Lahiri and Wadhwa (1986) dealing with reserve money multiplier; Virmani (1991) providing the analysis of the role of supply and demand factors in influencing foreign trade, Krishnamurty, Pandit and Palanivel (1995) on price behaviour and, Krishnamurty and Pandit (1996) on trade flows exchange rate and tariffs with alternative policy scenarios. Like second-generation models these were also policy oriented. Taking the advantage of increasing interest in macro modelling and relatively better database, a substantial progress has taken place in this field. These models have made an effort to deal more explicitly with the problems of macroeconomic adjustment, and discussed the issues that have not been endeavoured previously in formal quantitative terms and also towards the policy simulations.

The fourth generation models were developed in the nineties. A few of them were by Anjaneyulu (1993), Bhattacharya, Barman and Nag (1994), Rangarajan and Mohanty (1997), Klein and Palanivel (1999). They all dealt with the issues relevant to the new policy regime and policy scenario simulations. These models are also large in size and lay emphasis on sectoral interlinks and trade-offs. The current models come under fifth generation models that clearly capture the essence of new policy regime wherein the prices are market determined, role of public investment in a few sectors and monetary policy becomes independent of the fiscal stance.

The developments in macroeconometric modelling in India, thus, have followed policy evolution as well as development of data and estimation techniques. The prototype models have become increasingly complex from one of simple Keynesian system of expenditure accounting to a set of inter relationships that capture the dynamic linkages between investment and output; deficits and debt; and deregulation and growth.

Collective research in macroeconometric modelling also gained importance in India. The use of a team approach in macroeconometric modelling has been regarded as both cause and effect of large scale macroeconometric modelling (Intriligator, Bodkin and Hsiao, 1996). A group of researchers- NK Choudhry, Meghnad Desai, DB Gupta, K Krishnamurty, and KL Krishna- under the leadership of AL Nagar with support from the ICSSR made an effort to build and maintain a macroeconometric model for India (1974). Also, National Council of Applied Economic Research (NCAER) in mid eighties built a CGE model for India and the model being improved over the years by updating, and supplementing it with behavioural sub-systems and also with anticipatory survey data. They make forecasts and policy simulations regularly. K. Krishnamurty and V.N. Pandit from Institute of Economic Growth and Delhi School of Economics (IEG-DSE) respectively as project coordinators launched a macroeconometric model for India in early nineties, with financial support from National Science Foundation (US), IDBI and ICSSR. Now it is referred as CDE-DSE model.

The complexities in building macroeconometric models for developing countries like India still remain unchanged. The theoretical underpinnings remain elusive even now. Lack of clear theoretical framework probably may be a major reason

for the slow progress in econometric modelling. Klein discussed these drawbacks at length in his often-quoted essay “What kind of macro models for less developed countries?” (Klein, 1965). These issues were also raised in a paper by Krishna et al (1991).

The models constructed in the mid-seventies were structurally based on Keynesian theory. One major issue, on which there was debate, was regarding the application of Kenesiayan economics to developing countries or less developed countries. These issues were robustly debated by Rao (1952) and Dasgupta (1987). The LDCs were suffering from supply constraints, whereas the Keynesian theory talks about the situation where demand constraints exist. But, the imperfect market structure, substantial government intervention, imperfect information conditions strengthen the Keynesian framework. Chakrabarty (1979, 1983) had quite effectively brought out the distinction between the Keynesian methodology and the policy recommendations following from this methodology when combined with specific empirical assumptions. The consequence is that one may accept the methodology and not necessarily the empirical assumptions and the consequences therefrom. Klein (1965, 1989a) suggested that a Keynesian Macroeconometric model which is relevant to developed countries can also be appropriate for developing countries provided that relevant modifications are undertaken particularly in the specification of investment and production functions.

The salient features of the developing economies were discussed by Klein (1965, 1983) at length; government intervenes in formulating and implementing economic policies and also plays a role of predominant producer, investor and

consumer. This implies that modelling government activities are constrained in several ways. Consequently, government behaviour is neither fully exogenous nor market determined. Because of government intervention by way of administered prices, control over output and investment, prices may cease to be flexible in a large segment of the economy. This implies a larger role for quantity adjustment than is usually allowed for.

Credit plays an important role in production as well as in investment, thus credit availability tends to affect output via supply as well as demand. It is argued that expansion of output demand would induce demand for credit, affecting money multiplier, and hence money supply process becomes demand driven (Rath, 2001). This process shows money supply endogeneity. The interdependence between monetary and fiscal policies in LDCs is also very important. These issues were discussed at length by K. Krishnamurty (2001).

2.3 Imperative Issues in Macroeconometric Modelling:

The macroeconometric models have been used for exploring interactions between various sectors in the economy, and for analysing policy effects by undertaking simulations. It would be worthwhile to look into some important issues dealt in various macroeconometric models. Some of the important issues for macroeconometric modelling are price behaviour, inflation and growth, sectoral linkages, complementarity between public and private investments, monetary and fiscal sector linkages, relationship between internal and external balances etc.

The macro modelling research has followed the evolution of the economy both in terms of the policy thrust as well as the changing economic structure. For

example, while attention to agriculture and the subsistence nature of production for a majority of the producers in this sector has continued, greater attention is now paid to the services, trade and financial sectors. Attention has shifted from analysing merely the implications of government policies on the economy to such factors as private capital flows from abroad (Bhide, 2001). Sectoral disaggregation is the major concern in the field of macroeconometric models in the recent period. Some of the macroeconometric models (Krishnamurthy, 1984, Krishnamurthy, Pandit, Sharma, 1989, IEG-DES, 1999) have followed five-sector classification of production: agriculture, manufacturing, infrastructure, government services and the other services. In fact, Patnaik (1995) points out that agriculture has always received a distinct attention in understanding India's macro economy. In the same manner, one can also point to the unique nature of the infrastructure sector in the Indian economy. Its dominance by the public sector enterprises makes the sector unique in its response to demand conditions and pricing rules. Hence, macro models have incorporated a separate treatment of the services provided by the government from those provided by the private sector. In the case of agriculture and infrastructure, output is supply-constrained. In the case of manufacturing and services, output is often modelled as partly supply constrained and partly demand determined. The general prices are influenced by 'administered' or 'government-determined' prices.

The task of modelling capital formation in the macroeconometric models for India was achieved in different ways. The specification of capital formation reflects the structural characteristics of the 'mixed economy'. The desegregation of sectors is common. The relationship between private and public investment is treated as an

empirical issue with aspects of both ‘crowding-in’ and ‘crowding-out’. Beyond this, neo-classical factors such as real interest rate and taxes also find a role. The study by Krishnamurty (1985) highlights the crowding-in phenomenon in a proper understanding of the tradeoff between growth and inflation. This study emphasises the role of public sector investment and its allocation across the sectors. It also supports the complementarity between public and private investment in all sectors and the effect of increase in public investment on inflation and growth. The above study shows that a rise in public investment not only increases output growth more than the rate of inflation but also facilitates private investment in all sectors.

A contrary view is that public investment can exert a negative influence on private investment as both the sectors compete for scarce physical and financial resources in developing countries (Krishnamurty, 2001). Public investment can drain off resources to itself by a non-price rationing mechanism such as licensing and other controls. A few studies concluded on the basis of empirical analysis that the crowding out effect dominates in India (e.g. Sundararajan and Thakur 1980).

However, public investment not only provides supply of crucial inputs such as irrigation, power and transport, but also augments aggregate demand. It may encourage private investment from the supply as well as demand side. A few studies ascribe the deceleration in industrial growth in India since the mid-sixties to slowing down of public investment (Srinivasan and Narayana, 1977, and Ahulwalia 1982). This view projects the complementarity between public and private investments.

Modelling government activities became an important component of macroeconometric modelling as the decisions of government about investment and output controls, administered prices, procurements play an important role to achieve targeted growth rate. Government expenditure and revenues were modelled in detail to understand the fiscal balances in relation to other macro variables. Studies by Bhattacharya (1984), and Bhattacharya, Barman and Nag (1994) exclusively focused on government finances and related issues. They have a detailed model of government receipts and expenditures with most of the items endogenously determined. This is to an extent necessary in the Indian context because government includes not only administrative departments but also departmental enterprises and non-departmental enterprises. Monetised deficit feeds into the monetary base along with the foreign exchange assets, provide a link to the money supply growth (Pandit, 2000). Reserve bank credit to finance public sector investment leads to monetary expansion and investment, which together may lead to higher output with a lag.

The specification of the monetary and fiscal relationships in the macroeconometric models gained importance. Money supply is modelled as a function of reserve or 'high powered' money. High-powered money is a function of monetized deficit of the central government and changes in foreign exchange assets of the central bank. Changes in money supply originating from either of these sources affect prices and inflation, which in turn will have several channels of transmission of the shocks to other variables in the economy. Some studies (e.g. Pani 1977) analysed the India's money and credit markets. Higher money supply also had a 'supply side' effect: bank credit expansion followed the increase in

money supply and led to higher investment. Again, increased public spending had a 'crowding-in' effect through monetary channels also, besides the direct 'crowding-in' effect if expenditures were in infrastructure sector. Models built by Ahulwalia (1979), Jadhav and Singh (1990) and Rangarajan and Arif (1990) assumed money supply exogeneity in a monetarist framework. Some models attempt to link the real, monetary and fiscal sectors. Models by Rangarajan and Arrif (1990), Jadhav and Singh (1990), Pandit and Krishnamurty (1984) exhibit this form of linking.

Many recent macroeconometric models adopted money supply- money demand framework for determining price level. However, the fiscal and monetary sector specification generally treated interest rate as an exogenous variable. On the demand side, the real balances are assumed to be a stable function of real income and interest rate whereas money supply is a function of reserve money. When money supply is in excess of real money balances, inflation is inevitable and as money supply increases, rate of inflation increases. Money supply per unit of real output is taken as proxy for excess liquidity. Some of the models built recently for India have emphasized the cost-push factors, (Pandit, 1973, 1978, Bhattacharya 1984, Krishnamurty 1985, Krishnamurty and Pandit 1995). It is postulated that prices are market clearing in some sectors like agriculture, for others they are mark-up over costs.

Coming to external sector, a large number of the early models argued that the Indian economy could be treated as almost as a closed economy. Many of the later models too had only a rudimentary treatment of this sector (Pandit, 2000). But, in the recent years, several models emerged with detailed emphasis on the external

sector and it's interlinks with the monetary and fiscal sectors. These external sector linkages were discussed at length in the models built by Pandit (1986), Virmani (1991), Krishnamurty and Pandit (1996), Ragarajan and Mohanty (1997), Rajiv Ranjan and Nachane (2004). This aspect of the economy has assumed a considerable importance under the new policy regime. Dutt (1995) provides a review of the open-economy modelling framework found in the macroeconomic models of the Indian economy, in the context of the opening-up of the economy. Krishnamurty and Pandit (1996) modelled the merchandise trade flows in supply-demand framework. Import supply function is specified to be infinitely inelastic at fixed import price and the level of domestic economic activity. In modelling exports, demand is specified to depend on the world GDP and relative price, while supply depends on relative price and level of domestic output. However, exchange rate remained 'exogenous'. The invisibles account also was often exogenous as the capital account. Nevertheless, in some macroeconometric models (e.g. Ranjan and Nachane 2004) invisibles flows were specified as demand relationships.

2.4 The Present Study:

The present study focuses on building a comprehensive macroeconometric model for India for a most recent period and utilizing the tool of an aggregative, structural, macroeconometric model to analyze the macroeconomic effects of changes in public investment particularly infrastructure on growth and poverty. This study spotlights on sectoral disaggregation into agriculture, manufacturing, infrastructure and service sectors. The model has four blocks namely real, fiscal, monetary and external sectors. Real sector is modeled in detail by explaining output, capital formation and price behaviour in each sector. The model strives to

achieve the balance between growth and inflation as well as internal and external balances.

The model emphasises the complementarity between public and private investments in all sectors. Following Keynes (1936), the effect of public investment on private investment is expected to be positive through multiplier if the economy is operating under below capacity (Krishnamurty, 2000). Specifically, the investment in infrastructure activities like irrigation, power, transport etc. helps in stimulating and facilitating private investment by creating new capacities.

The present study tries to analyse the crowding-in or crowding-out effect of public investment on private investment in an open economy framework. It emphasises the effect of increase in public investment on internal and external balances along with output and prices. Unlike the other macroeconometric models, money market equilibrium determines interest rate in the present study. Exchange rate is treated as endogenous supporting the new policy regime of the Indian economy. The present study also postulates a simple relationship between head count ratio and the per capita real income, separately in rural and urban areas in order to link the output growth with poverty reduction.

The specific features are:

- Data has been used up to the most recent period
- A good part of reform period is covered
- The crowding-in or crowding-out effects are analysed

- The nexus of public investment growth and poverty has been analysed with proper understanding off trade-offs

- To best of our knowledge the inter relationship between poverty and growth in the context of macroeconometric modelling has not been covered. A modest attempt has been made towards that.

CHAPTER III

Proposed Model and Trends in Data

3.1 Structure of the Model:

The model is formulated to assess the impact of public investment on growth as well as poverty. Emphasis is particularly laid on public investment in infrastructure and agriculture. The model follows Keynesian framework. It has a comprehensive treatment of real, fiscal, monetary and external sectors. The model consists of seven sub models, each dealing with output, private investment and consumption, price behavior, fiscal operations, monetary sector, trade and poverty ratios. All these seven sub models are put into three modules namely real sector, fiscal, monetary sectors and external sector. The level of economic activity is measured by output. Beside output, capital formation and price behavior play a major role in determining economic activity. Demand side of the model is explained not much in detail except for aggregate consumption functions of private and government sectors. The model is simultaneously explained by aggregate demand, capacity creation in addition to natural factors and international economic factors. It has a fairly comprehensive treatment of all sectors and the interlinkages within and across the sectors.

The real sector is disaggregated into four sub sectors namely agriculture, manufacturing, infrastructure and service sectors. Agriculture sector includes agriculture, forestry and fishing; manufacturing includes mining and quarrying and manufacturing; infrastructure includes electricity, gas, water supply, construction, transport, storage and communication; and service sector includes

trade, hotels and restaurants, financing, insurance, real estate and business services, and community, social and personal services (NAS classification).

The output in agriculture is assumed to be determined by weather, land, net capital stock and infrastructure output. Manufacturing output is assumed to be explained by both supply and demand factors such as net capital stock, imports and aggregate demand. Output in infrastructure is postulated as a function of net capital stock. Service sector output is assumed to be determined by net capital stock and infrastructure output. Infrastructure output is taken as a capacity constraining factor in all the production functions. Higher infrastructure output leads to larger output of each of the sectors and vice versa. It should be noted that all four output functions portray the interdependence of the outputs in different sectors in addition to the net capital stock growth (Krishnamurthy, Pandit and Sharma, 1989; Berhman and Klein, 1970).

Private investment in each sector is assumed to be explained by its own output to account for accelerator phenomenon on expectations of demand (static expectations) given capacity constraints represented by capital stock; public investment and public sector resource gap capturing crowding in and crowding out phenomenon; real interest rate and terms of trade proxying resource cost and relative profitability respectively. Specifically, public investment in the model not only adds to capital stock there by augmenting the output but also influences the private investment and helps to improve the economic growth. Under the current regime, public investment should be neutral as far as private investment is concerned, but this feature has not percolated fully into the economy until recently (IEG-DSE, 1999). The model also aims to understand the complementarity

between public investment and private investment in all sectors. It can be observed that public investment tones-up private investment as a resource flow in all sectors (crowding-in). Additionally resource gap defined as the total public investment less public savings is expected to have a negative correlation with private investment (crowding-out). Crowing-in and crowding-out co exists in all sectors except in agriculture. The relative price of each sector vis-à-vis the rest of the economy defined as 'terms of trade' is expected to influence the private investment in each sector positively. The infrastructure investment from both private and public sectors is expected to effect private investment in manufacturing and services positively. Private consumption is postulated as a function personal disposable income, total public expenditure including current spending and investment.

A further dissection of the real sector is attempted in the next paragraph. Agriculture prices represented by wholesale price index in agriculture is assumed to be determined by liquidity in the economy in relation to real output i.e. the ratio of money stock to real GDP a proxy for demand and the procurement prices of rice and wheat representing cost elements. Manufacturing price determination is postulated based on mark-up mechanism and monetary factors. Here the cost elements are wholesale prices of fuel, power and lubricants and, price of imports. Wholesale prices of fuel, power and lubricants are taken into consideration as a price of infrastructure sector that is postulated as a function of monetary factor and, price of imported mineral fuels and lubricants etc. Wholesale price index for all commodities is simply the weighted sum of sectoral prices.

Fiscal sector sub model attempts to explain government consumption expenditure, revenues and fiscal deficit keeping investment exogenous. Among them public sector revenues consist of direct and indirect taxes, non-tax revenues. Total expenditure consists of current and investment expenditures of the public sector (administrative departments, departmental and, non-departmental enterprises and quasi governmental bodies). The model tries to explain current expenditure and total revenues also in detail. Gross fiscal deficit is postulated as a function of public sector resource gap. An attempt to understand the public sector resource gap defined as the difference between total public investment and public savings is undertaken.

Monetary sector sub model mainly focuses on the determination of money supply and its links with fiscal operations. In the model, equilibrium in the money market determines interest rate. Money supply is much easier to describe; the level of money balances available in an economy is simply set by the actions of the central bank. Money supply is postulated to depend on reserve money and Cash reserve ratio (CRR), where CRR works as a monetary policy instrument. When the expenditure exceeds revenues, the government has to resort to deficit financing basically by borrowing from public, commercial bank credit to government, market and non-market borrowings and external borrowings. Reserve bank gives credit to government to finance fiscal deficit if it is unable to meet its expenditure by above said sources. Further, RBI credit to finance the fiscal deficit causes money supply to increase endogenously with the rise in reserve money. This monetary expansion again affects the price level. The interdependence of fiscal deficit, money supply and prices are well explored in the model.

On the other side money demand function takes a reduced form as interest rate (PLR) which is assumed to be determined by real GDP, money supply, inflation and its own lagged value representing partial adjustment mechanism. A negative relationship presumed to prevail between the interest rate and money stock reflecting demand for and supply of money. If interest rates prevailing in the market are low people will not loose vast amount of money in the form of foregone interest if they hold a portion of their wealth in cash.

An analysis of external sector in the model is worth noting. External sector is modelled through exports supply and demand, import demand and trade balance. Assuming equilibrium in the exports market, the export demand function is specified as a price equation for unit value of exports. It incorporates real GDP, a proxy for overall demand and the ratio of domestic prices to world export prices. The export supply is assumed to be determined by domestic export prices relative to world export prices and world income representing world economic activity.

India is a price taker (small country assumption) as far as imports are concerned and it can only adjust these in terms of domestic currency at the market determined exchange rate (Krishnamurthy, Pandit, Sharma, 1989). Thus, import price (unit value of imports) is assumed to depend on trends in the world trade and therefore considered exogenous. The import demand is specified in terms of import price relative to the corresponding domestic price, domestic level of economic activity proxied by aggregate absorption.

Exchange rate (Rs/US $) is assumed to be determined by rate of inflation, ratio of current account deficit to foreign exchange assets of reserve of bank and the rate of change in reserve bank foreign exchange assets. Ratio of current account deficit

to foreign exchange assets of reserve bank is expected to have a negative effect on exchange rate as it accounts for external resources available to finance current account deficit. If current account deficit is larger than foreign exchange assets then the capacity to service deficits diminishes, i.e. the demand for foreign currency increases relative to domestic currency. In this case, for each unit of foreign currency (US $) more rupees have to be paid making the exchange rate depreciate and vice-versa. Current account deficit is defined as the total trade balance plus net invisibles. Foreign exchange reserves are related to current account deficit and net capital inflows. Exchange rate is expected to have a positive relation with rate of change in foreign exchange reserves. When India has more foreign exchange reserves then there is a less demand for foreign currency, thus exchange rate appreciates.

A small sub model on poverty is appended to the main model in order to link the economic growth with poverty reduction. Head count ratios in both rural and urban areas are postulated to have a negative relation with per capita personal disposable income.

In nutshell, the model highlights on complementarity between public and private investments, determination of sectoral outputs, sectoral prices, fiscal deficit, money supply, and external factors. The model concentrates more on the role of public investment particularly in infrastructure. Allocation of public investment in each sector is exogenous though the total public investment is endogenous. Other important exogenous variables in the model are rainfall index, procurement prices of rice and wheat, bank credit to govt., CRR, import prices, net capital inflows and, world income.

3.2 Proposed Model:

The proposed model consists of 4 blocks- real, fiscal, monetary and external sectors. These 4 blocks are regrouped into 3 separate modules for econometric estimation. Module-I covers all real sector equations, which include output, investment, and prices. Module-II consists of all macro economic equations covering fiscal, monetary and external sectors. Module-III has only two equations representing rural and urban poverty ratios. The description of the variables is given in Appendix-3.1.

3.2.1 Model Description:

Behavioral Equations:

Module-I

Real Sector:

Output Functions:

1. YAR = f (RAIN, AREA, $KAGR_{-1}$, YINFR)

2. YMNR = f (ADD, $KMNR_{-1}$, IMPTR)

3. YINFR = f ($KNIFR_{-1}$, $YINFR_{-1}$)

4. YSRR = f ($KSRR_{-1}$, YINFR)

Capital Formation: Private

5. PIAGR = f (YAR, $PCFAGR_{-1}$, PCFINFR, real PLR_{-1}, (PRAG/PGDP))

6. PIMNR = f (YMNR, PCFMNR, (PIINFR+ PCFINFR), (RGPUB/PGKE),
real PLR_{-1}, (PRMN/PGDP))

7. PIINFR = f (YINFR, PCFINFR, (RGPUB/PGKE), real PLR_{-1},

(PRINF/PGDP))

8. PISRR = f (YSRR, PCFSRR, (PIINFR+ PCFINFR), (RGPUB/PGKE),

real PLR, (PRSR/PGDP))

9. PIADJR = f (PITOTR, $PIADJR_{-1}$)

Consumption: Private

10. PCR = f (PYDR, $((GFCE/P)_{-1}+PCFTOTR_{-1})$)

Depreciation Equations:

11. DEPAG = f ($KAGR_{-1}$)

12. DEPMN = f ($KMNR_{-1}$)

13. DEPINF = f ($KINFR_{-1}$)

14. DEPSR = f ($KSRR_{-1}$)

Price Behaviour:

15. WPAG = f ((M3/YR), WPRW)

16. WPMN = f ((M3/YR), WPFPLL, UVIMP)

17. WPFPLL = f ((M3/YR), UVIMP4, $WPFPLL_{-1}$)

Implicit Price Deflators: Public and Private Investment

18. PGKE = f (P)

19. PPIE = f (P)

Sectoral Price Deflators:

20. PRAG = f (WPAG)

21. PRMN = f (WPMN, $PRMN_{-1}$)

22. PRINF = f (WPFPLL, (((P-P_{-1})*100)/P_{-1}))

23. PRSR = f (M3/YR)

Module-II

Fiscal, Monetary and External Sectors:

Fiscal Sector:

24. DT = f (YANR*PNA)

25. IDT = f (YM)

26. NTX = f (Y)

27. GFCE = f (TR)

28. GFD = f (RGPUB, GFD_{-1})

Monetary Sector:

29. M3 = f (RM, CRR)

30. PLR = f (YR, M3, (((P-P_{-1})*100)/P_{-1}), PLR_{-1})

External Sector:

31. EXPTR = f ((UVEXP/(WPEXP*EXRIDX)), WYR_{-1})

32. UVEXP = f (YR, (P/(WPEXP*EXRIDX)), $UVEXP_{-1}$)

33. IMPTR = f (AD, (UVIMP/P))

34. EXR = f ((((P-P_{-1})*100)/P_{-1}), (CAB/$RBFA_{-1}$), ΔRBFA)

Module-III

Poverty Ratios:

35. HCRRUR = f (PYDR/NTOT)

36. HCRURB = f (PYDR/NTOT)

Identities:

37. ABSP = PCR + PIADJR

38. ADD = ABSP + (GFCE / P) + PCFTOTR + EXPTR - IMPTR

39. AD = ADD + IMPTR

40. PYD = YM - TR + SUB + OTP

41. PYDR = PYD / PGDP

42. P = ((0.215 * WPAG) + (0.147 * WPFPLL) + (0.637 * WPMN))

43. YR = YAR + YNAR

44. YNAR = YMNR + YINFR + YSRR

45. Y = PGDP * YR

46. YM = Y + IDT - SUB

47. PGDP = ((PRAG * YAR) + (PRMN * YMNR) + (PRINF * YINFR) +
(PRSR * YSRR)) / YR

48. PNA = ((PRMN*YMNR)+(PRINF*YINFR)+(PRSR*YSRR))/YNAR

49. KAGR = KAGR(-1) + PIAGR + PCFAGR - DEPAG

50. KMNR = KMNR(-1) + PIMNR + PCFMNR - DEPMN

51. KINFR = KINFR(-1) + PIINFR + PCFINFR - DEPINF

52. KSRR = KSRR(-1) + PISRR + PCFSRR - DEPSR

53. PITOTR = PIAGR + PIMNR + PIINFR + PISRR

54. PCFTOTR = PCFAGR + PCFMNR + PCFINFR + PCFSRR

55. GCFTOT = ((PITOTR * PPIE) + (PCFTOTR * PGKE))

56. GCFADJ = ((PIADJR * PPIE) + (PCFTOTR * PGKE))

57. GDS = GCFADJ + CAB + EM2

58. GCE = GFCE + SUB + OGCE

59. GXP = (GCE + (PCFTOTR * PGKE))

60. TR = DT + IDT + NTX

61. GDSADORC = TR - GCE

62. GDSPUB = GDSADORC + GDSRCNDQG

63. RGPUB = ((PCFTOTR * PGKE) - GDSPUB)

64. RM = RCG + RBCS + RBFA + GCL + MISRM

65. D(RCG) = GFD - D(BCG) - DNB - EB - MISCR

66. BCP = M3 - RCG - BCG - RBFA - GCL + MISCRD

67. EXPT = EXPTR * UVEXP

68. IMPT = IMPTR * UVIMP

69. TB = EXPT - IMPT

70. EXPTBOP = K1T * EXPT

71. IMPTBOP = K2T * IMPT

72. TBBOP = EXPTBOP - IMPTBOP

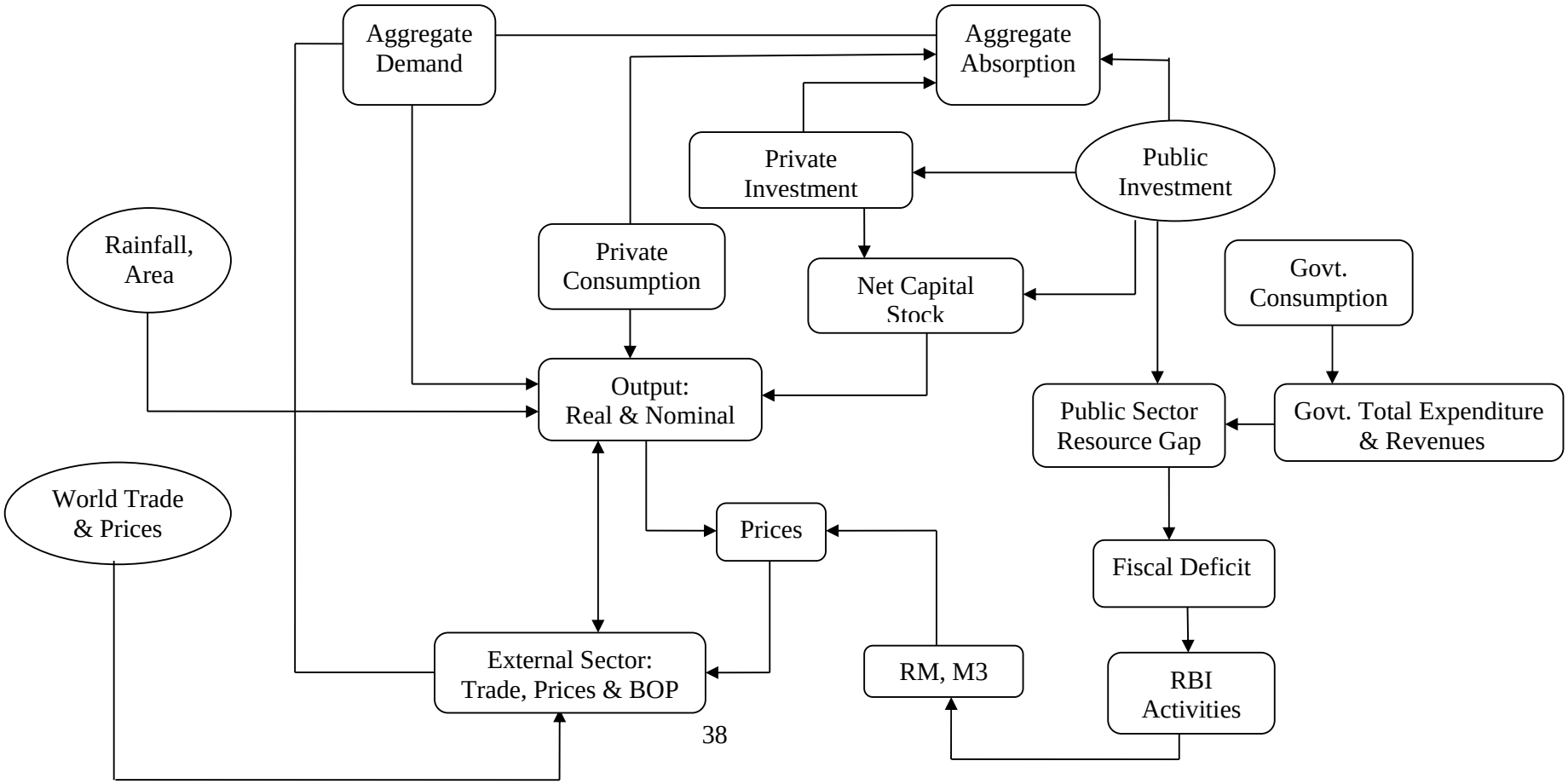
73. CAB = TBBOP + INVSB

74. RBFA = RBFA(-1) + TBBOP + INVSB + NCIF

75. EXRIDX = EXR / 31.44390

3.2.2 Model Structure: Flow Chart

(Variables in circles are exogenous)



3.3 Trends in Data:

It is important to understand the trends and patterns in the observed data to have a better overview of the economy, before estimating the proposed model and using it for counter factual simulations. It is important to understand the trends and patterns in the observed series of the variables in the proposed model, in order to have a better overview of the economy. This provides a backdrop for interpreting the estimated model and policy simulations, which will be discussed in the later chapters (Chapters 4 and 5). The over view is based on annual time series correspond to the fiscal year (1 April to 31 March). The data were drawn mostly from the National Accounts Statistics published by Central Statistical Organization (CSO); Handbook of Statistics on Indian economy, published by RBI; and International Financial Statistics, published by IMF.

The study period is taken as 1980-81 to 2002-03[4] (the latest year for which consistent data are available at 1993-94 base year). It would have been ideal to carry the model to the latest year say 2007-08 but the data for all the real and fiscal variables is not available in National Accounts Statistics (NAS) in the old base year that is 1993-94 (when this empirical work has started). Another criterion for selecting this particular period is to cover one decade in reform and pre reform periods. The major event that happened in the Indian economy in the study period (1980-81 to 2002-03) is the balance of payments (BOP) crisis in 1990-91 which lead to economic reforms from 1991 onwards. It was the balance of payment crisis in 1991 that was the key trigger for reforms. The motive of economic reforms is to

[4] However, the data on price variables for 1979-80 was also used for a specific purpose only in three equations while estimating the model. Otherwise, for all variables the study period is taken as 1980-2002. Therefore, here after the study period means 1980-2002 unless stated otherwise.

bring macroeconomic stabilization and structural reforms. Structural measures initially emphasized accelerating the process on industrial and import delicensing simultaneously with the switch to a flexible exchange rate regime and then shifted to further trade liberalization, financial sector reforms and tax reforms. In the second half of the 1980s, current account deficits widened. India's development policy emphasis shifted from import substitution toward export-led growth, supported by measures to promote exports and liberalize imports for exporters.

In the present study, decade wise annual compound growth rates for the periods 1980-89, 1990-99 and for the full period 1980-02 are computed for all the variables to understand the trends and patterns in them. For the three year period 2000-02, the average of year to year growth rates have been calculated. Most of the variables are in real form to avoid inflationary effects. Nevertheless, some of the fiscal and monetary variables are in current prices. For all the real variables base year has been taken as 1993-94 as per CSO source. All price variables are indices with 1993-94 as unity (Appendix-3.1). All variables in the model are classified into four broad groups namely real variables, fiscal and monetary variables and external sector variables. Some of the real variables seem to be very volatile during the study period and therefore compound growth rates for these variables are calculated after taking three year moving averages. Graphs are also provided for better visual understanding of the trends in the series. For certain variables, appropriate percentage shares are also computed.

3.3.1 Real Output and Prices:

A closer look at trends in real gross domestic product at factor cost (YR) (1993-94 prices, NAS) provides a broad view of the whole economic activity over the study

period. The real gross domestic product has been consistently increasing over time. A number of other studies have also analysed these trends and argued that the growth rate of Indian economy recorded a considerable acceleration during 1980. The initial surge in India's economic growth rate can be observed in the year 1977-78 when the economy grew at 7.7 percent followed by a slow down at 5.6 percent in 1978-79 (Panagariya, 2004, Dani Rodrik and Arvind Subramanian,2004, Srinivasan and Tendulkar, 2003). De Long (2003) and Williamson and Zagha (2002) have both emphasized that the approximate doubling of India's growth rate took place a full decade before the 1991 reforms. As per this study, during the period 1980-2002, real GDP at factor cost grew by a moderate 5.7% p.a. (Table-3.1). In fact, the real GDP growth has accelerated from 5.2% p.a. during 80's to 5.9% p.a. during 90's[5]. The average real GDP was Rs. 5106553 crores in 80's and it increased to Rs.8869258 crores in 90's. However, it has slowed down to 4.9% p.a. growth rate between 2000-01 and 2002-03. The overall average real GDP was Rs. 7722048 crores during the study period, 1980-2002.

Though the moving average compound growth rate over a whole decade witnessed a little above five percent for during 1980-90, year-to-year growth during this period exhibited considerable fragility. The highest year-to-year growth rate has been marked as 10.5% in 1988-89 and the lowest has been marked as 3.1% in 1982-83. The average growth rate of 5.2% from 1980-89 is largely the outcome of rapid growth in the last three years of the ten-year period. In contrast, growth during the 1990s has been more robust and far less volatile after

[5] Here after 80'**s** refers to the period from 1980-81 to 1989-90 and 90's refer to 1990-91 to 1999-2000 unless stated otherwise.

witnessing a very low year-to-year growth rate of 1.3 in 1991-92 the year of economic crisis. The annual growth rate quickly picked up and reached 5.1% in 1992-93 and never fell below 4.7% subsequently. After 1991 reforms growth rate showed a greater stability till 2001-02. Again the annual growth rate fell to 4% in 2002-03. However the drastic increase in growth rate of real GDP over decades can be attributed to liberalisation[6] which introduced policy measures such as import liberalization, export incentives and a more realistic real exchange rate contributed significantly to productive efficiency (Panagariya, 2004).

Total real output at factor cost is the sum total of real output in four sectors namely agriculture, manufacturing, infrastructure, services. Agriculture sector includes agriculture, forestry and fishing. Having a sizable share in total real GDP, agriculture recorded an annual compound growth rate of 3.1% p.a. during 1980-2002 (Table-3.2). It marked 2.6% p.a. in 80's and 3.2% p.a.in 90's. It recorded a negative growth rate (-0.4%) during 2000-02. The share of agricultural output (YAR) in total output was 36.4% in 80's but it reduced to 29.1% in 90's (Table-3.2). It further fell down to 23.1% during 2000-02. In the total study period it was 31.5%. During 80's and 90's agriculture growth marked wide fluctuations. The years 1986-87 and 1987-88 were the catastrophic years for agriculture due to bad weather. The subsequent three years, especially 1988-89 recorded a little above normal rainfall that might have helped producing unusually high agricultural growth. The year-to-year growth rate in 1988-89 was recorded as 15.5%, the highest during 1980-2002. The role of agriculture may also be mentioned in

[6] Rodrik and Subramanian (2004) argue that it is the reforms that sustained the growth rate of 80's well into the 90's

helping the high growth rate in total real GDP in 1988-89 (10.5%)[7]. The year 2002-03 again registered a negative year-to-year growth rate in agriculture (-7.0%). Thought the decade wise compound growth rate in agriculture was stable around 3.0% during 1980-2002, the year-to-year growth rates were highly fluctuating.

Manufacturing sector includes manufacturing and mining & quarrying. A number of studies have argued that manufacturing experienced a surge in productivity in the 1980s (Ahluwalia, 1995, Unel, 2003). Real output in manufacturing sector (YMNR) grew at 7.0% in 80's and 6.8% in 90's and it has come down to 5.2% during 2000-02. It recorded a 6.6% growth rate in the study period. The share of manufacturing output in total output has increased from 17.6% in 80's to 19.4 in 90's and it maintained the same share of 19.4% during 2000-02. . In the total study period it was 18.6%. The impact of reforms can also be seen in terms of higher manufacturing sector growth. According to Desai (1999) "The changes were complex and arbitrary, but they led to an acceleration of industrial growth from 4.5% in 1985-86 to a peak of 10.5% in 1989-90." However manufacturing growth started stimulating in 1980-81 and was soon joined by services. This led to a significant acceleration in overall growth starting from 1980-81 (Virmani, 2004). Manufacturing growth was very high during the 1992-97 in the immediate exuberance of industrial policy reforms. However, there was a significant slowdown during 1997-2002. The year-to-year growth rate of manufacturing sector in 1995-96 was recorded as 13.7, the highest during 1980-2002.

[7] Virmani (2004) argues in favour of agriculture that "there is no change in the impact of rainfall fluctuations on the Indian economy against conventional wisdom that Indian agriculture and the economy have become less dependent on the weather since the eighties. This has been based on the fact that share of GDP from agriculture has declined and that of services has increased".

Infrastructure sector includes electricity, gas & water supply; construction and transport, storage & communication. The share of infrastructure output (YINFR) in total output was increasing significantly. It rose at an average of 5.5% in 80's and 6.5% in 90's. It has drastically increased to 8.0% during 2000-02. The infrastructure sector recorded a gradual increase in annual growth rate during 1980-2002 except for the year 1982-83 in which it recorded a negative growth rate (-0.9%) . On the average the growth rate was 6.5% in the total study period. The year-to-year growth rate of infrastructure reached a peak (9.5%) in 2002-03. The share of infrastructure in total output was almost stable between 13-14% in 80's and 90's. It share was increased to 16.3% during 2000-02.

Service sector includes trade, hotels & restaurant; financing, insurance, real estate & business services and community, social & personal services. A stable and consistent growth in service sector has been witnessed over 1980-2002. The share of service sector (YSRR) output has increased rapidly. According to Rakesh Mohan (2008) "...it is the continuing and consistent acceleration in growth in services over the decades, that had earlier been ignored, that really accounts for the continuous acceleration in overall GDP growth". The share of service sector in total output was 32.3% in 80's, 37.0% in 90's and it has increased to 41.2% during 2000-02. The growth rate of service sector output was 7.0% in 80's, 7.5% in 90's and 6.6% during 2000-02. It was 7.3% during 1980-2002. The years 1995-96 and 1997-98 recorded high year-to-year growth rate, above 10%, in service sector.

Table - 3.1: Average Annual Compound Growth Rate in Output (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Nominal output (Y)	13.9	15.2	8.9	14.5
Real output (YR)*	5.2	5.9	4.9	5.7
Agriculture (YAR)*	2.6	3.2	-0.4	3.1
Manufacturing (YMNR)*	7.0	6.8	5.2	6.6
Infrastructure (YINFR)*	5.5	6.5	8.0	6.5
Services (YSRR)*	7.0	7.5	6.6	7.3

Source: NAS
*: Annual compound growth rates calculated after taking 3 year moving averages

Table - 3.2: Share of each Sector's Output in Total Output (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real output (YR)	100.0	100.0	100.0	100.0
Agriculture (YAR)	36.4	29.1	23.1	31.5
Manufacturing (YMNR)	17.6	19.4	19.4	18.6
Infrastructure (YINFR)	13.7	14.5	16.3	14.4
Services (YSRR)	32.3	37.0	41.2	35.5

Source: NAS

3.3.2 Prices:

The growth rate in wholesale price index (P), in other words, rate of inflation averaged 7.7% per annum in the entire study period. Inflation was higher in 90's (7.8%) when compared to 80's (6.6%) (Table-3.3). It was quite low (3.5%) during 2000-02. There were considerable year to year fluctuations in the annual rate of

inflation ranging from 3.3% to 18.2%. The wholesale price index was fluctuating between 0.505-1.130 (with 1993-94 value as 1.00) from 80's to 90's.

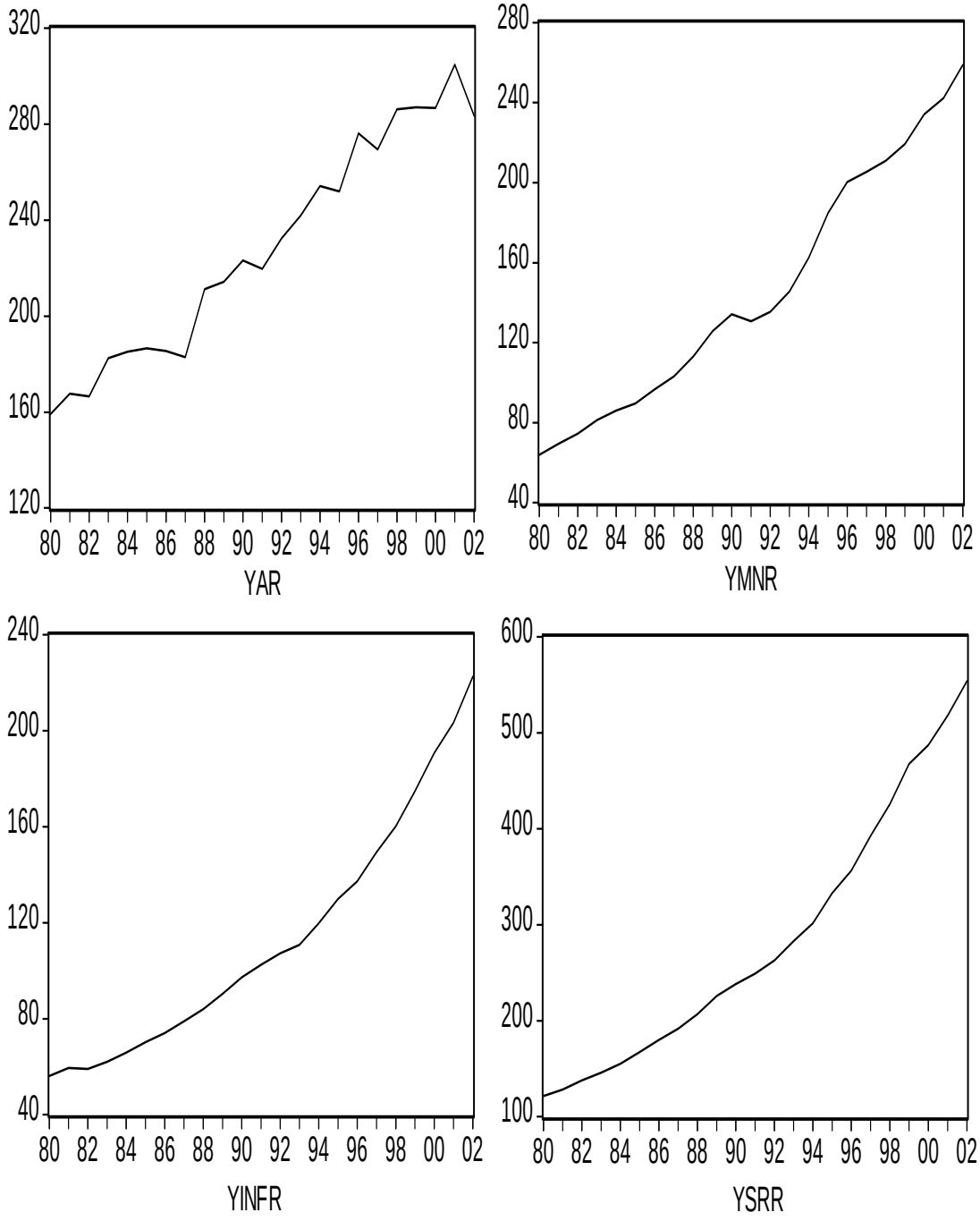
There were differences in the rate of increase in prices of different commodity groups. The growth rate in the price of agriculture commodities (WPAG) was on the average fluctuating between 7.8% and 8.8% in 80's to 90's, whereas the rate of growth in manufacturing prices (WPMN) was fluctuating between 6.4% and 7.0% in the same period. The rate of change in wholesale price index of fuel, power, light and lubricants (WPFPLL) was on the average 5.0% in 80's but it has drastically increased to 9.3% in 90's. It was 8.3% during 1980-2002. Wholesale price index for all types of commodities marked a very moderate growth rate during 2000-02.

Table - 3.3: Average Annual Compound Growth Rate in Prices (%)

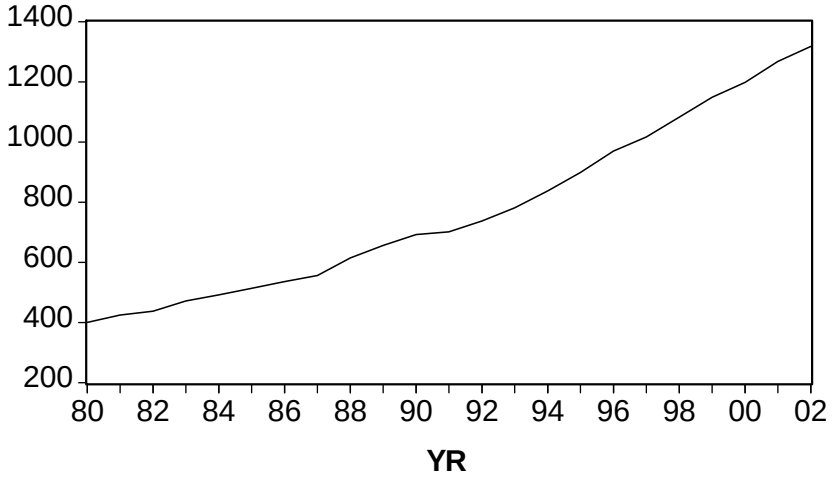
Variable	**1980-81 To 1989-90**	**1990-91 To 1999-00**	**2000-01 To 2002-03**	**1980-81 To 2002-03**
Wholesale Price Index (P)	6.6	7.8	3.5	7.7
Wholesale Price Index of Agriculture products (WPAG)	7.8	8.8	3.5	8.4
Wholesale Price Index of Manufacturing Products (WPMN)	6.4	7.0	2.2	7.1
Wholesale Price Index of Fuel, power, light lubricant (WPFPLL)	5.0	9.3	7.1	8.3

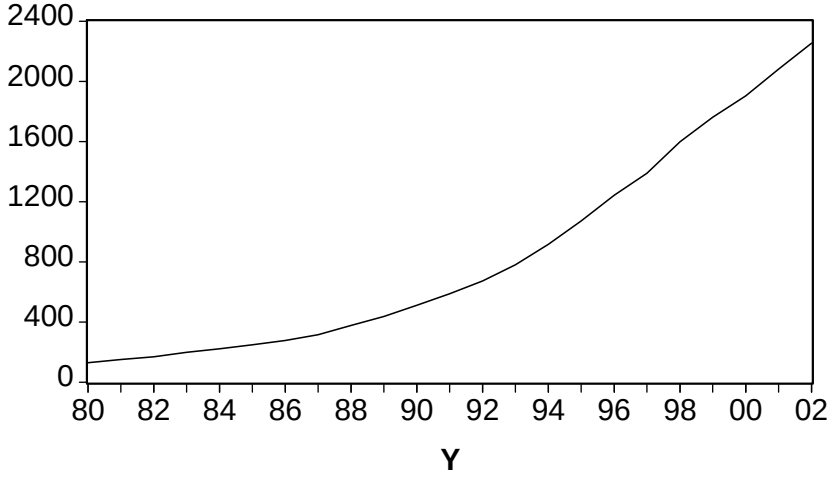
Source: RBI

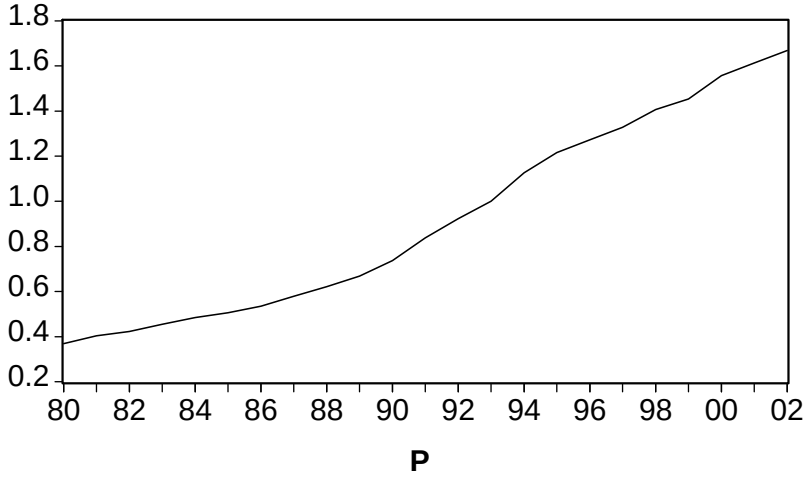
Panel-3.1: Trends in the observed values of real gross domestic product of each sector
(Values are in Rs.000'crores)



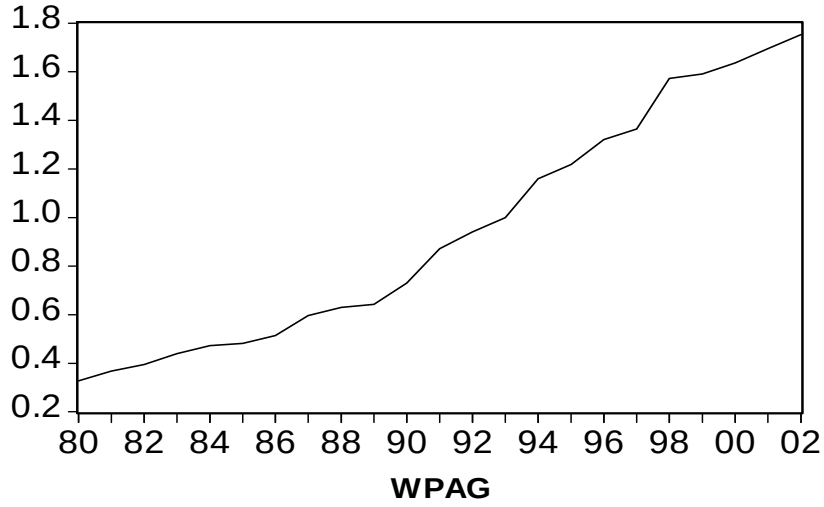
Panel-3.2: Trends in the observed values of nominal GDP (Y), real GDP (YR) and wholesale price index (P; 1993-94=1) (Values are in Rs.000'crores)

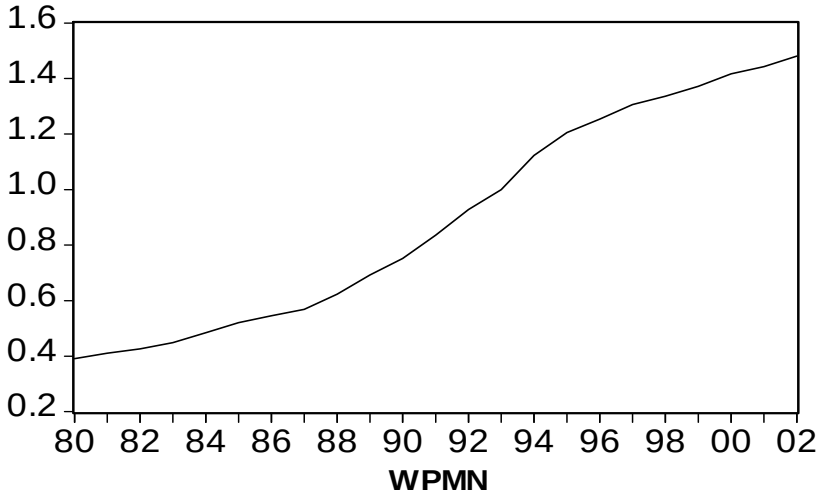


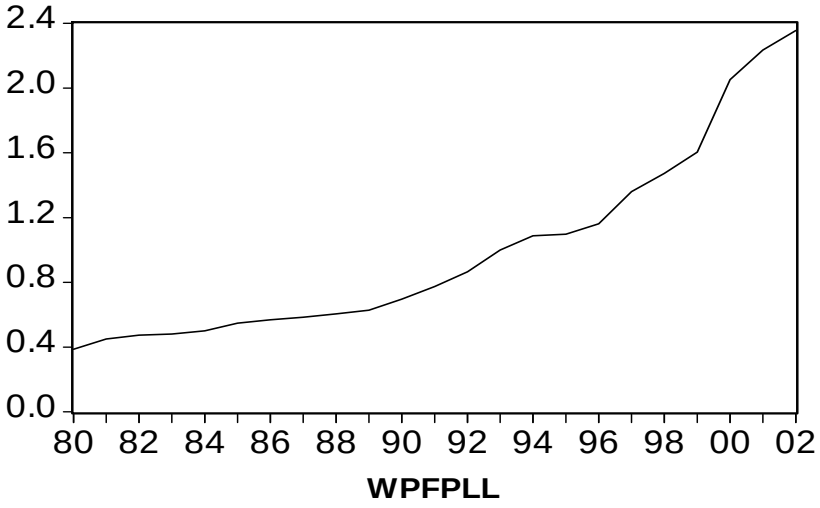




Panel-3.3: Trends in the observed values of wholesale price index of agriculture, manufacturing & fuel, power, light lubricants (1993-94=1)







3.3.3 Private Investment and Consumption:

The aggregate real private investment (PITOTR) recorded a distinct improvement from 80's 90's. It has accelerated from a low 4.7% in '80s to 9.1% during '90s but notably decelerated (4.5%) during 2000-03 (Table-3.4). The compound growth rate for the total study period was moderate at 6.8%. This increase can be attributed to agriculture (from 2.6% to 4.1% p.a.) and manufacturing in which the real private investment (PIMNR) has increased from 4.4% in 80's to 12.5% in 90's. It seemed to take the major share in the aggregate investment in 80's and 90's also. However the growth rate in real aggregate private investment marked a negative growth rate of 4.5% during 2000-02. This deceleration can be attributed to the steep decline in the real private investment in manufacturing (-0.2%) and infrastructure (-23.5%) sectors. The real private investment in agriculture (PIAGR) recorded a low growth rate (2.6%) during 80's. However, it has stepped up to 4.1% during 90's and 4.6% during 2000-02. The compound growth rate during 1980-2002 was 4.2%. The real investment in infrastructure (PIINFR) recorded a stable growth rate, a little above 6.0%, during '80s and '90s. It was 6.8% during 1980-2002. The service sector real investment (PISRR) has slightly accelerated from 5.5% in 80's to 5.6% during 90's. However it drastically decreased to 1.3% during 2000-02. It was 6.5% during 1980-2002. The growth rate of private consumption was a very modest 4.1% per annum a rate slower than that of GDP in 80's. It has accelerated to 4.6% in 90's and recorded a moderate 4.5% growth rate during 1980-2002.

Table - 3.4: Average annual compound growth rate in private investment and consumption (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real Private Investment (PITOTR)*	4.7	9.1	-4.5	6.8
Agriculture (PIAGR)*	2.6	4.1	4.6	4.2
Manufacturing (PIMNR)*	4.4	12.5	-0.2	7.4
Infrastructure (PIINFR)*	6.1	6.2	-23.5	6.8
Services (PISRR)*	5.5	5.6	1.3	6.5
Real Private Consumption (PCR)*	4.1	4.6	4.3	4.5

Source: NAS
*: Annual compound growth rates calculated after taking 3 year moving averages

3.3.4 Public Sector Investment and Savings:

Public sector includes administrative departments, department enterprises, non-departmental enterprises and quasi government bodies[8]. Data on aggregate and sector wise real public investment is collected from NAS. The slackening of growth is visible across all sectors except services from 80's to 90's and the aggregate real public investment (PCFTOTR) has also decelerated from 80's to 90's. The decade wise compound growth rate of aggregate real public investment marked as 4.0% in 80's and it rapidly fell to 1.8% in 90's (Table-3.5). It was 2.4% during 1980-2002. The share of total public investment in aggregate real output fell from 11.3% in 80's to 8.5% in 90's. It has further reduced to 6.4% during 2000-02. (Table-3.7). Public investment has been worsened in agriculture

[8] Data is available for quasi govt. bodies from 1993-94 only.

throughout the study period and it recorded a negative growth rate during 1980-2002. However in 80's Public investment in agriculture (PCFAGR) and manufacturing (PCFMNR) grew quite rapidly with agriculture registering some of the fastest rates it has ever recorded and it slowed down in the 90'. Agriculture's share of public investment in total was 11.6% in 80's and it gradually fell to 6.5% in 90's (Table-3.6) and it continued its fall (6.1%) in 2000-02. Manufacturing share of public investment also followed the same path as agriculture but with a better growth rates. The period between 1980 and 1989 witnessed a marked rise in manufacturing public investment and recorded a 5.4% growth rate, but it declined very fast and recorded a negative growth rate of -0.3% between 1990 and 1999. The share of manufacturing in total public investment fell from 25.9% in 80's to 22.3% in 90's and 12.9% during 2000-02. On the other hand the share of infrastructure and services in total public investment accelerated from 80's to 90's and for the period 2000-02. Infrastructure share of public investment increased from 38.0% in 80's to 44.3% in 90's and 49% during 2000-03. In the same way services share of public investment in total increased from 24.5% in 80's to 26.9% in 90's and 31.9% during 2000-02. However the compound growth rate of public investment in infrastructure (PCFINFR) declined rapidly from 6.9% in 80's to 2.2% in 90's and it recorded a negative growth rate of 3.1% during 2000-02. The year-to-year growth rate of infrastructure public investment marked the highest of 25.8% in the year 1986-87. However, it rapidly fell and recorded a negative growth rate (-1.5%) in 1987-88. Where as service sector public investment (PCFSRR) has been accelerated from 2.1% in 80's to 3.5% in 90's, but it rapidly fell down and marked a negative growth rate of 16.9% during 2000-02. It marked the highest year-to-year growth rate as 27.2% in 1999-2000.

The decade wise compound growth rate of nominal public savings (GDSPUB) gives very dissimilar results. The performance of public sector savings was sluggish. Public savings seemed to grow at a very low rate of 0.7% in 80's and stepped up unimaginably and marked a 21.0% growth rate in 90's. Public savings again decelerated and recorded a negative growth rate (-14.5%) during 2000-02 (Table-3.5) owing to sharp deterioration in the savings of government administration. It would be better to look into year-to-year growth rates instead of looking at decade wise compound growth rates. Annual growth rates give us the better picture of such high fluctuations in public savings occurred in 90's. The year-to-year growth rates of public savings marked usually high growth rates in the years 1991-92 (118.7%), 1994-95 (209.4), 2000-01 (141.2%). Both 80's and 90's witnessed negative growth rates in public savings. Public savings gradually deteriorated from the second half of 90's. Public savings even turned negative over the 5-year period 1998-2002 owing to sharp deterioration in savings of the government administration (Rakesh Mohan, 2008). The year-to-year growth rate marked a very high negative growth rate 1998-99 (-184.7%). Though the public sector revenues were increasing, because of increase in public current expenditure a little above revenues, the share of nominal public savings in nominal output was just above 3.1% in both 80's and it has reduced to 1.1% in 90's. As discussed before nominal public savings turned negative from 1998-99 to 2000-02. The share of nominal savings in nominal output between 2000-01 and 2002-03 was 2.2%. It became negative in the share was marked 1.4% during 1980-2002 (Table-3.7).

Table - 3.5: Average Annual Compound Growth Rate in Real Public Investment and Savings (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real Public Investment (PCFTOTR)*	4.0	1.8	-3.8	2.4
Agriculture (PCFAGR)*	-3.9	-0.3	5.2	-2.2
Manufacturing (PCFMNR)*	5.4	-0.3	31.2	-0.7
Infrastructure (PCFINFR)*	6.9	2.2	-3.1	3.9
Services (PCFSRR)*	2.1	3.5	-16.9	3.9
Nominal Gross Public Savings (GDSPUB)	0.7	21.0	-14.5	7.1

Source: NAS
*: Annual compound growth rates calculated after taking 3 year moving averages

Table - 3.6: Share of each Sector's Real Public Investment in Aggregate (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real Public Investment(PCFTOTR)	100.0	100.0	100.0	100.0
Agriculture (PCFAGR)	11.6	6.5	6.1	8.7
Manufacturing (PCFMNR)	25.9	22.3	12.9	22.6
Infrastructure (PCFINFR)	38.0	44.3	49.0	42.2
Services (PCFSRR)	24.5	26.9	31.9	26.5

Source: NAS

Table - 3.7: Share of each Sector's Real Public Investment in Real GDP (%)

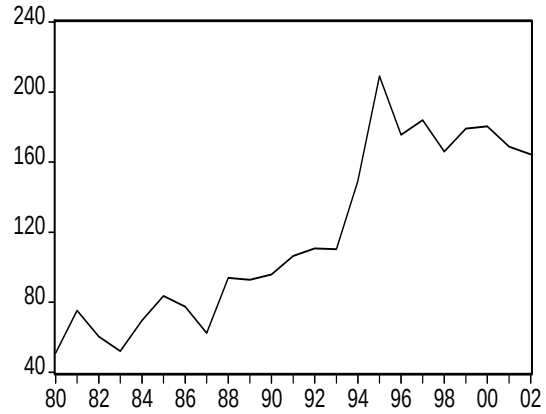
Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real GDP	100.0	100.0	100.0	100.0
Real Public Investment(PCFTOTR)	11.3	8.5	6.4	9.5
Agriculture (PCFAGR)	1.3	0.6	0.4	0.9
Manufacturing (PCFMNR)	2.9	1.9	0.8	2.2
Infrastructure (PCFINFR)	4.3	3.8	3.9	3.1
Services (PCFSRR)	2.8	2.3	2.5	2.1
Nominal Gross Public Savings (GDSPUB) (share in nominal GDP)	3.1	1.1	-2.2	1.4

Source: NAS

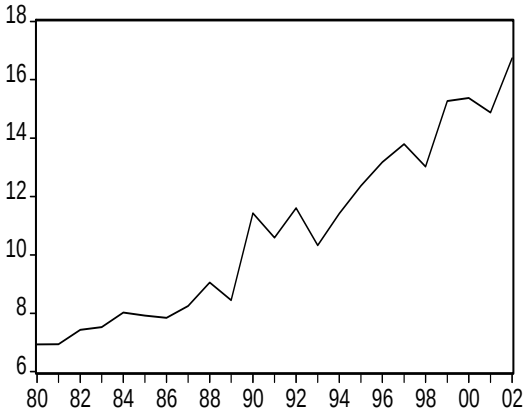
Table - 3.8: Share of each Sector's Investment in Aggregate Investment (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real Total Investment (PITOTR+PCFTOTR)	100.0	100.0	100.0	100.0
Real Private Investment (PITOTR)	55.3	65.8	68.2	61.5
Agriculture (PIAGR)	6.2	5.6	6.3	5.9
Manufacturing (PIMNR)	26.6	34.9	31.8	30.9
Infrastructure (PIINFR)	7.1	8.0	8.7	7.7
Services (PISRR)	15.4	17.3	21.3	17.0
Real Public Investment (PCFTOTR)	44.8	34.2	31.8	38.5
Agriculture (PCFAGR)	5.2	2.2	2.0	3.5
Manufacturing (PCFMNR)	11.6	7.6	4.1	8.9
Infrastructure (PCFINFR)	17.0	15.1	15.6	16.0
Services (PCFSRR)	11.0	9.2	10.1	10.2

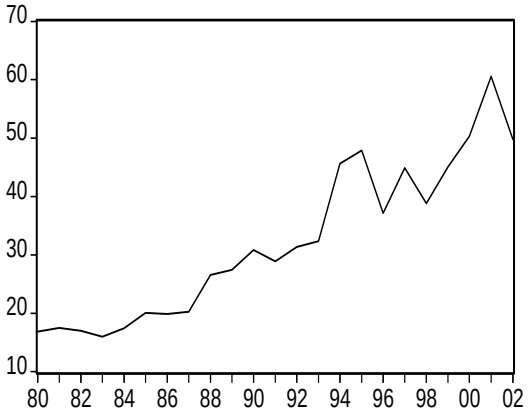
Panel-3.4: Trends in the observed values of aggregate and sectorwise real private investment (Values are in Rs.000'crores)



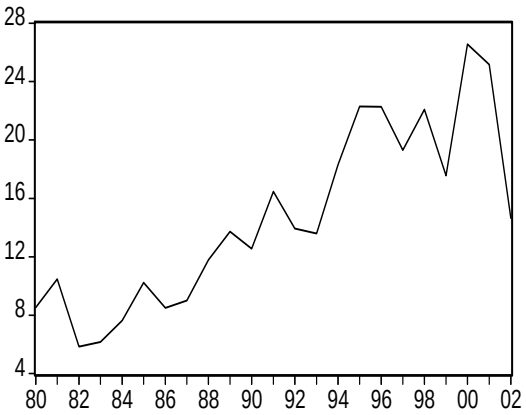
PITOTR



PIAGR



PISRR



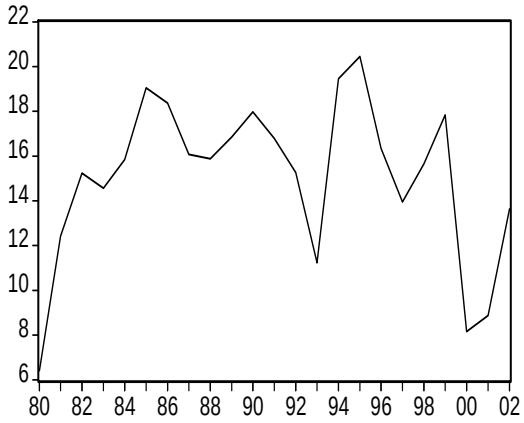
PIINFR

PIMNR

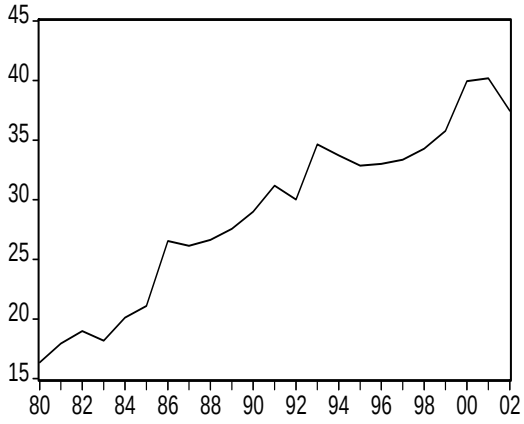
Panel-3.5: Trends in the observed values of aggregate and sectorwise real public investment (Values are in Rs.000'crores)

PCFTOTR

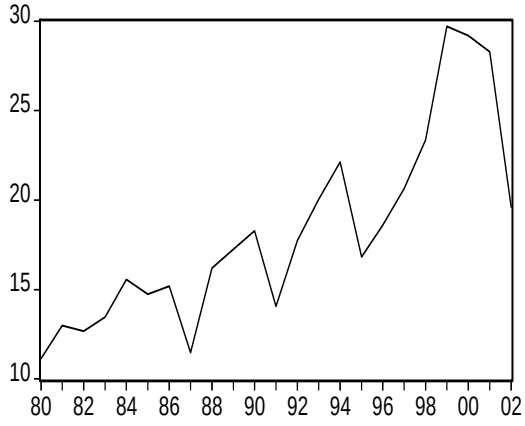
PCFAGR



PCFMNR



PCFINFR



PCFSRR

3.3.5 Fiscal and Monetary Variables:

Fiscal Variables:

In developing countries, the economic decisions of the government play an important role in studying the economy. Government total expenditure consists of current and capital expenditures (public investment). Increase in government current expenditure does not lead to any increase in tangible output and therefore it can be inflationary. In the model, these variables appear both in current and constant prices. As expected, variables those are in current prices show high rates of change compared to their counterparts in constant prices, signifying rapid rise in prices, or presence of inflationary effects. The data on all fiscal variables except for gross fiscal deficit is collected from NAS. The data on gross fiscal deficit is taken from RBI.

Nominal government final consumption expenditure (GFCE) grew at a high 17.4% in 80's and it decelerated marginally to 16.3% in 90's and it further slowed down to 4.2% during 2000-02. This high growth rate in government consumption must have stimulated large fiscal deficit during 80's and early 90's. Both external and internal borrowing allowed the government to maintain high levels of public expenditures and thus boost GDP growth through demand but eventually these factors ended up 1991 crisis (Panagaria, 2004). The government final consumption expenditure grew at 15.6% in the study period (Table-3.9). The real government final consumption expenditure has grown at 7.3% during 1980-2002 which far exceeded the GDP growth. In contrast, the growth of private consumption was at 4.4% which is less than GDP growth during 1980-2002. Government current expenditure includes final consumption expenditure,

subsidies and other inter government transactions. Nominal subsidies grew at a high 21.9% in 80's ad rapidly fell to 11.1% in 90's. Nominal subsidies marked 14.4% growth rate during 1980-2002. On the revenue side of the government total revenues (TR) include tax & non-tax revenues. The compound growth rate in government revenues has decelerated from 16.5% in 80's to 13.7% in 90's. The growth rate in revenues further decelerated to 9.1% during 2000-02. Revenues grew at 14.4% per year during the study period. The government expenditure, which was more than its revenues, widened the fiscal deficit in 1980's. As a result, fiscal deficit escalated sharply and reached 8.9% of nominal GDP in 80's. Increase in fiscal deficit necessitated the borrowing requirements which in turn lead to higher public debt. The BOP crisis in 1990-91 and consequent economic reforms related to elimination of automatic monetisation of fiscal deficit, introducing the market determined interest rates, tax reforms and investment policies etc. lead to further decrease in government expenditure as well as revenues resulting in lower fiscal deficit in 90's compared to 80's. As a result, the share of fiscal deficit has decreased to 8.5% in 90's. The compound growth rate in fiscal deficit was 18.7% in 80's and it fell to 15.8% in 90's. In the study period it marked 15.4%. Its share has increased to 10.6% during 2000-02 and it was 9% during the total study period, 1980-2002.

Table - 3.9: Average Annual Compound Growth Rate in Fiscal Variables (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Nominal Govt. Final Consumption Expenditure (GFCE)	17.4	16.3	4.2	15.6
Nominal Subsidies	21.9	11.1	13.5	14.4
Nominal Govt. Revenues (TR)	16.5	13.7	9.1	14.4
Nominal Gross Fiscal Deficit (GFD)	18.7	15.8	8.5	15.4

Source: NAS, RBI

Monetary Variables:

The data on all monetary variables are collected from RBI. Government borrows from the Reserve bank to fill the uncovered fiscal deficit. The Reserve Bank credit to government (RCG) plays an important role, as a component of reserve money, in determining money supply, which in turn affects the interest rate. The growth rate in RBI credit to government was very high at 17.7% during 80's compared to 90's (6.5%). The growth rate in RCG even turned negative (-10.9%) during 2000-02. It remained 10.5% during the study period (Table-3.10). However RBI foreign exchange assets (RBFA), another important component of reserve money, gained importance in 90's. The growth rate of RBI foreign exchange assets was phenomenal at 36.4% in 90's. On the average it increased at 29.2% during 1980-2002. The other components in reserve money (RM) are reserve bank credit to commercial sector (RBCS), govt. currency liabilities (GCL) less non-monetary liabilities of RBI (RNML). As a total, reserve money grew at 15.2% per year during the study period. The growth rate of reserve money stepped down from

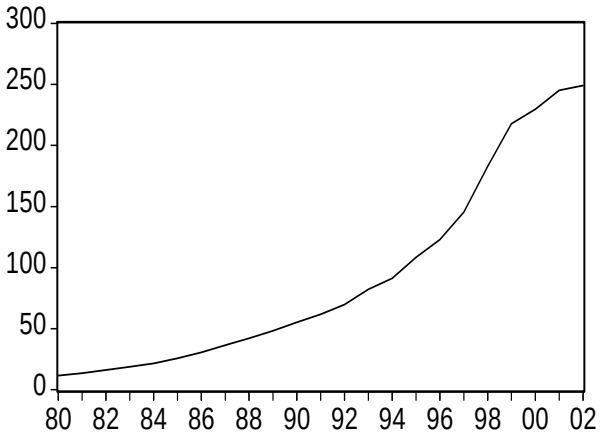
16.9% in 80's to 14.2% in 90's. Money supply (M3) grew much faster rate than real GDP. The compound growth rate of money supply was stable around 17% in the entire study period. Money supply share of real GDP grew from 23.0% in 80's to 65.9% in 90's.

Table - 3.10: Average Annual Compound Growth Rate in Monetary Variables (%)

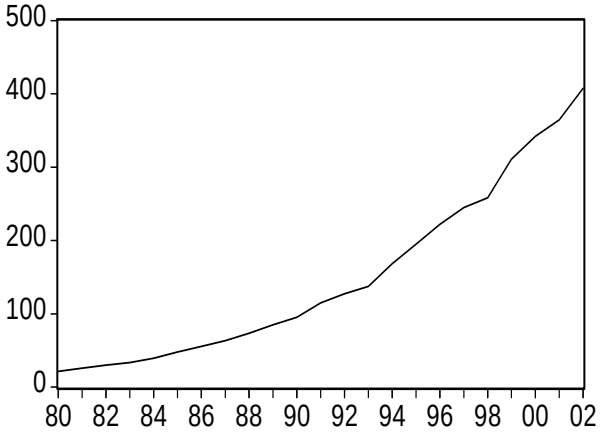
Variable	**1980-81 To 1989-90**	**1990-91 To 1999-00**	**2000-01 To 2002-03**	**1980-81 To 2002-03**
Reserve Money (RM)	16.9	14.2	10.3	15.2
Money Supply (M3)	17.3	17.4	14.4	17.2
RBI credit to Govt. (RCG)	17.7	6.5	-10.9	10.5
RBI foreign Exchange assets (RBFA)	10.9	36.4	34.8	29.2

Source: RBI

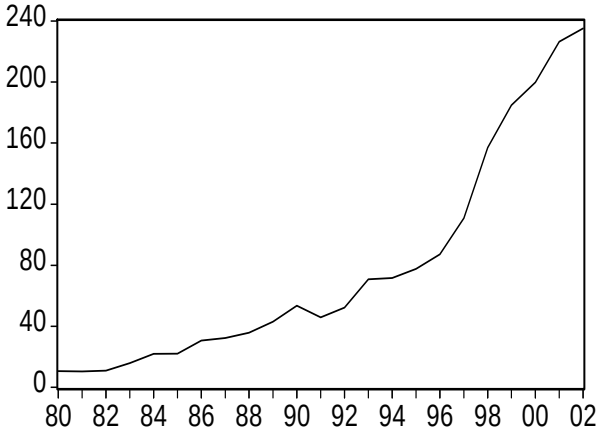
Panel-3.6: Trends in the observed values of govt. consumption exp. (GFCE), toral revenues (TR) and gross fiscal deficit (GFD) (Values are in Rs.000'crores)



GFCE

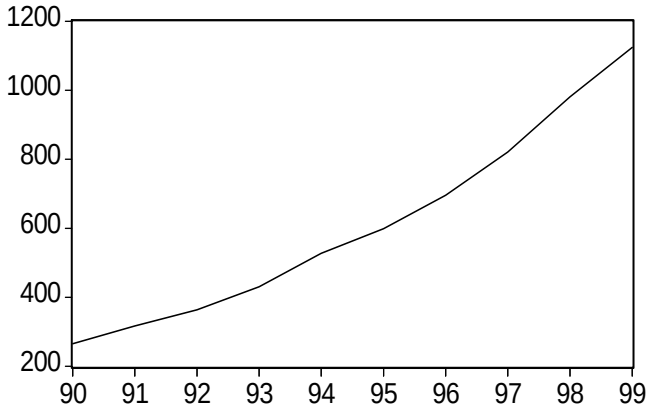


TR

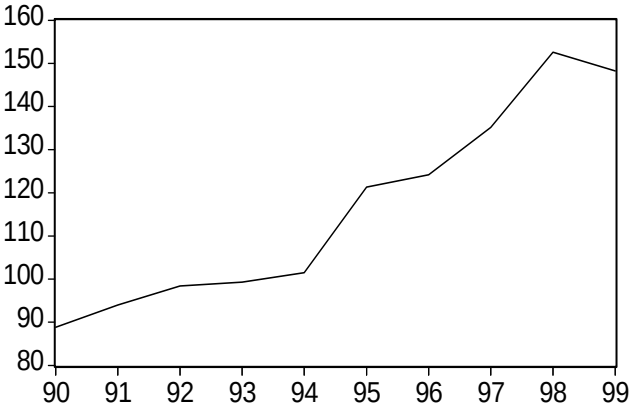


GFD

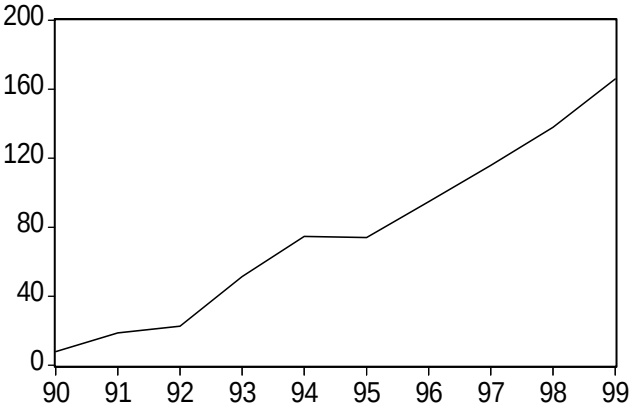
Panel-3.7: Trends in the observed values of Money supply (M3), RBI foreign exchange assets (RBFA), RBI credit to govt.(RCG) (Values are in Rs.000'crores)



M3



RCG



RBFA

3.3.6 External Sector:

The data on external sector variables is collected from RBI (Source: DGCI & S; Hand book on Indian Economy). Despite the existence of comprehensive quantitative trade restrictions along with high levels of tariffs, the balance of payments was under continuous pressure through the 1960s, 1970s and 1980s. Consequently, exogenous shocks such as oil price rises, or monsoon failures, invariably led to large crises necessitating recourse to IMF resources. With the existence of these trade restrictions, the exchange rate was typically overvalued over a long period of time. Hence, among the first reform moves was an ex ante real devaluation of the exchange rate in 1991 and a move of the exchange rate regime from that of a crawling peg towards a market determined one, though somewhat managed. The government began a process of gradual liberalization of trade, investment, and financial markets. Import and industrial licensing requirements were eased, and tariffs replaced some quantitative restrictions.

The export growth was slow in 80's but picked up in 90's. The compound growth rate of real exports (EXPTR) or exports volume was 4.2% in 80's and there was a steep acceleration to 11.3% per year during 90s and it further increased to 12.7% during 2000-02 (Table-3.11). Real exports grew at 9.7% per year during the study period. In the first half of 80's real exports marked a very low annual growth rate, in fact the years 1983-84 (-3.0%) and 1985-86 (-7.8%) registered a negative growth rate. It considerably picked up from 1986-87 and registered high growth rates in 1987-88 (15.6%) and 1989-90 (14.8%). Panagariya (2004)[9] argues that this sudden rise in real exports volume occurred because several export incentives

[9] See Aravind Panagariya (2004) for more discussion about export incentives given after 1985.

were introduced or expanded after 1985. Joshi and Little (1994) attribute a considerable part of the success in export expansion during the second half of the 1980s to the exchange rate management. Indian exports grew considerably faster than world trade and as fast as the exports of comparable developing countries after 1986-87, (Joshi and Little 1994, Chapter 7, p. 183). The years 1991-92 and 1993-94 registered less annual growth rate in real exports compared to late 80's. But it picked up faster after 1993-94 and marked 31.40% in 1995-96, which is the highest during 1980-2002. The ratio of total exports to GDP was around 7% in 80's and in the first of 90's and it started picking up from 1995-96. The ratio of total exports to GDP in India approximately doubled from 7.6% in 1990-91 to 14% in 2002-03.

Growth in real imports (IMPTR) has accelerated from 80's (5.8%) to 90's (13.6%) and again decelerated to 7.2% during 2000-02. They grew at 9.2% per year during 1980-2002 (Table-3.11). Panagaria (2004) argues that expansion of export incentives after 1995 helped expanding imports directly when imports were tied to exports and indirectly by relaxing the foreign exchange constraint. Though the decade wise average compound growth rates show a drastic increase from 80's to 90's, the year-to-year growth rates were highly fluctuating during the study period. In fact they were recorded negative in the years 1984-85 (-15.8%), 1987-88 (3.6%), 1991-92 (-4.1%), 1996-97 (-0.6%), 2000-01 (-0.9%). The annual growth rate was highest at 26.90% in the year 1995-96. The share of current account balance in nominal GDP was 2.1% in 80's and 1.4% in 90's. The continued large fiscal deficits inevitably fed into the current account deficits,

which kept rising steadily until they reached 3.4 percent of GDP in 1990–91. The eventual outcome of these developments was the BOP 1991 crisis.

The bilateral exchange rate (Rs per US $) has been depreciating throughout the study period. The compound growth rate in bilateral exchange rate (EXR), Indian rupee Vs dollar has increased from 80's (7.6%) to 90's (9.1%). The devaluation of rupee in 1991 worsened the current account deficits hence the crisis. The exchange rate regime in India has undergone significant changes since independence and particularly during the beginning of 1990. From 1975, the Rupee's ties to the Pound Sterling were broken. India introduced a managed floating exchange regime with the Rupee's effective rate placed on a controlled, floating basis and linked to a "basket of currencies" of India's major trading partners. In early 1990s, the above exchange rate regime came under severe pressures from the increase in trade deficit and net invisible deficit, which led the Reserve Bank of India (RBI) to devaluate the Rupee in two stages in 1991. This adjustment was followed by the introduction of the Liberalized Exchange Rate Management System (LERMS) in 1992 and hence the adoption of, for the first time, a dual (official as well as market determined) exchange rate in India. Subsequently, in March 1993, the LERMS was replaced by the unified exchange rate system and hence the system of market determined exchange rate was adopted.

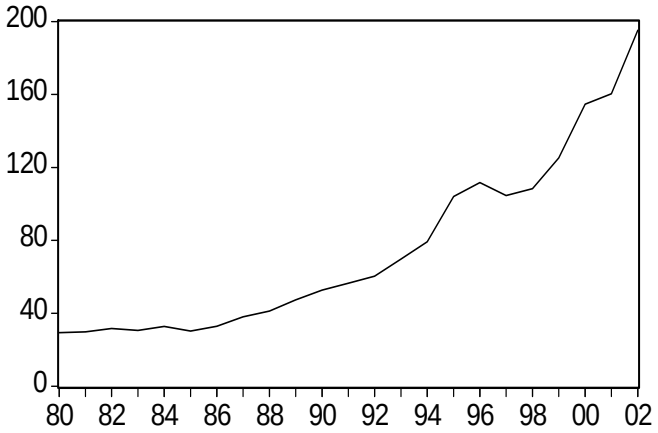
Table-3.11: Average Annual Compound Growth Rate in External Sector (%)

Variable	1980-81 To 1989-90	1990-91 To 1999-00	2000-01 To 2002-03	1980-81 To 2002-03
Real Exports (EXPTR)*	4.2	11.3	12.7	9.7
Real Imports (IMPTR)*	5.8	13.6	7.2	9.2
Nominal Exchange Rate (EXR) (RS/US $)	7.6	9.1	4.0	9.4
Average Share				
Current Account Balance / GDP	-2.1	-1.4	0.51	-1.0

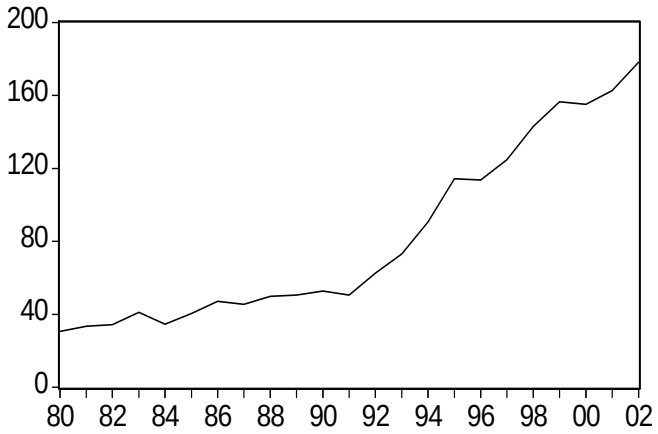
Source: RBI

*: Annual compound growth rates calculated after taking 3 year moving averages

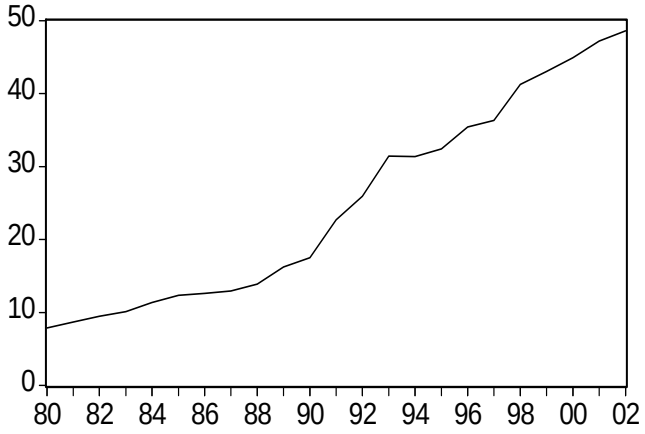
Panel-3.8: Trends in the observed values of real exports (EXPTR), real imports (IMPTR) and exchange rate (EXR: Rs/$) (Values are in Rs.000'crores)



EXPTR



IMPTR



EXR

In short, the analysis of growth rates and trends of the all macro variables in the model lead to the following important features.

1. The real GDP grew at the rate of 5.7% during the study period. The real output in manufacturing, infrastructure and services sectors grew at above 6% during 1980-2002. In contrast agriculture was stable at 3% in the entire study period.

2. Private investment showed a rapid increase in manufacturing sector in the entire period. Rest of the sectors witnessed a little slow down during the study period.

3. Public investment rapidly decelerated in all sectors except in service sector during 1980-2002 though not in the same rate. Infrastructure and agriculture marked a very poor rate of growth in the 90's and after.

4. Public sector savings witnessed a slow progress in 80's despite of fast increase in public sector revenues. However public savings picked up drastically and marked very high growth rates in 90's. Public sector current expenditure rose at a faster rate than public sector revenues during the study period. Fiscal deficit marked a very high growth rate in the study period. Nevertheless the share of fiscal deficit in nominal GDP was almost stable during the study period.

5. Money supply grew at a faster rate than real GDP during 1980-2002. RBI foreign exchange assets assumed importance in and after 90's where as RBI credit to government marked a slow down after 90's.

6. Real exports and imports increased at a very high rate from 80's to 90's where the later grew faster than the former leading to larger trade deficit. Nominal exchange rate has been depreciating throughout the study period.

APPENDIX-3.1

Description of the Variables

Data Sources: National Accounts Statistics published by CSO,
Handbook of Statistics on Indian Economy published by RBI,
International Financial Statistics published by IMF,
World Bank Reports.

Period: 1980-81 to 2002-2003

List of Variables:

Endogenous Variables (Rs. Crores):

1. ABSP: Real private absorption (NAS)
2. AD: Real aggregate absorption (NAS & RBI)
3. ADD: Real aggregate demand for domestically produced goods (NAS & RBI)
4. BCP: Bank credit to commercial sector (Nominal) (RBI)
5. CAB: Current account balance (Nominal) (RBI)
6. DEPAG: Real depreciation in agriculture (NAS)
7. DEPINF: Real depreciation in infrastructure (NAS)
8. DEPMN: Real depreciation in manufacturing (NAS)
9. DEPSR: Real depreciation in services (NAS)
10. DT: Direct tax revenues (Nominal) (NAS)
11. EXPT: Exports (DGCI&S) (Nominal) (RBI)
12. EXPTBOP: Exports (Merchandise) (Nominal) (RBI)
13. EXPTR: Real exports (DGCI&S) (RBI)
14. EXR: Exchange rate against US $ (Nominal, Rs. /$) (RBI)
15. EXRIDX: Index of exchange rate - Rs./$ (Base: 199394=1.000)(Nominal)(RBI)
16. GCE: Govt. current expenditure (ADORC) (Nominal) (NAS)
17. GCFADJ: Gross domestic capital formation by type of assets (adj) (Nominal NAS)
18. GCFTOT: Gross domestic capital formation by using sectors (Nominal) (NAS)

19. GDS: Gross domestic savings (Nominal) (NAS)
20. GDSADORC: Gross domestic savings of ADORC (Nominal) (NAS)
21. GDSPUB: Gross domestic savings of public sector (Nominal) (NAS)
22. GFCE: Govt. final consumption expenditure (doesn't include consumption of fixed capital) (ADORC) (Nominal) (NAS)
23. GFD: Gross fiscal deficit of both central and state govt. (Nominal) (RBI)
24. GXP: Govt. total expenditure (including current and capital) (ADORC) (Nomial) (NAS)
25. HCRRUR: Head count ratio in rural areas (%)
26. HCRURB: Head count ratio in urban areas (%)
27. IDT: Indirect tax revenues (Nominal) (NAS)
28. IMPT: Imports (DGCI&S) (Nominal) (RBI)
29. IMPTBOP: Imports (Merchandise) (Nominal) (RBI)
30. IMPTR: Real imports(DGCI&S) (RBI)
31. KAGR: Real net capital stock in agriculture (NAS)
32. KINFR: Real net capital stock in infrastructure (NAS)
33. KMNR: Real net capital stock in manufacturing (NAS)
34. KSRR: Real net capital stock in services (NAS)
35. M3: Money supply (Nominal) (RBI)
36. NTX: Non-tax revenues (including income from entrepreneurship and property and miscellaneous current receipts (Nominal) (NAS)
37. P: Wholesale price index (1993-94=1.0) (RBI)
38. PCFTOTR: Real aggregate public investment (NAS)
39. PCR: Real private consumption (NAS)
40. PGDP: GDP deflator (1993-94=1.0) (NAS)
41. PGKE: Implicit price deflator for public sector investment (1993-94=1.0) (NAS)
42. PIADJR: Real aggregate private investment adjusted to errors & omissions (NAS)
43. PIAGR: Real gross private investment in agriculture (NAS)
44. PIINFR: Real gross private investment in infrastructure (NAS)

45. PIMNR: Real gross private investment in manufacturing (NAS)

46. PISRR: Real gross private investment in services (NAS)

47. PITOTR: Real aggregate private investment (NAS)

48. PLR: Prime lending ratio (RBI)

49. PNA: Price of non-agriculture sector (NAS)

50. PPIE: Implicit price deflator for public sector investment (1993-94=1.0) (NAS)

51. PRAG: Price deflator for agriculture, forestry & fishing (Industry group 1 of NAS) (NAS)

52. PRINF: Price deflator for infrastructure incl. electricity, gas, water supply; construction; transport, storage & communication (Industry groups 4, 5 and 7 of NAS) (NAS)

53. PRMN: Price deflator for manufacturing incl. mining & quarrying (Industry groups 2 and 3 of NAS) (NAS)

54. PRSR: Price deflator for services incl. all others (Industry groups 6, 8 and 9 of NAS) (NAS)

55. PYD: Personal disposable income (Nominal) (NAS)

56. PYDR: Real personal disposable income (NAS)

57. RBFA: Net foreign exchange assets of RBI (Nominal) (RBI)

58. RCG: Reserve bank credit to the govt. (Nominal) (RBI)

59. RGPUB: Public sector resource gap (Nominal) (NAS)

60. RM: Reserve money (Nominal) (RBI)

61. TB: Trade balance (DGCI & S) (Nominal) (RBI)

62. TBBOP: Trade balance (Merchandise) (Nominal) (RBI)

63. TR: Govt. current revenues (ADORC) (Nominal) (NAS)

64. UVEXP: Unit value of exports (1993-94=1.0) (RBI)

65. WPAG: Wholesale price index for agricultural Commodities (1993-94=1.0)(RBI)

66. WPFPLL: Wholesale price index for minerals, fuels power, light and lubricants (1993-94=1.0) (RBI)

67. WPMN: Wholesale price index for manufactured products (1993-94=1.0) (RBI)

68. Y: Output at factor cost (Nominal) (NAS)

69. YAR: Real output in agriculture, forestry & fishing (Industry group 1 of NAS) (NAS)
70. YINFR: Real output in infrastructure incl. electricity, gas, water supply; construction; transport, storage & communication (Industry groups 4, 5 and 7 of NAS) (NAS)
71. YM: Gross domestic product at market prices (Nominal) (NAS)
72. YMNR: Real output in manufacturing incl. mining & quarrying (Industry groups 2 and 3 of NAS) (NAS)
73. YNAR: Real output in non-agriculture sector (=YMNR+YINFR+YSRR) (NAS)
74. YSRR: Real output in services incl. all others (Industry groups 6, 8 and 9 of NAS) (NAS)
75. YR: Real output at factor cost (NAS)

Exogenous Variables (Rs. '000 Crores):

1. AREA: Index of gross cropped area (1993-94=1.0) (RBI)
2. BCG: Commercial bank credit to government (Nominal) (RBI)
3. CRR: Cash reserve ratio (RBI)
4. DNB: Non-bank borrowings of both central and state govts. (Nominal) (RBI)
5. D81t91: Regime shift in exchange rate
6. D81t92: Dummy for pre reform period (1981-92)
7. D81t94 Unexpected fluctuations in WPMN, NTX
8. D81t96 Unexpected fluctuations in PRSR
9. D81t97 Unexpected fluctuations in GFCE
10. D81t99 Unexpected fluctuations in PRINF
11. D81, 95-6, 00-1: Unexpected fluctuations in PIINFR
12. D919496 Unexpected fluctuations in PLR
13. D92t97: Regime shift in exchange rate
14. D96 Unexpected fall in WPFPLL
15. D01 Unexpected fall in WPFPLL
16. EB: External borrowings by the govt. (Nominal) (RBI)

17. EM2: Errors and omissions in gross capital formation by using sectors (NAS)
18. GCL: Government's currency liabilities to public (Nominal)(RBI)
19. GDSRCNDQG: Gross domestic savings of railways, communications, non-departmental enterprises and quasi govt. bodies (Nominal) (NAS)
20. INVSB: Invisibles in current account balance (Nominal) (RBI)
21. MISCR: Other capital receipts of the govt. (Nominal) (RBI)
22. MISCRD: Miscellaneous bank credit available to commercial sector
23. MISRM: Miscellaneous components of reserve money including RBI non-monetary liabilities (Nominal) (RBI)
24. NCIF: Net capital inflows including net capital account in the balance of payments and errors & omissions (Nominal) (RBI)
25. NTOT: Aggregate population (millions) (NAS)
26. OGCE: Other govt. current expenditures (including IPD, CTS, IGAA) (Nominal) (NAS)
27. OTP: Other transfer payments (including IPD, CTS etc.) (Nominal) (NAS)
28. PCFAGR: Real gross public investment in agriculture (NAS)
29. PCFINFR: Real gross public investment in infrastructure (NAS)
30. PCFMNR: Real gross public investment in manufacturing (NAS)
31. PCFSRR: Real gross public investment in services (NAS)
32. RAIN: Annual rainfall (mm) (NAS)
33. RBCS: RBI credit to the commercial sector (Nominal) (RBI)
34. SUB: Subsidies (Nominal) (NAS)
35. UVIMP: Unit value of imports (1993-94=1.0) (RBI)
36. UVIMP4: Unit value of imports of Fuel (1993-94=1.0) (RBI)
37. WPEXP: World price index (1993-94=1.0) (IFS)
38. WPRW: Index of procurement prices of Rice and Wheat (1993-94=1.0) (RBI)
39. WYR: Real world income (IFS)

CHAPTER IV

Empirical Results of the Model

4.1 Introduction:

Large macroeconometric models, though a system of simultaneous equations (and indentities), are usually estimated using single equation methods namely ordinary least squares (OLS) or at most two stage least squares (2SLS) only. It has been well established that use of single equation methods to estimate simultaneous systems would result in simultaneity bias and inconsistent estimates. This limitation is often ignored by citing reasons such as shortness and unbalanced nature of the time series data, and non-availability of computer software for estimation of large systems. However, the proposed model in the present study is moderate in size (36 equations and 39 identities) and length of time series data is adequate (26 observations). More importantly, 'EViews' software has provision for systems estimation namely 3SLS and the same is used for estimation. Thus, the parameter estimates therefore, posses desirable statistical properties like asymptotic unbiased-ness and consistency. They will be efficient as well.

Since the model is a simultaneous system, statistical performance of individual equations has less importance. Despite these lacunae, the regression coefficients do help in understanding the economic behaviour of the underlying agents. However, there is a need to interpret the partial elasticities equation-wise.

The model includes 36 behavioural equations (estimated equations) and 39 identities. The structural equations are estimated by using annual data from 1980-81 to 2002-03. The initial period is taken as 1981-82. For completeness, all the

three methods of estimation viz. ordinary least squares (OLS), two-stage least squares (2SLS) and three-stage least squares (3SLS), are experimented with. The 3SLS estimates, which are also efficient, have been chosen for discussion and further analysis. 3SLS estimates are consistent and asymptotically normal and, under some conditions, asymptotically more efficient than single equation estimates (OLS).

The choice of variables and functional forms of equations are made on the basis of theoretical, and data availability criteria. While estimating the model, in some of the equations, 'trend' a catch all variable is included to capture the autonomous time related changes in the observed time series of endogenous variables. The trend variable reflects a host of excluded time related variables; some measurable and some other non-measurable. In some equations dummy variables are incorporated to neutralize the effects of outliers and sharp changes. This was necessary because some outliers arose due to changes in the definition of the variables. Dummy variables have also been introduced to incorporate the effects of major policy changes during the study period. One common dummy variable to dichotomise pre-liberalisation and liberalisation (1993-94 onwards) periods is included in many of the equations in the model. In some equations interaction dummies are also used. Wherever required, first order auto-correlation term is also introduced in specific equations. In addition, a lagged endogenous variable to represent partial adjustment mechanism is included in specific equations. Given the broad structure of the model, the empirical choice of the lag of each dependent variable, trend and dummy variable, is based on the usual statistical criteria such as expected sign of the coefficients, reasonableness of the magnitude of the

coefficients, their significance level, overall goodness-of-fit and Durbin-Watson or Durbin's h-statistic. Most of the estimated equations could trace the turning points reasonably well. (see Figures 4.1-4.15). Mean[10] elasticities are calculated for all regressors (excluding dummy variables) in each equations. Elasticities are given in table form for all important equations in Appendix-4.1.

Initially, the empirical results obtained by using 3SLS will be discussed equation-wise. This means, only the partial responses will be discussed under ceteris paribus condition. The net responses can be obtained only through complete model simulation, which will be called as impact and dynamic multipliers (Goldberger and Klein, 1970) One or a few similar equations together will be discussed at a time for convenience. The significance of the coefficients is judged by t-values given in brackets under each coefficient. DW or Durbin-h is given to judge the presence of serial correlation. The mean elasticities calculated for each dependent variable are partial elasticities and they are given with a 'EL' sign in general below t- values. Short-run and Long-run elasticities wherever applicable are also given with signs 'SR EL' and 'LR EL' respectively.

4.2 Estimated Model

Real Sector:

The real economy has been divided into four sectors namely agriculture, manufacturing, infrastructure and services. The level of economic activity is measured by output in each sector. It is supply driven in agriculture, manufacturing, infrastructure sectors and service sectors, whereas it is both supply

[10] Mean of each variable in the estimation period is considered.

and demand driven in manufacturing services. Capital formation and price behaviour take major part in explaining the real sector besides output.

Output:

Real GDP in Agriculture:

$$1.\ YAR = -262.417 + 32.099\ RAIN + 225.871\ AREA + 0.657\ KAGR_{-1}$$
$$(-25.75)\quad (9.83)\quad (16.70)\quad (26.68)$$
$$EL:\quad 0.13\quad 0.96\quad 0.87$$

$$+ 0.333\ YINFR - 0.485\ AR\ (1)$$
$$(17.24)\quad (-6.48)$$
$$0.17$$

$$\bar{R}^2 = 0.99 \qquad DW = 2.17$$

The real output in agriculture and allied activities (YAR) is determined by rainfall index (RAIN), gross cropped area (AREA) and lagged real net capital stock in agriculture (KAGR). It is also postulated that output in agriculture is constrained by capacity factor such as infrastructure output. Here, net capital stock appears with one year lag to represent the beginning of the year capital stock. Rainfall as well as gross cropped area has a positive relation with real output in agriculture as expected. Real net capital stock with one period lag and infrastructure output effects real GDP with a positive sign.

It is important to note that all the coefficients are statistically significant and the goodness of fit is high. After the inclusion of first order lagged residual term AR (1), the estimated Durbin-Watson value shows that there is no negative serial correlation at 1% level of significance. From the coefficient of the net capital stock variable in the agricultural output function, the implied ICOR in agriculture is low at 1.5. Thus, there exists significant (nearly unitary) output response in

Indian agriculture with respect to capital stock. It is interesting to note that there is a significant complementarity between outputs of agriculture and infrastructure, the latter acting as an essential input to the former. The estimated elasticity of real output with respect to gross cropped area and real capital stock turned out to be quite high at 0.96 and 0.87 respectively. This implies that for every 10% increase in any of these two factor inputs, the real aggregate agriculture output in the economy would increase by 9-10%. These elasticities are numerically high, implying high output response to changes in area or net capital stock. Elasticities of output with respect to rainfall index and infrastructure output are 0.13 and 0.17 respectively. This implies that for every 10% change in these variables agricultural output changes only 1.3% and 1.7% respectively.

Real GDP in Manufacturing:

2a. $YMNR = -2.638 + 0.125\ ADD + 0.049\ KMNR_{-1} + 0.177\ IMPTR + 0.701\ AR(1)$

	(-0.32)	(8.93)	(3.31)	(2.89)	(9.20)
EL:		0.73	0.20	0.10	

$\bar{R}^2 = 0.99$ DW = 1.26

Real output in manufacturing (YMNR) depends on aggregate demand (ADD), lagged net capital stock (KMNR) and real imports (IMPTR). Here the real output in manufacturing is influenced by both supply and demand factors. Interestingly aggregate demand has stronger effect on manufacturing output than other explanatory variables (according t-value). Given the capacity, demand governs output in manufacturing sector. Imports also play crucial role in determining manufacturing output, as they add to capital equipment and basic materials in producing output (Klein, 1988). In the manufacturing sector, which includes manufacturing and, mining and quarrying, the implied ICOR is very high at 20.4,

indicative of low productivity of capital or high capital intensity. The elasticity of output with respect to aggregate demand is high at 0.73 and that of net capital stock is much less at 0.2. For every 10% increase in the aggregate demand and net capital stock leads to 7% and 2% increase in the manufacturing output respectively. The imports multiplier seems to be positive. Though the Imports have a very less impact on manufacturing output, the coefficient of imports is statistically significant enough to postulate that the relationship between manufacturing output and imports is meaningful.

Alternative:

Real GDP in Manufacturing:

2b. $YMNR = 17.043 + 0.127\ (KMNR_{-1}*UT) + 7.800\ D94,96 + 0.469\ AR\ (1)$

	(-18.38)	(34.85)	(29.76)	(33.34)
EL:		0.44	0.01	

$\bar{R}^2 = 0.99$ DW = 1.60

Real output in manufacturing (YMNR) depends on the capital utilised i.e. interaction of lagged net capital stock in manufacturing (KMNR) and capacity utilization (UT). The capacity utilisation in turn depends on the rate of change in aggregate demand, money supply and real imports. A dummy variable is added to the unexpected fluctuations in the relation of interaction variable with manufacturing output. As expected the interaction variable has a positive effect on manufacturing output and it is highly significant. The elasticity of real output in manufacturing with respect to interaction variable is 0.44.

$$UT = 0.067 + 1.226\ \Delta ADD/ADD_{-1} + 0.278\ \Delta M3/M3_{-1} + 0.137\ \Delta IMPTR/IMPTR_{-1} + 0.769\ UT_{-1}$$

	(0.70)	(6.82)	(0.98)	(3.09) (9.25)
EL:		0.78	0.06	0.01

$\bar{R}^2 = 0.53$ DW = 1.08

Capacity utilization is a measure of the intensity with which an economy (or sector, or firm) makes use of its resources. The term is associated with a number of different concepts and methods of measurement. Output/capital ratio has been taken into consideration to calculate capacity utilization in manufacturing sector. Here capital is taken with one period lag. This method is used by Panic (1978), formerly with the British National Economic Development Office (NEDO), the Deutsches Institut fur Wirtschaftsforschung (DIW), and Statistics Canada. This measure relies on the existence of a stable proportional relation between the stock of capital and potential output. The method assumes that fluctuations in the observed output/capital (lagged) ratio are due to large deviations in output from its potential (Christiano 1981). According to the above said method, the capacity utilization calculation involves below steps.

Step1: Construct the series of output and lagged capital ratio (Y/K_{-1})

Step2: Construct "capacity" output/lagged capital series by fitting a linear trend to the actual output/lagged capital series (Y^c/K^c_{-1}). Plot both series one against another. This method assumes that actual and “capacity” output/capital ratios differ because of deviations of output from its potential.

Step3: Raise the trend line just enough to touch only one of the peaks in the actual output/capital ratio by adjusting the constant. Now the points on adjusted trend line gives the assumed "capacity" output/ capital ratio (Y^{ac}/K^{ac}_{-1}).

Step4: assumed "capacity" output/ capital ratio multiplied by lagged capital stock gives the potential output ($(Y^{ac}/K^{ac}_{-1}) * K_{-1} = Y^{P}$).

Step5: Construct the capacity utilization (CU) series by taking the ratio of actual and potential output ($CU=Y/Y^{P}$).

In the capacity utilization equation the elasticity of capacity utilization with respect to aggregate demand is high as 0.78. Though the rate of change in imports coefficient is highly significant and rate of change in money supply coefficient is not significant the elasticity of capacity utilization with respect to later is higher at 0.06 than the elasticity of capacity utilization with respect to former at 0.01.

Equation 2a has been selected for further analysis after comparing the in-sample validation of two equations (2a & 2b). Also when the summery measures like MAPE, RMPE Theil 'U', for two behavioural equations (2a, 2b) of manufacturing production function were compared, 2a found to performance better than 2b. Therefore 2a is selected for the base simulation and for other policy simulations.

Real GDP in Infrastructure:

3. $YINFR = -26.779 + 0.111\ KINFR_{-1} - 0.059\ (KINFR_{-1} * D81t92)$
(-8.51) (7.16) (-7.45)
SR EL: 0.36
LR EL: 3.24
$+ 24.853\ D81t92 + 0.888\ YINFR_{-1}$
(7.63) (27.14)

$\bar{R}^2 = 0.99$ DW = 2.42

Real output in infrastructure (YINFR) depends on the lagged net capital stock in infrastructure (KINFR) and lagged infrastructure output (YINFR) allowing slow adjustment. A dummy variable is included in the equation to represent pre reform period (1981-82 to 1992-93). The effect of lagged net capital stock in infrastructure on its real output is positive and highly significant in the reform period. It shows higher efficiency of capital in post 1993-94 period. For the infrastructure sector, the implied ICOR is 19 in the pre-reform period (1981-92) and 9 in reform period (1993-2002), which are somewhat high and reflect the relatively high capital intensity of this sector. Here the elasticities will be discussed in two folds. Since the lagged dependent variable is added to the equation, there will be short run and long run elasticities with respect to all explanatory variables. Likewise the interaction of dummy variable with the explanatory variable gives the elasticities in the pre and reform period. The short run elasticity of real output in infrastructure with respect to lagged net capital stock is 0.17 in the pre reform period and 0.36 in the reform period reflecting efficiency in the use of capital. Likewise the long run elasticity of real output in infrastructure with respect to lagged net capital stock is 0.65 in the pre reform period and 3.24 in the reform period.

Real GDP in Services:

4. $YSRR = -141.375 + 0.358\ KSRR_{-1} + 1.277\ YINFR + 0.379\ AR(1)$

	(-7.49)	(7.29)	(7.01)	(4.62)
EL:		0.98	0.51	

$\bar{R}^2 = 0.99$ DW = 1.48

Real output in services (YSRR) depends on the lagged net capital stock in services (KSRR) and infrastructure output (YINFR). It is also postulated that output in

services is constrained by capacity factor such as infrastructure output. The signs of the coefficients are as expected and statistically significant. The implied ICOR of the services sector is low at 2.8. The elasticity of real output in services with respect to lagged net capital stock in services and infrastructure output are 0.98 and 0.51 respectively.

Private Sector Activities:

Savings and investment processes are the root of economic growth for any developing country (Krishnamurthy, Pandit, Sharma, 1989). The Keynesian stand is that the public investment gives an adequate push to private investment through multiplier if the economy is operating under below capacity i.e. less than full employment (Krishnamurty, 2001). Especially the investment in infrastructure activities like irrigation, power, transport etc. would help in stimulating and facilitating private investment by creating new capacities. Complementarity between private and public investment is the key issue that we will draw attention to in further discussions. The focus is on the sectoral allocation of private investment as well as the total investment. The private investment is estimated separately in agriculture, manufacturing, infrastructure and service sectors. Most of the explanatory variables for private investment in each sector are sector specific. Both sector specific public investment and cross sector public investment are specified to affect the allocation to each sector. The pattern of allocation is visualised to respond to policy determined quantity variables like public sector investment and also to price signals which may be partly market determined and partly administered[11]. Here relative prices proxy relative profitability. Public

[11] This aspect of price signals will be discussed in price behaviour sub-model later in this chapter.

resource gap, dubbed as resource crunch in the public sector, is defined as the total public investment less public savings and is postulated to affect private investment adversely in each sector (K.Krishnamurthy, V. Pandit, 1985).

Capital Formation:

Real Gross Investment in Agriculture: Private

5. $PIAGR = -43.632 + 0.053\ YAR + 1.249\ PCFAGR_{-1} + 0.204\ PCFINFR$

(-10.74) (10.99) (8.40) (6.68)

EL: 1.12 0.63 0.55

$- 0.077\ (PLR_{-1} - ((P_{-1}-P_{-2})*100/P_{-2})) + 29.224\ (PRAG/PGDP)$

(-3.86) (7.71)

-0.05 2.63

$+ 1.828\ D81t92 - 0.543\ AR(1)$

(9.01) (-4.48)

$\bar{R}^2 = 0.94$ DW = 2.04

Real gross private investment in agriculture (PIAGR) depends on real output in agriculture (YAR) representing accelerator phenomenon, lagged real public investment in agriculture (PCFAGR) and current real public investment in infrastructure (PCFINFR), lagged real interest rate (real PLR), and terms of trade defined as the ratio of the relative price of agriculture (PRAG) vis-à-vis the rest of the economy i.e. GDP deflator (PGDP). A dummy variable is included to distinguish the pre reform period and reform period.

As expected, real output positively affects private investment in agriculture. The crowding-in affect is realised between public and private investments in agriculture as resource flows have been into agriculture rather than away from agriculture (Krishanamurthy, 1984). Public investment in both sectors (agriculture and infrastructure) seems to stimulate private investment in agriculture

significantly although the marginal effect is much larger from within the sector. Terms of trade in favour of agriculture seems to affect private investment in agriculture very strongly. All the regression coefficients have expected signs and statistically significant. The DW statistic is approximately 2.00 indicating no serial correlation, which also emphasises the plausibility of specification. The elasticity of private investment in agriculture, with respect to terms of trade is high at 2.63 and with respect to real agriculture output comes second at 1.12. As expected the elasticity with respect to real interest rate is quite low at 0.05. It is 0.63 and 0.55 with respect to public investment in agriculture and infrastructure respectively.

Real Gross Investment in Manufacturing: Private

$$\begin{array}{lccc} 6.\ PIMNR = -149.419 + 0.594\ YMNR + 1.996\ PCFMNR & & & \\ \qquad\qquad\quad (-2.27) \quad (6.39) \qquad\quad (4.70) & & & \\ \text{EL:} \qquad\qquad\quad 1.43 \qquad\quad 0.49 & & & \end{array}$$

$$\begin{array}{l} + 1.304\ (PCFINFR + PIINFR) - 0.905\ (RGPUB/PGKE) \\ \quad (4.85) \qquad\qquad\quad (-6.53) \\ \quad 0.93 \qquad\qquad\quad -0.91 \end{array}$$

$$\begin{array}{lccc} - 1.185\ (PLR_{-1} - (P_{-1} - P_{-2})*100/P_{-2}) + 96.742\ (PRMN/PGDP) + 0.536\ AR\ (1) & & & \\ \quad (-2.44) \qquad\qquad\quad (1.59) \qquad\qquad\quad (3.92) & & & \\ \quad -0.13 \qquad\qquad\quad 1.58 & & & \end{array}$$

$$\bar{R}^2 = 0.82 \qquad\qquad DW = 2.09$$

Real gross private investment in manufacturing (PIMNR) depends on real output in manufacturing (YMNR), public investment in manufacturing (PCFMNR), total real investment (private and public) in infrastructure (PIINFR + PCFINFR), public sector resource gap in real terms (RGPUB/PGKE), lagged real interest rate (PLR), terms of trade defined as the ratio of the relative price of manufacturing (PRMN) vis-à-vis the rest of the economy i.e. GDP deflator (PGDP).

Private investment is affected by the crowding-in effect of public investment. The crowding-in phenomena associated with private and public investments in manufacturing sector is captured well in the regression. Total investment in infrastructure encourages private investment in manufacturing as a crucial stimulus for all activities. The public resource gap, defined as the difference between total public investment and public savings, affects private investment negatively. If the public investment is more than public savings then there will be crowding-out affect on private investment and vice versa. Both crowding-in and crowding-out co exists in the above specification but former is more dominating. Again the effect of terms of trade in favour of manufacturing on private investment in manufacturing is positive though not significant. The effect of real interest rate on the private investment in manufacturing is negative and significant as it should be, but the impact is small. The elasticities of private investment in manufacturing with respect to real output, public investment, total infrastructure investment and terms of trade are 1.43, 0.49, 0.93 and 1.58 respectively, where as the elasticities with respect to resource gap and lagged interest rate are -0.91 and -0.13 respectively.

Real Gross Investment in Infrastructure: Private

$$7.\ PIINFR = -44.009 + 0.040\ YINFR + 0.022\ PCFINFR - 0.006\ (RGPUB/PGKE)$$
$$(-7.94) \quad (3.64) \quad (0.26) \quad (-0.35)$$
$$EL: \quad 0.31 \quad 0.04 \quad -0.03$$

$$- 0.116\ (PLR_{-1} - ((P_{-1}-P_{-2})*100/P_{-2})) + 55.47\ (PRINF/PGDP)$$
$$(-1.95) \quad (7.58)$$
$$-0.05 \quad 3.56$$

$$+ 7.170\ D81, 95\text{-}6, 00\text{-}1$$
$$(12.87)$$

$\bar{R}^2 = 0.89$ DW = 2.27

Real gross private investment in infrastructure (PIINFR) is a function of real output in infrastructure (YINFR), public investment in infrastructure (PCFINFR), public resource gap in real terms (RGPUB/PGKE), lagged real interest rate (real PLR), terms of trade defined as the ratio of the relative price of manufacturing (PRINF) vis-à-vis the rest of the economy i.e. GDP deflator (PGDP). A dummy variable is included to represent the wide fluctuations in the infrastructure private investment series. The private investment in infrastructure is positively related to its own real output and relative prices. The crowding-in phenomenon in infrastructure is weak i.e. it is statistically insignificant. The direct impact of public investment on private investment in infrastructure may be small, but its indirect effects on the economy are substantial. As expected, public resource gap and real interest rate affects private investment in infrastructure negatively. The effect of terms of trade is strong in infrastructure sector and the elasticity of private investment with respect to terms of trade is very high at 3.56. The elasticities of private investment with respect to real output in this sector, public investment, public resource gap in real terms, lagged real interest rate are a little low at 0.31, 0.04, -0.03, -0.05 respectively.

Real Gross Investment in Services: Private

8. $PISRR = -181.229 + 0.086\ YSRR + 0.886\ PCFSRR$
(-9.66) (11.87) (6.45)
EL: 0.76 0.50

$+ 0.898\ (PCFINFR+PIINFR) - 0.446\ (RGPUB/PGKE)$
(14.77) (-9.45)
1.21 -0.85

$– 1.282\ (PLR-((P-P_{-1})*100/P_{-1})) + 166.092\ (PRSR/PGDP) - 0.622\ AR\ (1)$
(-9.54) (9.73) (-10.38)
-0.26 5.16

$\bar{R}^2 = 0.94$ DW = 2.12

Real gross private investment in services (PISRR) is a function of real output in services (YSRR), public investment in services (PCFSRR), total real investment (private and public) in infrastructure (PIINFR + PCFINFR), public resource gap in real terms (RGPUB), lagged real interest rate (real PLR) and, terms of trade defined as the ratio of the relative price of services (PRSR) vis-à-vis the rest of the economy i.e. GDP deflator (PGDP).

The results are as expected apriori and statistically significant. The complementarity between private and public investments in service sector is well pronounced as seen in the results. The effect of total investment in infrastructure on private investment in services is positive and highly significant. Public sector resource gap seems to affect private investment in services very strongly indicating crowding-out. The relative price effect on private investment is positive and stronger than in other sectors. The elasticities of private investment in services with respect to terms of trade and public resource gap are high at 5.16 and -0.85 respectively. The elasticities of private investment with respect to real output, public investment, total infrastructure investment (private and public), real interest rate are 0.76, 0.50, 1.21, -0.26 respectively.

Adjusted Total Investment: Private

The gross capital formation is the sum total of private and public investments. The published data on gross capital formation (investment) shows a significant difference between the two sources (The CSO publishes data on this variable according to two different source/classification viz. by industry use and by assets and type of institutions). However, in public sector the two series of data on investment do not differ. Thus, the difference in the total could be attributed to

only data from private sector. In order to reconcile the two series on gross capital formation, we estimate a link equation as below. The adjusted total private investment is estimated as a function of unadjusted private investment, which is the sum total of sectoral private investments, both in real terms.

9. $PIADJR = -16.056 + 0.365\ PITOTR + 0.876\ PIADJR_{-1}$

	(-1.99)	(5.09)	(15.01)
SR EL:		0.31	
LR EL:		2.48	

$\bar{R}^2 = 0.94$ DW = 2.15

The relation between adjusted private investment (PIADJR) and total private investment (PITOTR) is rather definitional, but the difference between these two variables is highly fluctuating, therefore PIADJR is estimated as a function of PITOTR. The elasticity of PIADJR with respect to PITOTR is 0.31 in the short run where as in the long run it is 2.48.

Real Consumption: Private

10. $PCR = 157.792 + 0.530\ PYDR + 0.279\ ((GFCE/P)_{-1}+PCFTOTR_{-1})$

	(15.38)	(42.74)	(4.54)
EL:		0.66	0.07

$+ 0.663\ AR(1)$
(7.59)

$\bar{R}^2 = 0.99$ DW = 1.47

Real private consumption expenditure (PCR) is a function of real personal disposable income (PYDR) and both government consumption expenditure (GFCE) and investment expenditure (PCFTOTR) in real terms with a lag. The signs of the coefficients are as expected and statistically significant. The elasticities of real private consumption expenditure with respect to real personal disposable income and total government expenditure are 0.66 and 0.07.

Depreciation Equations:

As gross investment and net capital stock are used in all sectors, the depreciation in each sector is estimated separately as a function of sector specific net capital stock. The results are as expected.

Real Depreciation in Agriculture:

13. $DEPAG = -8.638 + 0.062\ KAGR_{-1}$
(-3.11) (6.92)
EL: 1.84

$\bar{R}^2 = 0.61$ DW = 1.58

Real Depreciation in Manufacturing:

14. $DEPMN = 18.888 + 0.032\ KMNR_{-1} + 0.231\ AR(1)$
(5.11) (5.91) (7.08)
EL: 0.52

$\bar{R}^2 = 0.74$ DW = 2.25

Real Depreciation in Infrastructure:

15. $DEPINF = -3.969 + 0.078\ KINFR_{-1} - 0.136\ AR(1)$
(-3.46) (27.19) (-2.13)
EL: 1.15

$\bar{R}^2 = 0.96$ DW = 1.91

Real Depreciation in Services:

16. $DEPSR = -4.875 + 0.032\ KSRR_{-1}$
(-2.98) (16.21)
EL: 1.22

$\bar{R}^2 = 0.91$ DW = 1.24

Price Behaviour:

Wholesale price for agriculture and manufactured products are estimated separately. The wholesale price of minerals, fuels, power, light lubricants are also estimated though some of the components are administered. These three equations

together determine the general price level represented by wholesale price index for all products. The weighted sum of these three price indices gives the general price index. Money supply per unit of real GDP is included in all the three equations.

Wholesale Prices: Agriculture

17. WPAG = 0.107 + 0.275 (M3/YR) + 0.762 WPRW + 0.508 AR (1)
(2.86) (2.98) (11.26) (4.99)
EL: 0.16 0.73

$\bar{R}^2$ = 0.99 DW = 2.20

The wholesale price index of agricultural commodities (WPAG) is defined as a function of money supply per unit of real output (M3/YR) representing demand factors and procurement prices of rice and wheat (WPRW) capturing the cost element. The signs of the coefficients in the estimated equation are as expected. The elasticities of wholesale price in agriculture with respect to M3/YR and WPRW are 0.16 and 0.73 respectively indicating much higher responsiveness of cost push than demand factors.

Wholesale Prices: Manufacturing

18. WPMN = 0.937 + 0.171 (M3/YR) + 1.084 ((M3/YR)*D81t94)
(46.34) (3.08) (35.88)
EL: 0.10

+ 0.067 WPFPLL + 0.104 UVIMP – 0.800 D81t94
(2.73) (6.34) (-35.76)
0.08 0.12

$\bar{R}^2$ = 0.99 DW = 1.74

The wholesale price index in manufacturing (WPMN) depends on money supply per unit of real output (M3/YR), import prices (UVIMP) and wholesale prices for

minerals, fuels, power, light and lubricants (WPFPLL). In this equation the cost elements are import prices and wholesale prices for minerals, fuels, power, light and lubricants. A Dummy variable is included for the structural changes in post 1991 reform years in the relation between WPMN and M3/YR. The elasticity of wholesale price index in manufacturing with respect to M3/YR is 0.77 for the period 1981-82 to 1994-95 and 0.10 for rest of the period. The elasticity of WPMN with respect to WPFPLL is very low at 0.07. Demand factor (M3/YR) is more dominant than cost factor (WPFPLL) in affecting wholesale price index of manufacturing products. The elasticity of WPMN with respect to import price is 0.12.

Wholesale Prices: (Minerals, Fuels, Power, Light and Lubricants)

19. $WPFPLL = 0.048 + 0.636\ (M3/YR) + 0.149\ UVIMP4$
(4.38) (11.58) (12.23)
SR EL: 0.35 0.16
LR EL: 0.68 0.31

$+ 0.143\ D01 - 0.084\ D96 + 0.487\ WPFPLL_{-1}$
(11.69) (-9.80) (16.50)

$\bar{R}^2 = 0.99$ DW = 1.95

The wholesale price index for minerals, fuels, power, light and lubricants (WPFPLL) is taken as prices in infrastructure sector. It depends on monetary factor (M3/YR), import price for mineral fuels, lubricants, etc. (UVIMP4) and lagged WPFPLL to allow partail adjustment. Two dummy variables for 1996 and 2001 are included in the equation for high fluctuations in the WPFPLL. The short-run elasticities of WPFPLL with respect to M3/YR and UVIMP4 are 0.35 and 0.16 where as the long run elasticities are 0.68 and 0.31 respectively.

Implicit Price Deflators:

The two implicit deflators for public investment (PGKE) and private investment (PPIE) are estimated separately as a function of wholesale price index (P). Both the equations poised unitary elasticities in line with apriori expectations/hypothesis.

Implicit Price Deflator for Gross Investment: Public

18. PGKE = -0.086 + 1.115 P + 0.763 AR (1)
(-2.24) (37.10) (18.16)
EL: 1.09

$\bar{R}^2 = 0.99$ DW = 1.61

Implicit Price Deflator for Gross Investment: Private

19. PPIE = 0.004 + 1.039 P + 0.561 AR (1)
(0.02) (5.40) (6.86)
EL: 0.99

$\bar{R}^2 = 0.85$ DW = 1.99

Sectoral Price Deflators:

Implicit price deflators for each sector are estimated as function of sector specific wholesale price index for agriculture, manufacturing and infrastructure sectors as link equations. In the manufacturing sector, lagged dependent variable is found to be more important than the sector specific wholesale price. In the infrastructure sector, rate of inflation and a dummy variable for 1981-99 are found useful. For services sector, the implicit price deflator is estimated as a function of monetary factor (M3/YR). Since services sector is a residual and includes divergent activities, it is not possible to construct a wholesale price index for this sector. However, a dummy variable for the period 1981-96 and its interaction with (M3/YR) are included in this regression. All the regressions showed good statistical properties. The responsiveness of implicit price deflator to its sectoral

wholesale price index is low in the manufacturing sector tan in agriculture and infrastructure sectors.

Implicit Price Deflator: Agriculture

20. PRAG = -0.052 + 1.035 WPAG - 0.259 AR (1)
(-5.79) (124.94) (-2.75)
EL: 1.05

$\bar{R}^2$= 0.99 DW = 2.09

Implicit Price Deflator: Manufacturing

21. PRMN = 0.011 + 0.397 WPMN + 0.636 $PRMN_{-1}$
(1.56) (12.48) (19.96)
SR EL: 0.39
LR EL: 0.80

$\bar{R}^2$= 0.99 DW = 1.57

Implicit Price Deflator: Infrastructure

22. PRINF = -0.974 + 1.160 WPFPLL + 0.007 $((P-P_{-1})/P_{-1})*100$ + 0.766 D81t99
(-13.80) (35.93) (2.52) (19.13)
EL: 1.28 0.05

$\bar{R}^2$= 0.98 DW = 1.51

Implicit Price Deflator: Services

23. PRSR = 0.727 + 0.804 (M3/YR) + 0.730 (M3/YR)*D81t96 - 0.572 D81t96
(43.84) (48.33) (34.83) (-32.42)
EL: 0.47 0.21

$\bar{R}^2$= 0.99 DW = 2.11

The elasticity of implicit price deflator with respect to M3/YR is 0.89 for the period 1981-82 to 1996-97 and 0.47 for rest of the period.

Module-II: Fiscal, Monetary and External Sectors:

The major part of module-II describes the interface between fiscal and monetary sectors. Fiscal sector explains about Government (public sector) activities. In the model, public sector includes administrative departments, departmental and, non-departmental enterprises and quasi governmental bodies as defined in the *National Accounts Statistics*. Government final consumption expenditure and total revenues are estimated. Public investment is taken as exogenous whereas public savings is endogenous. Public sector savings has two components; savings of administrative departments, departmental enterprises other than railways and communications (ADORC) and savings of non departmental enterprises and quasi government bodies. The former is endogenous where as the latter is exogenous in the model. It is simply the difference between total revenues and current expenditure of ADORC. The second component is however exogenous. Public resource gap is the intended nominal public investment less the available public sector savings (Krishnamurthy, Pandit and Sharma, 1989). Gross fiscal deficit is defined as a function of public resource gap. These two variables are expected to have a positive relationship. If the public investment is more than its savings then it will adversely affect private investment and increases fiscal deficit (siphoning of total resource in the economy). Deficit financing includes domestic borrowings (bank and non-bank) and external borrowings. To the extent credit is taken to finance deficit, there will be an increase in the reserve money, which will lead to increase in the money supply and prices. This captures the familiar interdependence between the fiscal and monetary policies. Monetary sector includes determination of money supply and money demand.

Fiscal Sector:

Direct-Taxes (ADORC) (Nominal)

24. DT = -2.424 + 0.052 (YNAR* PNA) - 0.102 AR (1)
(-3.36) (57.51) (-0.52)
EL: 1.09 0.02

$\bar{R}^2$ = 0.99 DW = 2.15

Indirect-Taxes (ADORC) (Nominal)

25. IDT = 9.233 + 0.109 YM + 0.482 AR (1)
(3.09) (48.49) (3.50)
EL: 0.92

$\bar{R}^2$ = 0.99 DW = 1.84

Non-Tax Revenues (ADORC) (Nominal)

26. NTX = -10.354 + 0.021 Y + 8.329 D81T94 + 0.292 AR (1)
(-4.87) (15.94) (5.31) (1.37)
EL: 1.39

$\bar{R}^2$ = 0.98 DW = 1.77

Government total revenue is the sum total of direct, indirect taxes and non-tax revenues. Direct taxes (DT) depends on non-agriculture GDP (YNAR) where as indirect taxes (IDT) depends on total GDP at market price (YM). Non-tax revenues (NTX) variable depends on nominal GDP (Y). A dummy variable is included to capture the fluctuations in non-tax revenue between 1981 and 1994. The results are as expected and generally satisfactory in all aspects. The elasticity of direct taxes with respect to non-agriculture GDP is 1.09 and the elasticity of indirect taxes with respect to total GDP at market price is 0.92. The elasticity of non-tax revenues with respect to on nominal GDP is more than proportionate at 1.39 which is fairly large and highly significant.

Govt. Final Consumption Expenditure (ADORC) (Nominal)

27. GFCE = 38.073 + 0.554 TR – 37.123 D81t97
(9.25) (45.82) (-12.00)
EL: 0.90

$\bar{R}^2 = 0.99$ DW = 1.69

This equation relates government final consumption expenditure (GFCE) to total revenues. As government spends from its own revenues, final consumption expenditure is expected to increase with the rise in total revenues. A dummy variable is included to capture the fluctuations in non-tax revenue between 1981 and 1997. The elasticity of government final consumption expenditure with respect to revenues is 0.90, which is close to one. Therefore GFCE increases almost proportionately with the rise in revenues.

Gross Fiscal Deficit (Nominal)

28. GFD = -1.063 + 0.512 RGPUB + 0.653 GFD_{-1}
(-0.45) (4.72) (6.57)
SR EL: 0.44
LR EL: 1.27

$\bar{R}^2 = 0.99$ DW = 1.48

Gross fiscal deficit (GFD) is estimated as a function of public resource gap (RGPUB) and its own lag. As expected gross fiscal deficit is positively related to public resource gap. The elasticity of gross fiscal deficit with respect to public resource gap in the short run is 0.44 where as in the long-run it is 1.27.

Monetary Sector:

Money Supply (Nominal)

29. $M_3 = 103.128 + 4.629\ RM - 24.579\ CRR + 5.942(CRR*D81t92) + 0.661\ AR(1)$

	(1.94)	(31.33)	(-7.59)	(4.18)	(4.49)
EL:		1.24	-0.49		

$\bar{R}^2 = 0.99$ DW = 1.75

Money supply (M3) is estimated as a function of reserve money (RM) and cash reserve ratio (CRR). Here CRR works as a monetary policy instrument to regulate movements in money supply. Money supply increases as CRR decreases. A slope dummy variable, representing the pre reform-period (1981-92), interaction with CRR is included to capture the changes in cash reserve ratio in the reform period.

The signs of the coefficients in both equations are as expected. In the money supply equation both reserve money and CRR seem to affect money supply very significantly. The elasticity of money supply with respect to reserve money is high at 1.24, indicating that for every 10% increase in reserve money, money supply increases by 12%. The elasticity of money supply with respect to CRR is -0.37 in the pre reform period and it is -0.49 in the reform period.

Prime Lending Rate

30. $PLR = 3.392 + 0.003\ YR - 0.003\ M3 + 0.053\ ((P-P_{-1})*100/P_{-1})$

	(1.60)	(0.78)	(-1.32)	(0.57)
SR EL:		0.17	-0.11	0.03
LR EL:		0.48	-0.33	0.08

$+1.008\ D919496 + 0.658\ PLR_{-1}$

(0.90) (4.42)

$\bar{R}^2 = 0.53$ DW = 2.16

Equilibrium in the money market determines the interest rate. Prime Lending Rate (PLR) is considered for this purpose. Demand for money is normalised with interest rate as dependent variable. Nominal PLR is explained as a function of real output (YR), money supply (M3), rate of inflation, and lagged PLR. A dummy variable is added to the explanatory variables to capture the sudden peaks and troughs in PLR. Since nominal interest rate is the cost of holding money, interest rate responds negatively as the money stock increases. Thus, a rise in money stock is expected to decrease the interest rate while a rise in real output is expected to increase the interest rate. Rate of Inflation causes nominal interest rate to rise.

The nominal interest rate equation explains only about 50% of variations in the nominal interest rate in a partial adjustment framework. The short-run elasticity of the nominal interest rate with respect to real output is 0.17 where as the long-run response is 0.48. The elasticity of nominal interest rate with respect to money stock (representing money supply) in the short run is -0.11 and in the long run it is -0.33. The short-run elasticity of nominal interest rate with respect to rate of inflation is quite low at -0.03, whereas the long run elasticity of nominal interest with respect to expected rate of inflation is a little better than the short run at -0.08.

External Sector:

Real Exports

31. $EXPTR = 2.700 + 37.219\ (UVEXP/\ (WPEXP*EXRIDX)) + 0.001\ WYR_{-1}$
(0.21) (2.32) (1.86)
EL: 0.52 0.66

$+ 10.777\ D81t92$
(1.29)

$\bar{R}^2 = 0.94$ DW = 1.27

Exports supply and demand determines unit value of exports. Export supply incorporates both relative price factor and world economic activity. It is postulated as a function of export price relative to world exports price and world income (excluding that of India). Here, world exports price (excluding that of India) is taken as a proxy for the prices of trading partners and competitors and world income (excluding that of India) is taken as a proxy for the world economic activity. Real exports are positively related to both world income and export price relative to world export prices. The Implication of above specification is that when the domestic export price increases relative to world export price then real exports supply of India will increase, likewise if world exports price comes down relative to domestic export price world demand for exports would shift in favour of India's exports. As world income increases the demand for exports will be high thus India's exports will increase.

The estimated coefficients are of expected signs. A dummy variable is included to represent the pre reform period in India. The elasticity of real exports with respect to relative export prices and world income is 0.52 and 0.66 respectively; implying a 10% increase in relative export price and world, raises real exports by 5.2% and the same 10% increase in world income raises real exports by 6.6%.

Unit Value of Exports

32. $UVEXP = -0.191 + 0.001\ YR - 0.166\ (P/(WPEXP*EXRIDX))$

	(-2.12)	(2.34)	(-3.46)
SR EL:		0.99	-0.26
LR EL:		18.28	-4.75

$+ 0.946\ UVEXP_{-1}$
(8.59)

$\bar{R}^2 = 0.98$ DW = 1.89

Export demand is renormalised by treating unit value of exports as an endogenous variable. Unit value of exports is a function of real output (domestic), domestic price relative to world price index, and lagged unit value of exports. Here, the domestic price relative to world exports price is expected to affect unit value of exports (export price) negatively representing a trade off between domestic market and export market outlets. If the price level in domestic market is high relative to world exports price, then there is a less incentive to export more; thus the export price decreases. This can be interpreted as an indicator of the relative attractiveness or relative profitability of supplying to the export markets compared to the domestic market (V. Sundararajan, 1986). Domestic income is expected to have a direct relation with exports price. As domestic income rises, export supply (equal to export demand for India's exports) increases. As a result, price of exports will rise.

The signs of the coefficients are as expected and the coefficients are significant. In the short run the elasticity of unit value of exports with respect to domestic real income is approximately one i.e. exports price increases equi-proportionally with the rise in domestic real income where as on the long run it is 18.28. The elasticity of exports price with respect to relative price is -0.26 in the short run. The same is -4.75 in the long run.

Real Imports

33. IMPTR = -32.480 + 0.184 AD – 50.557 (UVIMP/P)
(-1.77) (6.57) (-5.84)
EL: 2.06 -0.58

- 0.080 (TREND*TREND) + 0.692 AR (1)
(-1.28) (7.98)

$\bar{R}^2 = 0.99$ DW = 1.99

Imports demand is posited as a function of real aggregate absorption (AD) and ratio of unit value of imports (UVIMP) to domestic prices (P). Here the real imports are related to an aggregate demand variable (AD), which is defined as the sum of private sector absorption, government expenditure and exports. Each of these sectors generates demand for imports (Rangarajan, and Mohanthy, 1997). It is expected that the aggregate absorption representing the level of economic activity has a direct positive relation with real imports. Unit value of imports relative to domestic prices is expected to have an inverse relation with quantity of real imports. The trend variable appears in the above equation is intended to capture the secular changes.

There is no serial correlation in residuals based on DW statistic. The coefficients have expected signs. The affect of relative prices and real aggregate absorption on imports demand is highly significant. The aggregate absorption seems to have a strong influence on volume of imports. The elasticity of imports with respect to real aggregate absorption and relative prices is 2.06 and -0.58 respectively. Price elasticity is much lower compared to demand variable. For every 10% decrease in relative import prices, import demand increases approximately by a 6%. Likewise, for every 10% increase in real aggregate absorption, demand for imports will increase by 20.6%.

Exchange Rate

$$\begin{array}{lccccc} 34.\ EXR = 33.054 + 0.618\ ((P-P_{-1})*100/P_{-1}) - 2.534\ CAB/RBFA_{-1} + 0.198\ \Delta RBFA \\ & (8.38) & (1.87) & & (-1.38) & & (3.62) \\ EL: & & 0.17 & & -0.09 & & 0.13 \end{array}$$

$$- 28.363\ D\ 81t91 - 10.937\ D\ 92t97$$
$$(-8.52) \qquad (-4.48)$$

$$\bar{R}^2 = 0.92 \qquad DW = 1.54$$

Exchange rate is specified as a function of rate of inflation ($(P-P_{-1})*100/P_{-1}$), ratio of current account deficit (CAB) to lagged foreign exchange assets of reserve bank ($RBFA_{-1}$) and the rate of change in reserve bank foreign exchange assets ($\Delta RBFA$). As expected the rate of inflation and rate of change in foreign exchange assets of reserve bank have a positive relation with exchange rate. The ratio of current account deficit to foreign exchange assets of reserve bank is negatively related to exchange rate. This explains if the current account deficit is larger relative to foreign exchange assets of reserve bank then the exchange rate depreciates as the country has less foreign currency in its account. Despite of the lack of statistical significance, the above discussed coefficient bares out the right sign proposed in the theory.

Two dummy variables are included in the exchange rate equation representing regime shifts. From 1975, the Rupee's ties to the Pound Sterling were broken. India introduced a managed floating exchange regime with the Rupee's effective rate placed on a controlled, floating basis and linked to a "basket of currencies" of India's major trading partners. In early 1990s, the above exchange rate regime came under severe pressures from the increase in trade deficit and net invisible deficit, which led the Reserve Bank of India (RBI) to undertake downward adjustment of Rupee in two stages in 1991. This adjustment was followed by the introduction of the Liberalized Exchange Rate Management System (LERMS) in 1992 based on the recommendations of Rangarajan's committee and hence the adoption of, for the first time, a dual (official as well as market determined) exchange rate in India. There seems to be lots of fluctuations in the exchange rate after introducing the dual exchange rate system. Keeping these two regime shifts

in mind two dummy variables for the period 1981 to 1991 and 1992-1997 are included in the exchange rate equation. These two dummy variables turned out to be highly significant supporting the regime shifts.

The estimated equation explains a little low of the variations in the exchange rate in terms of elasticities. The elasticities of exchange rate with respect to rate of inflation, ratio of CAB and lagged RBFA and rate of change in RBFA are 0.17, -0.09 and 0.13 respectively.

Module-III:

Poverty Ratios:

Module-3 includes a small sub model on poverty ratios where the head count ratios in both rural and urban areas are defined as function of per capita personal disposable income.

Head Count Ratio: Rural

35. HCRRUR = 61.404 - 29.999 (PYDR/NTOT) + 0.559 AR (1)
(14.52) (-6.18) (3.36)
EL: 0.64

$\bar{R}^2 = 0.88$ DW = 2.12

Head Count Ratio: Urban

36. HCRURB = 60.0937 - 32.093 (PYDR/NTOT)
(51.56) (-22.83)
EL: 0.75

$\bar{R}^2 = 0.96$ DW = 1.63

As Expected there is a negative relation between poverty and per capita personal disposable income in both rural and urban areas. Headcount rate response to

increase in per capita personal disposable income seems to be is higher in urban areas. The elasticities of head count ratios with respect per capita personal disposable income in rural and urban areas are 0.64 and 0.75 respectively.

4.3 Identities:

37. ABSP = PCR + PIADJR

38. ADD = ABSP + (GFCE / P) + PCFTOTR + EXPTR - IMPTR

39. AD = ADD + IMPTR

40. PYD = YM - TR + SUB + OTP

41. PYDR = PYD / PGDP

42. P = 0.215 * WPAG + 0.147 * WPFPLL + 0.637 * WPMN

43. YR = YAR + YNAR

44. YNAR = YMNR + YINFR + YSRR

45. Y = PGDP * YR

46. YM = Y + IDT - SUB

47. PGDP = (PRAG * YAR + PRMN * YMNR + PRINF * YINFR + PRSR *YSRR) / YR

48. PNA = (PRMN * YMNR + PRINF * YINFR + PRSR * YSRR) / YNAR

49. KAGR = KAGR(-1) + PIAGR + PCFAGR - DEPAG

50. KMNR = KMNR(-1) + PIMNR + PCFMNR - DEPMN

51. KINFR = KINFR(-1) + PIINFR + PCFINFR - DEPINF

52. KSRR = KSRR(-1) + PISRR + PCFSRR - DEPSR

53. PITOTR = PIAGR + PIMNR + PIINFR + PISRR

54. PCFTOTR = PCFAGR + PCFMNR + PCFINFR + PCFSRR

55. GCFTOT = (PITOTR * PPIE) + (PCFTOTR * PGKE)

56. GCFADJ = (PIADJR * PPIE) + (PCFTOTR * PGKE)

57. GDS = GCFADJ + CAB + EM2

58. GCE = GFCE + SUB + OGCE

59. GXP = GCE + (PCFTOTR * PGKE)

60. TR = DT + IDT + NTX

61. GDSADORC = TR - GCE

62. GDSPUB = GDSADORC + GDSRCNDQG

63. RGPUB = (PCFTOTR * PGKE) - GDSPUB

64. RM = RCG + RBCS + RBFA + GCL + MISRM

65. D(RCG) = GFD - D(BCG) - DNB - EB - MISCR

66. BCP = M3 - RCG - BCG - RBFA - GCL + MISCRD

67. EXPT = EXPTR * UVEXP

68. IMPT = IMPTR * UVIMP

69. TB = EXPT - IMPT

70. EXPTBOP = K1T * EXPT

71. IMPTBOP = K2T * IMPT

72. TBBOP = EXPTBOP - IMPTBOP

73. CAB = TBBOP + INVSB

74. RBFA = RBFA(-1) + TBBOP + INVSB + NCIF

75. EXRIDX = EXR / 31.44390

4.4 Simulation Methodology:

A simulation is to obtain solutions for each endogenous variable by solving a model over a period of time, given estimated values of the parameters and initial values of the endogenous variables and time series of exogenous variables. In the words of Sowey **"**The synthetic representation of reality by sequential solution of a mathematical model, conditional on estimates of the model's parameters and on actual or supposed values of the exogenous variables, is commonly termed as simulation. The simulation is particularly relevant for the validation of dynamic non-linear econometric models" (Sowey, 1973).

To perform *ex-post* or historical simulation, one needs the values of observed endogenous and exogenous variables, and the parameters estimated in the model. Evaluating historical simulation is a difficult task. Each individual equation in the model may fit the data well but the simulated values may not be close to observed values. The models having a good statistical fit may simulate badly because "behaviour of the model as a dynamic structure may bear little relation to the way individual equations fit historical data" (Sowey, 1973).

Sometimes, a model may have a bad fit but may simulate well. So the model builder has to trade off between the goodness of fit and simulated values. A few equations, which may not have a good fit, are accepted as long as good simulation results are obtained[12].

Simulations, applied in the evaluation of macroeconometric models, have a number of assignable characteristics, which govern the interpretation to be given

[12] See Pindyck and Rubinfeld, 1976 for more discussion.

to the results derived. There are three dichotomous simulation categories to apply to the model.

1. Static (one-step) or Dynamic simulations;

2. Deterministic or Stochastic simulation;

3. Control or Experimental simulation.

Static vs. Dynamic Simulation:

In static simulation, the model is solved, each period, using actual values for the lagged endogenous variables, whereas in dynamic simulation, previous solution values are used for the lagged endogenous variables. Thus, dynamic simulation displays the model's inherent dynamic characteristics, whilst in one-step simulation; the model is continually constrained to follow closely the actual path of the endogenous variables.

Deterministic vs. Stochastic Simulation:

In stochastic simulation, the presence of stochastic elements in each behavioural equation of the model will not be embodied while simulating, whereas in deterministic simulation, each disturbance will be assigned its certainty equivalence expectation namely zero.

Control vs. Experimental Simulation:

Control simulation is the one performed with all variable values as actually measured and all regression coefficients as actually estimated. The results of this mode of simulation form the basis of comparison for any further experimental simulations. The experimental simulation is the one in which certain coefficients or certain variable values may deliberately be modified.

4.5 Historical or Baseline Simulation:

Comparing of the base simulation values with the actual values of all variables is the next task after obtaining base simulation values to the proposed model. In this regard, some form of the graphical representation of the actual and simulated time series is usually considered indispensable. When turning points exhibited by the original series in the endogenous variables are traced by the simulated series of the respective variables, then the model performance may be pronounced as good.

Much more detailed information is derivable by computing a variety of summary measures, some of which can be tested for significance using established statistical techniques. The techniques that are appropriate differ depending on the objective of the simulation, namely the validation of the model, or the evaluation of alternative policy proposals in the *ex-post* and *ex-ante* domain. The common statistical measures to check the closeness of the base simulation and actual values are the Mean Absolute Error (MAE) and the Root Mean square Error (RMSE). These indicate the first and second moments of relative error distribution. An equation may have low RMSE values but may not trace the turning points well. The opposite may also hold true. But, as pointed out by Pindyck and Rubinfeld (1976), “model building is very much an art, and part of the art is learning to trade off alternative criteria in different ways”. The ‘EViews’ package can do all these tasks in an excellent way.

The complete simultaneous equations model consists of 75 relations, viz. (a) 36 behavioural equations estimated from 1981-82 to 2002-03 by using 3SLS method, (b) 39 identities.

The model is solved to obtain base simulation values for the entire period. The 'EViews' package is used to perform the above tasks in a most convenient and simple fashion. The full model is simulated using the commonly required options, namely deterministic simulation and dynamic solving options for the entire sample period, 1981-82 to 2002-03. Static solving option was also done, but not presented here, to confirm the absence of accumulation of errors over time. The assessment of the full model is done by (a) comparing the time series plots of actual and base simulation values of a few important variables (Figures 4.1-4.15) and (b) computing the summary measures MAE, RMSE and Theil's inequality coefficient (Table-4.1).

In a truly dynamic model like the present one, accumulation of errors over time is inevitable in dynamic simulation. The errors may get compounded in dynamic simulation because the current year solution vector is linked to the estimated values (not the observed values like in static simulation) in the previous year. A large error in simulated value in one year gets transmitted to all the subsequent years.

4.6 Post-Sample Forecasts:

As mentioned already, the base simulation with deterministic and dynamic options, after tuning for systemic adjustments, is used to make post-sample forecasts. The forecasts have been made for the period 2003-04 to 2005-06 (the latest year for which consistent data are available at 1999-00 base year). As mentioned in Chapter-3, consistent data on variables at 1993-94 base year is available only up to 2002-03. After that the base year has been changed to 1999-

00[13]. Therefore we had to convert all the variables into 1993-94 base to make post-sample forecasts for the period 2003-05. For the post-sample period, 2003-2005, deterministic and dynamic simulation is done using the 'Eviews' package.

The forecasts are also plotted along with in-sample solutions in Figures 4.1-4.15 for important endogenous variables. The post-sample forecasts are a little away from the actual series for a few variables, probably due to the conversion in base year. Summery measures like RMSE, MSE, Theli-u are given in Table 4.1.

[13] NAS has brought out the series with new base year (1999-00) very recently.

Table-4.1: Summary Measures to Assess Base Simulation

	***Ex-Post* (1981-2002)**			***Ex-Ante* (2003-2005)**		
Endogenous variable	**MAE**	**RMSE**	**Theil-U**	**MAE**	**RMSE**	**Theil-U**
Nominal output (Y)	0.04	0.06	0.02	0.09	0.11	0.06
Real output (YR)	0.02	0.02	0.01	0.02	0.02	0.01
Agriculture (YAR)	0.03	0.04	0.02	0.11	0.12	0.05
Manufacturing (YR)	0.05	0.06	0.03	0.04	0.04	0.02
Infrastructure (YINFR)	0.02	0.02	0.01	0.10	0.11	0.06
Services (YSRR)	0.06	0.07	0.03	0.03	0.03	0.01
Real Private Investment(PITOTR)	0.18	0.25	0.08	0.33	0.33	0.19
Agriculture (PIAGR)	0.19	0.22	0.09	0.28	0.28	0.16
Manufacturing (PIMNR)	0.19	0.25	0.09	0.34	0.35	0.23
Infrastructure (PIINFR)	0.21	0.26	0.10	0.52	0.53	0.35
Services (PISRR)	0.40	0.57	0.16	0.17	0.22	0.11
Real Private Consumption (PCR)	0.02	0.03	0.01	0.03	0.03	0.02
WP for all commodities (P)	0.05	0.06	0.02	0.03	0.03	0.02
WP-Agriculture (WPAG)	0.04	0.04	0.01	0.04	0.05	0.03
WP-Manufacturing (WPMN)	0.06	0.08	0.03	0.03	0.03	0.02
WP-Fuel, Power Lubricants (WPFPLL)	0.07	0.08	0.03	0.06	0.06	0.03
Price Deflator-Agriculture (PRAG)	0.03	0.04	0.01	0.04	0.05	0.03
Price Deflator-Manufacturing (PRMN)	0.05	0.06	0.03	0.08	0.09	0.05
Price Deflator-Infrastructure (PRINFR)	0.08	0.10	0.04	0.32	0.39	0.17
Price Deflator-Services (PRSR)	0.09	0.10	0.05	0.08	0.12	0.06

Table-4.1: Summary Measures to Assess Base Simulation, Continued...						
	***Ex-Post* (1981-2002)**			***Ex-Ante* (2003-2005)**		
Head Count Ratio-Rural (%)(HCRRUR)	0.07	0.09	0.04	0.38	0.43	0.16
Head Count Ratio-Urban (%)(HCRURB)	0.05	0.06	0.03	0.09	0.11	0.06
Govt. Final Consumption (GFCE) (N)	0.07	0.09	0.03	0.24	0.25	0.12
Govt.Total Expenditure (GXP) (N)	0.03	0.04	0.01	0.08	0.09	0.05
Govt. Revenues (TR) (N)	0.06	0.07	0.03	0.04	0.05	0.02
Direct Taxes (DT) (N)	0.17	0.21	0.05	0.13	0.13	0.07
Indirect Taxes (IDT) (N)	0.08	0.10	0.03	0.06	0.07	0.03
Non-tax Revenue (NTX) (N)	0.15	0.19	0.06	0.27	0.29	0.17
Gross Fiscal Deficit (GFD) (N)	0.12	0.15	0.06	0.23	0.26	0.12
Money Supply (M3)	0.11	0.13	0.04	0.10	0.14	0.08
Interest rate (PLR) (N)	0.07	0.08	0.04	0.20	0.30	0.14
Real Exports (EXPTR)	0.14	0.19	0.08	0.19	0.20	0.12
Real Imports (IMPTR)	0.09	0.12	0.04	0.18	0.22	0.15
Unit Value of Exports (UVEXP)	0.11	0.13	0.05	0.09	0.12	0.06
Exchange Rate (EXR)	0.30	0.62	0.13	0.31	0.31	0.14
Trade Balance (TB)	0.72	1.12	0.32	0.14	0.14	0.08

N: Nominal

Figure-4.1: Actual and baseline values of real output

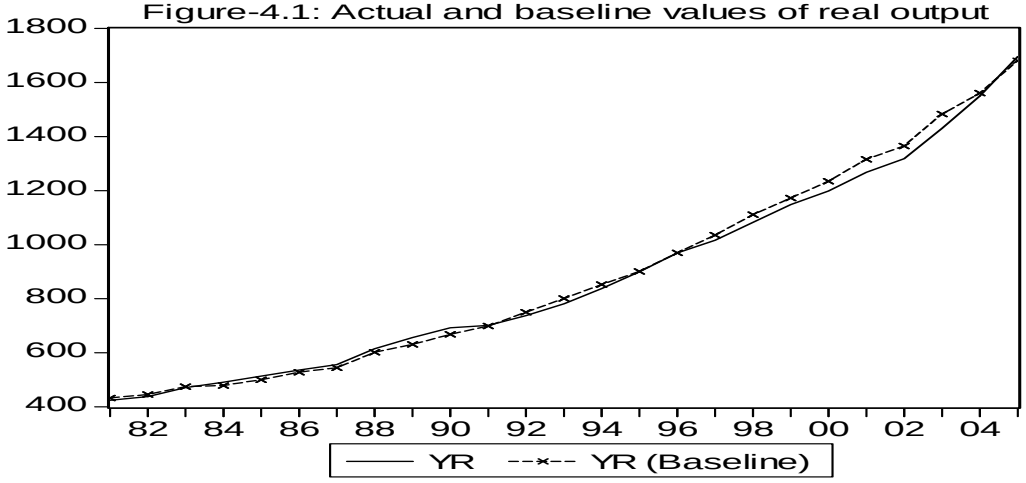


Figure-4.2: Actual and baseline values of nominal output

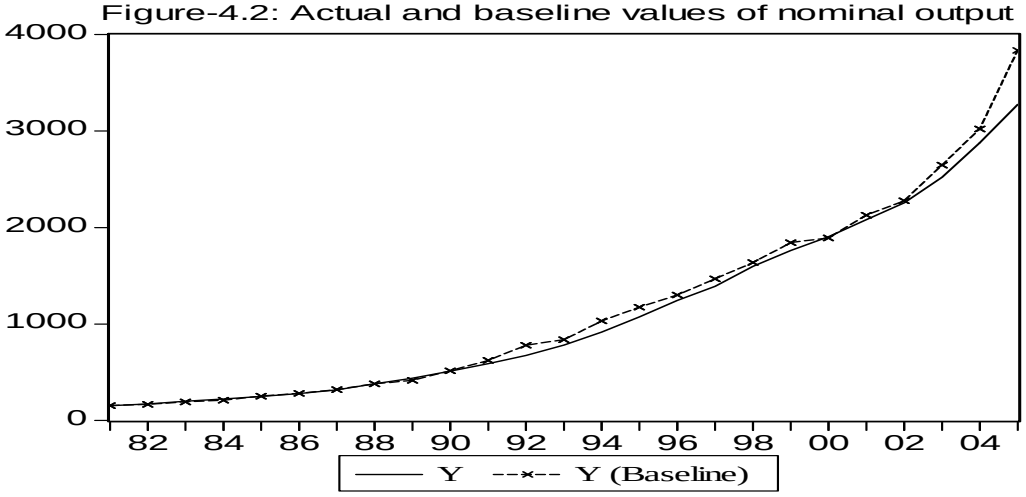


Figure-4.3: Actual and baseline values of real output in agriculture

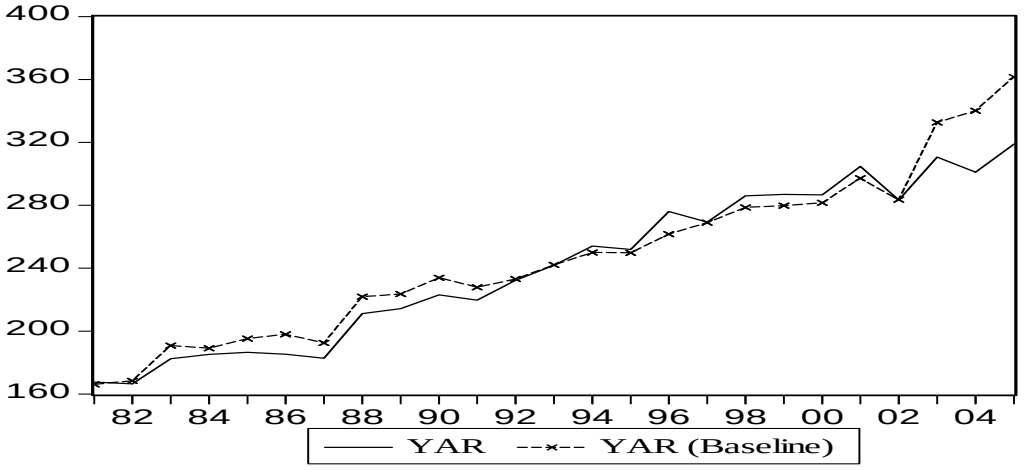


Figure-4.4: Actual and baseline values of real output in manufacturing

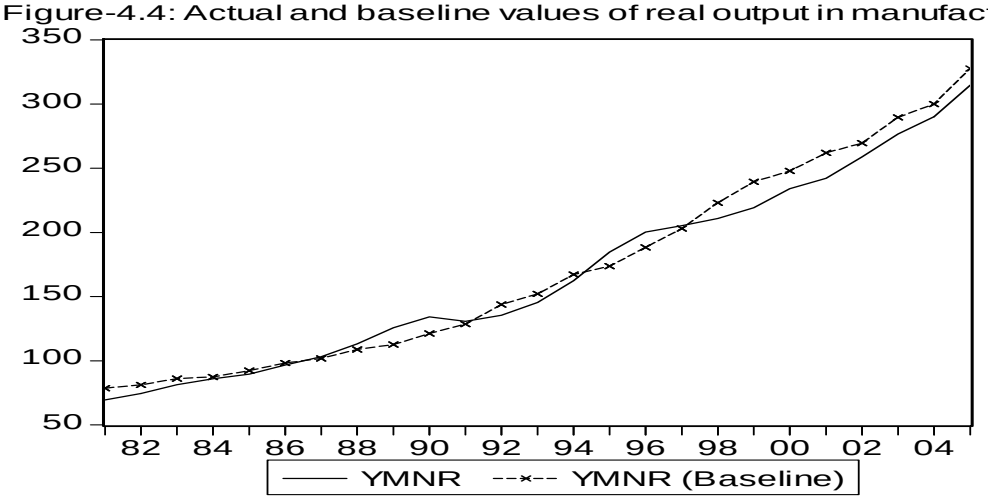


Figure 4.5: Actual and baseline values of real output in infrastructure

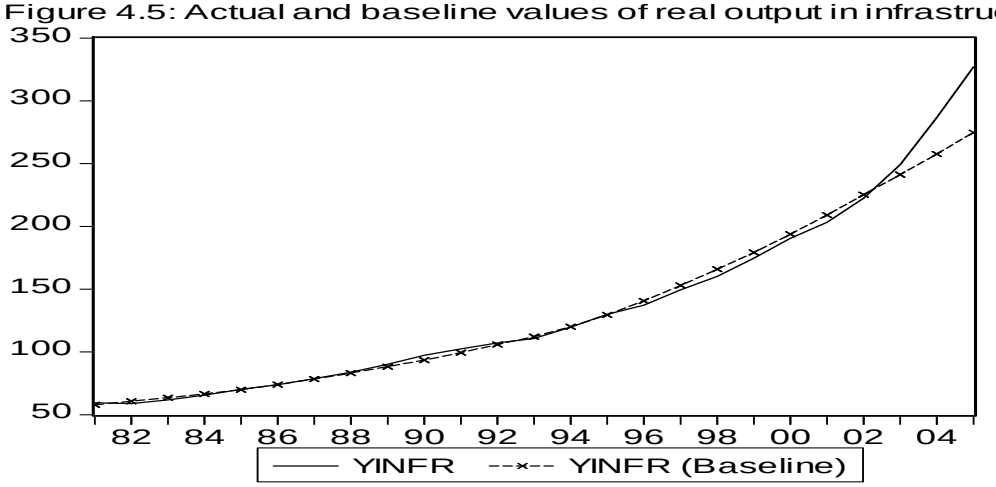


Figure 4.6: Actual and baseline values of real output in services

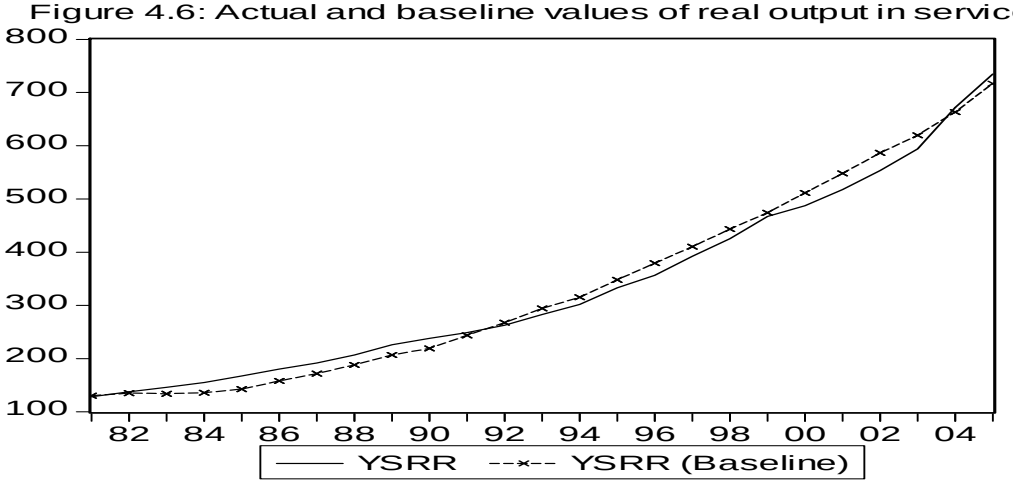


Figure 4.7: Actual and baseline values of total real private investment

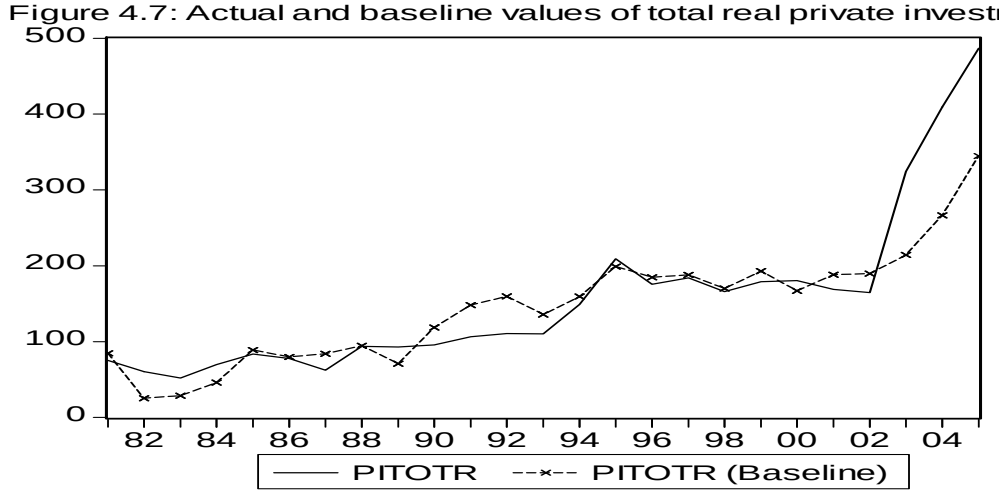


Figure-4.8: Actual and baseline values of real private consumption

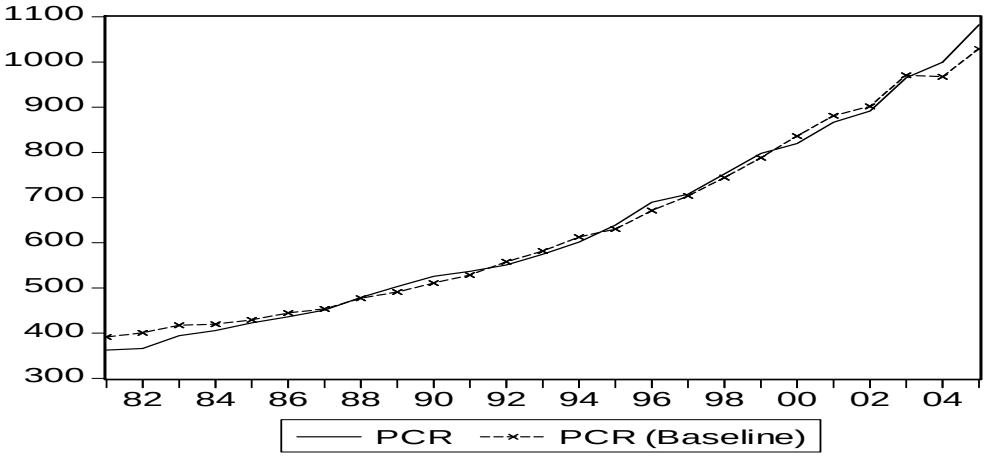


Figure-4.9: Actual and baseline values of government consumption

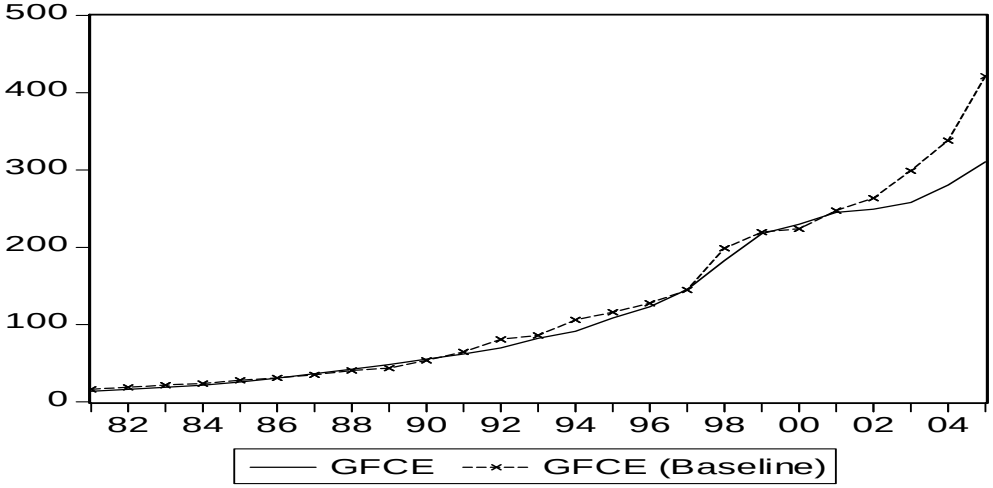


Figure-4.10: Actual and baseline values of gross fiscal deficit

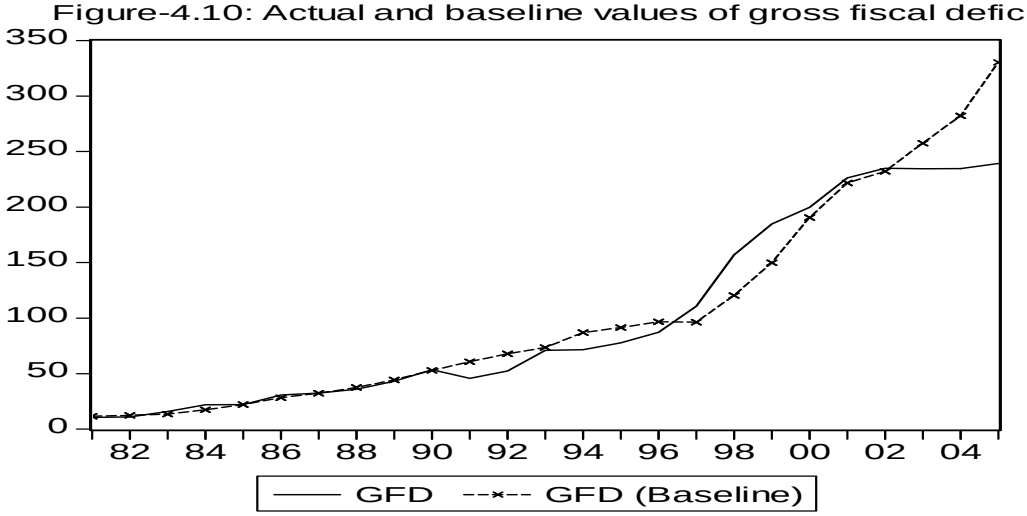


Figure-4.11: Actual and baseline values of money supply

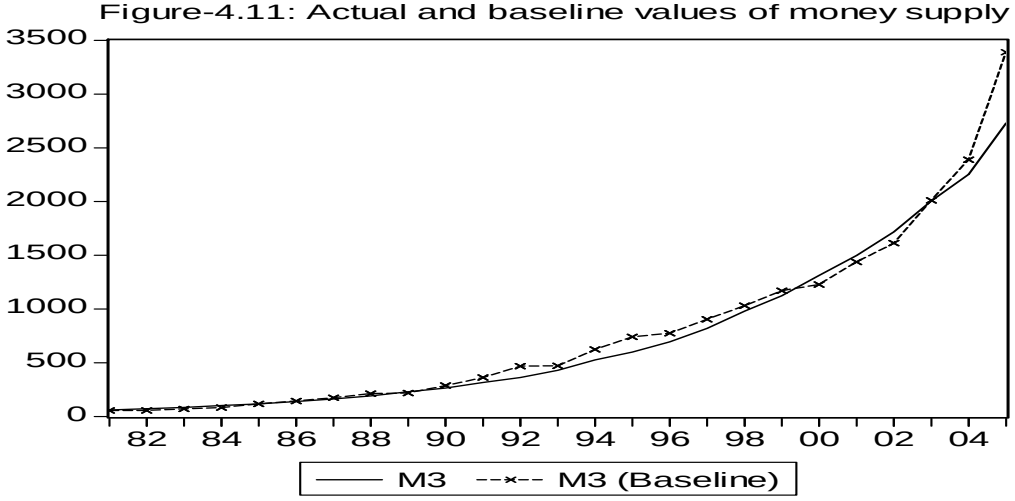


Figure-4.12: Actual and baseline values of wholesale price index

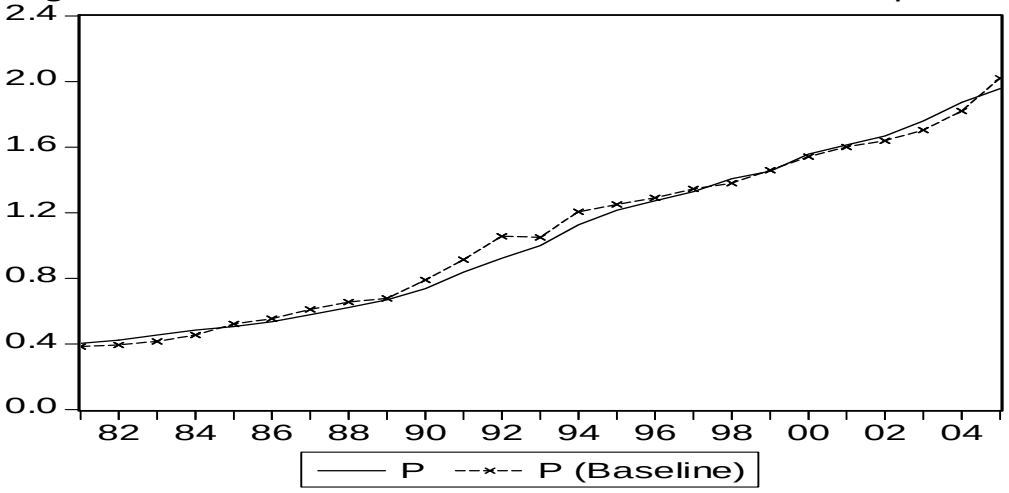


Figure-4.13: Actual and baseline values of real exports

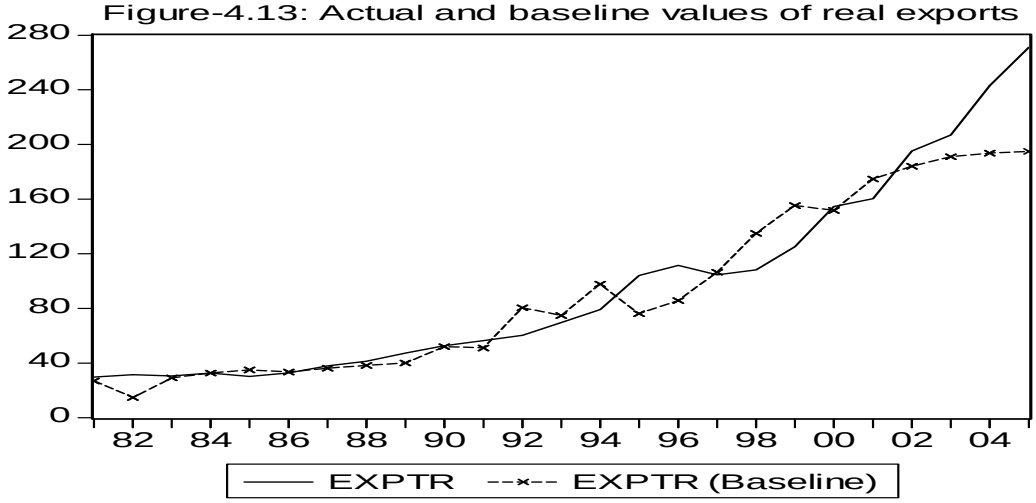


Figure-4.14: Actual and baseline values of real imports

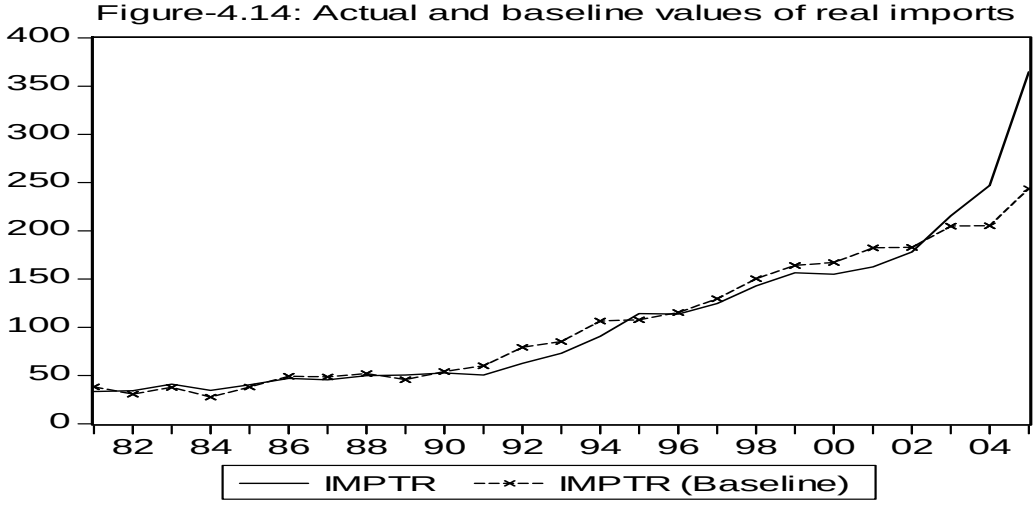
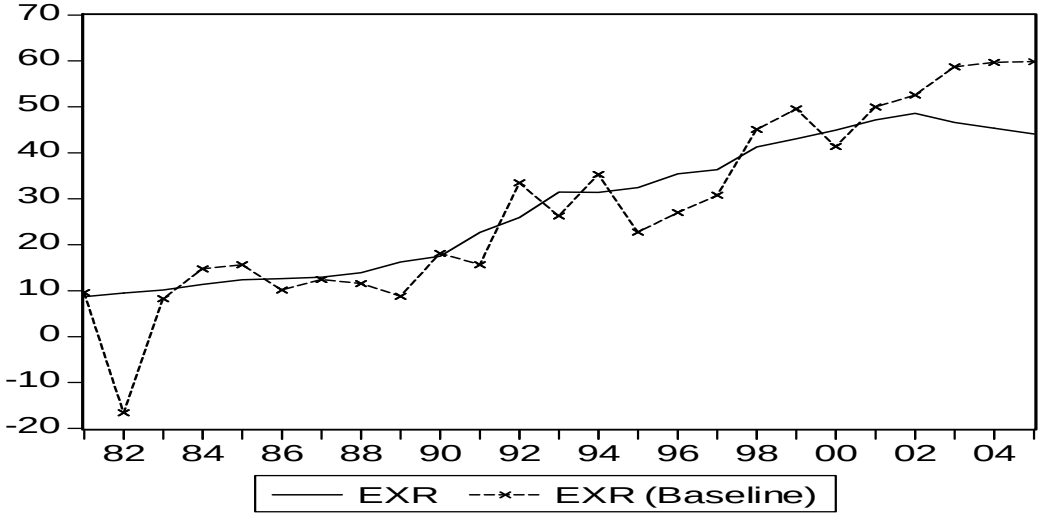


Figure-4.15: Actual and baseline values of exchange rate



A quick perusal at the plots (Figure 4.1-4.15) shows that, by and large, the endogenous variables are traced out quite well even in the dynamic base simulation. Simulated values for variables like YR, YMNR, YINFR, PCR, M3, P, IMPTR are very close to observed values throughout the data period. But, some variables like PITOTR, GFD, EXPTR, EXR could not be tracked well during the reform period (from 1993-94).

The summary measures also broadly confirm this (Table-4.1). More specifically, as expected, for all variables, the MAE values are smaller than the RMSE values. The magnitudes of these summary statistics are very small indicating fairly good fit in the in-sample validation. It must be mentioned that the 25-year data period is quite long and characterized by structural changes, data revisions and changes in definitions of some variables. It would be difficult to model all such variables uniformly well. This is reflected in the base simulation.

APPENDIX-4.1

Estimated Partial Elasticities of the Dependent Variables w.r.t. Selected Independent Variables

Dependent variable	Independent variables					
YAR	RAIN **0.13**	AREA **0.96**	$KAGR_{-1}$ **0.87**	YINFR **0.17**		
YMNR	ADD **0.73**	$KMNR_{-1}$ **0.2**	IMPTR **0.1**			
YINFR	$KINFR_{-1}$ Pre-reform (1981-93) SR: **0.17** LR: **0.65**		Reform (1993-2003) SR: **0.36** LR: **3.24**			
YSRR	$KSRR_{-1}$ **0.98**		YINFR **0.51**			
PIAGR	YAR **1.12**	$PCFAGR_{-1}$ **0.63**	PCFINFR **0.55**	Real PLR **-0.05**	(PRAG/PGDP) **2.63**	
PIMNR	YMNR **1.43**	PCFMNR **0.49**	(PCFINFR + PIINFR) **0.93**	(RGPUB/ PGKE) **-0.91**	Real PLR **0.13**	(PRMN/ PGDP) **1.58**
PIINFR	YINFR **0.31**	PCFINFR **0.04**	(RGPUB/ PGKE) **-0.03**	Real PLR **-0.05**		(PRINF/ PGDP) **3.56**
PISRR	YSRR **0.76**	PCFSRR **0.5**	(PCFINFR + PIINFR) **1.21**	(RGPUB/ PGKE) **-0.85**	Real PLR **-0.26**	(PRSR/ PGDP) **5.16**
PCR	PYDR **0.66**		$((GFCE/P)_{-1}+PCFTOTR_{-1})$ **0.07**			
WPAG	M3/YR **0.16**		WPRW **0.73**			
WPMN	M3/YR 1981-95 **0.77** 1995-02 **0.1**		WPFPLL **0.08**		UVIMP **0.12**	
WPFPLL	M3/YR SR: **0.35** LR: **0.68**		UVIMP4 SR: **0.16** LR: **0.31**			
DT	(YNAR*PNA) **1.09**					
IDT	YM **0.92**					
NTX	Y **1.39**					
GFCE	TR **0.9**					

Estimated Partial Elasticities of the Dependent Variables w.r.t. Selected Independent Variables - Continued…				
Dependent variable	**Independent variables**			
GFD	RGPUB SR: **0.44** LR: **1.27**			
M3	RM **1.24**	CRR Pre-reform (1981-93) **-0.37**	Reform (1993-2003) **-0.49**	
PLR	YR SR: **0.17** LR: **0.48**	M3 SR: **-0.11** LR: **-0.33**	((P-P_{-1})*100/P_{-1}) SR: **0.03** LR: **0.08**	
EXPTR	(UVEXP/ (WPEXP*EXRIDX)) **0.52**		WYR_{-1} **0.66**	
UVEXP	YR SR: **0.99** LR: **18.28**	(P/(WPEXP*EXRIDX)) SR: **-0.26** LR: **-4.75**		
IMPTR	AD **2.06**	(UVIMP/P) **-0.58**		
EXR	((P-P_{-1})*100/P_{-1}) **0.17**	$CAB/RBFA_{-1}$ **-0.09**	ΔRBFA **0.13**	

SR: Short-run; LR: Long-run

Chapter V

Policy Simulations

5.1 Introduction:

As mentioned earlier, the simulation methodology can conveniently be used to analyse the impacts of counter factual scenarios about certain policy variables, on all important endogenous variables. It is important to know the response characteristics of the model to policy change. In this context, the model has been put for experiments on exogenous (policy) variables to illustrate the impacts of changes in them. Here, two types of simulations have been experimented; one is a shock simulation, where the change in a particular exogenous variable is limited to one year. This kind of shock simulation verifies the convergence and stability of the model over time. Two variables namely rain fall index (RAIN) and real public investment in infrastructure (PCFINFR) have been used for this purpose. The years 1987-1988 and 1981-82 are used for shock simulations in RAIN and PCFINFR respectively.

Second kind of simulation is sustained change simulation, where hypothetical changes in each policy instrument are incorporated for a specified sample period and the full model is solved for each year during that sample period. The time path of each endogenous variable in a policy simulation is compared and contrasted with the base simulation (not the actual series) as reference path. Such comparison only can facilitate quantification of the impacts of a policy change on the endogenous variables without confounding the effects of the inaccuracies of estimated model. In this exercise, eight policy simulations have been conducted and they are grouped into fiscal, monetary and trade related simulations. The

policy variables chosen here from the model for sustained simulations are public investment in agriculture and infrastructure (PCFAGR, PCFINFR), government external borrowings (EB), net capital inflows (NCIF), commercial bank credit to government (BCG), direct taxes (DT), cash reserve ratio (CRR), world income (WYR) and unit value of imports (UVIMP).

The public investment has been rapidly decreasing and the share of real public investment in real GDP is also declining. Therefore, as a counter factual scenario, it would be worthwhile to analyse the impact of increase in public investment on macro economic variables of interest. Another crucial issue would be the crowding-in or crowding-out effect between public and private investments in all sectors. The next important issue would be the effect of increase in public investment towards infrastructure and agriculture along with the mode of financing such public investment. All the foregoing issues are dealt with by carrying out a series of counterfactual simulations.

In order to evaluate the simulation outcomes, the model is first solved in its dynamic and deterministic mode by holding all exogenous variables to their historical levels and baseline values are obtained for all endogenous variables. Then, to allow a policy induced change to be transmitted throughout the system, a particular exogenous variable is chosen for altering its temporal path during a specific period. The sustained change arising out of this policy change is allowed to work through the system along with the feedback effects to provide the policy solution for all the endogenous variables. The simulated path of the endogenous variables therefore provides the model generated solutions of the endogenous variables during the specified period. The simulation results are compared and

contrasted with the base simulation as well as other policy simulations in terms of average percentage deviations from baseline and rates of growth.

The counter factual simulations undertaken can suggest the direction of changes and broad dimensions of change under specific assumptions made for each scenario. All the simulations are dynamic and deterministic in nature. These are experimented to illustrate the usefulness of the model for analysing the policy options relating to the exogenous variables in a simultaneous equations framework. The policy effects are plotted in Graphs. The allocative and dynamic macroeconomic effects due to the above exogenous/policy change are quantified as percentage changes, also known as multipliers, with reference to base simulation values. They are reported at five points of time, namely same year of exogenous change (immediate or instantaneous or impact), after one year (short-term), after five years (medium-term) after ten years (long-term). The responses for the years beyond sample period are reported as forecast-period. For all five terms, percentage deviation from baseline is calculated by first averaging the base simulation and policy simulation values for the specified periods. In the case of three variables namely interest rate, trade balance and head-count ratios, the impacts are simply the difference between averages of policy and base simulation values. It may be mentioned that these percentage responses are contemporaneous in nature (policy simulation vs. base simulation) and should not be treated as percentage rate of change over time for any of the variables. Further, these responses are likely to be different from the responses (coefficients or even partial elasticities) implied by the estimated equations.

The period 1993-2005[14] is used for all sustained policy simulations. The policy simulation can be done for any sample period or even post-sample period. Here, the period 1993-94 to 2003-05 is chosen because it covers the first decade after the implementation of economic reforms and their taking roots into the economy.

5.2 Shock Simulations:

One period shock simulations help us in understanding the dynamics as captured by the patterns of lagged response to policy changes. The primary focus of this kind of analysis is to study the convergence of the model in the sense that the time paths of all endogenous variables will return to the base simulation paths or not after some initial deviations from base path. If the underlying estimated model is dynamically stable, the impacts of any one-period exogenous change should decay over time and all the endogenous variables return to base simulation levels. The shock simulation given below was conducted to check the convergence of all endogenous variables over the years. For this simulation the whole study period is taken in to consideration.

(i) Rainfall index (RAIN), postulated to take the value 1.000 in 1987-88 when it was below 1.000 viz. 0.778. i.e. 28.5% increase in rainfall index in 1987-88 only.

5.2.1 Simulation (i): Exogenous Variable - Rainfall Index (RAIN)

An important feature of the Indian economy is the crucial role of weather i.e. rainfall. Therefore, it is essential to examine the growth path of the economy when

[14] As discussed in Chapter-4, data for the period 2003-2005 was available in 1999-00 base, and was converted into 1993-94 base. This resulted in abrupt up or down ward shift (break) in the series for some variables. Consequently, both model forecasts (Chaper-4) and policy effects being quantified in this chapter are likely to be very crude approximations to reality and indicate substantial differences from earlier base (1993-94) series. Hence the discussion on shares, growth rates and simulation results will be divided into two phases; 1993-02 and 2003-05.

the rainfall index has increased to 1.000 when it is below 1.000 (0.778). The year 1987-88 was a catastrophic year for weather. The rainfall index in 1987-88 is 0.778 compared to an index value of 1.000 in 1993-94 (base year). Given a one period shock in rainfall index in 1987-88, the model is solved for 1981-2005, the entire study period. The impacts are calculated i.e. percentage deviations of simulated path from baseline for the entire period 1981-2005. The impacts are given in five different time periods namely immediate (the same year; 1987-88), short-term (after two years; 1987-89), medium-term-1 (after five years 1987-92) medium-term-2 (after ten years 1987-97) and long-term (after 16 years 1987-03). The results are given in Table-5.1.

Increase in the rainfall index in year 1987-88 by 28.5% has direct effect on the real output in agriculture, which has increased from Rs. 192,515 crores to Rs. 199,641 crores i.e. 3.7% in the first period (1987-88) itself. There seems to be a small 0.4% increase in real output in manufacturing sector due to rise in aggregate demand (0.5%) whereas there is no effect on real output in infrastructure and service sectors. Consequently, aggregate real output has increased by 1.4%. This in turn reduces the wholesale prices in all sectors. Due to rise in real output in agriculture and manufacturing, the private investment in both sectors seems to increase by 8.4% and 0.6% respectively in the first year. Though the real output in both infrastructure and service sectors is unaffected, the fall in sectoral prices (as well as terms of trade) seems to cause decrease in private investment of both sectors by 6.1% and 7.9% respectively. The rise in aggregate real output seems to affect both indirect taxes and non-tax revenues positively (0.2% & 0.4% respectively). The negative price effect seems to dominate the positive output

effect in influencing direct taxes leading to 1.6% decline. Consequently, total revenues seem to fall negligibly. Government expenditure has also declined negligibly, as it purely depends on its revenues, leading to a marginal 0.4% fall in total expenditure. As a result, public sector resource gap (1.4%) there by fiscal deficit (0.6%) worsened, which in turn decreases money supply (0.6%). The combined effect of increase in real output and decrease in money supply seems to pull down all the sectoral prices as well as wholesale price index (1.0%). In the external sector, real exports fell marginally by 0.9% and real imports increased a little by 0.4% leading to an insignificant change in trade balance in the first year. Rise in real income helped reducing both rural and urban poverty (0.3%) represented by head count ratios.

In the short-term (1987-89), there seems to be deceleration in most of the variables. The increase in real agricultural output dampened to 1.8% because there is no exogenous increase in rainfall index as that in 1987-88. Interestingly, real output in infrastructure and service sectors decreased by 0.02% and 0.3% respectively. Real output in manufacturing sector has dampened (0.2%) due to deceleration in aggregate demand (0.2%) in the second period. As a result aggregate real output has decelerated by 0.6%. Agriculture prices have decreased by a negligible 0.1% with the coupled effect of decrease in the real aggregate output and money supply (0.1%). In the same way all other sectoral prices showed a marginal decrease in the second period. Government total revenues showed negligible increase as both tax and not-tax revenues dampened marginally. Government consumption expenditure seems to decelerate at the same rate as revenues causing fall in public sector resource gap (0.6%) and thereby fiscal

deficit (0.5%). Interestingly, real exports (0.3%) have increased, but real imports (0.3%) have dampened with the former dominating the latter. As a result, trade balance seems to improve by Rs. 219 crores.

However, the changes observed in most of the endogenous variables from the medium-term-1 (1987-92) are simply residual effects attributable to the endogenous lags in the model. For most of the endogenous variables, these small percentage deviations from base simulation have almost died down over time, thereby confirming the stability of the model.

In short, in case of this one period shock simulation, it takes about 3 years to recede though small effects persist for a longer period. This indicates the convergence and dynamic stability of the model. However, disturbances occurred because of the one period shock in most of the variables show damped fluctuations indicating the significant feedback effects over time and across the sectors.

5.3 Simulations on Real Public Investment (Fiscal Policy):

Aggregate real public investment, which is endogenous in the model, is the sum total of sector wise real public investments which are exogenous to the model. Public investment has a two-fold role in the model. It not only adds to net capital stock and generates output with a lag but also influences private investment in all sectors. In the estimated model, a significant crowding-in relation between public and private investment has been noticed in all sectors. However, crowding-in effect is not very significant in infrastructure sector. Therefore, the model is simulated to assess the crowding-in effect of public investment on private investment by raising the real public investment under certain hypothetical changes. It is also important to see the effect of such a simulation on other key endogenous variables such as real output, prices, money supply and, fiscal and trade deficits. The period 1993-2005 (reform period) is used for all these policy simulations. The results of the policy simulation are compared and contrasted with base simulation solved for 1993-2005[15].

Before discussing the above simulation on real public investment, it would be worthwhile to recall the trends and shares of aggregate and sector-wise public investment. The analysis of shares of policy variables would give us a better idea while deciding the hypothetical changes in real public investment. The share of real public investment (PCFTOTR) in real GDP (YR) has been falling rapidly after 1992-93. The shares of sector wise public investment in total public investment, except for infrastructure and service sectors, have been also rapidly declining after 1992-93. The share of public investment in real GDP was 11%

[15] Base simulation results solved for the sub-period 1993-2005 are very close to the base simulation results solved for the entire period (1981-2005).

between 1981-82 and 1992-93 and the same is 7.6% between 1993-94 and 2002-03 (Table-5.2). The share of public investment in agriculture (PCFAGR) and manufacturing (PCFMNR) in total public investment is lesser in the period 1993-02 while it is the opposite for the other two sectors. This implies a shift in public investment from agriculture and manufacturing to infrastructure and service sectors.

Table-5.2: Average Shares of Real Public Investment and Its Sectoral Composition (%)

	1981-92	1993-02	2003-05
PCFTOTR/YR	11.0	7.6	6.9
PCFAGR/PCFTOTR	9.9	6.3	6.7
PCFMNR/ PCFTOTR	26.4	18.8	17.2
PCFINFR/PCFTOTR	39.4	45.7	40.1
PCFSRR/ PCFTOTR	24.3	29.2	36.0

The sustained simulations are experimented keeping the above trends in public investment and its targeted growth rates in 11th five year plan[16] in mind. Comparisons of each scenario with the base simulation or of one scenario with another are in terms of growth rates and percentage deviations from baseline values.

[16]

Target GDP Growth Rate in 11th Plan (%)	7.0	8.0	9.0
Public Investment (as % of GDP)	8.4	9.8	11.2

5.3.1 Shock Simulation (ii): Exogenous Variable: Real Public Investment in Infrastructure

It is important to check the convergence and stability of the model by giving one-period shock in real public investment in infrastructure (PCFINFR) before analysing the sustained simulations on the same variable, which forms a substantial part (and main focus) of empirical work in this thesis. For this purpose, the real public investment in infrastructure has been increased by 10% in 1981-82 only. The 10% increase in 1981-82 makes real public investment in infrastructure to increase from Rs. 17,942 crores to Rs. 19,736 crores in 1981-82. The impacts in the form of percentage deviations from the baseline are given in five time periods namely immediate (first year; 1981-82), short-term (after two years; 1981-83), medium-term-1 (after five years; 1981-86), medium-term-2 (after ten years; 1981-91), long-term (after 22 years; 1981-03). They are given in Table-5.3.

Turning to the results, a 10% increase in real public investment in infrastructure would increase total public investment (PCFTOTR) from Rs. 50,480 crores to Rs. 52,274 crores i.e. 3.6% in 1981-82. The immediate impact of increased real public investment in infrastructure would be on real private investment in infrastructure (PIINFR), which will increase from Rs. 14,073 crores to Rs. 14,207 crores i.e. 0.9% (Table-5.3). Real private investment in all other sectors has also increased due to strong complementarity. Real private investment in agriculture (PIAGR) has increased by 3.8%. The combined increase in both private and public investment in infrastructure would lead to increase in private investment in manufacturing (PIMNR) by 2.3% and private investment in services (PISRR) by a large 8.8% over and above the baseline in 1981-82 itself. The aggregate private investment (PITOTR) which is the sum total of all sectoral private investments

seems to increase by 3.3% in the first year. On the other hand, public sector resource gap (RGPUB) defined as the difference between aggregate public investment and public savings has increased by 5.5%, due to 10% increase in real public investment in infrastructure in 1981-92. Public investment in infrastructure, which adds to net capital stock, has no impact on real output in all sectors except for manufacturing in the first year. This is due to one-period lag for net capital stock in the output equations of all sectors. However, real output in manufacturing has increased by 0.5% due to increase in aggregate demand (0.5%). Hence, there is an increase in the aggregate real output (YR) by a small 0.1%. There seems to be an increase in GDP deflator (PGDP) by 0.1%, causing a 0.2% increase in nominal output (Y). In the fiscal sector, direct-taxes (0.7%), indirect-taxes (0.2%) and non-tax revenues (0.6%) have increased due to rise in nominal output. As a result, government revenues increased by 0.2%, which in turn increased government consumption (0.2%). Gross fiscal deficit (GFD) has increased by 2.7% due to rise in public sector resource gap. This will lead to a series of changes on monetary side. A rise in fiscal deficit necessitates an increase in RBI credit to government and thereby raises reserve money. All these changes lead to increase in money supply (M3) by 0.4% above baseline. Increase in both money supply and real output would increase wholesale price index by a small 0.1%. Coming to the external sector, real exports have increased by 0.2%. Real imports have increased by 1.7% due to rise in aggregate demand (absorption) which in turn worsened trade deficit by Rs. -250 crores (Rs. -9,068 crores to Rs. -9,319 crores) in the first year. Exchange rate seems to depreciate by 1.6% in the first year. There is only a negligible change in poverty ratios in both rural and urban areas because of the marginal increase in real output in the first year.

In the short-term, due to on-period lag in capital stock variables in output equations, real output increases although there is no fresh increase in investment. Real private investment in infrastructure (5.5%) and manufacturing (4%) has increased due to increase in output whereas real private investment in agriculture has decelerated (0.8%). However, real private investment in services has registered a high increase (126%) due to low-base value. Hence, there is an increase in total real private investment by 7.1% in the short-term. Real output in all sectors have increased causing a 0.3% increase in aggregate real output. Aggregate demand has increased by 0.9%. Public sector resource gap (2.7%) as well as fiscal deficit (2.2%) has decelerated in the short-term as the exogenous increase in real public investment is confined to only first year i.e.1981-82. Money supply has increased by 1.8% causing wholesale prices in all sectors to increase in the short-term. On the fiscal side, government consumption (0.8%) as well as revenues (0.9%) increased as nominal income increased. In the external sector, real exports (10.6%) and real imports (4%) have increased more rapidly compared to first year.

However, in the subsequent years, many of these impacts get dampened except real private investment and output in agriculture may be due to cyclical behaviour. Since the exogenous change is of shock type, the long run path gradually gets closure to the base simulation, indicating the convergence and stability of the model. Thus, a 10% increase in real public investment in infrastructure in one-year (1981-82) gives a boost up to the Indian economy in the short-run but the effects get dampened in the long-run and get closer to base path.

5.3.2 Simulation-1: Sustained Increase in Real Public Investment in Infrastructure:

The 11th five year plan report suggests that public investment in infrastructure has to be increased between 70%-75% to achieve 8% growth rate in real GDP. Following the report, the public investment in infrastructure has been increased by 70% over its historical level in each year of the simulation period (1993-94 to 2005-06) in this exercise. This 70% increase in public investment in infrastructure will result in 30% increase in aggregate public investment on the average for the period 1993-94 to 2005-06. This 30% rise in real public investment increases its share in real output to 9.7% implying 2.3% above the actual share (7.4%) for the period 1993-2005. The share of infrastructure in real aggregate public investment becomes 57.5% (actual share is 44.4%) for the period 1993-2005. The share of infrastructure in real GDP becomes 5.6% (actual share is 3.3%). Due to 70% sustained increase, the real public investment in infrastructure has increased from Rs. 37,228 crores to Rs. 63,287 crores on the average for the period 1993-94 to 2005-06.

The sustain increase in public investment in infrastructure will have immediate positive effect (crowding-in) on private investment as it enters into real private investment equations for all sectors directly. On the other hand, it has immediate expansionary effect on public sector resource gap thereby affecting real private investment negatively. At the same time, the increase in public sector resource gap will lead to rise in fiscal deficit and thereby rise in net RBI credit to government. As a result, the reserve money will increase with the feed-back from RBI credit, leading to expansion of money supply and consequent increase in prices. The

ensuing output increase due to increase in total investment is expected to moderate the price rise to some extent.

On the other side, increase in real public investment might have an adverse effect on trade balance. Rise in aggregate absorption stemming from the higher public investment (through aggregate demand) spills over to the current account balance through increase in imports as real imports are postulated to have a positive relation with aggregate absorption. Another series of changes happens through prices. As the ratio of domestic price to world export price is negatively related to unit value of exports, a rise in domestic price decreases unit value of exports thereby causing fall in volume of real exports. On the other hand, a rise in output affects unit value of exports positively thereby causing the real exports to rise. The net effect can be positive or negative. If real imports rise over and above real exports there will be deterioration in the current account deficit thereby trade deficit. Exchange rate depreciates as the current account balance declines due to the above said changes. Therefore, the output and price effects of increase in real public investment outlay are expected to be accompanied by the rise in fiscal deficit, money supply and deterioration in current account deficit in the balance of payments. This is a kind of trade off that is likely from the postulated scenario of increase in the share of real public investment in real GDP.

The simulation results of this counterfactual scenario will be discussed in terms of percentage deviation from baseline values and growth rates for all important endogenous variables. The percentage deviations from baseline values are given in Table-5.4 and the growth rates are given in Table-5.5. Graphs comparing, baseline and policy simulation values are given in Figure-5.1to5.12.

Percentage Deviation between Policy and Base Simulations:

A sustained 70% increase in real public investment in infrastructure (PCFINFR), has both allocative and dynamic effects on the Indian economy. The effect of the above policy change will be initiated through equations 5-8 in 1993-94 itself. This will trigger a series of further changes. In all sectors, complementarity between public investment in infrastructure and private investment in rest of the sectors noticed in the estimation results. Therefore, real public investment in infrastructure (PCFINFR) seems to encourage private investment in all sectors in the first year, 1993-94. Further, agriculture, manufacturing and service sectors exhibit a cross-complementarity with the infrastructure sector, both in production and private investment. This latter feature highlights the linkage between the private investment decisions of the three sectors. Thus, any change in public investment in infrastructure will not only affect private investment in that sector, but also in other three sectors and thereby rest of the economy through macroeconomic linkages.

In response to a 70% increase in public investment in infrastructure in 1993-94, average real private investment in infrastructure (PIINFR) has increased from Rs. 12,656 crores to Rs.13,418 crores i.e. 6% increase in the same year (Table-5.3). Private investment in agriculture (PIAGR) has increased by a large 42.6%, probably due to low base value, in the first year itself. The combined increase in both private and public investment in infrastructure has a high impact on private investment in manufacturing and services (see eq. 6&8). Therefore, the total investment in infrastructure seems to increase private investment in manufacturing (PIMNR) by 28.1% and private investment in services (PISRR) by a large 68.3%

above the baseline in 1993-94. The aggregate private investment (PITOTR) which is the sum total of all sectoral private investments seems to register a large increase from Rs.97,091 crores to Rs.132,023 crores on an average i.e. by 36% in the first year. Likewise, aggregate public investment has increased from Rs.70,834 crores to Rs.95,078 crores on an average i.e. 34.2% above the baseline in 1993-94. Public resource gap (RGPUB), defined as the difference between aggregate public investment and public savings, has increased by 38.9% due to 70% increase in real public investment in infrastructure in the first year. However, 70% increase in public investment has two fold effect on private investment one through public investment (crowding-in and complementarity) and another through public resource gap (Crowding-out). Complementarity (and crowding-in) effect seems to be stronger than significant negative effect of (crowding-out) public sector resource gap resulting in a significant increase in private investment in all sectors in the first year itself.

Public investment in infrastructure, which adds to net capital stock, has no impact on real output in all sectors except for manufacturing in the first year. This is due to one-period lag for net capital stock in the production functions of all sectors. However, due to increase in both public and private investments, the aggregate demand for all domestically produced goods will increase. Therefore, real output in manufacturing (YMNR) alone, which is a function of aggregate demand, would increase at a moderate rate of 3.8% (Rs. 144,507 crores to Rs.149,972 crores on an average) thereby increasing the aggregate real output (YR) by a small 0.7%. There will be an increase in GDP deflator (PGDP) by 1.2%, resulting in a 1.9% increase in nominal output (Y). Aggregate demand has increased from Rs.

856,674 crores to Rs. 889,035 crores i.e. 3.8% increase above baseline in the first year.

On the fiscal side, the immediate impact of the policy change is a rise in gross fiscal deficit (GFD) by 18.6% through public sector resource gap, which itself has gone up by 38.9%. This will lead to a series of changes on monetary side. A rise in fiscal deficit necessitates an increase in RBI credit to government and thereby raises reserve money. All these changes lead to increase in average money supply (M3) from Rs. 401,028 crores to Rs. 413,252 crores i.e. 3% increase above baseline. On the other hand, due to increase in nominal output, direct tax (DT), indirect tax (IDT) and non-tax revenues (NTX) will increase by 2.9%, 1.7% and 2.2% respectively. As a result, there will a moderate increase in total government revenues (TR) by 2%. Rise in total government revenues will increase government final consumption expenditure (GFCE) at merely the same rate as that of TR (1.9%). The combined increase in GFCE and PCFTOTR raises government total expenditure (GXP) from Rs. 231,103 crores to Rs. 256,865 crores i.e. 11.1% increase above baseline in 1993-94.

The initial price (P) effect (1.2%) comes from sectoral prices. Due to increase in money supply per unit of real output (M3/YR), wholesale prices of agriculture (WPAG) and fuel, power, lubricants (WPFPLL) will increase by 0.3% and 0.8% respectively. The rise in money supply per unit of real output and rise in wholesale price of fuel, power, lubricants (positively effects WPMN; eq 16) together will lead to a rise in wholesale price of manufacturing (WPMN) by 1.6%. All these changes lead to a rise in implicit deflators for all sectors. The terms of trade in infrastructure and service sectors (PRINF/PGDP and PRSR/PGDP) seems

to affect private investment higher compared to that of agriculture and manufacturing (PRAG/PGDP and PRMN/PGDP). There is a negligible 0.05% change in interest rate (PLR) in the first year. Probably, the rise in money supply off sets the rise in both real output and price level hence negligible change in PLR in the first year.

Coming to the external sector, rise in real output seems to effect unit value of exports marginally higher than the relative prices, hence a negligible increase in unit value of exports (UVEXP) by 0.1%. Therefore, there will be a negligible increase in real exports (EXPTR) by 0.1%. The increase in aggregate absorption creates an instantaneous demand for real imports, which will rise by 11%. The larger increase in real imports than the real exports seems to decrease trade balance (TB) by Rs. 7967 crores (from Rs. 1,529 crores to Rs. -6,438 crores) in the first year. There is seems to be a negligible depreciation (0.01%) exchange rate in 1993-94. Poverty ratios in both rural and urban areas have decreased by a 0.2% because of the marginal increase in per capital real income in India.

In the short-term (1993-95), due to the continued hypothetical exogenous change coupled with the changes that have taken place in 1993-94 in all the endogenous variables, the responses seem to strengthen for some of the variables and weaken for others in terms of percentage deviations from baseline. Due to crowding-in effect, 70% increase in public sector investment in infrastructure also in the short-term encourages private real investment in infrastructure (PIINFR) by 5%, marginally lower than that in 1993-94. It is very interesting to note that the crowding-in effect strengthened by next year in both agriculture (45.8%) and manufacturing sectors (29.9%) of the Indian economy, but the private investment

in services substantially decelerated to 37.1% from the previous years. Due to increase in lagged net capital stock, real output in agriculture, manufacturing, infrastructure and services will increase 0.8%, 5.2%, 1.2% and 1.5% respectively in the short-term. Hence, there will be 2% increase in aggregate real output, which is much rapid than the previous year. The nominal output also rises faster (3.2%). This sets-in other macro economic effects. Prominent among these are increases in government consumption expenditure and revenues (3.3%), public resource gap (34.8%), fiscal deficit (22.1%), money supply (4.3%), price level (1.2%) and real imports (12.8%). However, real exports seems to fall by 0.6% and trade balance from Rs. -135 crores to Rs. -10,152 crores. The Indian rupee appreciates significantly (3%) against the US$. Poverty ratios have decreased significantly by 0.5% in both rural and urban areas due to rise in per capita real income.

The medium term (1993-98) effects are similar in direction but larger in magnitude. As expected, all these effects get strengthened over time (since the policy is a sustained change) and lead to significant and wide spread real benefits to the economy. Thus, 70% sustained increase in real public investment in infrastructure will lead to 15.8% increase in the aggregate real output (Rs.1,212,310 crores) over and above the baseline (Rs.1,047,215 crores) in the long-term. Real output in manufacturing (20%) and infrastructure (19.5%) increased higher than agriculture (9%) and services (16.6%). There seems to be huge increase occurred in private investment in manufacturing (62.2%) and services (60.4%) and comparatively there is less increase in real private investment in agriculture (46.7%) and infrastructure (13.3%) in the long-term. With increase in both public and private investments, aggregate demand seems to

rise by 18% in the long-term. Wholesale price index (1.5%) as well as sectoral prices increased and money supply has gone up by 26.1% in the long-term. Interest rate (PLR) seems to decrease by 0.4%, which is a perverse response. Despite faster rise in real imports (36.7%) than real exports (15.4%), trade balance has improved by Rs. 6,451 crores in the long-term. Indian rupee seems to depreciate by 2.9% in the long-run. Poverty ratios have decreased significantly by 4.6% and 4.9% in rural and urban areas respectively. This simulation exercise reveals that the increase in real GDP has a trade off namely the increase in price level, money supply and fiscal deficit.

In the forecast period (2003-06), most of the macro economic variables seem to behave in an unrealistic way. This probably is due to break in series caused by change in base year as pointed out already.

Comparison of Growth Rates:

Since percentage deviations of policy path from base path is different from conventional rate of growth in a variable, as an alternative measure of policy effect, we compute the difference between compound growth rate in policy simulation path and baseline path over the ten year period. These are reported in Table-5.4. The variables included are aggregate demand, nominal and real output, private consumption and investment, government consumption and revenues, wholesale price index, money supply, real exports and real imports. In addition, the share of real private investment in real output and, the shares of public sector resource gap, gross fiscal deficit and current account balance in nominal output are also analysed for each policy simulation. The compound growth rates are calculated by estimating semi-log trend equations for the ten year period (1993-94

to 2002-03). The compound growth rates of base simulation and policy simulation and, their difference are given in Table-5.5.

Due to a sustained 70% increase in real public investment in infrastructure, the aggregate public investment is increased by 0.2% over and above the baseline growth rate (1.1%) for the total simulation period. As discussed earlier, the first and far most effect of such an increase is on the real private investment. Due to complementarity, private investment in all sectors recorded a higher growth rate than in base simulation except for agriculture, which has decelerated. Private investment in infrastructure has increased by 3% over base simulation. The extents of acceleration in private investment are manufacturing (7.7%) and service sectors (5.4%) and deceleration is agriculture (0.1%). The share of aggregate real private investment in real output seems to increase (20.8%), when compared to its share of baseline (15.8%). The aggregate real output seems to register a 3% increase above the baseline (6.3%), which matches the target of 11th five year plan. There seems to be substantial increase in growth rates of real output in agriculture (1.9%), manufacturing (3.3%), infrastructure (3.8%) and services (3.2%). These increases seem to match the sector wise growth rates of real output projected in 11th five year plan. Compound growth rate of private consumption has increased by 2.4% due to increase in real output and public expenditure. Aggregate demand has increased by 3 percentage points almost equal to aggregate supply (real output).

On the fiscal side, government revenues has increased by 4.1% and government consumption by 3.5% which should lower fiscal deficit. This does not seem to happen. The share of public resource gap and fiscal deficit in nominal output seem

to remain unchanged in the long run when compared to baseline. Money supply (5.1%) seems to increase considerably in the long-term. Price level showed a very low (0.3%) increase in its growth arte when compared to baseline. Both real exports (4.2%) and real imports (4.7%) increased substantially, the latter dominating the former. However, current account balance as a share of nominal output seems to deteriorate negligibly (-0.5%).

In short, the 70% sustained increase in real public investment in infrastructure sector seems to have a wide range of positive effects on the economy. A substantial rise in real public investment in infrastructure seems to encourage private investment in all sectors with strong crowding-in in itself and complementarity effect in other sectors. The aggregate and sector wise real outputs seem to increase substantially. However, there seems to be moderate increase in price level, fiscal deficit and money supply which can be seen as a trade-off for the increase in real output. Also, trade balance as well as current account balance seems to deteriorate in the short-term but improve in the long-term.

Table-5.5: Impacts of a Sustained 70% Increase in Real Public Investment in Infrastructure

	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	9.0	**3.0**
Nominal Output (Y)	12.2	16.1	**3.9**
Real Output (YR)	6.3	9.3	**3.0**
Agriculture (YAR)	2.2	4.1	**1.9**
Manufacturing (YMNR)	6.8	10.1	**3.3**
Infrastructure (YINFR)	7.9	11.7	**3.8**
Services (YSRR)	8.1	11.3	**3.2**
Private Investment (PITOTR)	3.3	9.2	**5.9**
Agriculture (PIAGR)	6.1	6.0	**-0.1**
Manufacturing (PIMNR)	2.7	10.4	**7.7**
Infrastructure (PIINFR)	4.2	7.2	**3.0**
Services (PISRR)	3.6	9.0	**5.4**
Real Private Consumption (PCR)	5.2	7.6	**2.4**
Public Investment (PCFTOTR)	1.1	1.3	**0.2**
Government Consumption (GFCE)(N)	14.6	18.1	**3.5**
Government Revenues (TR) (N)	11.8	15.9	**4.1**
Wholesale Price Index (P)	5.4	5.8	**0.4**
Money Supply (M3)	15.0	20.1	**5.1**
Real Exports (EXPTR)	9.7	14.0	**4.3**
Real Imports (IMPTR)	9.5	14.3	**4.8**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	20.8	**5.0**
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.6	**0.0**
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	8.7	**0.0**
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.8	**-0.4**

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

Figure-5.1: Impact of 70% sustained increase in PCFINFR on real private investment in infrastructure

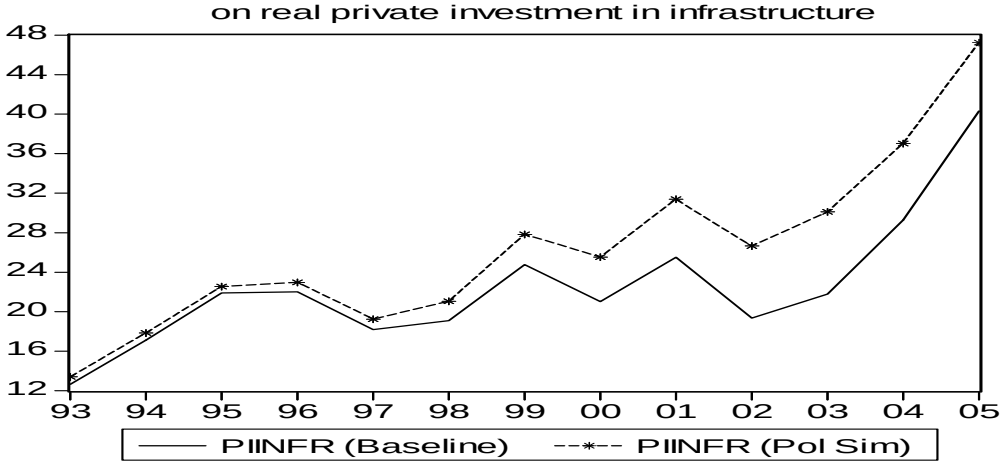


Figure-5.2: Impact of 70% sustained increase in PCFINFR on real private investment in manufacturing

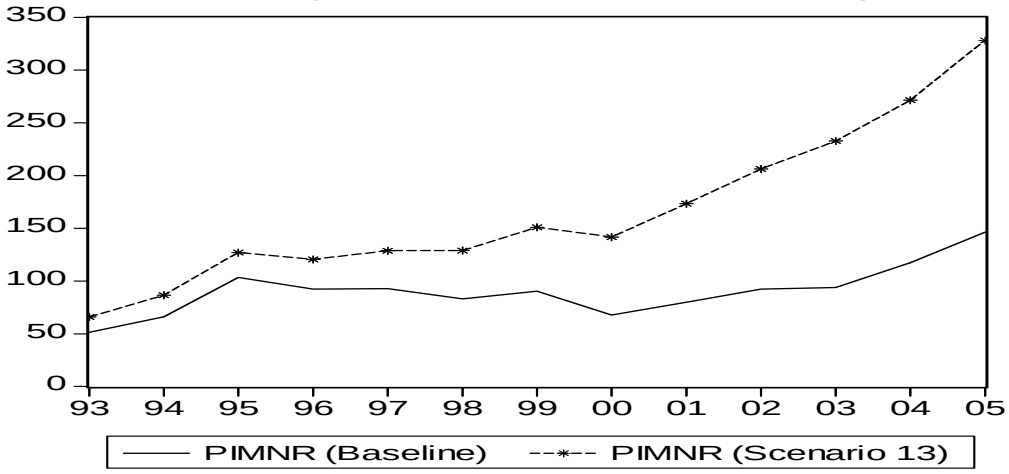


Figure-5.3: Impact of 70% sustained increase in PCFINFR on real private investment in services

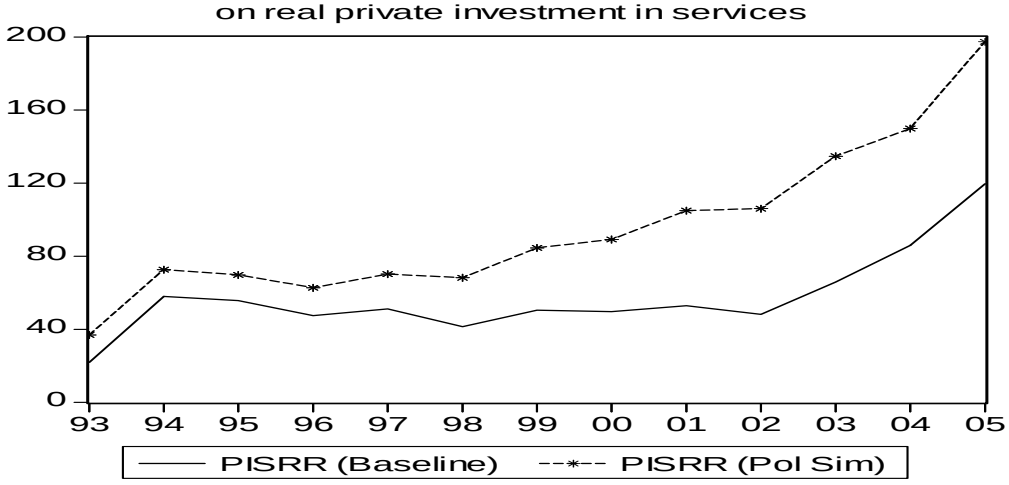


Figure-5.4: Impact of 70% sustained increase in PCFINFR on aggregate real output

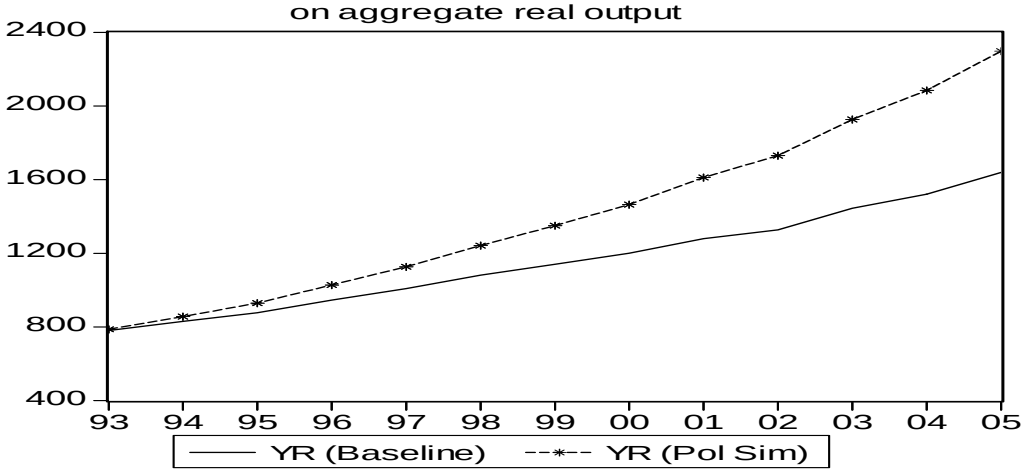


Figure-5.5: Impact of 70% sustained increase in PCFINFR on real output in infrastructure

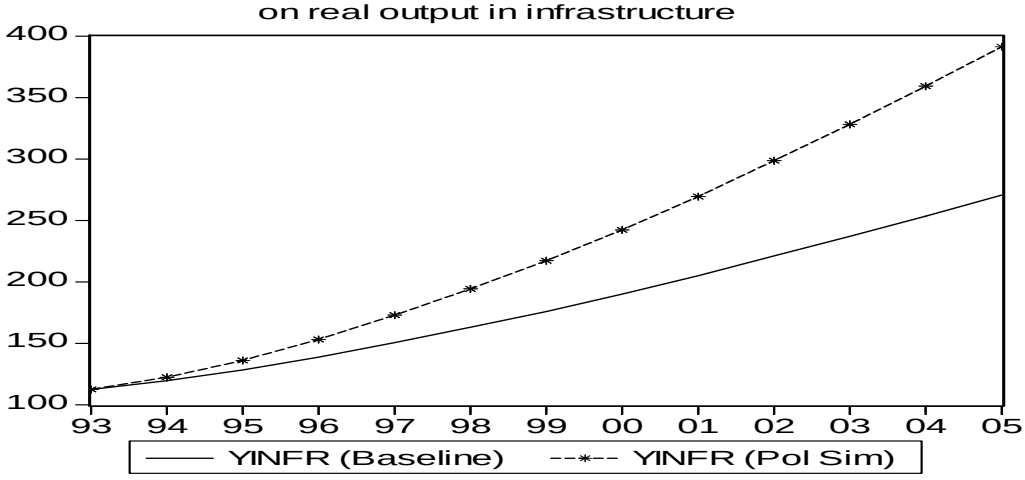


Figure-5.6: Impact of 70% sustained increase in PCFINFR on real output in manufacturing

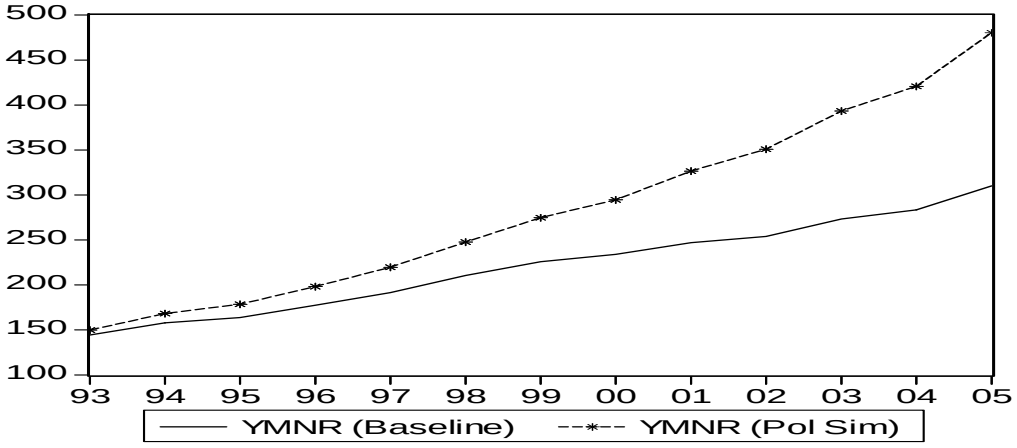


Figure-5.7: Impact of 70% sustained increase in PCFINFR on public sector resource gap

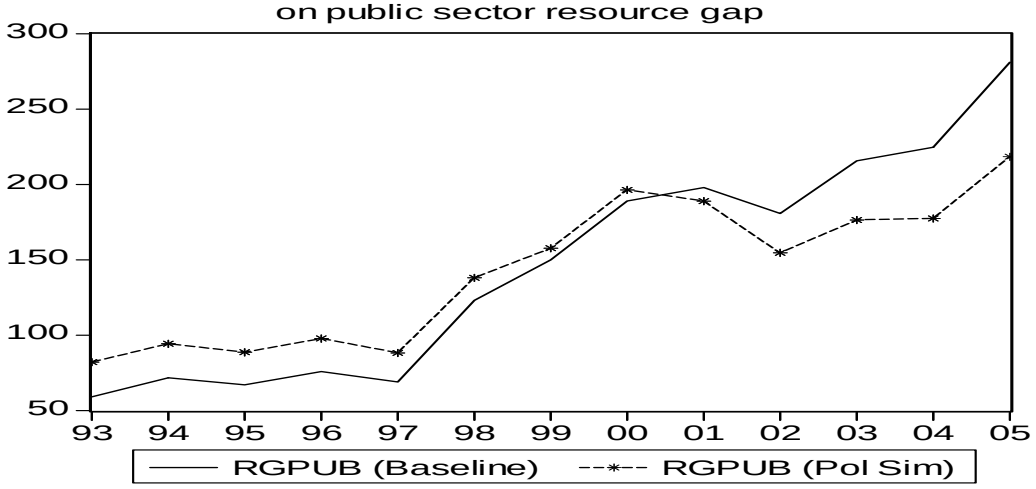


Figure-5.8: Impact of 70% sustained increase in PCFINFR on gross fiscal deficit

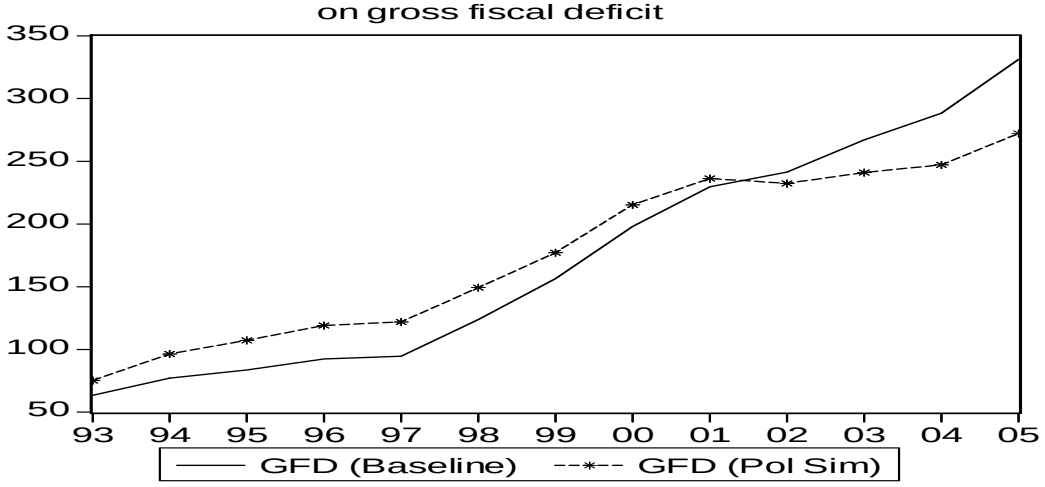


Figure-5.9: Impact of 70% sustained increase in PCFINFR on money supply

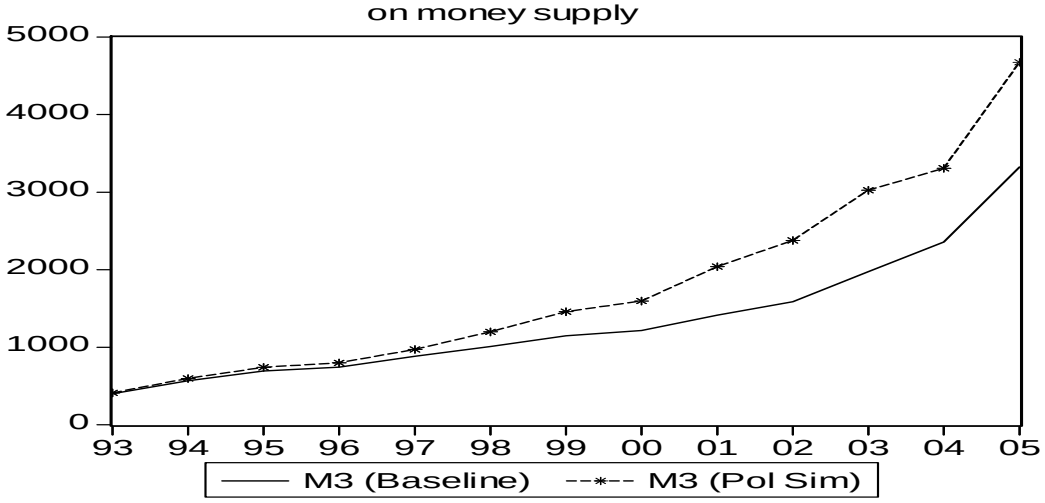


Figure-5.10: Impact of 70% sustained increase in PCFINFR on wholesale price index

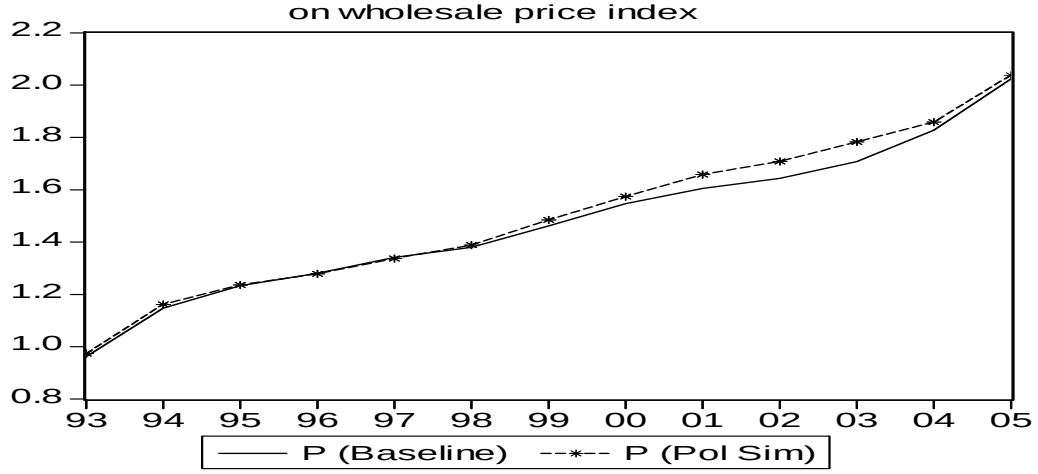


Figure-5.11: Impact of 70% sustained increase in PCFINFR on real exports

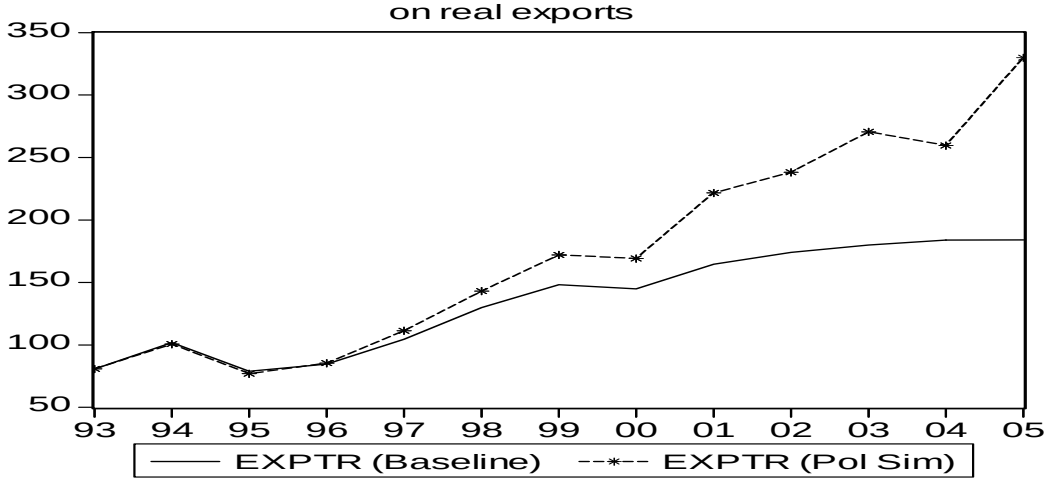
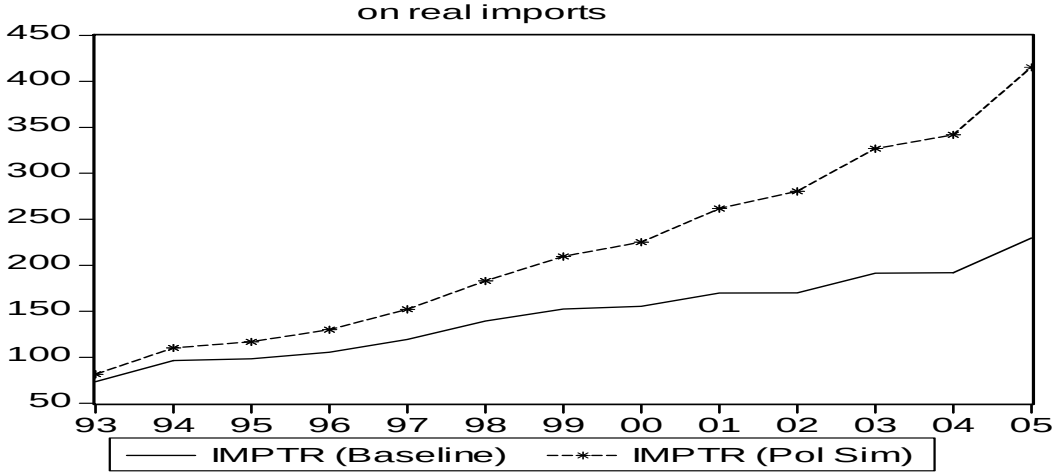


Figure-5.12: Impact of 70% sustained increase in PCFINFR on real imports



5.3.3 Simulation-2: Sustained Increase in Real Public Investment in Infrastructure Financed by External Borrowings:

In simulation-1, it was assumed that the necessary resources for public investment in infrastructure are available free of cost. This assumption is being relaxed in this and subsequent scenarios. The required resources are assumed to be generated within the model. In this simulation, it is hypothesized that the government will raise the necessary investment resources through external borrowing, which will flow through net capital inflows. Therefore in this simulation, all three variables namely real public investment in infrastructure (PCFINFR), external borrowings (EB) and net capital inflows (NCIF) are increased by 70% of PCFINFR each on a sustained basis. Since EB and NCIF are in current rupees (nominal terms), the amount of external borrowings required to finance public investment is also expressed in current prices using gross investment deflator (PGKE)[17]. Due to a 70% sustained increase in public investment in infrastructure and an equivalent addition to EB in current rupees, external borrowings are increased from Rs. 1,733 crores to RS. 42,767 crores and net capital inflows increased from Rs. 54,994 crores to Rs. 96,028 crores during 1993-2005. As the additional borrowings of the government from external sources will be used to finance increased fiscal deficit due to rise in public investment in infrastructure, the net RBI credit to government will reduce and there by reserve money and money supply. However external borrowings which come through capital inflows will be added to net foreign exchange assets of RBI, which in turn increases reserve money there by money supply. Hence, there will be a moderate increase in money supply. Changes in

[17] Since PGKE is used as a conversion deflator, it has been made exogenous in both base as well as policy simulations for simulations 1-5 to make them comparable.

money supply will trigger several other changes in the economy. A sustained 70% increase in real public investment in infrastructure, envisaged as above, has both short- and long-run effects on all the sectors of the Indian economy. Here also the policy simulation results are compared with base simulation results in terms of average percentage deviations and compound growth rates. The impacts and the dynamic multipliers in terms of percentage deviations from baseline are given in Table-5.6 and comparison of growth rates are given in Table-5.7.

Percentage Deviation between Policy and Base Simulations:

From the estimated model, it can be seen that public investment in infrastructure affects private investment in all sectors as discussed in the earlier simulation. As a first step, the 70% rise in public investment in infrastructure increases private investment in infrastructure (6.7%) due to crowding-in effect. Due to complementarity, there will be an increase in private investment in agriculture (42.1%), manufacturing (29.4%) and services (71.9%) sectors. Combined increase in both public and private investment in infrastructure seems to increase private investment in manufacturing and services at a very high rate. The average aggregate private investment has therefore increased from Rs. 97,091 to Rs. 133,477 crores i.e. 37.5%. The 70% increase in public investment in infrastructure increases aggregate public investment (34.2%) thereby public sector resource gap (38.5%), which in turn lead to higher fiscal deficit (18.4%) in 1993-94. These results are similar to simulation-1. The rise in public investment in infrastructure adding to net capital stock leads to no change in real output in all sectors except manufacturing in the first year as the net capital stock affects real output with a one-period lag in all sectors. However, a 4.3% increase in real output of

manufacturing stems from rise in aggregate demand (4.3%), seems to increase aggregate real output by a small 0.8%. Further, there are other macro economic effects.

Since the government is envisaged to borrow the required funds from the external sources, it may require less support from the RBI. This should result in a reduction in reserve money there by money supply compared to simulation-1. However increase in net capital inflows will raise net RBI foreign exchange assets which again increases reserve money there by money supply. The combined effect in net RBI credit to government and net RBI foreign exchange assets seems to increase money supply (3.7%) slightly above simulation-1 (3%) in the first year. Increase in liquidity as a ratio of real output (M3/YR) seems to increase wholesale prices of all sectors. As a result, there is a 1.5% increase in wholesale price index for all commodities.

On the fiscal side, the impacts are significant in the first year itself. The government consumption, which is structurally related to government revenues, has increased from Rs. 78,594 crores to Rs. 80,398 crores i.e. 2.3% on an average. Higher public investment along with rise in government consumption will increase government total expenditure by 11.3%. Due to increase in nominal output (2.2%), there will be an increase in revenues from direct taxes (3.4%), indirect taxes (2%) and non-tax revenues (2.6%) of the government, resulting in 2.3% increase in government total revenues.

In the external sector, real exports seems to rise by 5.5%. The increase in domestic absorption (aggregate demand) seems to create an instantaneous demand for real imports (12.6%) in 1993-94. Consequently, there seems to be deterioration in

trade balance (7.2%) and current account balance. Increase in domestic price as a ratio of world export price seems to offset the rise in real output resulting in a reduction in exports price (2.7%). An increase in net RBI foreign exchange assets along with deterioration in current account balance and inflation seems to depreciate Indian rupee against US dollar by 16.1% in the first year.

Since the head count ratio is inversely related to per capita real income, the former declines (0.2%) due to increase in the latter in both rural and urban areas in 1993-94, the year of 70% increase in public investment in infrastructure. Thus, growth in income leads to decline in poverty instantaneously, though very small in magnitude.

The impacts get strengthened by 1993-95 (after two years) and subsequent years. Due to crowding-in effect, 70% increase in public sector investment in infrastructure encourages private real investment in infrastructure by 4.5% in the short-term, a significant positive response of private sector. It is very interesting to note that private investment responds positively in all the other three sectors of the Indian economy, with lead role from the agriculture (46.4%), services (34.4%) followed by manufacturing (30.4%) and in that order. As a result, the total real private investment has increased by 29.9%. Due to increase in real net capital stock in infrastructure in 1993-94 (lag), there seems to be an increase in infrastructure output (1.2%) in the short-term. Likewise, real output in agriculture (0.8%), manufacturing (5.5%) and services (1.6%) also increased leading to increase in aggregate real output (2%). The nominal income will however increases (3%) due to a rise in the GDP deflator (0.8%) in the short-term. A moderate rise in nominal output would increase government revenues (3%), which

in turn increases government consumption with the same percentage. Money supply seems to continue the same increase (3.7%), but lesser when compared to simulation-1 (M3-4.3%). Real exports (2.8%) and real imports (13.4%) seem to increase latter dominating the former worsening the trade balance (10.9%) in the short-term. After two years (1993-95), the decline in poverty gained momentum in both rural and urban areas. Due to larger increase in per capita real income, the head count (poverty) ratio in rural and urban areas declined by 0.5% each.

As expected, all these effects get strengthened further over time (since the policy is a sustained change) and lead to significant and wide spread real benefits to the economy. In the long-term (after ten years; 1993-2003), private investment in infrastructure (6.6%) there by real output in infrastructure (19.2%) seems to increase significantly with a higher increase in aggregate demand (16.7%). The price level seems to decline (0.3%) marginally with a higher aggregate real output (15%) compared to money supply (14.8%). Public sector resource gap (14.3%) and fiscal deficit (16.8%) will continue to increase in the long-term. Real exports (15%) as well as real imports (33.3%) seem to increase rapidly. resulting in a moderate deterioration in nominal trade balance (7.3%). The current account balance is also expected to fall by the same extent. The Indian Rupee will depreciate by 12.3% against the US $. Poverty seems to decline by 4.3% and 4.7% in both rural and urban areas respectively.

In the forecast period (2003-05), most of the macro economic variables seem to continue the trends. The exceptions are public resource gap and fiscal deficit.

Comparison of Growth Rates:

Due to a 70% sustained increase in real public investment in infrastructure financed by external borrowings, the growth rate of aggregate public investment has increased from 1.1% to 1.3%. Growth rate of private investment in infrastructure has increased by 1.2%. Likewise, growth rate of private investment in manufacturing seems to increase by a very high rate (6.2%) when compared to agriculture (0.4%) and services (3.4%) during 1993-2005. Aggregate demand has increased by 2.6% as the aggregate absorption in the economy has increased due to rise in aggregate investment. Real output seems to increase by 2.8% over and above baseline growth rate (6.3%) during 1993-2005. The growth rate in real output is a little less than that of in simulation-1. Real private consumption has increased by 2.3% where as government consumption has increased by 2.5%. Government revenues seems to increase by 3%. Due to 70% increase in real public investment in infrastructure, public resource gap there by fiscal deficit as a share of nominal GDP has increased by 3% and 1% respectively. The increase in growth rate of money supply (2.8%) is lesser compared to that of in simulation-1 (5.1%). The share of current account balance in nominal GDP has decreased (0.5%) as the current account balance deteriorated due to lower increase in both real exports (3.3%) and imports (4%) compared to simulation-1.

In short, due to a 70% sustained increase in public investment in infrastructure financed through external borrowings, the growth rate of real output has increased from 6.3% to 9.1% but it is less than that of in simulation-1 by a small 0.2%. However along with growth rate in real output, prices and money supply also declined when compared to simulation-1.

Table-5.7: Impacts of a Sustained 70% Increase in Real Public Investment in Infrastructure Financed through External Borrowings

	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	8.6	**2.6**
Nominal Output (Y)	12.2	15.0	**2.8**
Real Output (YR)	6.3	9.1	**2.8**
Agriculture (YAR)	2.2	4.2	**2.0**
Manufacturing (YMNR)	6.8	9.7	**2.9**
Infrastructure (YINFR)	7.9	11.7	**3.8**
Services (YSRR)	8.1	11.0	**2.9**
Private Investment (PITOTR)	3.3	7.8	**4.5**
Agriculture (PIAGR)	6.1	6.5	**0.4**
Manufacturing (PIMNR)	2.7	8.9	**6.2**
Infrastructure (PIINFR)	4.2	5.4	**1.2**
Services (PISRR)	3.6	7.0	**3.4**
Real Private Consumption (PCR)	5.2	7.5	**2.3**
Public Investment (PCFTOTR)	1.1	1.3	**0.2**
Government Consumption (GFCE)(N)	14.6	17.1	**2.5**
Government Revenues (TR) (N)	11.8	14.8	**3.0**
Wholesale Price Index (P)	5.4	5.3	**-0.1**
Money Supply (M3)	15.0	17.8	**2.8**
Real Exports (EXPTR)	9.7	13.0	**3.3**
Real Imports (IMPTR)	9.5	13.5	**4.0**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	17.0	1.2
Resource Gap / Nominal Output (RGPUB/Y)	7.6	10.6	3.0
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	9.7	1.0
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.9	-0.5

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

5.3.4 Simulation-3: Sustained Increase in Real Public Investment in Infrastructure Financed by Commercial Bank Credit:

In this exercise, a sustained 70% increase in real public investment in infrastructure is assumed to be financed by borrowings from commercial banks. Commercial bank credit constitutes an alternative source of financing the additional public investment in infrastructure. Assuming competing needs for money, in other words 'liquidity crunch', the bank credit that was available to commercial sector earlier will be lesser by the amount borrowed by the government for investment in the infrastructure sector. Consequently, the increased flow of bank credit to government will reduce the resources available for private investment. Hence, there will be an increase in interest rate. Another consequence is that net RBI credit to government will reduce as the increased fiscal deficit, due to additional investment, will be financed through commercial bank credit to government, which in turn will reduce reserve money and thereby money supply. For this simulation along with 70% sustained increase in real public investment in infrastructure (PCFINFR), commercial bank credit to government (BCG) also will increase by the same amount during 1993-2005. This will increase average BCG from Rs. 371,943 crores to Rs. 412,977 crores during 1993-2005. The results in terms of percentage deviations are given in Table-5.8 and growth rates are given in Table-5.9.

Percentage Deviation between Policy and Base Simulations:

The outcome of this policy change will be perceptibly different from the earlier policies (simulations-1 & 2). Here also the results are reported at five points of time, namely same year of exogenous change (immediate or instantaneous or

impact), after one year (short-term), after five years (medium-term) after ten years (long-term). The responses for the years beyond sample period are reported as forecast-period. For all five periods, percentage deviation from baseline are calculated by taking the means of the base simulation and policy simulation for the specified periods. In the case of rate of interest and trade balance and head-count ratios, the impacts are changes in means, not rate of change.

The immediate impact of the 70% sustained increase in real public investment in infrastructure financed by commercial bank credit will be on private investment. Higher credit flows to government seem to crowd-out (reduce) real private investment in infrastructure and services by (15%) and (41.4%) respectively compared to base simulation. The average private investment in infrastructure has decreased from Rs. 12,656 crores to Rs. 10,756 crores in 1993-94. The service sector seems to absorb the maximum crowding-out effect namely Rs 9105 crores out of the total Rs. 24,244 crores of additional real public investment. However, there is a sizable increase in real private investment in agriculture (58.9%) and manufacturing (16.5%), leading to an increase in the total private investment by a moderate 4.1% in the first year. Thus, there is a reallocation of private investment from infrastructure and services to agriculture and manufacturing. Due to this policy change, public sector resource gap will increase by 47.8% and fiscal deficit by 22.8%.

Due to one-period lag for the net capital stock variable in the production function for the infrastructure sector, the output will increase only with a lag. Due to increase in investment, aggregate demand in the economy will increase by 2.6%, which in turn increases manufacturing output (2%) and there by total real output

(0.4%). There seems to be a large decrease in GDP deflator (6.6%), leaving an equally large decrease in nominal output (6.3%). Real private consumption seems to be increased marginally by 0.1%.

Government total expenditure increases substantially by 8.3% with increase in public investment and large decrease in government consumption (6.4%) due to decrease in its revenues. Government revenues seems to decrease by 6.4% due to fall in all its components - direct (9.2%), indirect (5.7%) tax and non-tax revenue (7.4%) in view of decline in nominal income (6.3%). Increase in commercial bank credit to government will have an adverse effect on net RBI credit to government there by reducing reserve money and money supply (12.9%). Wholesale prices in all sectors seem to fall as the money supply as a ratio to real output has decreased, causing a significant decline in wholesale price index for all commodities (6.9%). Interest rate has declined by a smaller 0.2% contrast to expectations.

The exports price seems to increase (3.7%) significantly as the domestic price decreases in the first year. Surprisingly, there seems to be a decrease in real exports by 4.9% whereas real imports seems to increase marginally by 0.4% due to a moderate increase in aggregate demand (2.6%). Indian rupee seems to appreciate significantly by 14.6% due to decrease in prices as well as net foreign exchange assets of RBI. There seems to be negligible change in poverty ratios in the same year of the increase in public investment financed through bank credit.

In the short-term, the trends seem to continue in most of the variables. Increase in real public investment in infrastructure seems to crowd-out private investment in infrastructure (2.3%) in the short-term also. However, the level of crowding-out has reduced from first year to short-term. Nevertheless, private investment in all

other sectors has increased due to complementarity causing total private investment to increase by 16%. Real output in agriculture (1%), manufacturing (3.7%) and infrastructure (1.1%) has increased where as real output in service sector has decreased negligibly (0.02%) causing aggregate real output to increase by 1.2% in the short-term. Public sector resource gap (40.4%) and fiscal deficit (26%) seem to continue their trend in the short-term also. Average money supply has decreased from Rs. 484,603 crores to Rs. 464,353 crores i.e.4.2%. Interest rate seems to increase by 0.1% due to more competition for resources from private sector investment. Both real exports (0.8%) and real imports (6.6%) seems to improve latter dominating the former. Hence, there seems to be Rs. 2698 crores decline in trade balance.

The medium-term effects are similar to short-term effects. Thus in the long run, due to a 70% sustained change in public investment in infrastructure, private investment in infrastructure increases by 12.1% while the same in agriculture (49%), manufacturing (58.1%) and services (55.8%) sectors increases remarkably. Aggregate real output has increased by 15% with higher increase in infrastructure output (19.2%) compared to other sectors. Aggregate demand seems to increas at a faster rate (17%) with increased aggregate investment. Public sector resource gap (10.4%) and fiscal deficit (14.2%) seem to increase at a lesser rate than short and medium-terms. However, government consumption (17.5%) and revenues (19.8%) seem to improve in the long-term. Money supply seems to improve by 24.1% leading to a marginal increase in wholesale prices (0.6%) with a moderate increase in wholesale of agriculture (0.8%), manufacturing (0.1%) and fuel power, lubricants (2.2%). In the external sector, both real exports (14.8%) and real

imports (34.1%) have increased. Head count ratios in both rural and urban areas have declined by 4.3% and 4.7% in rural and urban areas respectively in the long-term.

Comparison of Growth Rates:

The compound growth rates of important variables in this simulation for the period 1993-2002 (long-term) are given in Table-5.8. A sustained increase in 70% real public investment in infrastructure financed by borrowings from commercial banks would lead to an increase of 3.9% in the growth rate of real private investment in infrastructure. There seems to be a small decline in private investment in agriculture (0.7%) in the long-term. However growth rate of private investment in manufacturing (8.6%) and services (10.9%) have increased remarkably when compared to baseline growth rates. Hence, there is a significant increase in the growth rate of total private investment (7.3%) during 1993-2002. Aggregate real output has increased from 6.3% to 9.3% which is slightly higher than that of in simulation-2. Aggregate demand seems to increase by 3%. Real private consumption seems to grow from 5.2% to 7.7% during 1993-2002. The shares of public sector resource gap and fiscal deficit in nominal output seem to increase at the same rate (0.3) when compared to their respective shares in baseline. Growth rate of government revenues (4.7%) seems to increase higher than its consumption (4.1%). Wholesale prices has increased by 0.9% due to increase in money supply. Real exports and real imports have increased by 4.2% and 5.4% respectively leading to slight deterioration in the share of current account balance in nominal output (0.2%). In short, increase in public investment financed by commercial bank credit seems to increase real output higher with increase in price level and money supply when compared to simulation-2.

Table-5.9: Impacts of a Sustained 70% Increase in Real Public Investment in Infrastructure Financed through Borrowings from Commercial Banks

	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	9.0	**3.0**
Nominal Output (Y)	12.2	16.7	**4.5**
Real Output (YR)	6.3	9.3	**3.0**
Agriculture (YAR)	2.2	4.1	**1.9**
Manufacturing (YMNR)	6.8	10.2	**3.4**
Infrastructure (YINFR)	7.9	11.7	**3.8**
Services (YSRR)	8.1	11.4	**3.3**
Private Investment (PITOTR)	3.3	10.6	**7.3**
Agriculture (PIAGR)	6.1	5.4	**-0.7**
Manufacturing (PIMNR)	2.7	11.3	**8.6**
Infrastructure (PIINFR)	4.2	8.1	**3.9**
Services (PISRR)	3.6	14.5	**10.9**
Real Private Consumption (PCR)	5.2	7.7	**2.5**
Public Investment (PCFTOTR)	1.1	1.3	**0.2**
Government Consumption (GFCE)(N)	14.6	18.7	**4.1**
Government Revenues (TR) (N)	11.8	16.5	**4.7**
Wholesale Price Index (P)	5.4	6.3	**0.9**
Money Supply (M3)	15.0	21.2	**6.2**
Real Exports (EXPTR)	9.7	13.9	**4.2**
Real Imports (IMPTR)	9.5	14.9	**5.4**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	20.4	4.6
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.9	0.3
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	9.0	0.3
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.6	-0.2

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

5.3.5 Simulation-4: Sustained Increase in Real Public Investment in Infrastructure Financed through Taxation (Increase in Direct-Taxes):

In this scenario, increase in real public investment in infrastructure is assumed to be financed through increase in direct-taxes. Thus, increase in real public investment will be internally get adjusted by increasing the direct taxes. It is postulated that a sustained 70% increase in real public investment in infrastructure will be financed by increasing direct-taxes (DT) in the same amount. Such a policy will reduce the public sector resource gap thereby fiscal deficit. Due to sustained 70% increase, DT[18] has increased from Rs. 75,595 crores to Rs. 93,322 crores. Percentage deviations are given in Table-5.10 and growth rates are given in Table-5.11.

Percentage Deviation between Policy and Base Simulations:

The immediate change due to sustained 70% increase in real public investment in infrastructure internally financed by increase in direct-taxes will be in government revenues which has increased significantly from Rs. 140,017 crores to 163,721 crores i.e. 16.9% on the average in the first year itself. This in turn will increase public savings thereby reduce public sector resource gap when compared to earlier simulations (1-3). However, public sector resource gap (23.1%) has increased when compared to base line as the aggregate public investment increased due to a sustained 70% increase in real public investment in infrastructure. As public sector resource gap positively affects fiscal deficit, it has increased by 11.1%. However the increase in fiscal deficit is less than that of in earlier simulations. In

[18] Since direct-taxes is endogenous to the model, it has been increased without changing the basic structure of the model by using add factor. Eviews package facilitates such a modification through add factor.

this situation, the need for RBI credit to government will be decreased to finance fiscal deficit as government tries to finance it from its own savings by increasing direct-taxes. Hence, reserve money and there by money supply (1.5%) decreases moderately. Wholesale price indices in all sectors have decreased as money supply declined, causing wholesale price index for all commodities to fall by 1.2%. Interestingly, indirect-taxes (0.4%) and non-tax (0.5%) revenues seem to decline due to decrease in price level. However, government consumption seems to increase at a high rate (16.7%) due to increase in revenues.

Real private investment in infrastructure has increased by a small 0.7% in the first year. However, real private investment in other sectors seems to increase enormously leading to high increase in total private investment (42.7%). Real output in all sectors except manufacturing (3.9%) has no change in the first year causing aggregate real output to increase marginally (0.7%). Aggregate demand has increased by 4.1% in the first year. Coming to external sector, real exports seem to decrease (1.5%) and real imports seem to increase (9.7%). Hence, trade balance has deteriorated by Rs. 7272 crores. Exchange rate seems to appreciate by 4.7%.

In the short-term, trends seem to continue in government revenues (16%) and consumption (15.8%), public sector resource gap (21.2%) and fiscal deficit (13.4%). As a result, money supply declined at the same rate as first year (2.7%) leading to higher decline in wholesale prices index (2%). The private investment in infrastructure (0.2%) has increased marginally in the second-term also. Probably, the fall in terms of trade is offsetting the rise in public investment. Therefore, there seems to be lesser increase in private investment in infrastructure.

Nevertheless, complementarity seems to be strong in other sectors leading to 33.7% increase in total private investment. Real output in manufacturing has increased (5.7%) significantly, where as it has marginally increased in agriculture (0.9%), infrastructure (1.2%) and services (1.4%) leading to a moderate increase in aggregate real output by 2%. Real private consumption (0.1%) seems to increase in the second-term marginally. Indirect-tax (0.1%) and non-tax (0.1%) revenues seem to improve marginally in the second-term. Real exports seems to decline by 1.5% and real imports seem to increase by 12% causing more pressure on trade balance. The medium-terms impacts are similar in trend but stronger in magnitudes.

Thus, a sustained 70% increase in real public investment in infrastructure financed by increase in direct-taxes seems to give better benefits to the economy in the long-term. Crowding-in and complementarity seem to prevail in the long-term leading to higher increase in real private investment in all sectors. Hence, there is a 55.1% increase in total real private investment. Aggregate real output has increased by 15.3% a little above than that of in earlier simulations (simulations 2-3) accompanied by significant decline in wholesale price index (1.2%), lesser increase in fiscal deficit (4.8%) and money supply (14.5%). In the external sector, both real exports (17.1%) and real imports (36.3%) seem to improve rapidly bettering the trade balance by Rs. 12,114 crores. Poverty ratios have declined by 3.6% and 3.9% in rural and urban areas significantly due to significant increase real per capita income.

Comparison of Growth Rates:

In this exercise also, growth rates of important endogenous variables are computed for comparison not only with baseline growth rates but also with simulation-2 &3 growth rates. Also the shares of private investment, public sector resource gap, gross fiscal deficit and current account balance in output are analysed for this particular simulation. The compound growth rates are computed by using the semi-log trend equations for the period 1993-2002.

Due to a sustained 70% increase in real public investment in infrastructure, the growth rate of aggregate real output has increased by 2.9% with significant increase in agriculture (2%), manufacturing (3.3%), infrastructure (3.7%) and services (3%) sectors. Real private investment in manufacturing increased significantly (6.7%) followed by services (5.6%) and infrastructure (2%) leading to 5.4% increase in the growth rate of total real private investment. However, the growth rate of real private investment in agriculture has decelerated by a small 0.2%. Government revenues seems to increase by 3.1% causing government consumption to increase by 2.4%. Real private consumption has increased by 2.5% due to increase in real output as well as government expenditure. The share of both public sector resource gap and fiscal deficit in nominal output has declined by 0.3% each. Growth rate of money supply showed a significant increase (4.7%) above the baseline causing wholesale price index to increase by a small 0.4% above baseline. Growth rates of real exports (4.6%) and real imports (4.8%) showed enormous increase. However, share of current account balance in nominal output has deteriorated by a small 0.2%. Graphs comparing simulations-1 to 4 are given in Figure-5.13 to 5.31.

Table-5.11: Impacts of a Sustained 70% Increase in Real Public Investment in Infrastructure Financed by Increase in Direct-Taxes

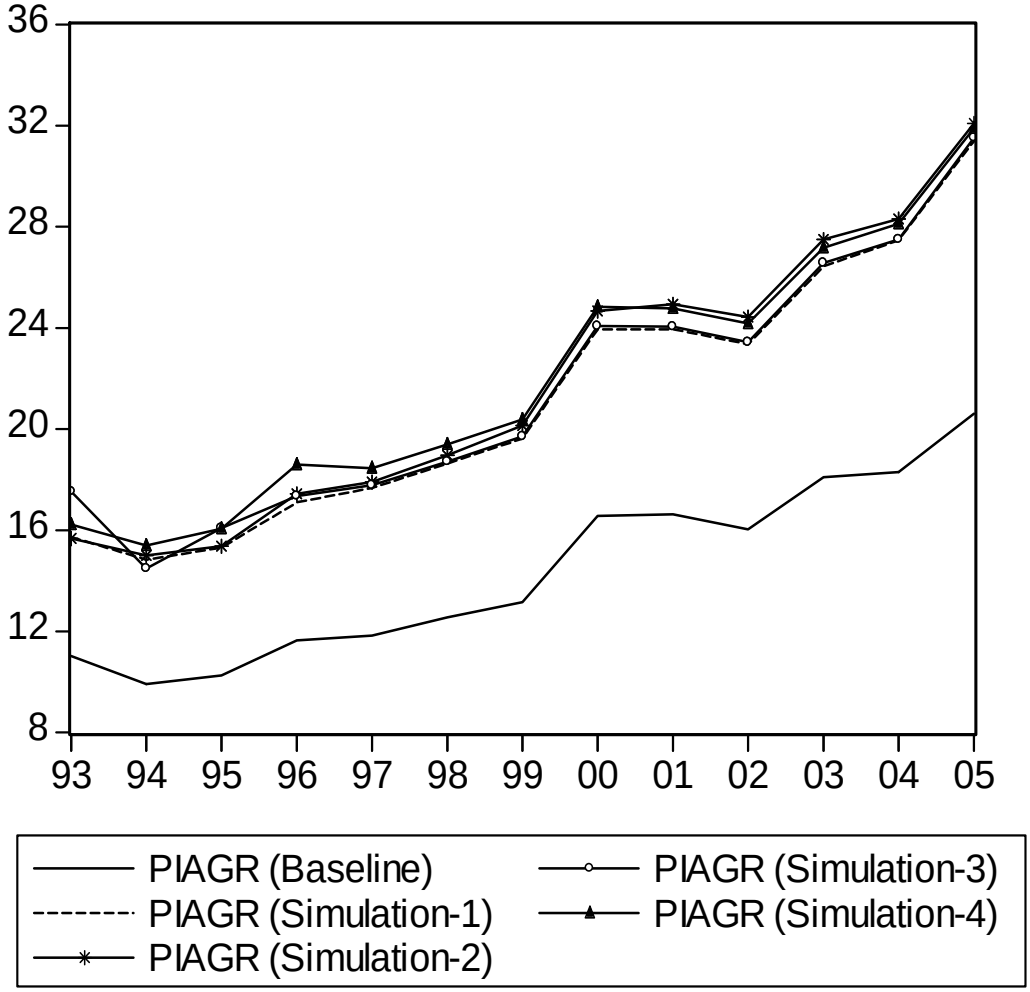
	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	8.9	**2.9**
Nominal Output (Y)	12.2	15.9	**3.7**
Real Output (YR)	6.3	9.2	**2.9**
Agriculture (YAR)	2.2	4.2	**2.0**
Manufacturing (YMNR)	6.8	10.1	**3.3**
Infrastructure (YINFR)	7.9	11.6	**3.7**
Services (YSRR)	8.1	11.1	**3.0**
Private Investment (PITOTR)	3.3	8.7	**5.4**
Agriculture (PIAGR)	6.1	5.9	**-0.2**
Manufacturing (PIMNR)	2.7	9.4	**6.7**
Infrastructure (PIINFR)	4.2	6.2	**2.0**
Services (PISRR)	3.6	9.2	**5.6**
Real Private Consumption (PCR)	5.2	7.7	**2.5**
Public Investment (PCFTOTR)	1.1	1.3	**0.2**
Government Consumption (GFCE)(N)	14.6	17.0	**2.4**
Government Revenues (TR) (N)	11.8	14.9	**3.1**
Wholesale Price Index (P)	5.4	5.8	**0.4**
Money Supply (M3)	15.0	19.7	**4.7**
Real Exports (EXPTR)	9.7	14.3	**4.6**
Real Imports (IMPTR)	9.5	14.3	**4.8**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	21.0	5.2
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.3	-0.3
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	8.4	-0.3
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.6	-0.2

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.13: Impact on real private investment in agriculture



Simulation-1: 70% sustained increase in real public investment in infrastructure

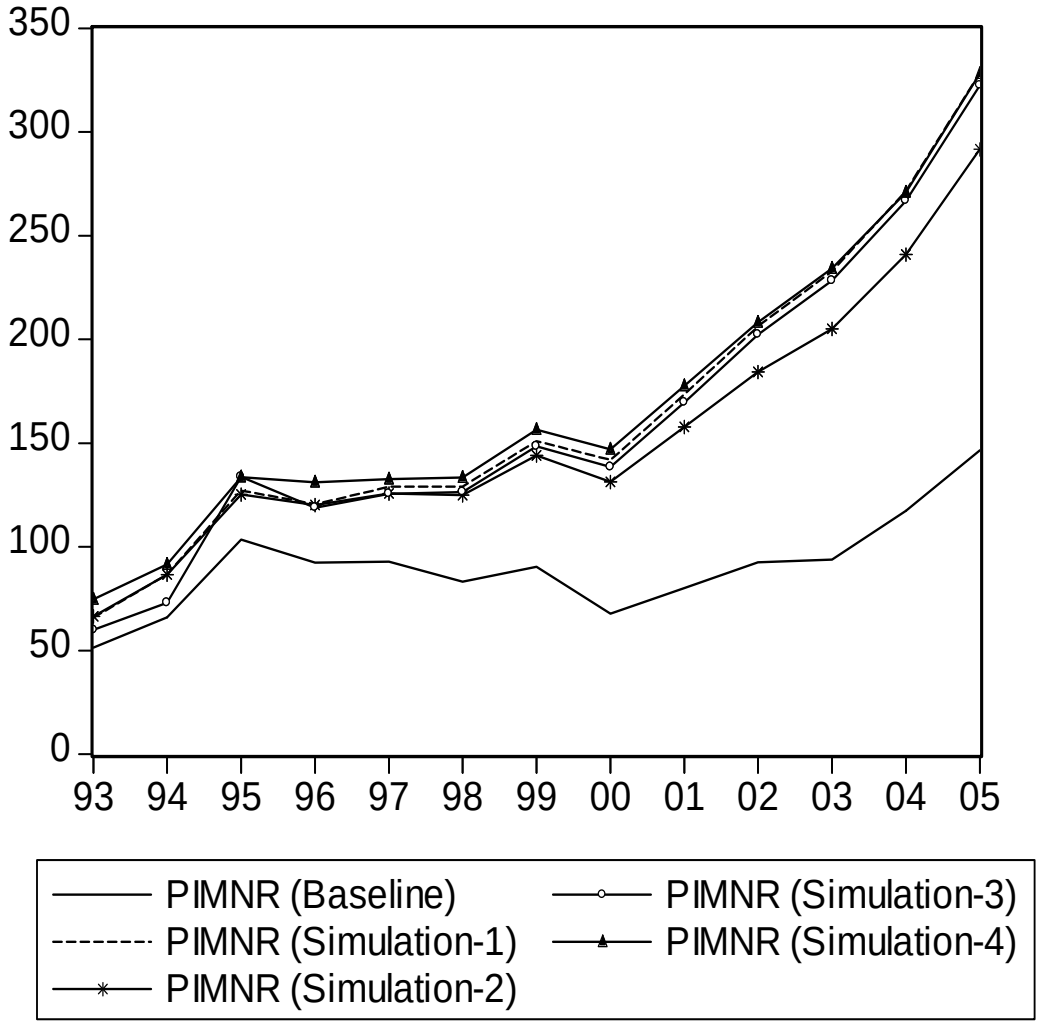
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.14: Impact on real private investment in manufacturing



Simulation-1: 70% sustained increase in real public investment in infrastructure

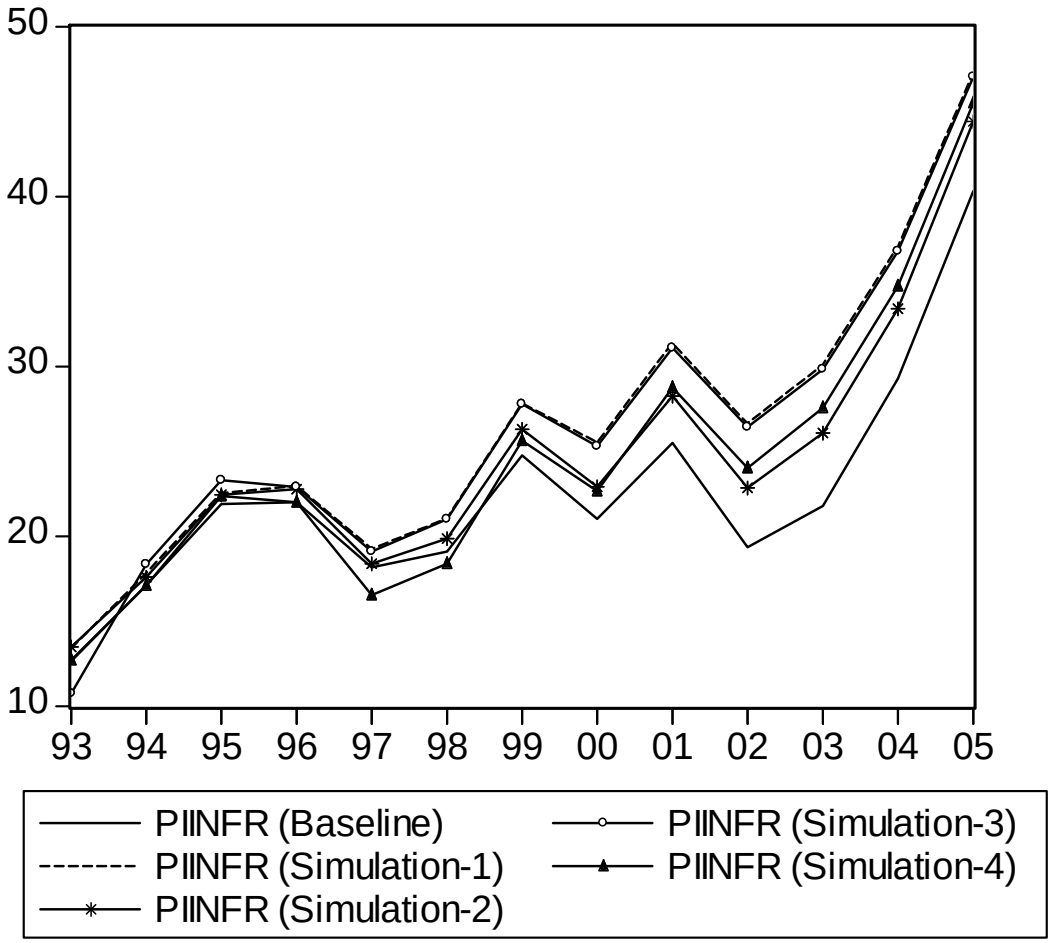
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.15: Impact on real private investment in infrastructure



Simulation-1: 70% sustained increase in real public investment in infrastructure

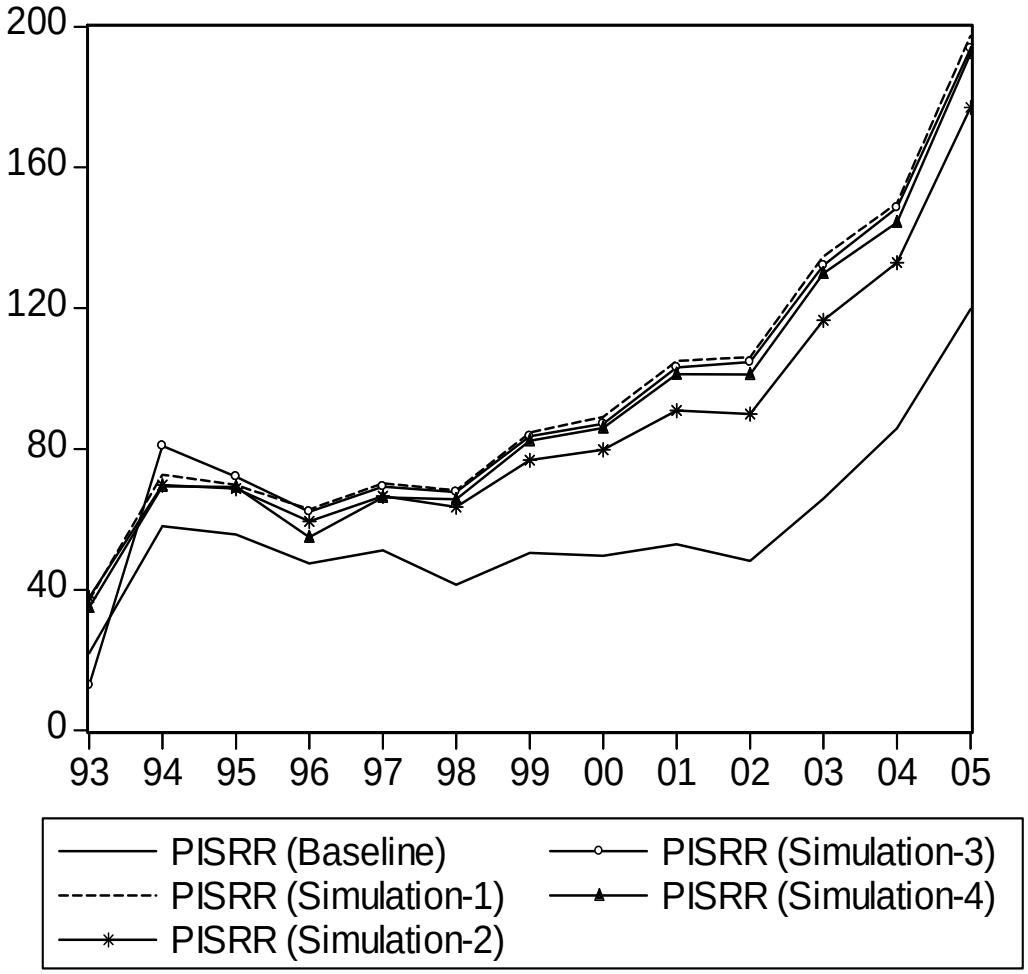
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.16: Impact on real private investment in services



Simulation-1: 70% sustained increase in real public investment in infrastructure

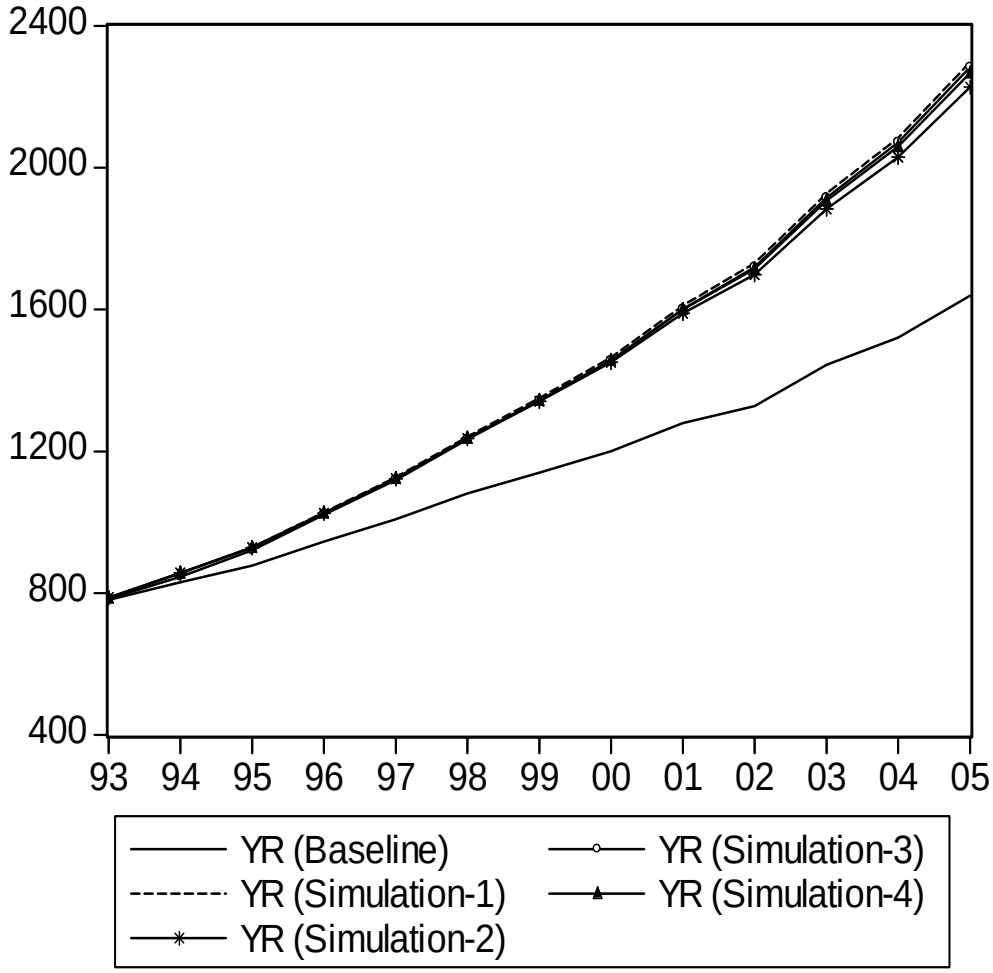
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.17: Impact on aggregate real output



Simulation-1: 70% sustained increase in real public investment in infrastructure

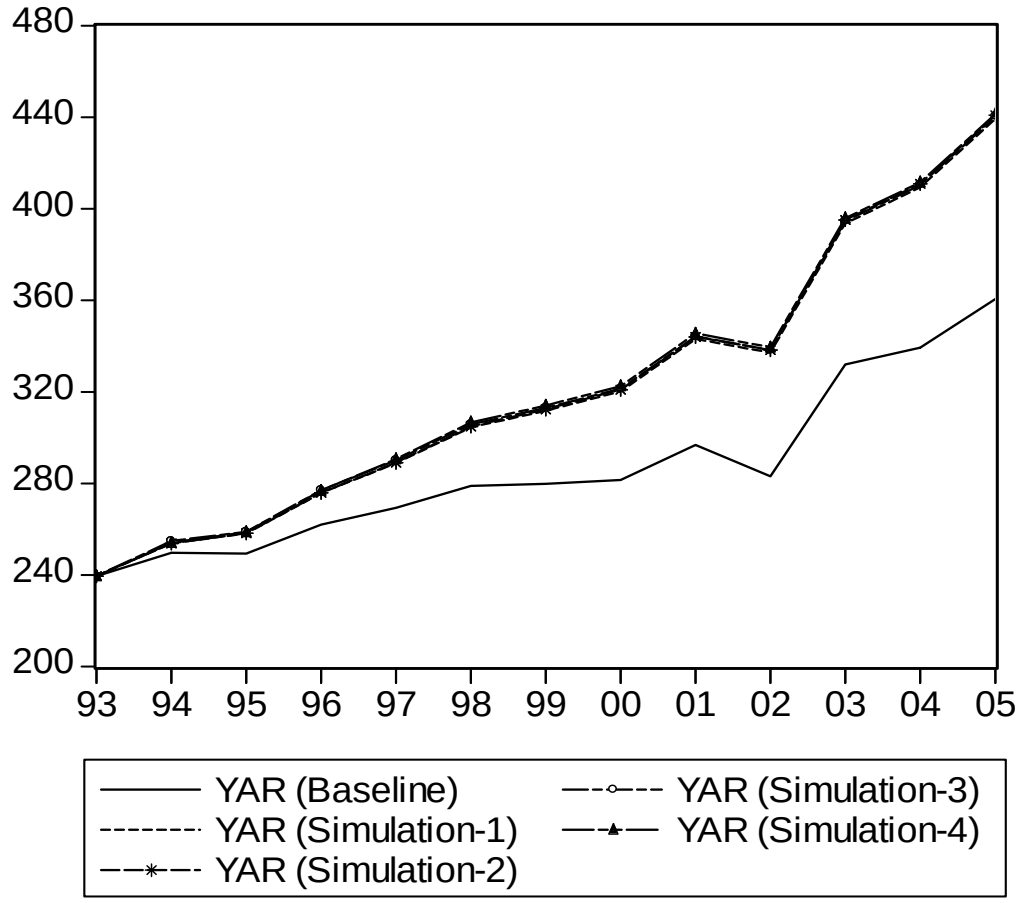
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.18: Impact on real output in agriculture



Simulation-1: 70% sustained increase in real public investment in infrastructure

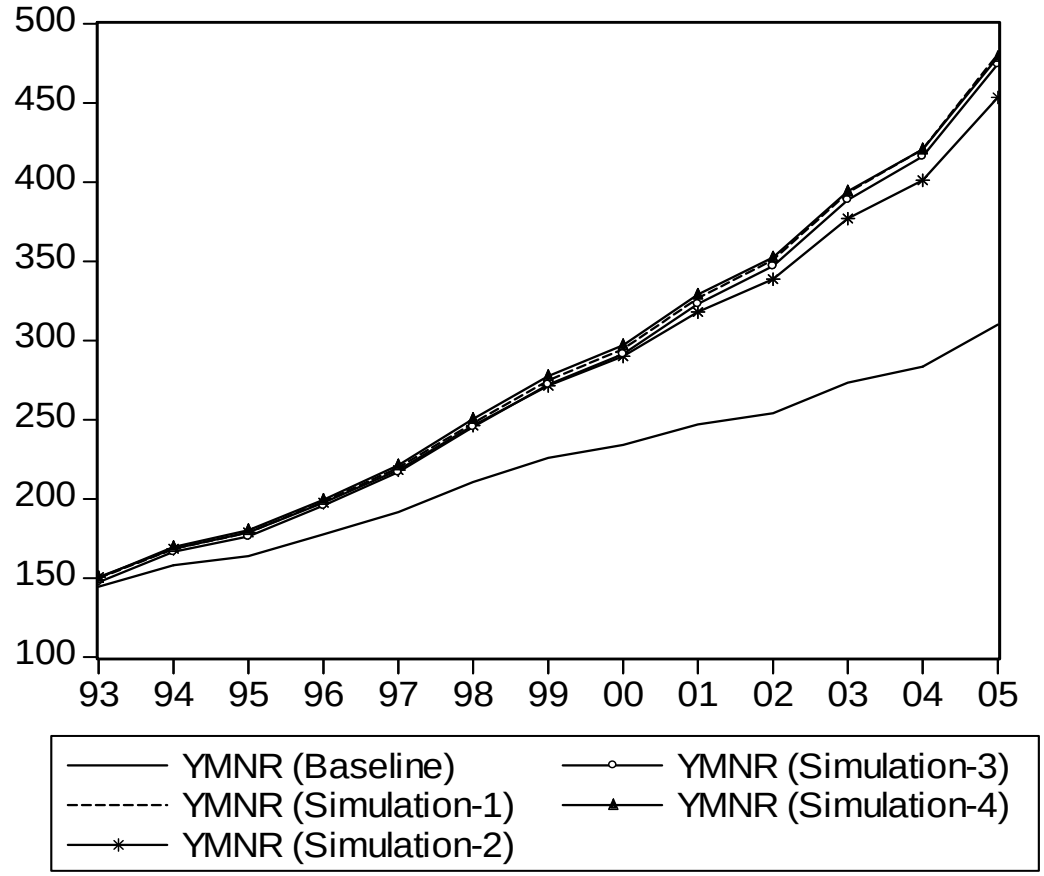
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.19: Impact on real output in manufacturing



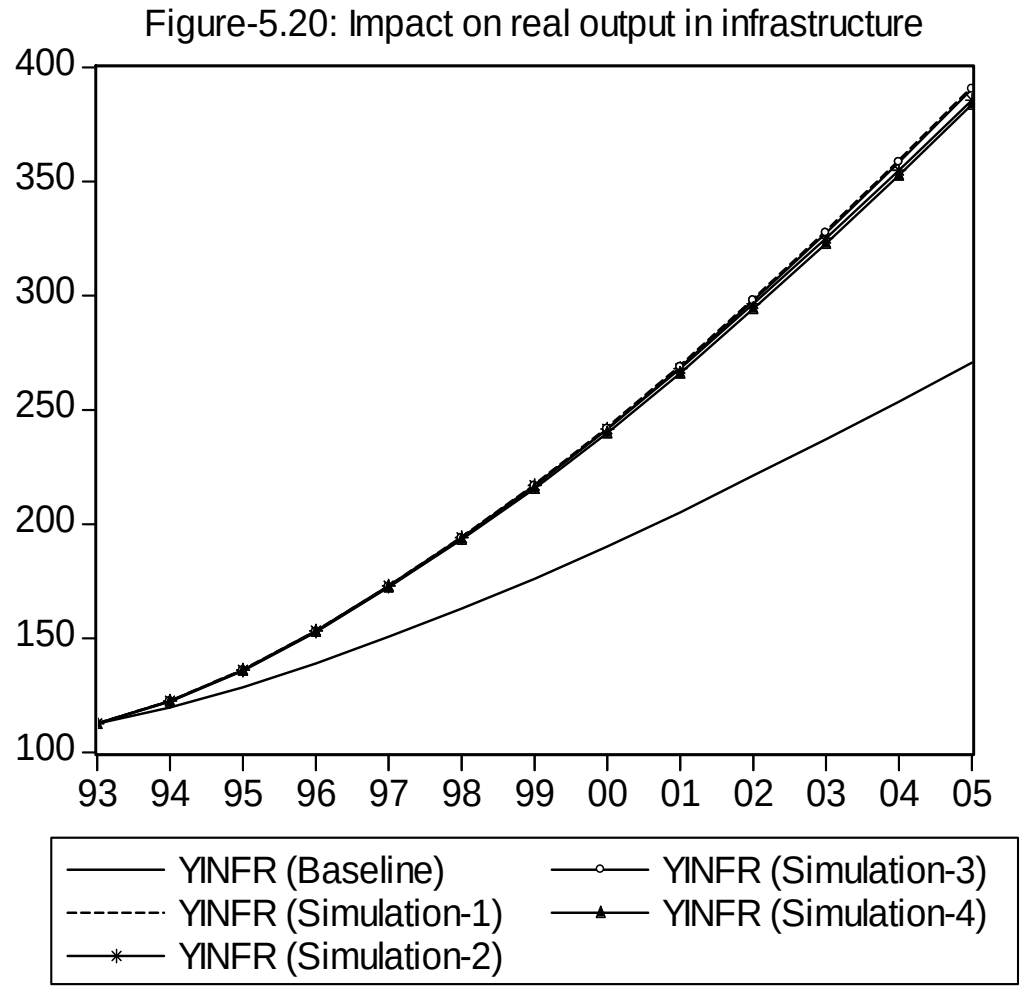
Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources



Simulation-1: 70% sustained increase in real public investment in infrastructure

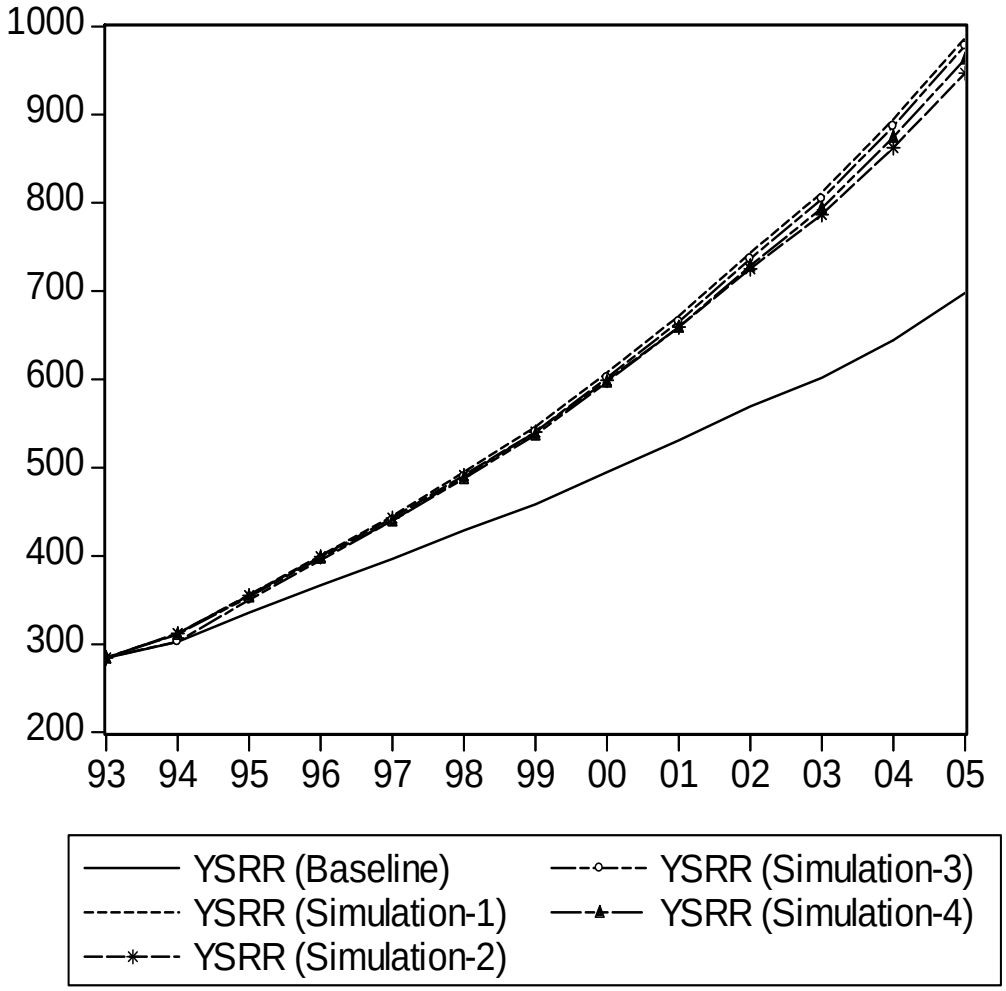
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.21: Impact on real output in services



Simulation-1: 70% sustained increase in real public investment in infrastructure

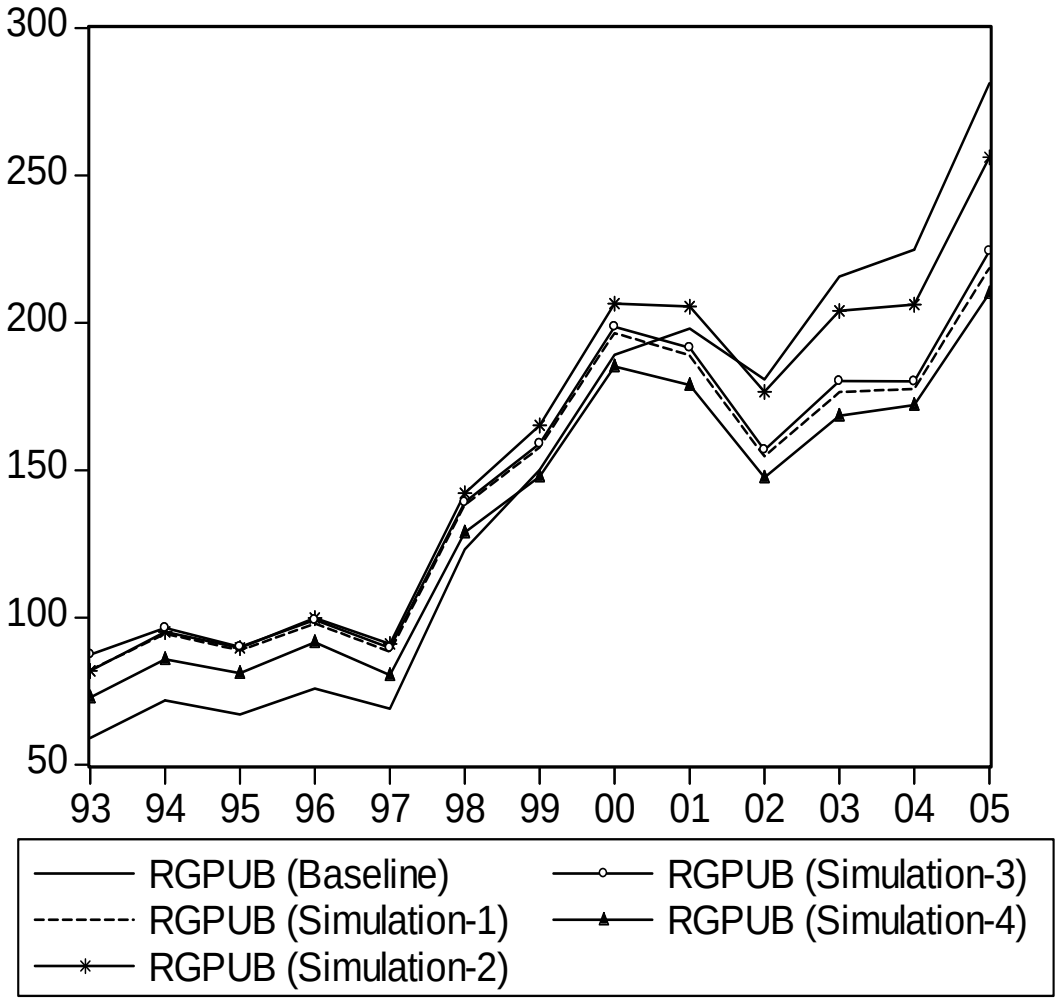
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.22: Impact on public sector resource gap



Simulation-1: 70% sustained increase in real public investment in infrastructure

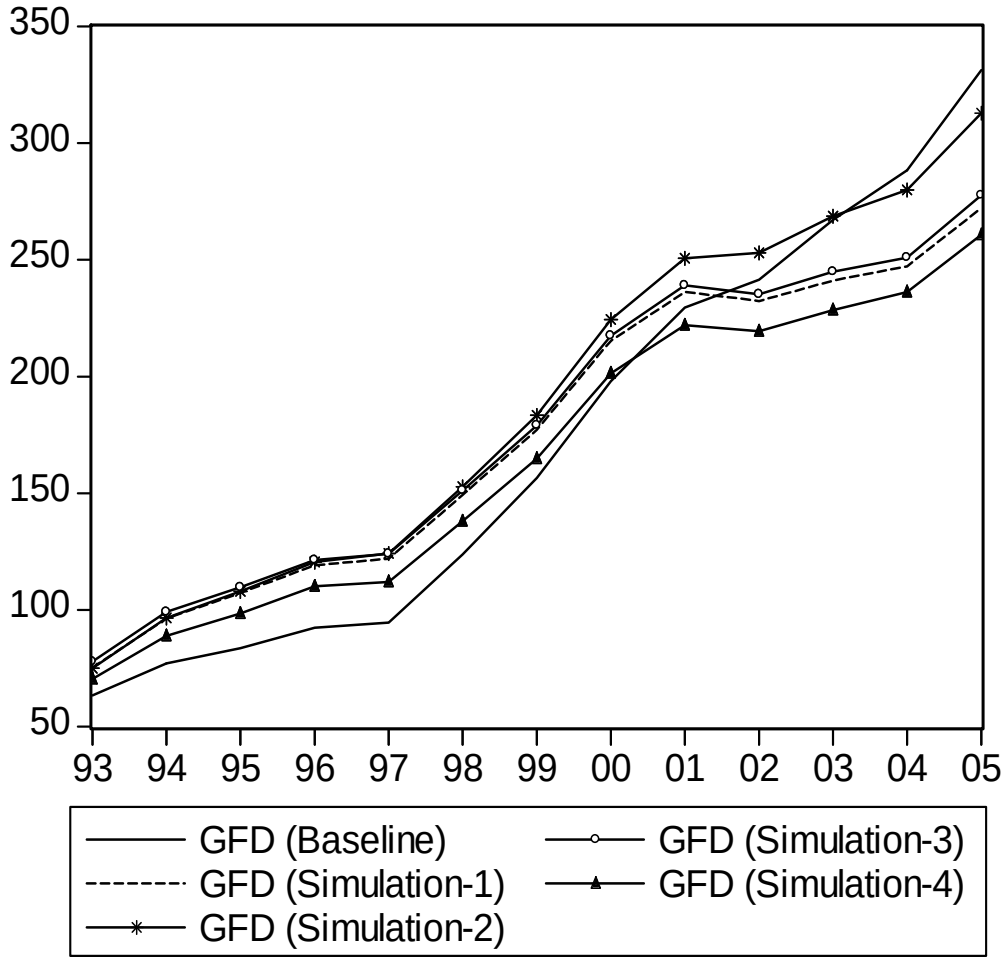
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.23: Impact on gross fiscal deficit



Simulation-1: 70% sustained increase in real public investment in infrastructure

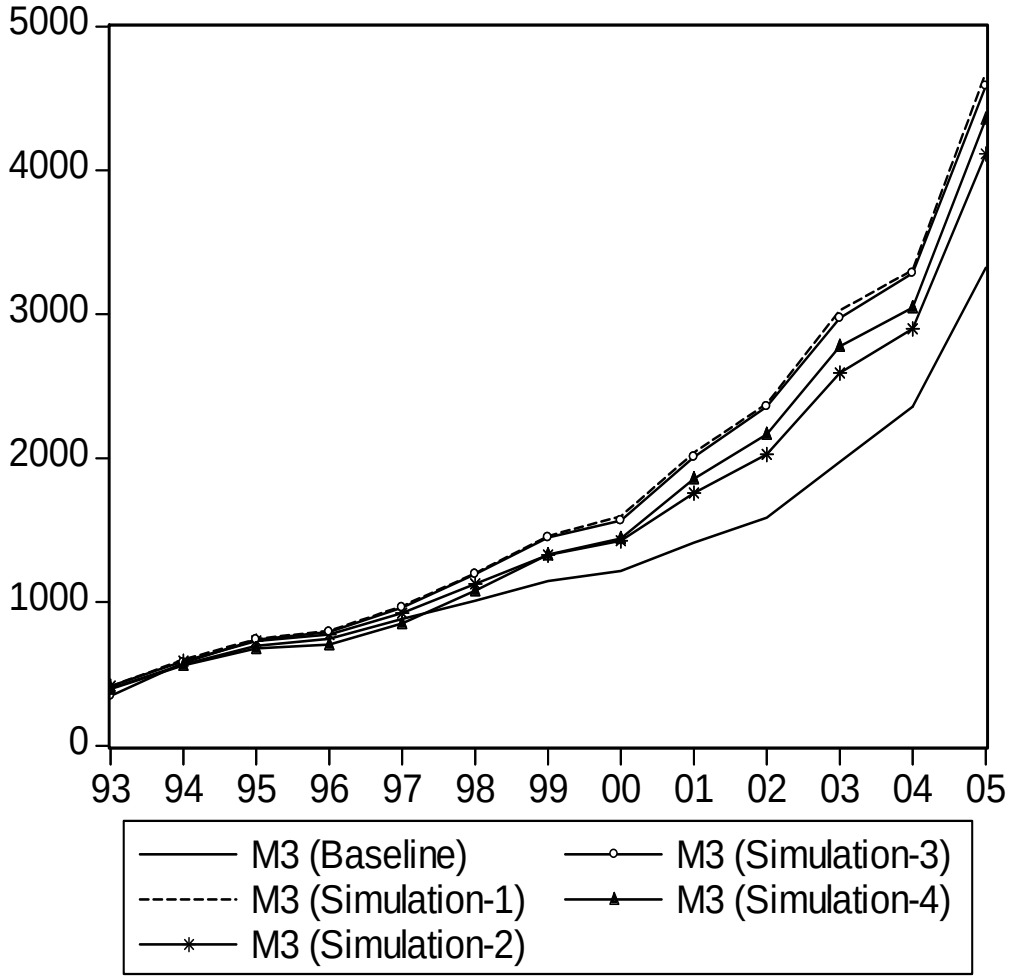
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.24: Impact on money supply



Simulation-1: 70% sustained increase in real public investment in infrastructure

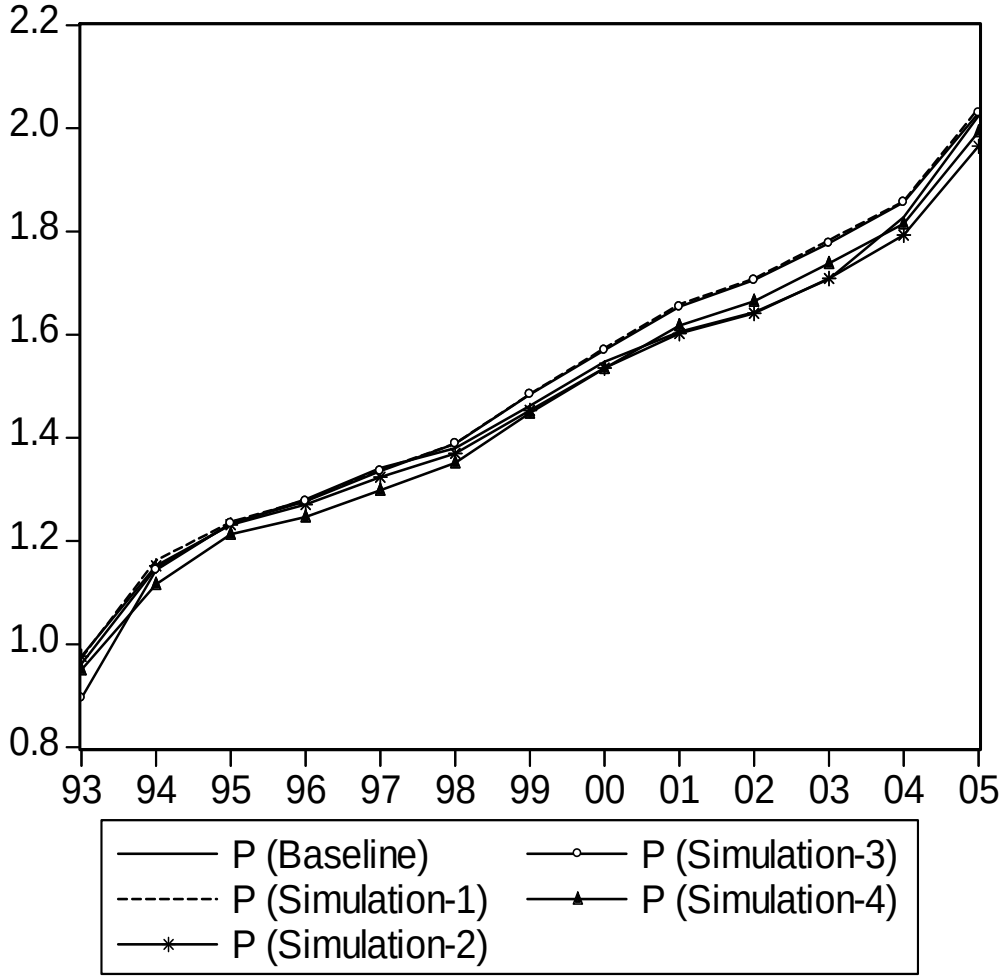
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.25: Impact on wholesale price index



Simulation-1: 70% sustained increase in real public investment in infrastructure

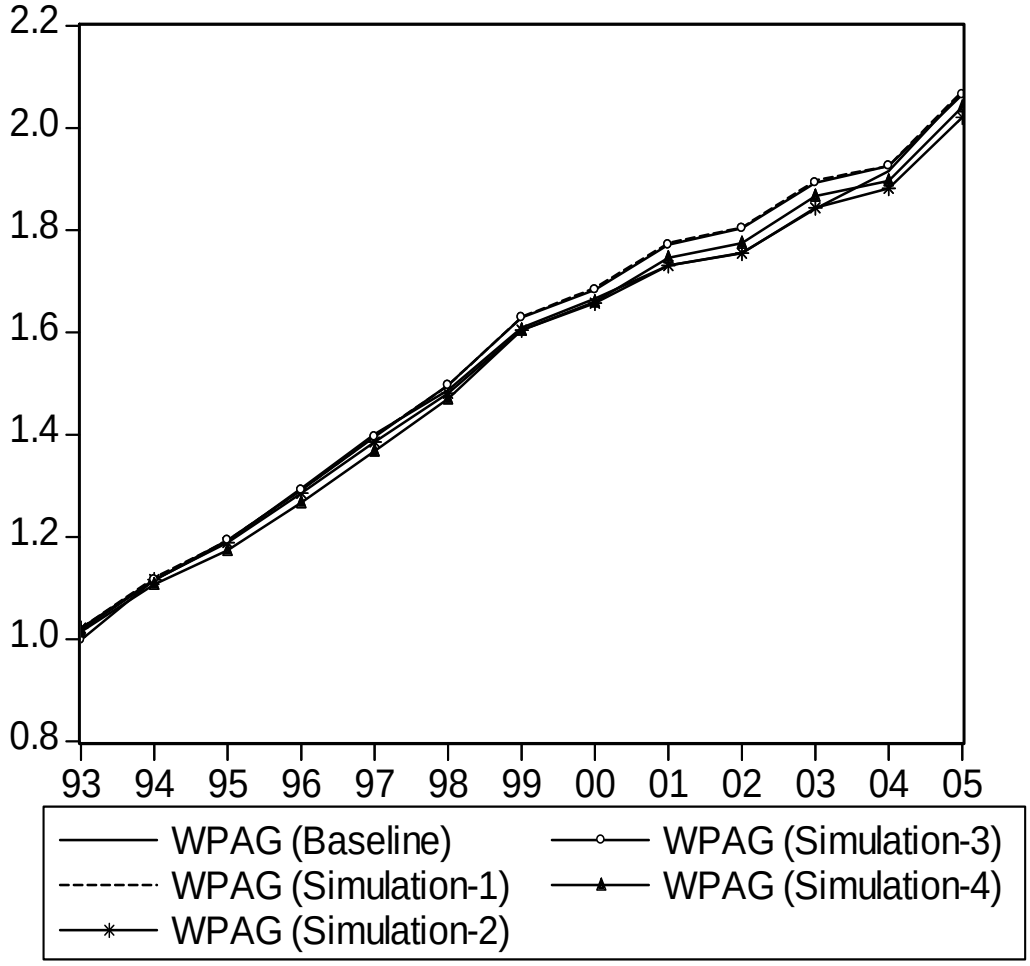
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.26: Impact on wholesale price index of agriculture



Simulation-1: 70% sustained increase in real public investment in infrastructure

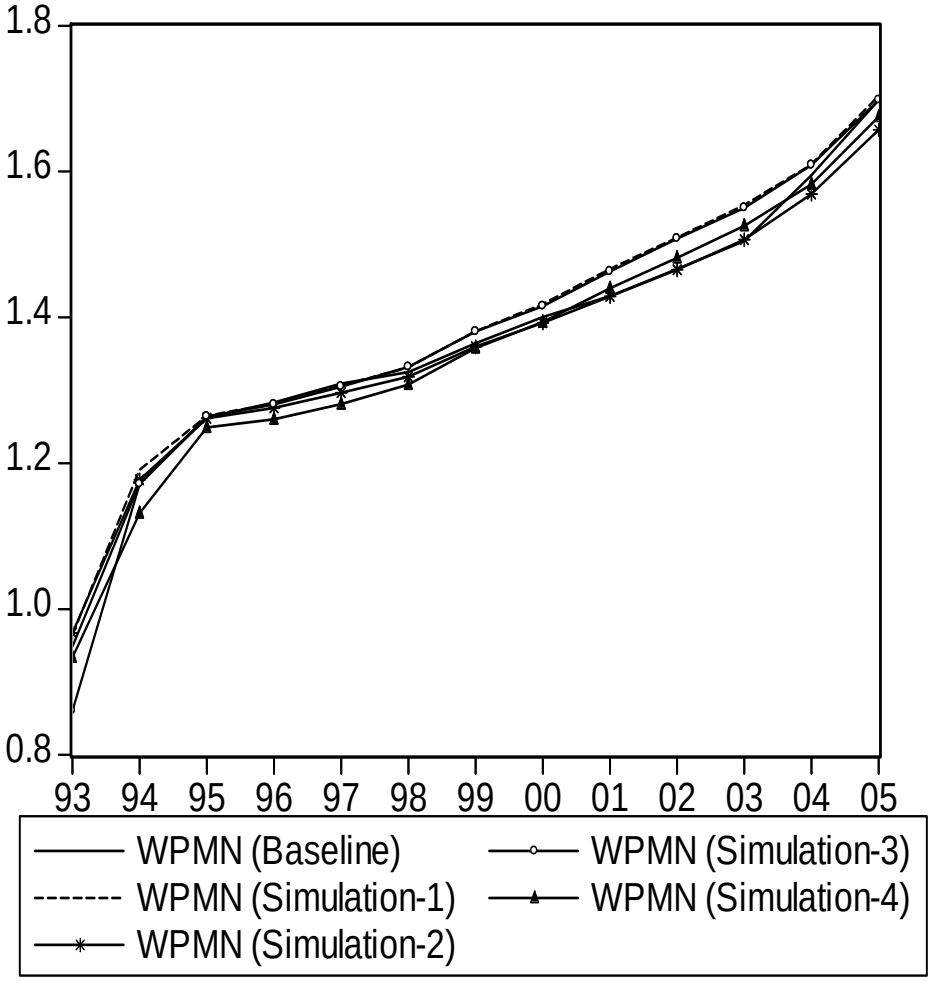
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.27: Impact on wholesale price index of manufacturing



Simulation-1: 70% sustained increase in real public investment in infrastructure

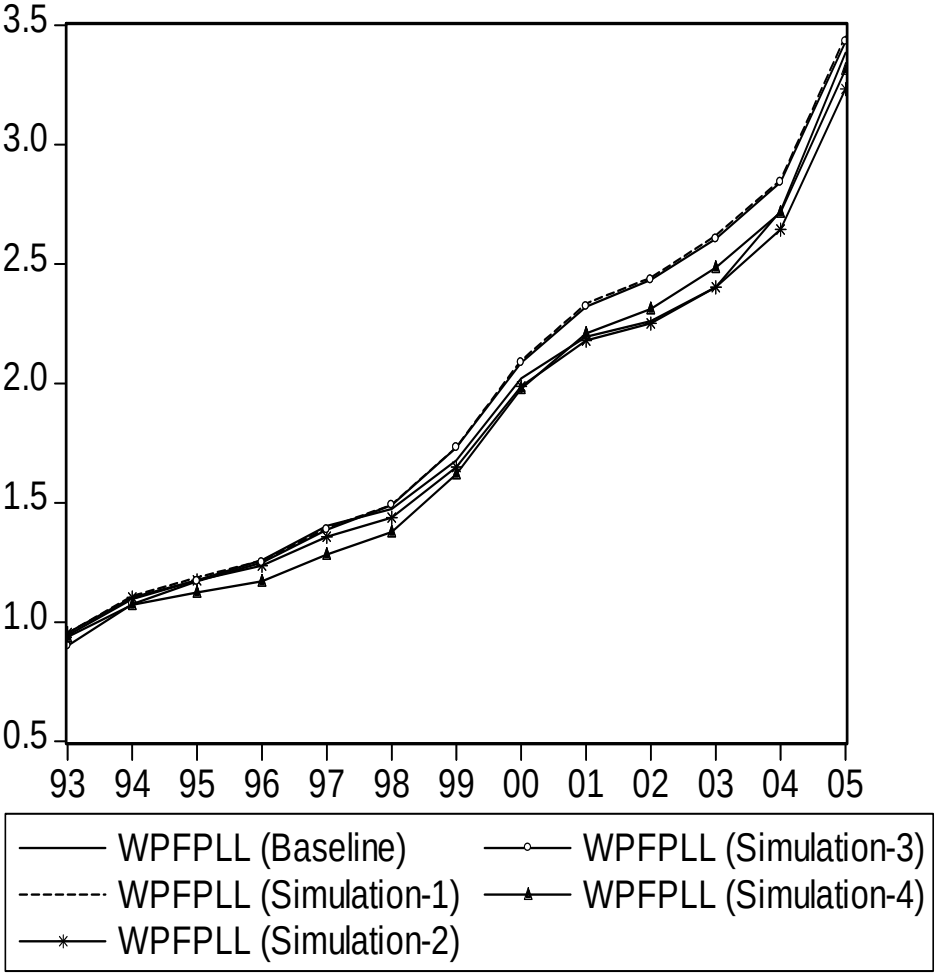
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.28: Impact on wholesale price index of fuel, power, light, lubricants



Simulation-1: 70% sustained increase in real public investment in infrastructure

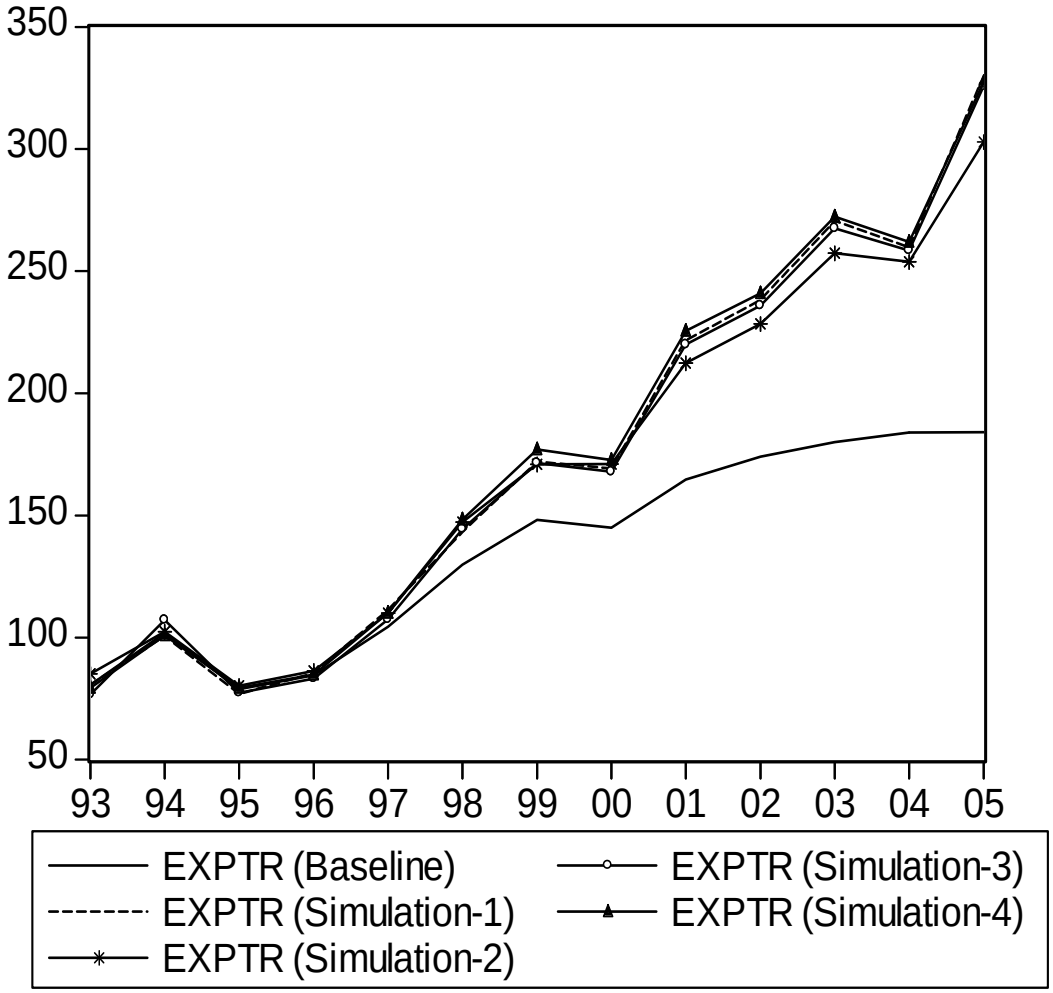
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.29: Impact on real exports



Simulation-1: 70% sustained increase in real public investment in infrastructure

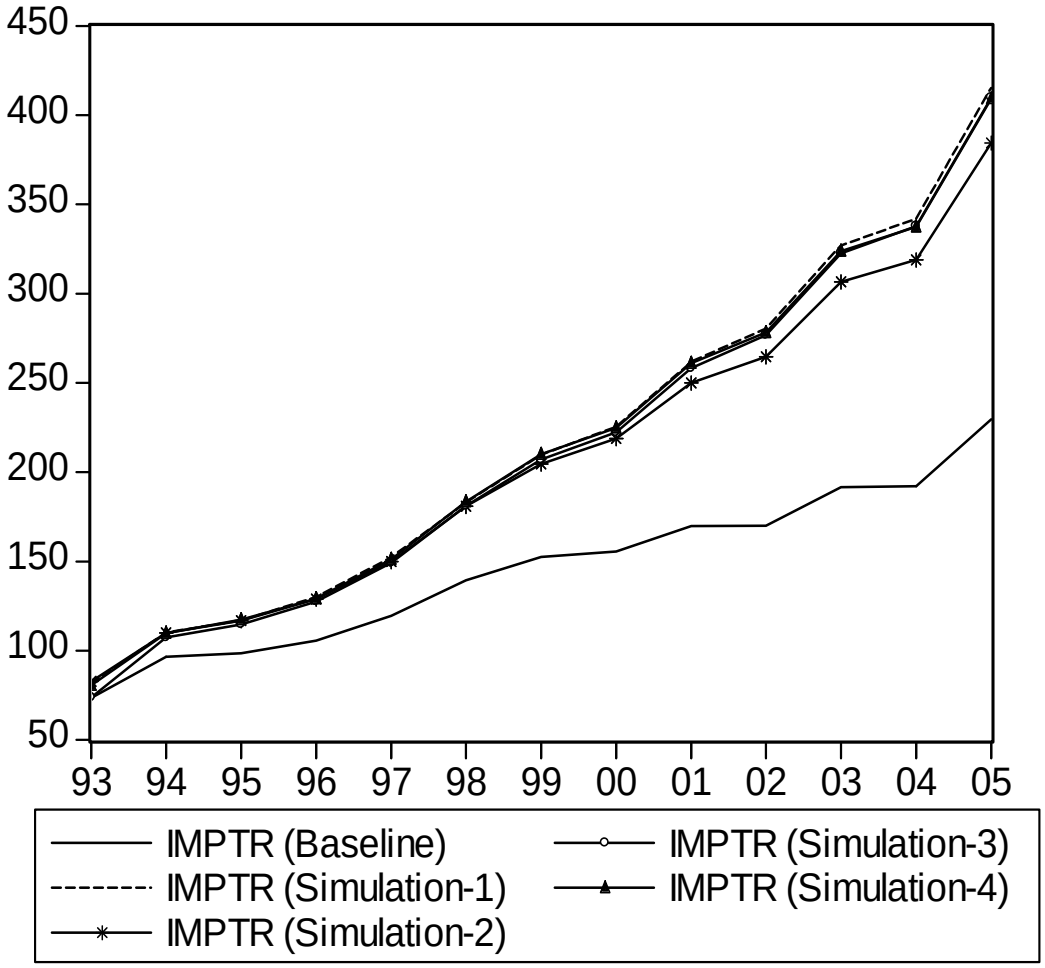
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.30: Impact on real imports



Simulation-1: 70% sustained increase in real public investment in infrastructure

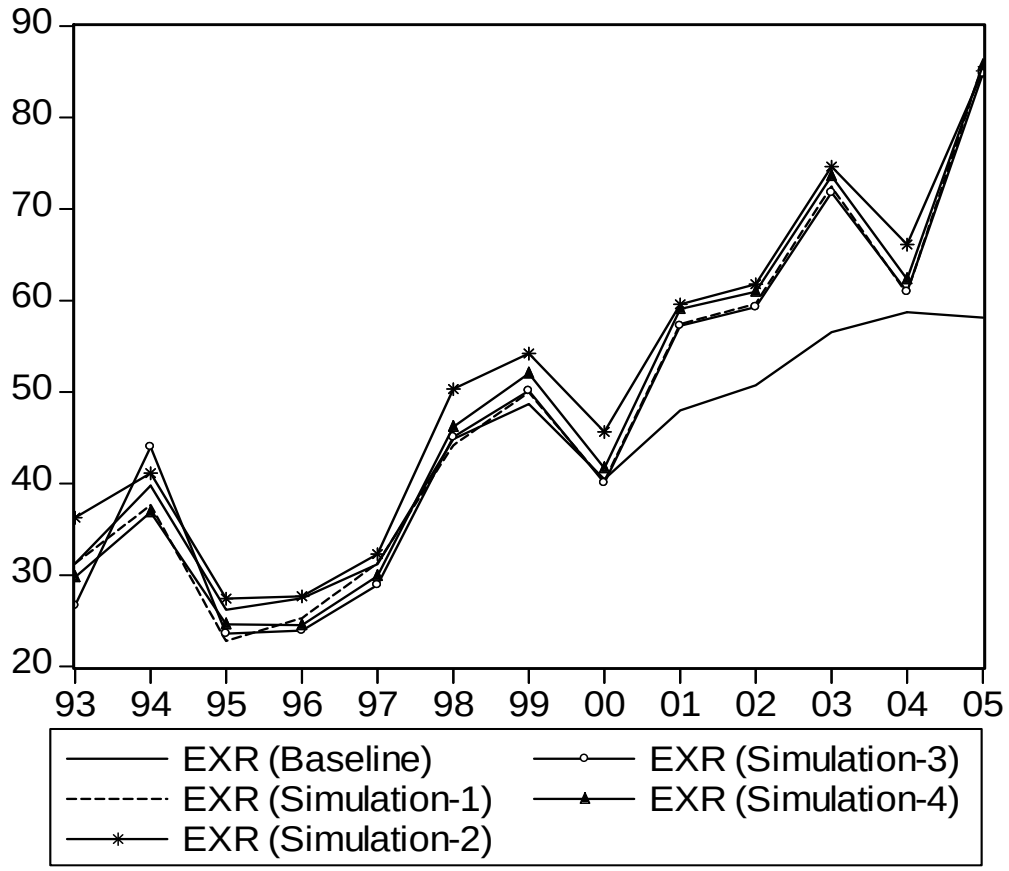
Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

Comparison of Impacts of 70% Sustained Increase in Real Public Investment in Infrastructure Financed through Various Sources

Figure-5.31: Impact on exchange rate (Rs/$)



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 70% sustained increase in real public investment in infrastructure financed by external borrowings

Simulation-3: 70% sustained increase in real public investment in infrastructure financed by commercial bank credit to government

Simulation-4: 70% sustained increase in real public investment in infrastructure financed through increase in direct-taxes

5.3.6 Simulation-5: Sustained Increase in Real Public Investment in Favour of Infrastructure (PCFINFR) and Agriculture (PCFAGR):

According to 11th five year plan report, a new stimulus to public sector investment is important particularly in agriculture and infrastructure and, both the centre and states have to take steps to mobilize resources to make this possible. In light of this, it will be interesting to see the impact of increased public investment allocated not only to infrastructure but also to agriculture. 11th five year plan report suggests that the share of public investment in infrastructure should be at least half (50%) of the total public investment to achieve inclusive growth. Therefore in this simulation, real public investment in infrastructure (PCFINFR) would increase only by 50%, which will be 50.7% of total public investment. To make it comparable with the Simulation-1, i.e. 30% increase in total public investment above its historical level; public investment in agriculture (PCFAGR) has been increased by 140% in each year of the simulation period (1993-94 to 2005-06). This makes the share of agriculture in total public investment to rise from 6.4% to 11.7% for the period 1993-2005. The real public investment in infrastructure has increased from Rs. 37,228 crores to Rs. 55,841 crores due to 50% sustained increase, whereas the real public investment in agriculture has increased from Rs. 5,454 crores to Rs. 13,091 crores due to 140% sustained increase. The share of real public investment in infrastructure in real GDP has increased from 3.3% to 4.9% where as the share of real public investment in agriculture in real GDP has increased from 0.7% to 1.1%. The simulation results of this counterfactual scenario in terms of percentage deviations are given in Table-5.12 and the growth rates are given in Table-5.13.

Percentage Deviation between Policy and Base Simulations:

The impact of a 50% increase in PCFINFR and a 140% increase PCFAGR seems to show similar trends in most of the variables but magnitudes are a little different when compared to Simulation-1. The increased public investment in both infrastructure and agriculture will have immediate effect (crowding-in) on private investment in all sectors. Real private investment in agriculture seems to increase significantly (28.8%) in the first year itself. It is interesting to note that this 28.8% increase above the baseline is less than that of in simulation-1 (42.6 %). But the private investment in infrastructure (6.1%) seems to maintain almost the same speed when compared to simulation-1. Real private investment in both manufacturing and services showed lesser increase above the baseline (9.8% & 46.3% respectively) compared to simulation-1. As the real private investment in both manufacturing and services positively depend on real public investment in infrastructure, the lower percentage increase in public investment in infrastructure caused lesser increase above the baseline in both private investments than that of in simulation-1. There is absolutely no increase in the real output of any sector except manufacturing (3.2%) leading to a very small increase in aggregate real output (0.6%) in the first year. Aggregate demand seems to increase by 3.2% due to increase in aggregate investment. On the other hand, public resource gap (38.4%) has expanded significantly causing decline in real private investment. However, crowding-in effect seems to dominate in this exercise also. The increase in public resource gap will lead to rise in fiscal deficit (18.3%) and thereby rise in net RBI credit to government. As a result, the reserve money will grow with the feed-back from RBI credit, leading to expansion of money supply (4%) and consequent increase in prices. Agriculture prices seems to increase marginally

(0.5%), whereas manufacturing prices (2.4%) and fuel, power light & lubricant prices (1.2%) seems to increase significantly. All these changes in sectoral prices lead to increase in wholesale price index for all commodities (1.8%). The real imports increased (9.9%), due to rise in aggregate demand, much higher than real exports (0.5%) deteriorating the trade balance by Rs. -7123 crores in, 1993-94. Surprisingly, unit value of exports fell marginally (-0.3%) in the first year. This may be because of the higher negative domestic price effect over lesser real output effect. Exchange rate has been depreciated (1.4%) in the first year which is significantly different from simulation-1. Head count ratios fell marginally by 0.2% in both rural and urban areas.

In the short-term the impacts gets strengthen but follow the same trend. Real private investment in agriculture increased astonishingly by 73.4%, which lead to significant increase in real output in agriculture by 1.5% in the short-term. Surprisingly private investment in infrastructure has decelerated marginally (5%), leading to a marginal increase in real output in infrastructure (0.9%). The real private investment in manufacturing has increased (13.7%) whereas the same in services has drastically decelerated (24.5%) in the short-term. As a result, real output in manufacturing and services sectors increased by 4.4% and 1.1% respectively. Consequently, aggregate real output has increased by 1.8%. There seems to be a slight deceleration in public sector resource gap (35%) compared to first year whereas fiscal deficit has increased by 22.1%. wholesale price index for all commodities has been increased by 2% and money supply increased by 5.5%. Real exports fell marginally by a small 0.4% and real imports increased by 11.6%

worsening trade balance (Rs. -9,442 crores). Indian rupee against US dollar has appreciated by 2%) in the short-term.

The medium-term effects are similar in direction but higher size. As expected, all these effects get strengthened in the long run. Thus, 50% sustained increase in real public investment in infrastructure and 140% in agriculture will lead to a 15.6% increase in real output in the long-term, which is slightly lower than that of in simulation-1. However, the real output in agriculture is more than doubled (20.7%) when compared to simulation-1 (9%). However the real output in manufacturing (18%), infrastructure (14.2%) and services (11.9%) recorded lesser increase compared to simulation-1. Real private investment in agriculture has increased by 106.9% whereas the same in the infrastructure is increased by 12.9% in the lone run. Real private investment in manufacturing and services has increased by 47.9% and 45.5% respectively. Again there is not much difference in public sector resource gap (8.2%) when compared to simulation-1 (8.7%). The same trend continued for fiscal deficit (11.9%) and money supply (28.6%) also. Wholesale price index has showed higher increase (2.1%) compared to simulation-1 (1.5%). Both real exports (15.1%) and real imports (34.7%) have increased rapidly. As a result, trade balance seems to improve by Rs. 7,320 crores. Exchange rate has been depreciated (3.2%) in the long-run. Poverty ratios have been reduced by 4.6% and 4.9% in both rural and urban areas respectively.

Comparison of Growth Rates:

In this exercise also, growth rates of important endogenous variables like aggregate demand, nominal and real output, private investment, private consumption, government consumption and revenues, wholesale prices, money

supply and, real exports and real imports are considered for comparison. It is also interesting to compare growth rates of important endogenous variables not only with baseline growth rates but also with simulation-1 growth rates. Also the shares of private investment, public sector resource gap, gross fiscal deficit, current account balance in output are analysed for this particular simulation. The compound growth rates are computed by using the semi-log trend equations for the period 1993-2002. A sustained 50% increase in real public investment in infrastructure and 140% increase in agriculture together lead to 3% increase in growth rate of aggregate real output. Growth rate of real output in agriculture has increased by a high 3.9% followed by manufacturing (3.1%), infrastructure (3%) and services (2.6%) during 1993-2002. Growth rate of real private investment in agriculture (1.9%) showed a remarkable increase when compared to baseline as well as simulation-1. Growth rates of real private investment in manufacturing (8.4%), infrastructure (2.7%) and services (5.2%) increased significantly above the baseline growth rates, leading to a 6.3% increase growth rate of total private investment. Real private consumption seems to increase by 2.4% where as government consumption as increased by 3.3% due to increase in government revenues (3.8%) above the baseline. The share of public sector resource gap and fiscal deficit in nominal output seem to show a small decline by 0.1% and 0.2% respectively. Growth rate in money supply and wholesale price index has increased by 4.9% and 0.3% respectively. Real exports (4.2%) and real imports (4.7%) seem to grow at a higher rate. Nevertheless, the share of current account balance in nominal output has deteriorated by 0.4%. Graphs comparing simulatin-1 with simulation-5 are given in Figure-5.32 to 5.46.

Table-5.13: Impacts of a Sustained Increase in Real Public Investment in Infrastructure (50%) and Agriculture (140%)

	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	8.9	**2.9**
Nominal Output (Y)	12.2	16	**3.8**
Real Output (YR)	6.3	9.3	**3.0**
Agriculture (YAR)	2.2	6.1	**3.9**
Manufacturing (YMNR)	6.8	9.9	**3.1**
Infrastructure (YINFR)	7.9	10.9	**3.0**
Services (YSRR)	8.1	10.7	**2.6**
Private Investment (PITOTR)	3.3	9.6	**6.3**
Agriculture (PIAGR)	6.1	8	**1.9**
Manufacturing (PIMNR)	2.7	11.1	**8.4**
Infrastructure (PIINFR)	4.2	6.9	**2.7**
Services (PISRR)	3.6	8.8	**5.2**
Real Private Consumption (PCR)	5.2	7.6	**2.4**
Public Investment (PCFTOTR)	1.1	1.1	**0.0**
Government Consumption (GFCE)(N)	14.6	17.9	**3.3**
Government Revenues (TR) (N)	11.8	15.6	**3.8**
Wholesale Price Index (P)	5.4	5.7	**0.3**
Money Supply (M3)	15.0	19.9	**4.9**
Real Exports (EXPTR)	9.7	13.9	**4.2**
Real Imports (IMPTR)	9.5	14.2	**4.7**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	19.9	4.1
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.5	-0.1
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	8.5	-0.2
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.8	-0.4

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.32: Impact on real private investment in agriculture

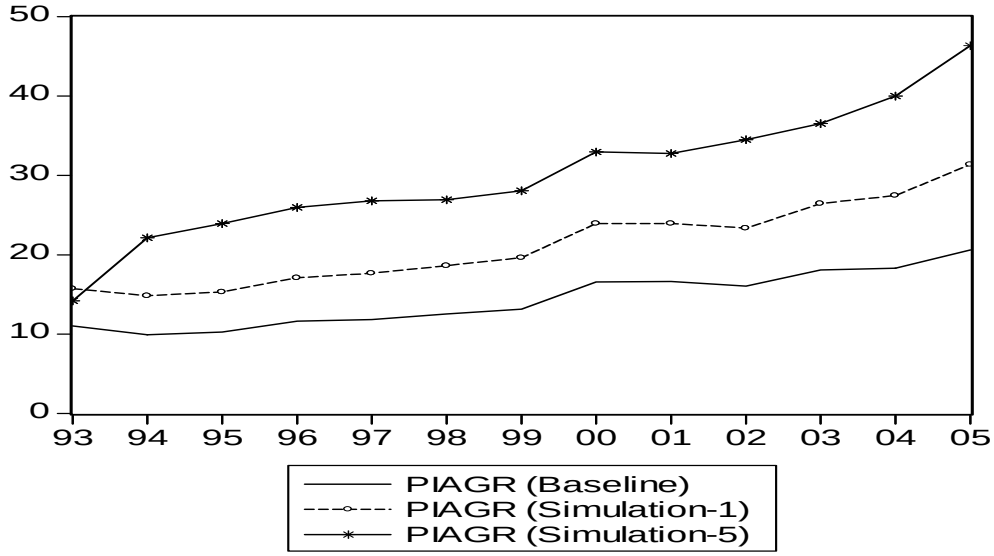
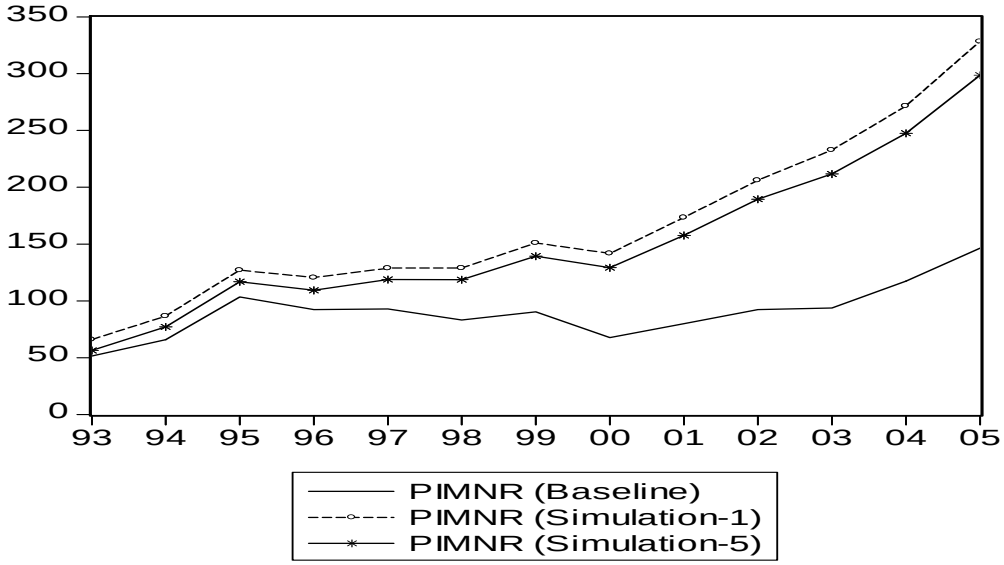


Figure-5.33: Impact on real private investment in manufacturing



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.34: Impact on real private investment in infrastructure

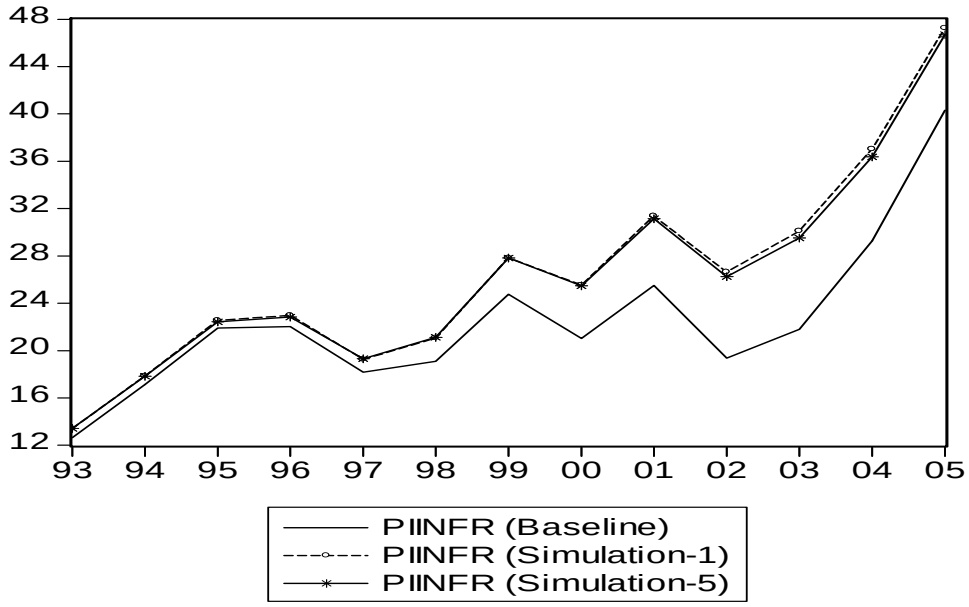
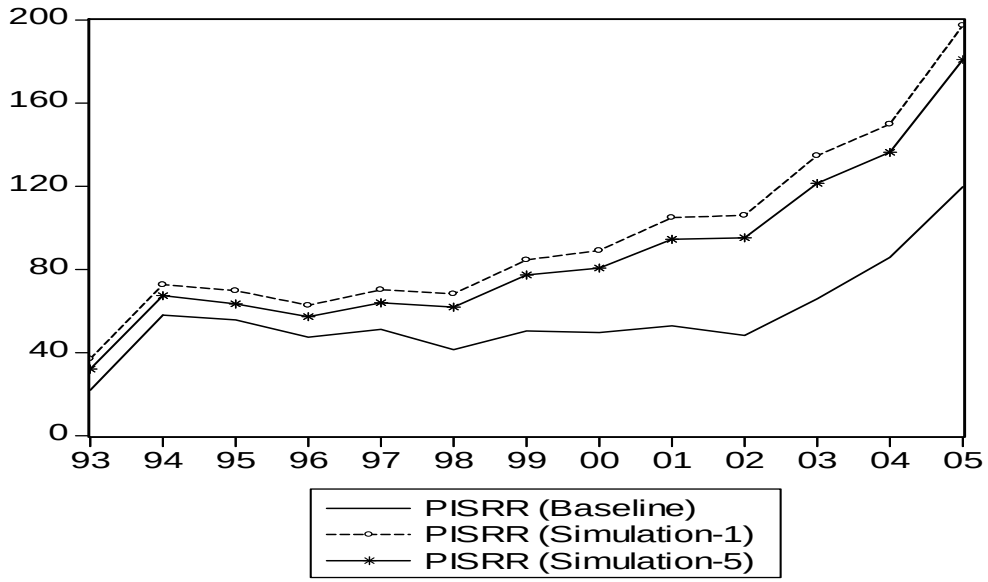


Figure-5.35: Impact on real private investment in services



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.36: Impact on real output in agriculture

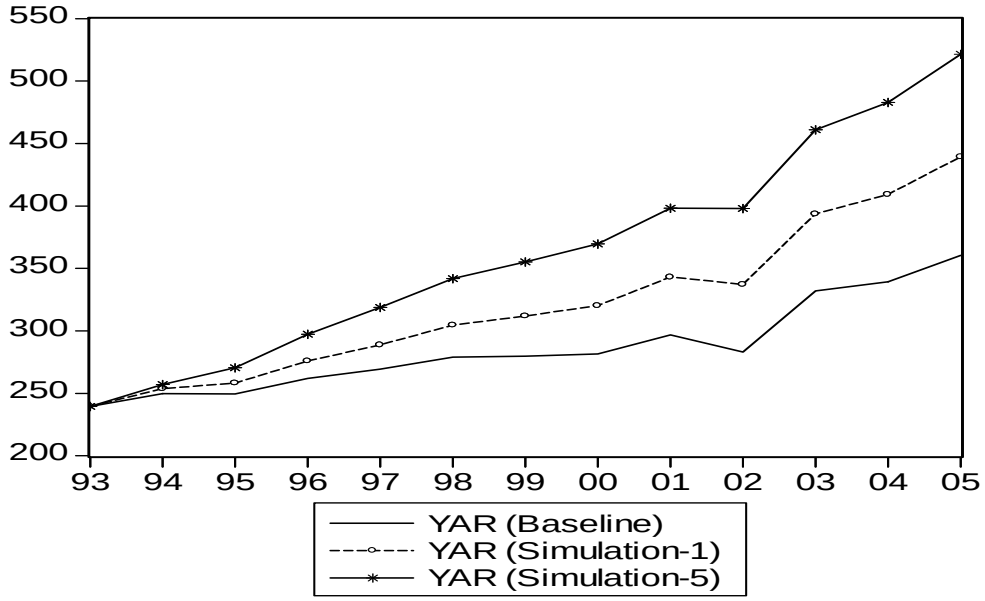
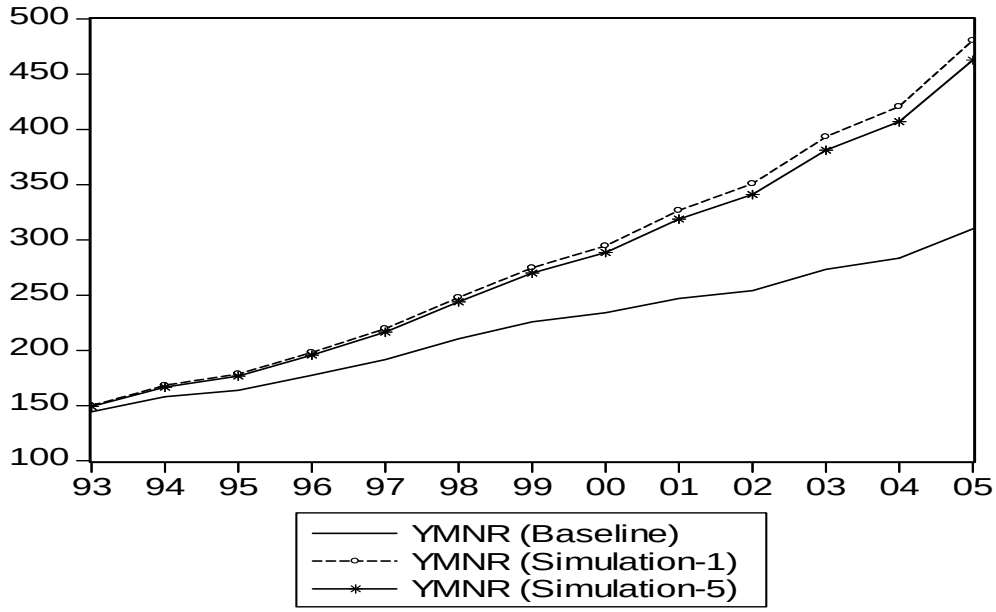


Figure-5.37: Impact on real output in manufacturing



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.37: Impact on real output in infrastructure

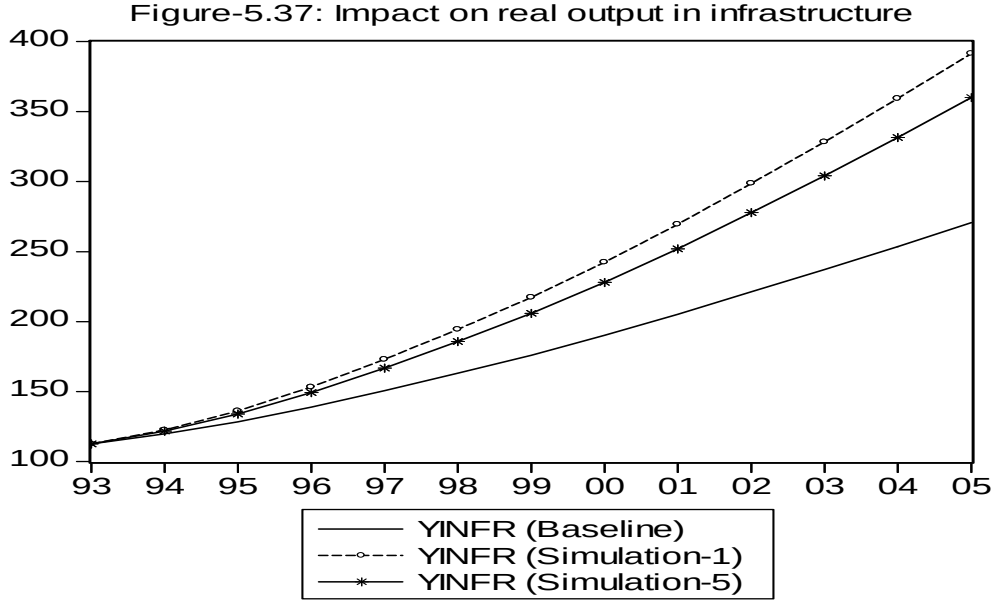
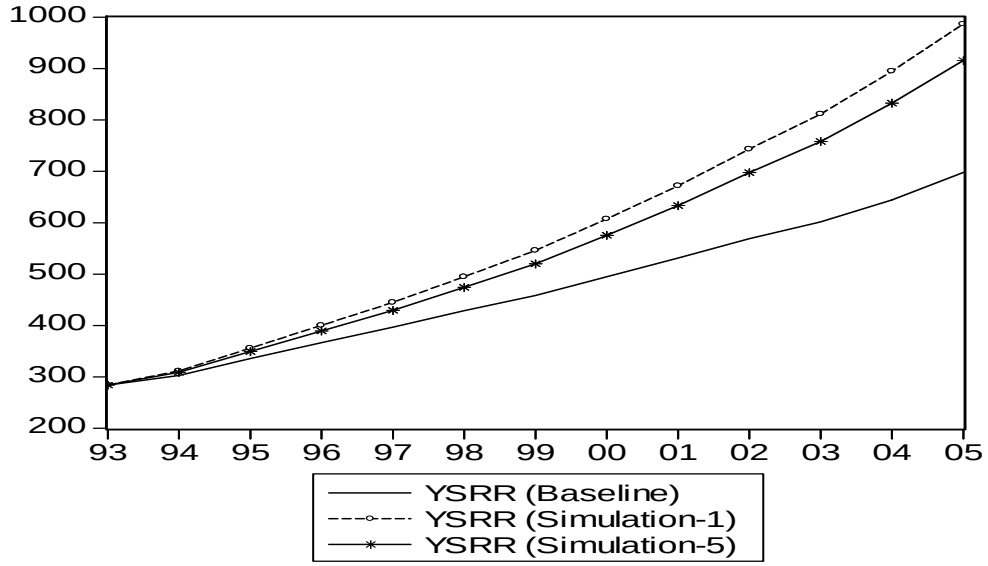


Figure-5.38: Impact on real output in services



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.39: Impact on aggregate real output

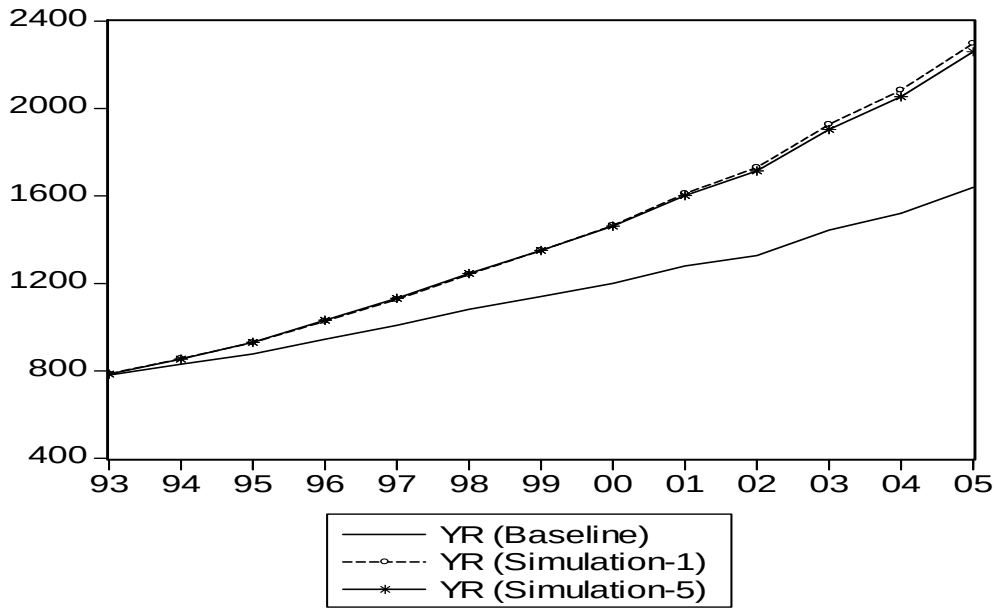
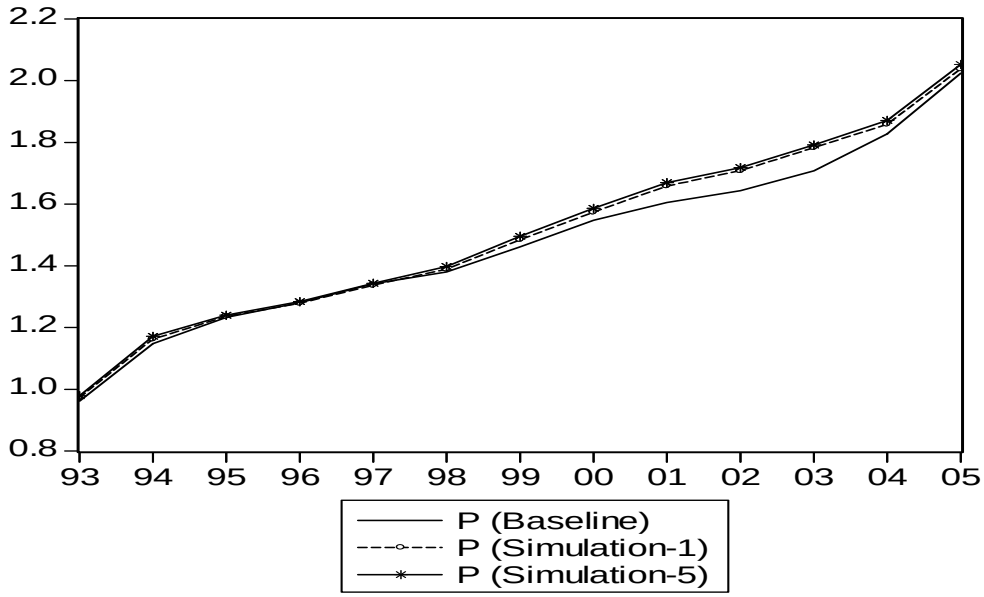


Figure-5.40: Impact on wholesale price index



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.41: Impact on public sector resource gap

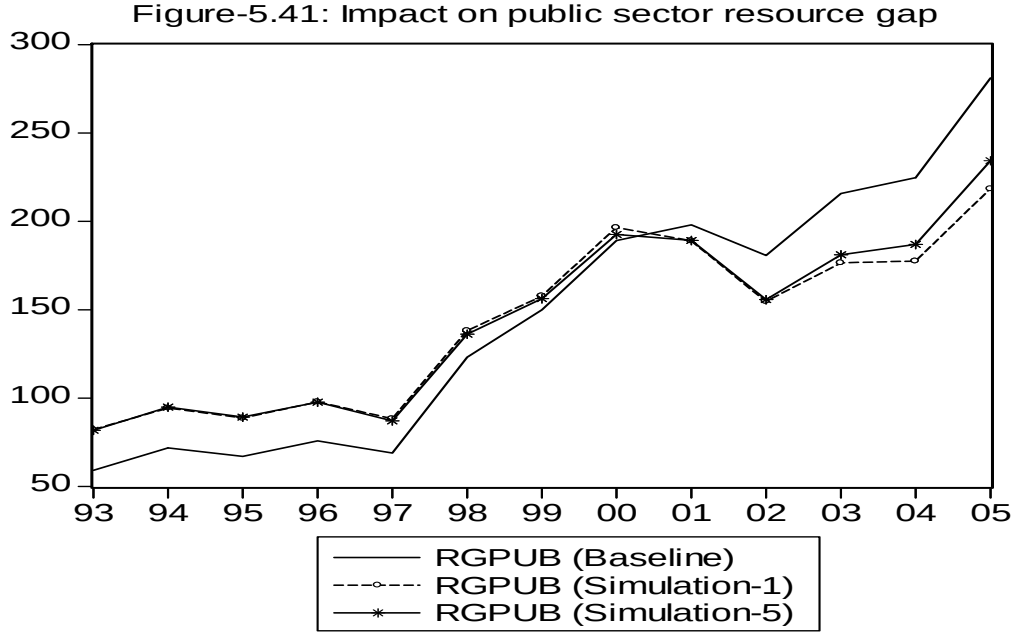
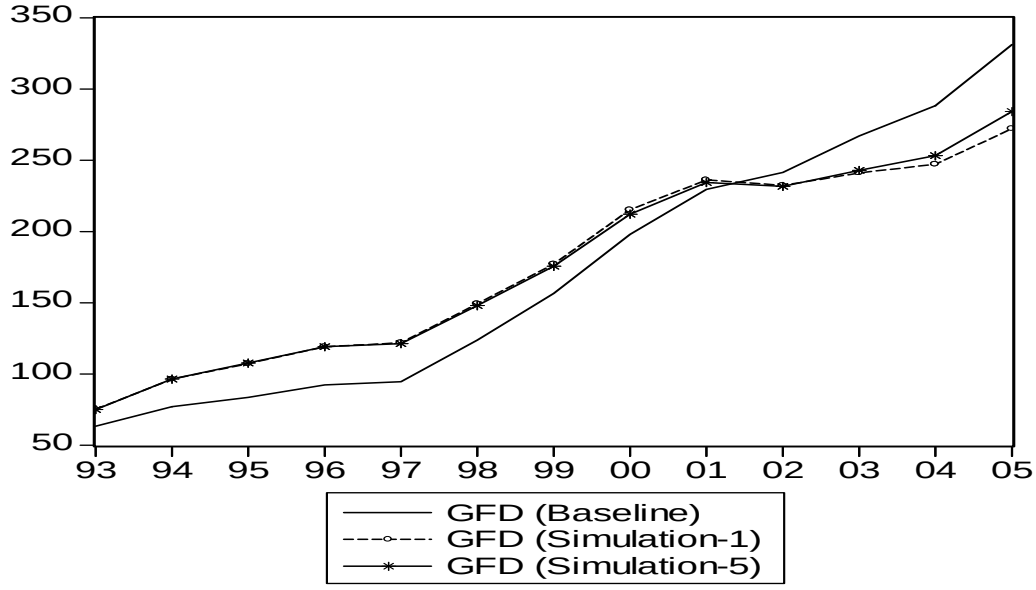


Figure-5.42: Impact on gross fiscal deficit



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.43: Impact on money supply

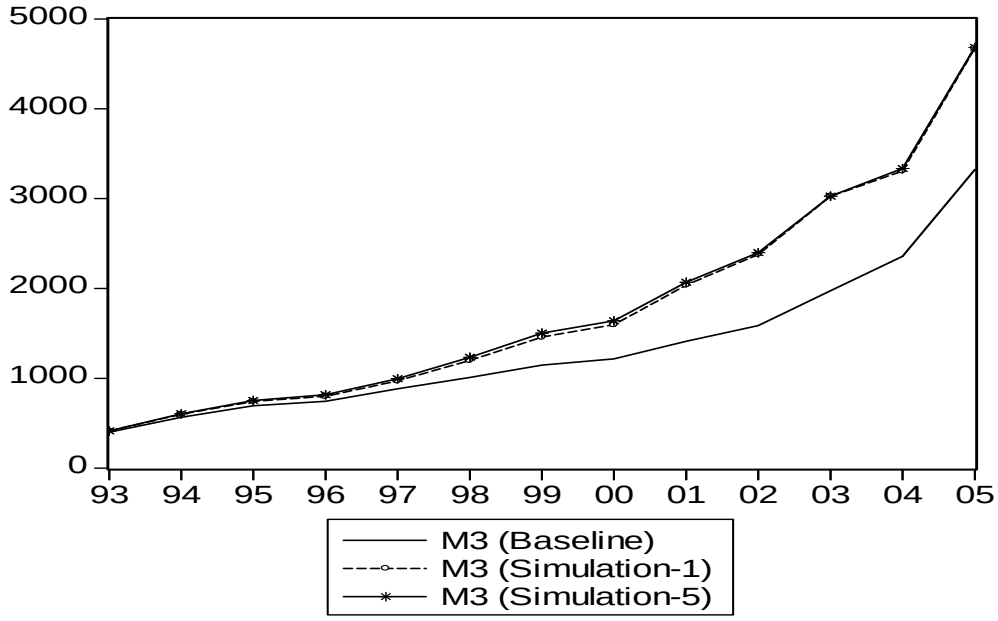
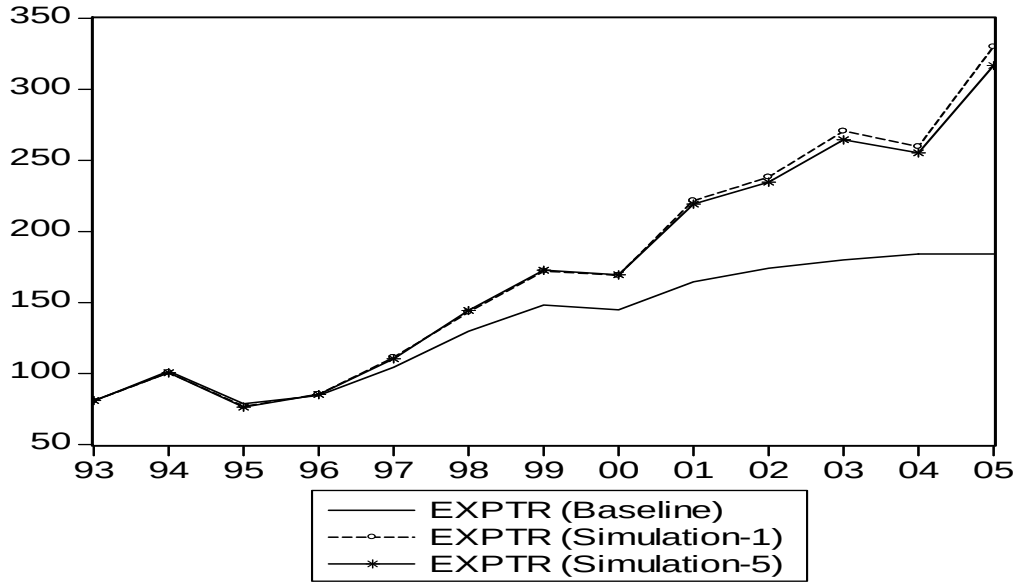


Figure-5.44: Impact on real exports



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

Comparison of Impacts of 50% Sustained Increase in Real Public Investment in Infrastructure and 140% Sustained Increase in Agriculture with Simulation-1

Figure-5.45: Impact on real imports

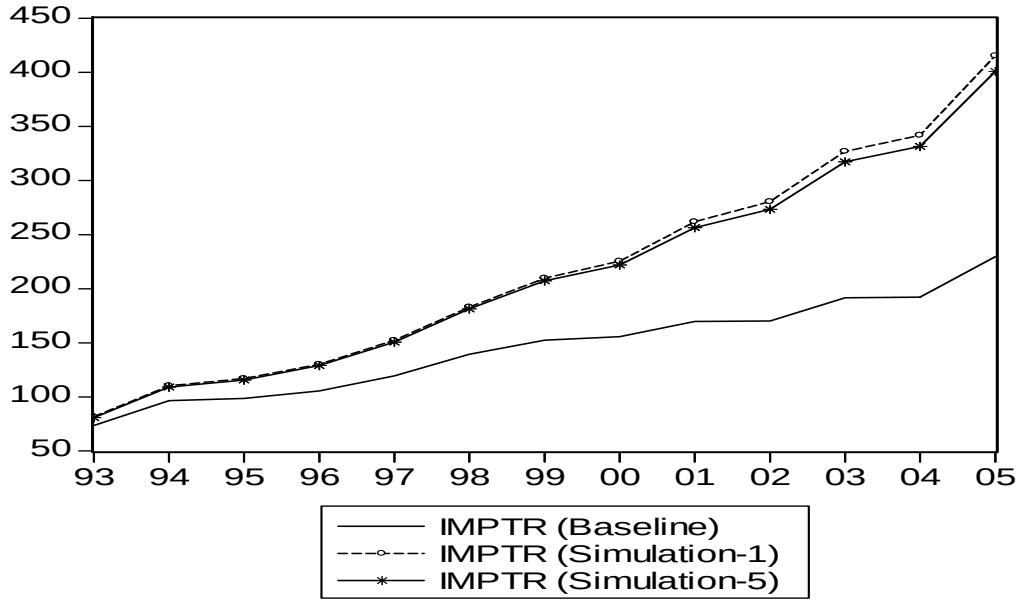
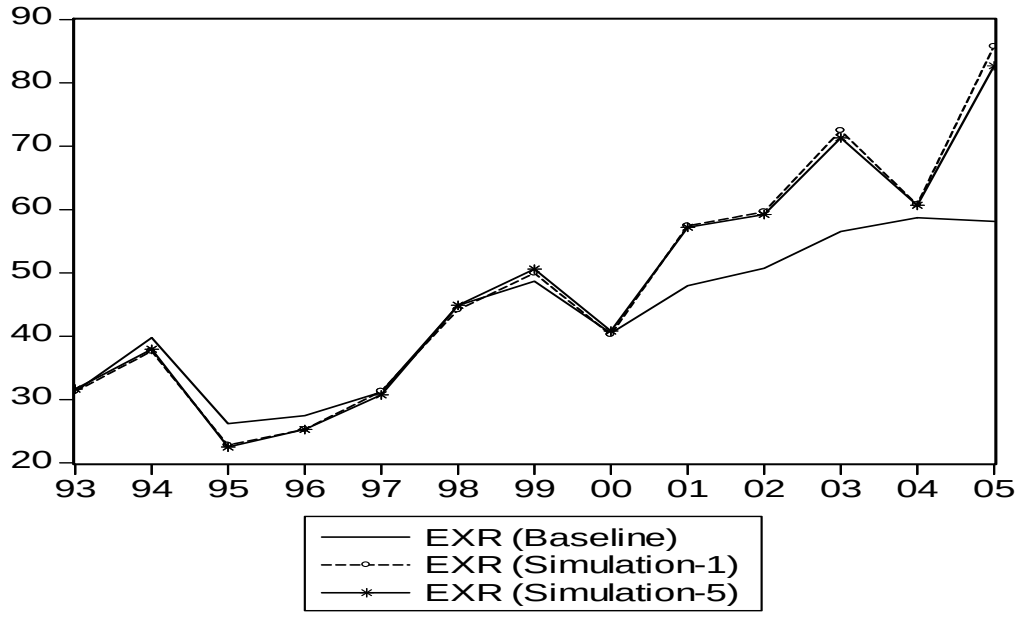


Figure-5.46: Impact on exchange rate (Rs/$)



Simulation-1: 70% sustained increase in real public investment in infrastructure

Simulation-2: 50% sustained increase in real public in investment infrastructure and 140% sustained increase in real public investment in agriculture

5.4 Monetary Policy Simulations:

5.4.1 Simulation-6: A Sustained 2% Decrease in CRR

In India, RBI uses CRR as a policy instrument to control money supply. In the recent period CRR has been falling drastically. It would be interesting to see what happens if CRR falls further more. Therefore CRR has been reduced by 2 percentage points from 1993-2005. Percentage deviations are given in Table-5.14 and growth rates are given Table-5.15.

Percentage Deviation between Policy and Base Simulations:

Two percentage points reduction in CRR would have immediate impact on money supply, which has increased from Rs. 396,583 crores Rs. 428,815 crores i.e. 8.1% in the first year. However, interest rate has increased by a small 0.1% in the first year. Increase in money supply would lead to changes in sectoral prices. Therefore, agriculture prices have increased by 1.1% whereas manufacturing prices and fuel, power lubricants prices have increased by 5.6%, 2.7% respectively. As a result, wholesale prices index for all commodities has increased by 4.1% in 1993-94. Private investment in all sectors except agriculture has increased due to rise in terms of trade. Especially, Private investment in services has increased at a very high rate (55.9%) where as manufacturing (4.8%) and infrastructure (9.9%) has increased moderately. Increase in private investment would help increase aggregate demand by 0.5%. This in turn affects real output in manufacturing (0.8%) positively. There seems to be no increase in real output of other sectors. Hence, there is a 0.2% increase in real aggregate output. In the fiscal sector, direct (6.1%) and indirect taxes (3.7%) as well as non-tax revenues (4.9%) seem to increase moderately due to increase in nominal output (4.2%).

Hence, government total revenues (4.3%) thereby consumption increases (4.2%) in the first year. This in turn increases public sector resource gap (0.9%) thereby fiscal deficit (0.4%) by a small percentage. In the external sector, real exports seems to increase by 2.3% and real imports seems to increase by 5% due to rise in aggregate demand (absorption). Head count ratios in both rural and urban areas have decreased by 0.1% each.

In the short-term, money supply has increased by 4.5% due to 2% sustained decrease in CRR. Interest rate seems to decrease negligibly due to increase in money supply in the short-term. Wholesale prices of agriculture (0.6%), manufacturing (3.1%) and fuel, power light, lubricants (2.2%) have increased due to increase in money supply. Real private investment in manufacturing, infrastructre and services has increased significantly due to increase in terms of trade. Real private investment in agriculture (3.4%) continues to fall. However, total real private investment has increased by 7.3% in the short-term. Aggregate demand seems to increase by 0.5% due to increase in private investment as well as private consumption (0.3%). Real output in all sectors except agriculture seems to increase marginally leading to increase in real output by 0.4%. Real output in agriculture seems to decline due to decline in real private investment in agriculture, which adds to net capital stock. Government revenues there by consumption have reduced by 2.7% each leading to marginal increase in public sector resource gap (0.3%) as well as fiscal deficit (0.2%). Real exports seems to decrease by 0.7%. Real imports seems to increase by 3% worsening the trade deficit.

Thus, in the long-term, 2% reduction in CRR would lead to a marginal rise in money supply (0.6%) thereby prices (0.4%). Total real private investment has increased by 1.3%. Aggregate real output seems to increase by 0.3% due to increase in all real output of all sectors except agriculture. However, real private investment as well as real output agriculture continues to fall in the long-term. Aggregate demand has increased 0.4% due to increase in real private investment as well as private consumption (0.3%). Government consumption and revenues seems to increase by 0.6% each. Real exports and real imports seem to fall by 0.3% and 1.1% respectively. Poverty ratios seem to decline by a small 0.1% due to increase in per capital real income.

Comparison of Growth Rates:

Due to 2% reduction in CRR, growth rate of money supply seems to decline by 0.6% though the policy path of money supply is above its base path. As a result, wholesale price index seems to decline 0.3%. Private investment in all sectors except agriculture seems to decline due to decrease in terms of trade. Hence, there is a 0.7% decline in the growth rate of total real private investment. There seems to be no change in the growth rates of aggregate demand as well as aggregate real output. Growth rate of government consumption as well as revenues has declined by 0.3% each. As a result, the share of public sector resource gap and fiscal deficit in nominal output has declined marginally by 0.1% each. Real exports seems to increase marginally by 0.1% where as real imports seems to decline by 0.3% deteriorating the trade deficit.

Table-5.15: Impacts of 2% Decrease in CRR

	Compound growth rate (%)* (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	6.0	**0.0**
Nominal Output (Y)	12.0	11.7	**-0.3**
Real Output (YR)	6.3	6.3	**0.0**
Agriculture (YAR)	2.2	2.2	**0.0**
Manufacturing (YMNR)	6.8	6.8	**0.0**
Infrastructure (YINFR)	8.0	8.0	**0.0**
Services (YSRR)	8.2	8.1	**-0.1**
Private Investment (PITOTR)	3.1	2.4	**-0.7**
Agriculture (PIAGR)	6.3	6.8	**0.5**
Manufacturing (PIMNR)	2.6	2.1	**-0.5**
Infrastructure (PIINFR)	4.0	3.5	**-0.5**
Services (PISRR)	3.2	1.2	**-2.0**
Real Private Consumption (PCR)	5.2	5.2	**0.0**
Public Investment (PCFTOTR)	1.1	1.1	**0.0**
Government Consumption (GFCE)(N)	14.5	14.2	**-0.3**
Government Revenues (TR) (N)	11.6	11.3	**-0.3**
Wholesale Price Index (P)	5.4	5.1	**-0.3**
Money Supply (M3)	14.6	14.0	**-0.6**
Real Exports (EXPTR)	9.8	9.9	**0.1**
Real Imports (IMPTR)	9.6	9.3	**-0.3**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	16.0	0.2
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.5	-0.1
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	8.6	-0.1
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.5	-0.1

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

5.5 Trade related simulations:

5.5.1 Simulation-7: A 20% Sustained Increase in World Income

In the backdrop of global financial crisis and contagion to developing countries, it would be worthwhile to study the impacts of decrease in world income, a proxy for world economic activity, on Indian economy. Therefore, in this exercise, it is postulated that world income in real terms would decrease by 20% during 1993-2005 and, the resulting impacts are analysed for all important endogenous variables. Such a decrease in world income would imply a shrinkage from Rs. 966,19,420 crores to Rs. 772,95,540 crores during 1993-2005. The results are given in terms of percentage deviations in Table-16 and growth rates in Table-17.

Percentage Deviation between Policy and Base Simulations:

A 20% decrease in world income in real terms is expected to decrease real exports and worsen trade balance thereby current account deficit. This in turn will trigger the economy-wide changes. In the model world income affects real exports with one-period lag. Therefore is no change in the real exports and other endogenous variables in the first year. However, a sustained 20% fall in world income would decrease average real exports from Rs. 91,437 crores to Rs. 84,819 crores i.e. 7.2% in the short-term. A moderate decline in real exports seems to decrease aggregate demand by 0.8%, which in turn decreases real imports (2.6%) through aggregate absorption. This in turn worsens trade balance by Rs. -3027 crores in the short-term. Decrease in trade balance and consequent decline in current account balance would dampen the net foreign exchange assets of RBI. As a result, Indian rupee against US dollar seems to appreciate by 3.6%. Decline in

RBI foreign exchange asset leads to decrease in reserve money and thereby money supply (2.5%).

Fall in aggregate demand leads to fall in real output in manufacturing (0.8%). There seems to be no change in real output in agriculture, infrastructure and services sectors. Hence, there is a marginal fall in aggregate real output (0.2%). Decrease in real output and money supply together leads to fall in wholesale prices of agriculture (0.4%), manufacturing (1.7%) and, fuel, power, light, lubricants (0.9%). Hence, there is a fall in wholesale price index for all commodities (1.3%). Fall in terms of trade seems to affect real private investment in all sectors except agriculture leading to 3.9% reduction in total real private investment. However, real private investment in agriculture has increased by 2.1% in the short-term.

In fiscal sector, direct-taxes (2%), indirect-taxes (1.3%) and non-tax revenues (1.6%) have declined due to fall in nominal output (1.4%). As a result, decline in total revenues (1.5%) there by government consumption expenditure (1.5%). Due to changes in government revenues and consumption, public sector resource gap (0.3%) and there by fiscal deficit (0.1%) worsened marginally. There seems to be negligible increase in head count ratios of both rural and urban areas due to fall in real output in the short-term.

In the medium-term, trends are similar but magnitudes are strengthened for all variables. Real exports seems to decrease significantly by 9.8%. Real imports fell by 3.9% worsening trade deficit by Rs. -4021 crores. Consequent decrease in current account balance and net RBI foreign exchange assets lead Indian rupee against US dollar to appreciate by 2.1%. Due to reduction in net RBI foreign

exchange assets, money supply has decreased by 4.5%. Real output has declined by 0.5% due to decrease in all sectoral outputs except agriculture, which has increased by a small 0.1%. Real private investment has decreased by 4.3% due to decrease in all sectors except agriculture, which has increased by 2.9%. Wholesale price index has decreased by 1.1% due to decline in money supply and real output. Private consumption had declined by 0.5% due to decline in real output. Government consumption as well as revenues fell by 2.6% and 2.7% respectively leading to increase in public sector resource gap (1.7%) there by fiscal deficit (1.1%) in the medium-term.

In the long-term, real exports continue to fall by 9.8% leading to a decrease in aggregate demand by 2.3%. Real imports have decreased by 5% due to decline in aggregate absorption (demand). Hence, there is a decrease in trade balance (Rs. -4376 crores) thereby current account balance. Exchange rate seems to appreciate by 1.6% in the long-term. Aggregate real output seems to decline by 1.1% whereas total real private investment has declined by 6%. Government consumption (2.6%) and revenues (2.9%) have decreased due to decrease in nominal output (2.7%) leading to increase in public sector resource gap (1.9%) thereby fiscal deficit (1.8%) marginally. Head count ratios in both rural and urban areas increased by 0.3% due to decline in real output.

Comparison of Growth Rates:

Due to a 20% sustained decrease in world income, growth rate of real exports seems decline by 0.4% compared to baseline growth rate. Growth rate of aggregate demand seems to decline by 0.3% due to fall in real exports, which in turn decreases growth rate of real imports by 0.6%. Fall in real imports decreases

the share of current account balance in nominal output by 0.3%. Growth rate of real output seems to decrease by 0.2% due to decrease in sector-wise real outputs. Growth rate of total real private investment has decreased by 0.8% where as private consumption has decreased by 0.2%. Growth rate of government revenues as well as consumption has decreased marginally by 0.2% and 0.1% respectively. As a result, the share of public resource gap (0.3%) and fiscal deficit (0.4%) in nominal output has increased marginally. Growth rate of money supply seems to decrease by a marginal 0.2%. There seem to be no effect on price level. Thus, a 20% decrease in the world income would have severe adverse effects on Indian economy in the long-term. Graphs of above simulations are given in Figure - 5.47 to 5.52.

Table-5.17: Impacts of 20% Decrease in World Income (%)

	Compound growth rate (%) * (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	5.7	**-0.3**
Nominal Output (Y)	12.0	11.9	**-0.1**
Real Output (YR)	6.3	6.1	**-0.2**
Agriculture (YAR)	2.2	2.2	**0.0**
Manufacturing (YMNR)	6.8	6.4	**-0.4**
Infrastructure (YINFR)	8.0	7.8	**-0.2**
Services (YSRR)	8.2	7.9	**-0.3**
Private Investment (PITOTR)	3.1	2.3	**-0.8**
Agriculture (PIAGR)	6.3	6.2	**-0.1**
Manufacturing (PIMNR)	2.6	1.2	**-1.4**
Infrastructure (PIINFR)	4.0	3.5	**-0.5**
Services (PISRR)	3.2	2.9	**-0.3**
Real Private Consumption (PCR)	5.2	5.0	**-0.2**
Public Investment (PCFTOTR)	1.1	1.1	**0.0**
Government Consumption (GFCE)(N)	14.5	14.4	**-0.1**
Government Revenues (TR) (N)	11.6	11.4	**-0.2**
Wholesale Price Index (P)	5.4	5.4	**0.0**
Money Supply (M3)	14.6	14.4	**-0.2**
Real Exports (EXPTR)	9.8	9.4	**-0.4**
Real Imports (IMPTR)	9.6	9.0	**-0.6**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	15.0	-0.8
Resource Gap / Nominal Output (RGPUB/Y)	7.6	7.9	0.3
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	9.1	0.4
Current Account Balance / Nominal Output (CAB/Y)	-0.4	-0.7	-0.3

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

Figure-5.47: Impact of 20% sustained decrease in WYR on aggregate real output

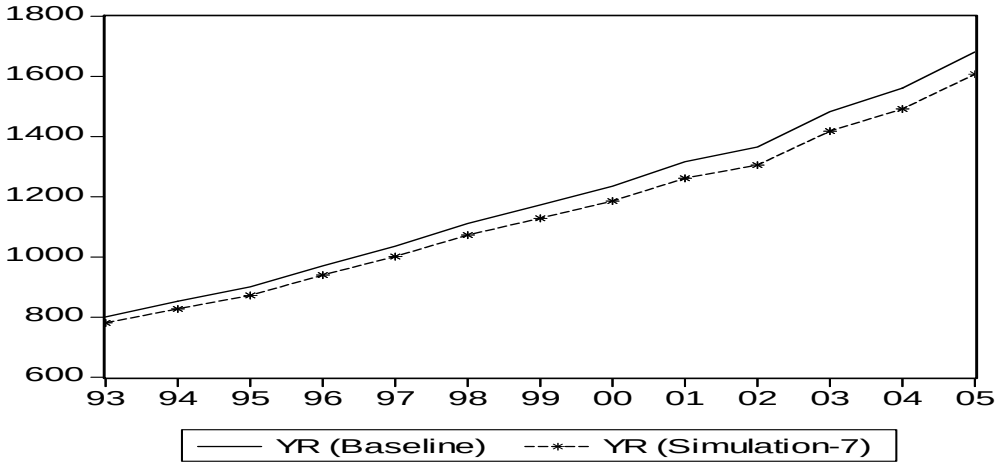


Figure-5.48: Impact of 20% sustained decrease in WYR on wholesale price index

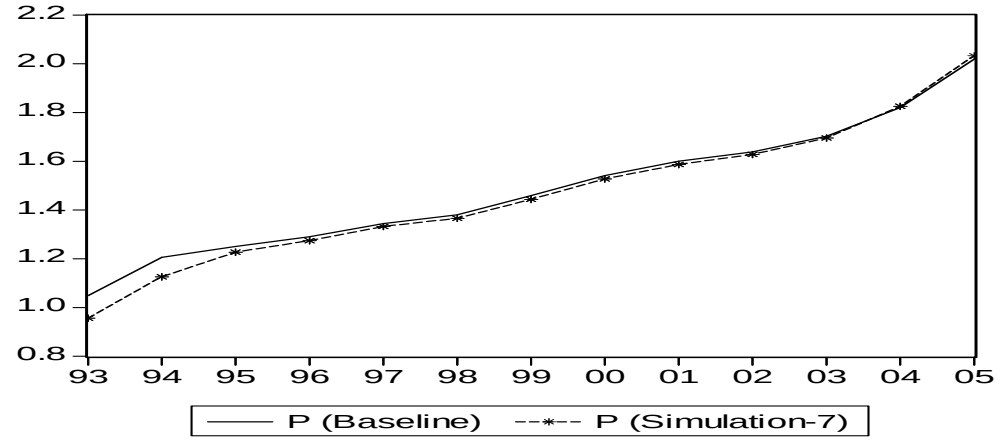


Figure-5.49: Impact of 20% sustained decrease in WYR on money supply

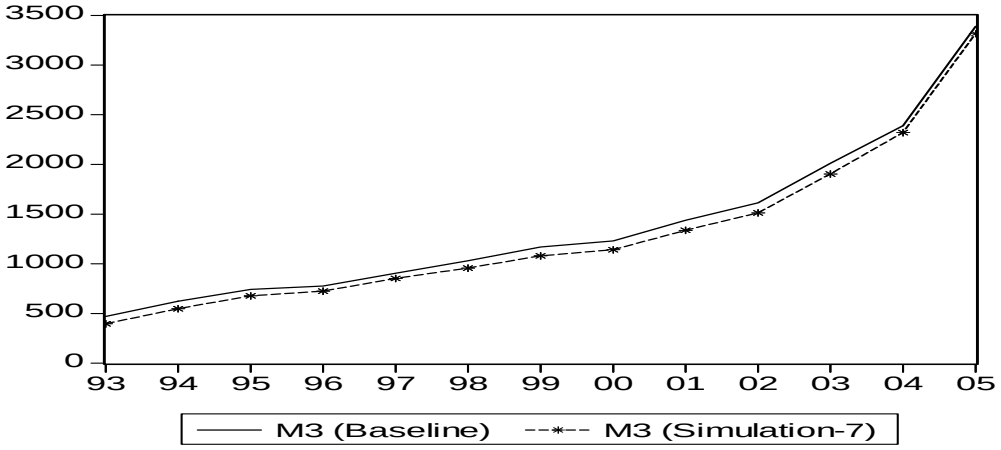


Figure-5.50: Impact of 20% sustained decrease in WYR on real exports

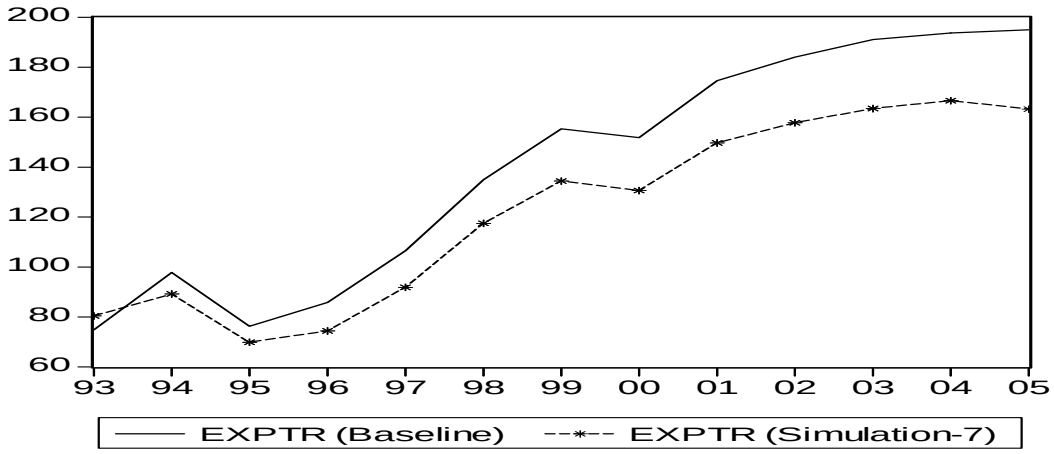


Figure-5.51: Impact of 20% sustained decrease in WYR on real imports

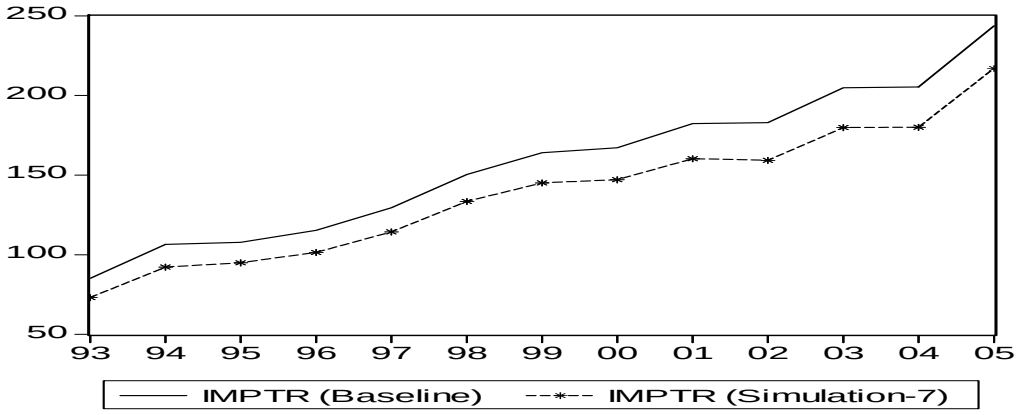
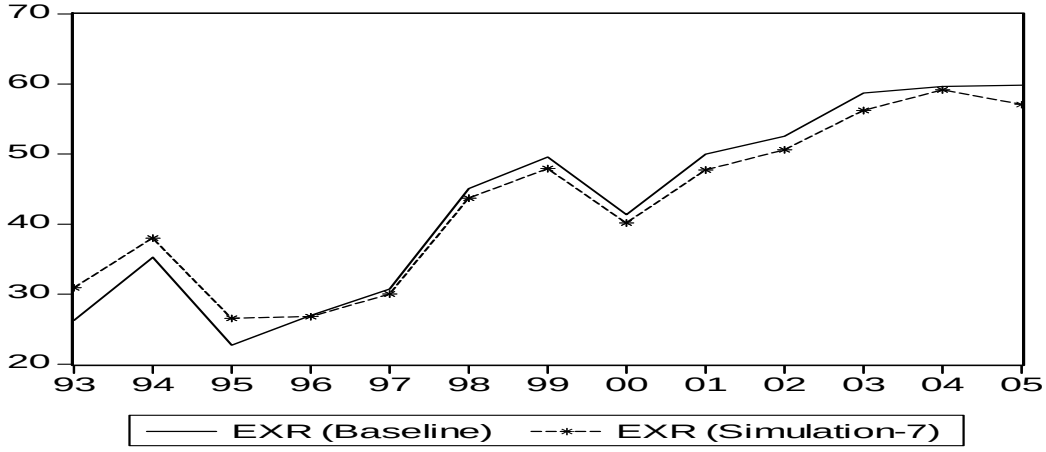


Figure-5.52: Impact of 20% sustained decrease in WYR on exchange rate (Rs/$)



5.5.2 Simulation-8: A 20% Sustained Decrease in Unit Value of Imports

India is a price taker as far as imports are concerned. Import prices especially for oil products have fallen drastically during 2008-09. As crude oil is one of the major import goods, a fall in its price would decrease unit value of imports (UVIMP), which in turn will have a positive impact on imports and ultimately on the Indian economy. In light of this, it would be interesting to see what will happen to Indian economy if unit value of imports decreases. In this simulation it is postulated that unit value of imports would fall by 20% for the period 1993-2005. Such a change would decrease import price index (UVIMP) from 1.409 to 1.127 on the average. The results are given in terms of percentage deviations in Table-18 and growth rates in Table-19.

A sustained 20% decrease in UVIMP will have immediate effect on real imports (eq 33) which has increased from Rs. 73,106 crores to Rs. 85,661 crores i.e. 17.2% in the first year. Real exports also seems to increase by 1.8% in first year. Trade balance (Rs. 5045 crores) seems to improve in the first year as nominal imports reduced, which in turn improves current account balance as well as net foreign exchange assets of RBI. As a result, there seems to be increase in reserve money and thereby money supply (6.4%). Increase in real imports in turn reduces the aggregate demand (0.7%) for domestically produced goods. However, rise in real imports would increase real output in manufacturing by 1% despite of decline in aggregate demand. As a result, aggregate real output has increased by a small 0.2%. Real output in other sectors remain unchanged. Wholesale price index (1.8%) has increased as setcoral prices have increased due to larger increase in money supply than real output. Real private investment in manufacturing (2.5%)

seems to increase due to increase in its sectoral real output as well as terms of trade. Likewise real private investment in infrastructure (4.7%) and services (35.8%) also increased due to rise in terms of trade, but there seems to be a reduction in real private investment in agriculture (5.1%). However, total real private investment has increased by 9.1%. Coming to fiscal sector, direct (4.4%) and indirect taxes (2.7%) as well as non-tax revenue (3.5%) would increase due to rise in nominal output (3%). Hence, government total revenues (3.1%) thereby consumption (3%) have increased causing public sector resource gap (0.9%) and thereby fiscal deficit to fall (0.4%) in the first year. Head count ratios both in rural and urban areas have decreased by a small 0.1% as real output increased.

In the short-term, real imports have increased by 15.2% due to 20% sustained decrease in unit value of imports. Real exports seems to increase by 1.7% leading to improvement in trade balance (Rs. 5482 crores) thereby current account balance and net RBI foreign exchange assets. Hence, reserve money thereby money supply (9%) has increased. Aggregate demand has reduced by 0.2% due to increase in real imports. Manufacturing real output (1.4%) has increased due to rise in real imports. Real output in infrastructure (0.03%) and services (0.5%) seems to increase marginally whereas real output in agriculture has decreased by a small 0.1%. Private investment in all sectors except agriculture has increased leading to rise in total real private investment (11.4%). Rise in money supply and aggregate real output lead to rise in sectoral prices and thereby wholesale price index (3.5%). Government revenues and consumption have increased by 4.9% each leading to decline in public sector resource gap (0.3%) thereby fiscal deficit (0.3%).

In the medium-term and long-term, impacts get strengthened due to sustained change in unit value of imports. Real imports seems to increase by 15.1% in the long-term whereas real exports seems to increase by 0.7%. Interestingly, trade balance has improved by Rs. 9293 crores. Real aggregate output has increased by 2.5% and total real private investment has increased by 14.2% in the long-term. Money supply (13%) as well as wholesale price (1.8%) has increased in the long-term. Government consumption (6.9%) and revenues (7.8%) have increased. As a result, there is a reduction in public sector resource gap (6%) thereby fiscal deficit (5.5%). Aggregate demand (2.7%) seems to increase, probably due to increase in real exports as well as consumption of both private and public sectors despite of increase in real imports. Poverty ratios seem to decrease by 0.7% and 0.8% in rural and urban areas respectively in the long-term.

Comparison of Growth Rates:

Due to a 20% sustained decrease in unit value of imports (import price) there seems to be no change in the growth rate of real imports though the policy path is above baseline path. Real exports seems to decline marginally by 0.1%. However, the share of current account balance in nominal output (0.7%) seems to improve in the long-term. Aggregate demand seems to increase by 0.7% probably due to increase in private investment of all sectors. Aggregate real output seems to increase by 0.5%. On the fiscal side, government revenues as well as consumption have increased by 0.4% and 0.2% respectively. As a result, the share of public sector resource gap (0.9%) and fiscal deficit (1%) in nominal output has decreased. Money supply seems to increase by 0.4%, but prices seems to fall marginally by 0.2%. Thus, a 20% decrease in unit value of imports seems to give real benefits to the Indian economy in the long-term.

Table-5.19: Impacts of 20% Increase in Unit Value of Imports (Import Prices)

	Compound growth rate (%) * (1993-94 to 2002-03)		
Variable	**Baseline**	**Pol sim**	**Difference**
Aggregate Demand	6.0	6.7	**0.7**
Nominal Output (Y)	12.0	12.4	**0.4**
Real Output (YR)	6.3	6.8	**0.5**
Agriculture (YAR)	2.2	2.1	**-0.1**
Manufacturing (YMNR)	6.8	7.4	**0.6**
Infrastructure (YINFR)	8.0	8.3	**0.3**
Services (YSRR)	8.2	8.9	**0.7**
Private Investment (PITOTR)	3.1	4.3	**1.2**
Agriculture (PIAGR)	6.3	6.8	**0.5**
Manufacturing (PIMNR)	2.6	4.8	**2.2**
Infrastructure (PIINFR)	4.0	5.3	**1.3**
Services (PISRR)	3.2	3.2	**0.0**
Real Private Consumption (PCR)	5.2	5.6	**0.4**
Public Investment (PCFTOTR)	1.1	1.1	**0.0**
Government Consumption (GFCE)(N)	14.5	14.7	**0.2**
Government Revenues (TR) (N)	11.6	12.0	**0.4**
Wholesale Price Index (P)	5.4	5.2	**-0.2**
Money Supply (M3)	14.6	15.0	**0.4**
Real Exports (EXPTR)	9.8	9.7	**-0.1**
Real Imports (IMPTR)	9.6	9.6	**0.0**
	Average Shares		**Difference**
Real Private Investment / Real Output (PITOTR/YR)	15.8	17.6	1.8
Resource Gap / Nominal Output (RGPUB/Y)	7.6	6.7	-0.9
Gross Fiscal Deficit / Nominal Output (GFD/Y)	8.7	7.7	-1.0
Current Account Balance / Nominal Output (CAB/Y)	-0.4	0.3	0.7

N: Nominal

*: Compound growth rates are calculated by estimating semi-log trend equations

Figure-5.43: Impact of 20% sustained decrease in UVIMP on real imports

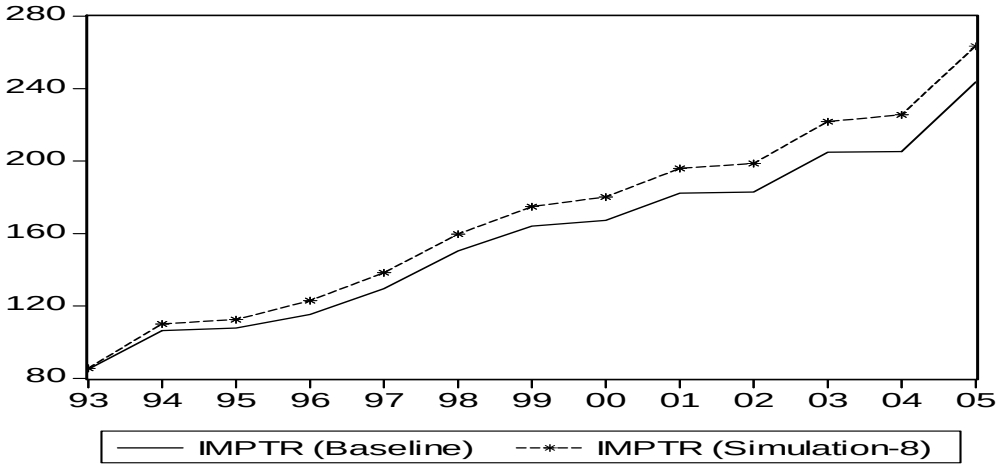


Figure-5.54: Impact of 20% sustained decrease in UVIMP on aggregate real output

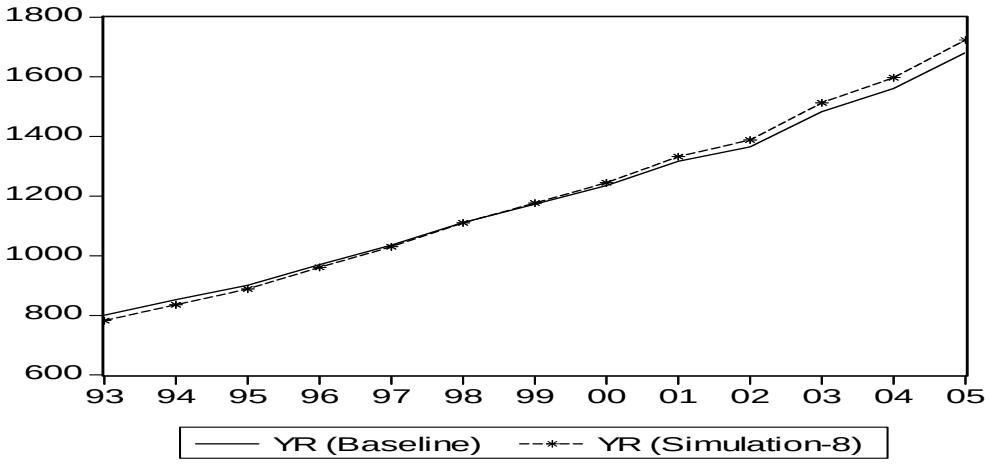
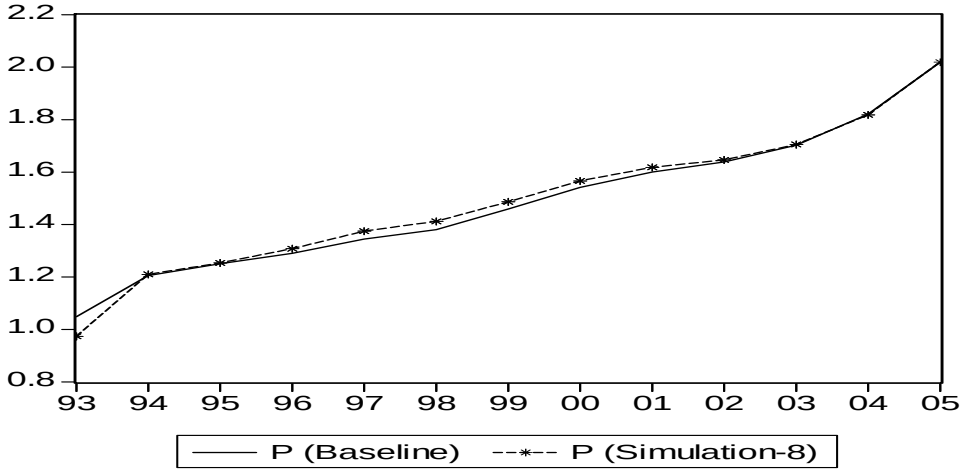


Figure-5.55: Impact of 20% sustained decrease in UVIMP on wholesale price index



CHAPTER VI

Summary and Conclusion

6.1: Model Summary:

This study has attempted to build an aggregative, structural, macroeconometric model for India. The study focused on the role of public investment especially in infrastructure on growth and poverty. The model has a comprehensive treatment of real, fiscal, monetary and external sectors. It emphasises the inter-relationships between internal and external balances and also the relation between money, output, prices and trade balance. Broad framework is Keynesian.

In the real sector, the model distinguishes four sectors on supply side, namely agriculture, manufacturing infrastructure and services. Output is supply driven in agriculture, infrastructure and services sector, where as it is supply as well as demand driven in manufacturing. Real output in all sectors is commonly explained by net capital stock, besides that natural factors like rainfall and cropped area effect agriculture output and, aggregate demand and imports play a major role in determining manufacturing output. Infrastructure output serves as a capacity constraining factor in determining output in both agriculture and services sector. Aggregate supply is the summation of real output from all the four sectors. Aggregate demand is specified as an identity that is equal to the sum of private consumption and investment, government consumption and investment and, net exports.

Investment behaviour in the model is dealt in a very detailed fashion. Public investment is assumed to be exogenous and private investment to be endogenous.

Private investment in all four sectors (agriculture, manufacturing, infrastructure and services sectors) depends on output following accelerator principle, public investment to account for crowding-in effect. Infrastructure investment is included as a determinant in rest of the sectors to observe the complementarity across the sectors. In addition, private investment in all sectors depends on real interest rate and terms of trade. The distinguishing feature is to include public resource gap, defined as public investment and savings, in determining private investment. The rationale is to observe the resource availability for private sector. Public sector resource gap has a negative effect on private investment indicating crowding-out effect. Thus crowding-in and crowding-out co-exists in private investment equations.

In fiscal sector, an attempt is made to explain government activities including current expenditure, revenues and fiscal deficit keeping investment exogenous. Government revenues consist of direct and indirect taxes and, non-tax revenues which in turn depend on nominal output. Government consumption purely depends on its own revenues. Gross fiscal deficit is positively related to public sector resource gap, which is the difference between total public investment and public savings. When the expenditure outplays revenues, the government has to resort to deficit financing basically by borrowing from commercial banks, non-bank borrowings and external borrowings. The left-out deficit that is uncovered by above said sources will be me met by reserve bank credit to government.

Coming to monetary sector, equilibrium in the money market determines interest rate. Money supply depends on reserve money and Cash reserve ratio (CRR). On the other side money demand function takes a reduced form as interest rate (PLR)

which is determined by real GDP, money supply, inflation and its own lagged value representing partial adjustment mechanism. Money stock affects interest rate negatively.

Price behaviour is modelled in detail. Sectoral prices represented by wholesale prices in agriculture, manufacturing and fuel, power light lubricants are commonly determined by liquidity in the economy in relation to real output i.e. the ratio of money stock to real GDP a proxy for demand. In addition, procurement prices of rice and wheat, which represents cost factors, influences agriculture prices. Wholesale prices of fuel, power and lubricants and, price of imports (cost factor) plays a crucial role in determining manufacturing prices. Price of fuel, power and lubricants are taken in to consideration as price of infrastructure, which depends on monetary factor and, import price minerals, fuels and lubricants etc. General price level represented by wholesale price index for all commodities is simply the weighted sum of sectoral prices.

In the external sector, real exports depend on domestic export prices relative to world export prices and world income representing world economic activity. Exports price (unit value of exports) depends on real GDP, a proxy for overall demand and the ratio of domestic prices to world export prices. India is a price taker as far as imports are concerned. Therefore, import price (unit value of imports) is exogenous to the model. The import demand is specified in terms of import price relative to the corresponding domestic price, domestic level of economic activity that is captured by aggregate absorption. Exchange rate is treated as endogenous supporting the new policy regime of the Indian economy. It is determined by rate of inflation, ratio of current account deficit to foreign

exchange assets of reserve of bank and the rate of change in reserve bank foreign exchange assets. Current account deficit is defined as the total trade balance plus net invisibles. Foreign exchange reserves are related to current account deficit and net capital inflows, which is exogenous to the model.

In the model, a simple relationship between head count ratio and the per capita real income, separately in rural and urban areas is postulated in order to link the output growth with poverty reduction. To best of our knowledge the inter relationship between poverty and growth in the context of macroeconometric modelling has not been covered. A modest attempt has been made towards that.

The model is fairly large to include 75 relations (36 equations and 39 identities). It covers the period from 1980-81 to 2005-06. The model has behavioral relations specified as linear in parameters. Annual time series data for the period 1981-2002 is used for estimation purpose. The methods of three stage least squares is used for the estimation of the model. The model is solved for baseline simulation using deterministic and dynamic options and tuned it suitably to trace the historical data well. The policy simulations are then undertaken to contrast with the base simulation. Post-sample forecasts (deterministic) are also analysed for the 3-year period 2002-03 to 2005-06. The full model is validated for its ex-post and ex-ante forecasting performance. Overall performance of the model is satisfactory in terms of summery measures (RMSE, MAE, Theil-U) and graphical representation of historical tracking shows that both levels and turning points are tracked well. The model is satisfactory in terms of a priori signs of the coefficients in each equation. The mean elasticities of dependent variables with respect to independent variables in important equations are given in Tabal-6.1.

6.2 Summery of Policy Simulations:

Policy simulation exercise has been carried out to bring out the various ways in which the economy responds to exogenous shifts or shocks. Some policy simulations are conducted considering various issues like fiscal stimulus through increase in public investment in infrastructure, monetary stance on economic growth and trade related policy changes.

Fiscal Policy:

Given the performance of the model, a few scenarios of fiscal stimulus have been postulated considering public investment in infrastructure as a policy variable to measure the likely macroeconomic effects of changes in public investment in infrastructure in India. The quantified effects include the allocative and dynamic responses of the chosen policy change on important macroeconomic variables relating to four broad sectors- real, fiscal, monetary and external sectors of the Indian economy. The sign and magnitude of the effects vary over time- immediate to long- run.

Public investment has a two-fold role in the model. It not only adds to net capital stock and generates output with a lag but also influences private investment in all sectors. Substantial increase in public investment, especially in infrastructure advocates economic growth. The model is simulated to assess the crowding-in effect of public investment on private investment by raising the real public investment in infrastructure under certain hypothetical changes. It is also important to see the effect of such a simulation on other key endogenous variables such as real output, prices, money supply and fiscal and trade deficits. Various

sources of financing the increased public investment in infrastructure are also considered. A combination of public investment in infrastructure and agriculture also tried out for comparison.

6.2.1 Simulation-1:

Real public investment in infrastructure has been increased by 70% on a sustained basis during 1993-2005. The increased public investment in infrastructure has immediate positive effect (crowding-in) on private investment and immediate expansionary effect on public sector resource gap thereby affecting real private investment negatively. However, crowding-in effect seems to be stronger than crowding-effect in the simulation. Therefore, real private investment in infrastructure has been increased Likewise, complementarity effect is realised on real private investments in rest of the sectors due to increase in public investment in infrastructure. As a result, real total private investment has increased tremendously in the long-run. Increase in public investment in infrastructure adding to net capital stock seems to increase sectoral as well as aggregate real output significantly. Increase in both real public investment in infrastructure as well as real private investment in all sectors, seems to increase aggregate demand. Government consumption and revenues have registered high growth rates. Increase in fiscal deficit would lead to increase in net RBI credit to government which in turn increases reserve money and there by money supply. On the other side, increase in real public investment has an adverse effect on trade balance. Rise in aggregate absorption stemming from the higher public investment (through aggregate demand) has increased real imports. Real exports have also increased, but less than the increase in real imports. Therefore trade balance as

well as current account balance has deteriorated. Thus, due to a sustained 70% increase in real public investment in infrastructure, aggregate real output would grow at a 9.3% per annum with prices and money supply growing at 5.8% and 20.1% respectively. Poverty ratios in both rural and urban areas seem to fall considerably due to increase in per capita real income in the long-run.

6.2.2 Simulation-2:

A 70% sustained increase in public investment in infrastructure financed by external borrowings, which will be a part of net capital inflows, will have crowding-in effect on private investment. At the same time, it has expansionary effect on public sector resource gap thereby affecting real private investment negatively. Rise in public sector resource gap would increase fiscal deficit. However, crowding-in effect seems to be stronger than crowding-out effect in this exercise also. Hence there is an increase in real private investment in infrastructure. Due to complementarity effect, real private investment in rest of the sectors also increased. As a result, total real private investment has increased drastically. Increase in external borrowings will reduce the requirement of net RBI credit to government in financing fiscal deficit. Therefore, reserve money thereby money supply will decrease. However, external borrowings which will come through capital flows would increase net RBI foreign exchange assets thereby reserve money and money supply. Ultimately, money supply seems to increase as a net effect of the above said changes. Nevertheless growth in money supply will be lesser when compared to the same in simulation-1. Further, money supply increases setcoral prices and thereby wholesale price index for all commodities. The ensuing increase in output due to increase in total investment is

expected to moderate the price rise to some extent. Nominal interest rate is expected to fall as money supply increasing, but the increase in output in a non-inflationary way seems to offset the decrease in interest rate caused by rise in money supply. Hence raise in nominal interest rate thereby decrease in private investment. However, empirical results show that the crowding-in effect is stronger than the negative interest rate affect in all sectors. Thus the net effect of increase in public investment on private investment is positive. Real imports seems to rise over and above real exports deteriorating in the current account deficit thereby trade deficit. Exchange rate depreciates as the current account balance declines due to the above said changes. Therefore, the output and price effects of increase in real public investment in infrastructure are accompanied by the rise in fiscal deficit, money supply and deterioration in current account deficit in the balance of payments. This is a kind of trade off that is likely from the postulated scenario of increase in the real public investment in infrastructure. Thus, due to 70% increase in real public investment in infrastructure financed through external borrowings, aggregate real output would grow at a 9.1% with prices and money supply growing at 5.3% and 17.8% respectively. The share of fiscal deficit in nominal output (9.7%) seems to increase and the share of current account balance in nominal output (-0.9%) seems to deteriorate in the long-run.

6.2.3 Simulations-3&4:

Two other alternative simulations are also attempted aimed at raising the necessary resources for public investment through (a) commercial bank credit to government (b) increase in direct-taxes. Financing public investment by borrowing from commercial banks tried out to compare the effect of increasing

internal and external borrowings. The long-run effects of these two scenarios are also found to be quite similar.

A 70% increase in real public investment in infrastructure financed through commercial bank credit also gives similar results when compared to simulation-2. Due to crowding in effect, real private investment in infrastructure has increased leading to a rise in total real private investment. Public sector resource gap would increase leading to a rise in fiscal deficit. Since, the increase in real public investment in infrastructure would be financed through bank credit to government, the requirement of net RBI credit to government to finance fiscal deficit will reduce, which in turn reduces reserve money thereby money supply. In the short-term money supply seems to decline drastically. However, the reserve money will grow with a little feed-back from net RBI credit to government leading to expansion of money supply and consequent increase in prices in the long-run. Thus, due to a 70% sustained increase in real public investment in infrastructure financed through band credit to government, real aggregate output would grow at 9.3% with prices (6.3%) and money supply (21.2%) growing at a higher rate in the long-run, when compared to simulation-2. The share of fiscal deficit (9%) and current account balance (-0.6%) in nominal output is a little lesser when compared to simulation-2. Nonetheless, the public debt (internal) as a ratio of GDP is very high already; it might be implausible to increase it further. Hence borrowing from external sources seems to be a feasible phenomenon to stimulate the growth in Indian context.

Taxation also tried out to internalise the increase in public investment which gave similar results to above discussed scenarios. Due to a 70% sustained increase in

infrastructure financed by revenues from increased direct taxes, real aggregate output would grow at 9.2% with prices and money supply growing at 5.8% and 19.7% respectively in the long-run. The share of public sector resource gap (7.3%) as well as fiscal deficit (8.4%) has reduced due to increase in public investment as well as government revenues.

6.2.4 Simulation-5:

A combination of increase in real public investment in infrastructure (50% of rise) as well as agriculture (140% of rise) during 1993-2005 also tried out. The results of this scenario seem to be equally better with a little more increase in money supply and related changes when compared to simulation-1. Due to increase in real public investment in both infrastructure and agriculture, real private investment in agriculture seems to grow at a higher rate (8%). However, growth in real private investment in infrastructure seems to reduce (6.9%) when compared to simulation-1. Nevertheless, total real private investment seems to grow at a higher rate when compared to simulation-1. The real output in agriculture seems to grow at 6.1% and infrastructure seems to grow at 10.9%. The effect of this scenario on rest of the variables is quite similar to that of in simulation-1. Thus, Due to a 50% increase in real public investment in infrastructure and a 140% increase in agriculture, real aggregate output seems to grow at 9.3% with increase in prices (5.7%) and money supply (19.9%). It is interesting note that the share of public sector resource gap (7.5%) and fiscal deficit (8.5%) in nominal output has decreased. Real exports and real imports would grow at 13.9% and 14.2% respectively deteriorating the share of current account balance in nominal output. Head count ratios seem to fall significantly in both rural and urban areas.

6.2.5 Simulations-6 to 8:

Monetary and trade related simulation also tried out in the study. CRR as a monetary policy instrument has been reduced by 2 percentage points on a sustained basis during 1993-2002 and the consequent results are as expected. Money supply has increased when compared to baseline. However, there seems to be a little lesser growth in money supply (14%) when compared to baseline though the policy simulation path is above base path. The consequent results are the following. Prices would grow at 5.1%. Sector wise as well as total real private investment would increase due to rise in terms of trade. There seems to be a negligible growth in aggregate real output. There seems to be slight decrease in growth rate of government consumption as well as revenues. As a result, the share of public resource gap as well as fiscal deficit in nominal output would decline in the long-run.

Trade related simulations are conducted considering world income and import prices (unit value of imports) as policy variables. World income has been reduced by 20% to observe the effects of such a change on important macro variables. Due to 20% sustained decrease in world income, growth rate of real exports (9.4%) seems to fall considerably. Growth rate of real imports (9%) also seems to fall worsening the trade balance. Due to decrease in real exports, there seems to be fall in growth rate of aggregate demand thereby real output (6.1%). Total real private investment (2.3%) seems grow at a slower pace. Money supply has decelerated (14.4%) leading to negligible fall in prices. Poverty ratios seem to increase in both rural and urban areas due to decline in real per capita income in the long-run.

There seems to be significant adverse effects on the Indian economy due to decrease in world income.

A 20% decrease in unit value of imports seems to have a prosperous effect on the Indian economy. Due to 20% decrease in import prices, real imports have increased rapidly when compared to baseline. However there seems to be negligible increase in growth rate of real imports when compared to baseline growth rate though the simulation path is above baseline path. This in turn will have affluent effect on other macroeconomic variables. Due to increase in real imports, manufacturing output (7.4%) as well as private investment (4.8%) has grown at a higher rate. Real output in rest of the sectors also increased. As a result, aggregate real output seems to grow at 6.8%. Growth rate of wholesale price index (5.2%) seems to fall marginally and money supply (15%) seems to grow significantly. There seems to be marginal decline in real exports. However, the share of current account balance in nominal output seems to improve in the long-run.

6.3 Conclusion:

The aggregative, open-economy, macroeconometric model built here has been found to be quite satisfactory in explaining the historical data on the chosen macro variables for the Indian economy. Despite the fact that the 26-year data period is quite long and the economy had undergone structural changes, the econometric model built in this study can be considered fairly appropriate, except for the most recent 2-3 years for some variables. This shows that the model could integrate the behaviour of economic agents representing the three sectors, monetary, fiscal and foreign trade. Most of the behavioural parameters are of expected sign and

statistical significance. The counter factual policy simulations undertaken with the estimated model also look meaningful and provide valuable information for the policy maker.

The approach paper by the Planning Commission for the 11th Five Year Plan documented that the Indian economy had registered an average 7% real GDP growth during the first 4 years of the 10th Five Year Plan (2002-03 to 2005-06) and indicated the potential for achieving 9% real GDP growth. The 11th Five year plan report suggests that 8% GDP growth is achievable, if public investment in infrastructure increases by above 70%. This study confirms such scenario provided the necessary infrastructural investments are made. If the 11th plan estimates of 8% or even higher GDP growth was true and sustainable, then our scenario projection will make it nearly 10% p.a. Further, it is interesting to note that in the long-run, the head count (poverty) ratios are declining in both rural and urban areas of India. This is a very significant result and offers credence to policy initiatives aimed at reducing poverty through economic growth.

As pointed out in the introduction, any macroeconometric model is a living organism and it requires continuous upkeep and monitoring. Given the vastness/diversity of the country and its regional specificity, an aggregate model like the present one is certainly inadequate. The model requires elaboration in many aspects, which perhaps will be our future endeavour.

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