Macroeconomic Impact of Fiscal Deficit in India

An Intertemporal Analysis of Selected Macrovariables

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Dissertation submitted to the Jawaharlal Nehru University, New Delhi for the award of the Degree of Doctor of Philosophy in Economics

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I hereby affirm that the work for the dissertation, ***Macroeconomic Impact of Fiscal Deficit In India: An Intertemporal Analysis of Selected Macrovariables***, being submitted for the degree of Doctor of Philosophy in Economics of the Jawaharlal Nehru University, New Delhi, was carried out entirely by myself and has not formed part of any other programme of the study and not submitted to any other university for the award of any degree or programme of study.

April 9, 2003

Lekha S

Certified that this study is the bona fide work of Lekha S, carried out under our supervision at the Centre for Development Studies.

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Dedicated to the Memory of Professor I S Gulati

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LEKHA S

Abstract of the Dissertation

Macroeconomic Impact of Fiscal Deficit in India
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The macroeconomic impact of fiscal deficit depends not only on the levels of deficit, but also on the modes of financing the deficit. Excessive use of any financing mode of fiscal deficit results in the macroeconomic imbalances, viz., seigniorage financing leads to inflationary pressures in the economy and domestic debt financing leads to a credit squeeze through higher interest rates, and consequent crowding out of private investment. This study looked into the impact of fiscal deficit of the central government on selected macrovariables, viz., private capital formation, rate of interest, seigniorage, money supply and rate of inflation over the last three decades.

The study looked into the taxonomy of crowding out, whether high fiscal deficit affects the capital formation in the economy both by reducing private investment through increase in public sector's own investment and also through an increase in the rate of interest arising out of high fiscal deficit. Using Hsiao (1981) autoregressive modeling of sequential causality detection and error correction model, we found that public investment crowds in rather than crowds out private investment. The results also refuted the McKinnon hypothesis; and found that it is the cost of credit that matters for private investment, and not the quantity of credit. But the point to be noted here is that the interest rate sensitivity of private investment itself does not indicate *financial* crowding out. The evidence for *financial* crowding out can only be established after checking whether real rates of interest rise is induced by fiscal deficit. This is because adhoc configurations of demand and supply of loanable funds in the market is affected by various factors and these factors may have their respective role in the determination of the rate of interest. But from the perspective of *financial* crowding out hypothesis, what is relevant is the extent to which the rate of interest rise is induced by the fiscal deficit. In the error correction model, we have found no evidence of *financial* crowding out for both administered and deregulated interest rate regime. In other words, it was found that in both regime, that increase in fiscal deficit does not induce a rise in the rate of interest, but it is the rate of interest that induce fiscal deficit. The reason beneath this trend can be that high interest rate fuelled the accumulation of more debt through increase in interest payments and the consequent debt deficit spiral.

While looking at the interlinkages between fiscal deficit, seigniorage, money supply and inflation, we have estimated the revenue generated by the government through seigniorage, which showed that seigniorage revenue as a percentage of GDP has increased over the decades from 1 per cent in the seventies to 3 per cent in the nineties, though late nineties showed a tremendous decline in the revenue generated from seigniorage. Also, we have estimated *Seigniorage Laffer curve* for India where we found that the squared inflation term which gives rise to the inverted U-curve phenomenon is negative and significant, thereby reinforcing the existence of a non linear relation between revenue from seigniorage (μ_t) and inflation rate (π_t). The result from sequential autoregressive modeling of seigniorage for causality detection of last three decades revealed that fiscal deficit causes seigniorage. But seigniorage *per se* does not translate into money supply; the stability of money multipliers is the prerequisite condition for the interlinkages between seigniorage, money supply and fiscal deficit. It was found that money multipliers were not stable in India over the last three decades. The results of causality detection also showed that fiscal deficit does not cause

money supply in India. At the same time, a self-perpetuating process of inflation induced deficits and deficit induced inflation is found in the context of India over the last three decades.

The point to be noted here is that the analysis of link between fiscal deficit and changes in reserve money in the deregulated financial regime revealed that fiscal deficit does not induce creation of reserve money; which is in conformity with the recent shift in the financing pattern of fiscal deficit away from seigniorage financing to bond financing. The real effective exchange rate is found to be a significant causal factor of reserve money creation in the deregulated financial regime. The result is in conformity with recent trends in monetary stance; that for the first time, external sector became the main cause of expansion of money supply through active intervention in the FOREX market to stabilize the exchange rate and regulated money supply through sterilization. The important question thus is whether inflationary consequences of fiscal deficit can be considered as an insignificant issue or a switching over to rules of constraint on the extent of fiscal deficit (through Fiscal Responsibility Act) an appropriate policy step. It is also to be noted that inflationary nature of fiscal deficit, even if not via monetary root, may be essentially due to the nature of expenditure that are being financed by fiscal deficit. In a situation where increasing proportion of fiscal deficit is diverted to finance the current consumption expenditure, there is a high possibility that such expenditure will have higher inflationary potential. But as the analysis revealed that there is a positive relationship between private investment and fiscal deficit, a cap on fiscal deficit may essentially reduce the volume of overall investment in the economy and thereby growth. Thus, efforts should be made to restructure the expenditure pattern of the government in such a way that inflationary tendencies are controlled.

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Chapter 1

Introduction

In recent years, fiscal deficit reduction has become one of the principle objectives of fiscal reforms in both developed and developing countries[1]. In India also, in the backdrop of stabilisation and structural adjustment programmes, fiscal consolidation is identified as one of the primary instruments to achieve macroeconomic stability. Efforts were thus made to contain the fiscal deficit by both the Central and State Governments. The rationale behind the reduction in fiscal deficit emanated from the theoretical paradigms of macroeconomics which argued that excessive fiscal deficit often triggers inflationary pressures in the economy, increases rate of interest and crowds out private capital formation, creates balance of payment crisis and in turn debt spiraling[2]. However, considerable ambiguity exits about the link between fiscal deficit and the macroeconomic activity.

Is fiscal deficit containment a prerequisite for sustained reduction in the rate of inflation in India? If so, is the extent of monetisation of fiscal deficit in India eventually spell inflation? Does fiscal deficit crowd out private investment in India, if so, to what extent? Is the transmission channel for the crowding out via changes in rate of interest? Does fiscal deficit affect rate of interest in India? It is imperative to analyze these macroeconomic consequences of fiscal deficit in India, as a prelude to the attempts to achieve macroeconomic stability through containment of fiscal deficit. This study attempts to analyze each of these impacts of fiscal deficit in India.

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[1]Two of the Maashtricht criteria for the entry into the European Monetary Union is that member nations should have a budget deficit of no more than 3 per cent of GDP and a national debt of no more than 60 per cent of GDP. In US, policy initiatives were taken not only to reduce the budget deficit but also to balance the budget. In UK, fiscal policy targeted a reduction in Public Sector Borrowing Requirement to a certain figure. In Costa Rica, it is proposed to have the yearly Public Sector Deficit limit to be targeted at 1 per cent of GDP. In Indonesia, in the absence of sufficiently developed domestic financial markets or given limited access to external sources of financing, there has been prohibition on domestic borrowing since 1967. In CFC franc zone member countries, borrowing from Central Bank has been limited to 20 per cent of the last year's revenue since 1973. In Brazil, Egypt, Morocco, Philippines, Slovak Republic too, the borrowing from Central Bank is limited as fixed proportion of last year's revenue. Also, there were Medium Term Fiscal Consolidation Plans launched in the industrial countries in the 1980s; for instance, Deficit Reduction and Debt Control Act in Canada, the Goria Plan in Italy, the Medium Term Financial Strategy in the United Kingdom, and the Gramm-Rudman-Hollings Act in the United States, Trilogy in Australia (see Kopits and Symansky (1998) for detailed discussion on these Fiscal Policy Rules).

[2] *Economic Survey, 2001* stressed that the persistence of high fiscal deficits and ever increasing debt service payments constrain the ability of Government at any level to undertake the necessary expenditures for productive investment for the provision of essential services and also crowd out the more efficient private sector. Survey further pointed out that the pressure of market borrowing by the Government increases real rate of interest in the economy at the cost of all other economic factors. The *Report of Economic Advisory Council, 2001* also emphasized that high fiscal deficit crowds out private investment by raising rates of interest.

1.1 Fiscal Deficit: Relevance of the Concept in Measuring Macroeconomic Impact

Though the interaction between fiscal deficit and real economic activity is an issue, which got enormous attention in the recent years, literature on this issue did not have a definite conclusion regarding the impact of deficit on real economy. The questions that have been frequently addressed are whether deficits are (i) inflationary, (ii) expansionary, (iii), alter the composition of output away from investment and net exports, or (iv) do not have any impact on real economy (Boskin: 1988). As the importance of analysing the impact of deficit on the real economy increased, attention has also been given to develop an appropriate concept of deficit, which can capture the exact impact of fiscal policy on the macroeconomy. It is argued that unless a correct indicator of government deficit is adopted, there is a possibility of mis-calculation of pre-emption of resources by the government and thus the assessment of the fiscal policy and its impact on macroeconomy.

As for the coverage, the ideal concept of deficit to study the macroeconomic impact is the Public Sector Borrowing Requirement (PSBR). In other words, ideally, any measurement of government deficit should consider the deficit of the public sector as a whole instead of sectoral deficit of different public sector entities. But problem lies in covering the public sector as a whole for a comprehensive measurement of public sector deficit because there are more exhaustive lists of government entities and there are intra public sector transactions for which data is not readily available. Unless, intra public sector transactions are netted out, estimation of public sector deficit may suffer from the problem of double counting leading to the over estimation of deficit. Thus, any measurement of government deficit should be defined of a public sector of given coverage, the intersectoral linkage within the public sector has to be delineated and a time horizon should be specified to assess the impact of fiscal deficit (Blejer and Cheasty: 1991).

Apart from the above-discussed Public Sector Borrowing Requirement (PSBR), various concepts of deficit and their use as indicators to evaluate the budgetary performance of the government is a recent phenomenon in India. This evolution is also a result of the contemporaneous paradigm shift to a series of *purpose specific* deficit measures worldwide, from the conventional approach of *single measure* of budget deficit[3]. Traditionally (up to the

[3] Four pioneering surveys on the measurement of *purpose-specific* budgetary deficits are Blinder and Solow (1974), Heller, et al (1980), Blejer and Chu (1988) and Blejer and Cheasty (1993). [see Patnaik, et al (1999) for detailed discussion)]

late '80s), concept of *budget deficit* was in prominence in India and containing of *budget deficit* was the prime objective of fiscal management. *Budget deficit* or the overall deficit of the central government is that part of the deficit which was covered by 91 days Treasury bills and withdrawal of cash balances with RBI. As the *budget deficit* is the borrowing from the central bank, it increases reserve money into the system and could fuel inflation and destabilize the monetary system. Thus, emphasis was given to reduce the volume of *budget deficit.*[4] As RBI holds dated government securities,[5] which also increases the volume of reserve money into the system, *budget deficit* could only give a partial picture of the total increase in the reserve money. In order to capture the exact impact of deficits in the creation of reserve money, Chakraborty Committee (RBI: 1985) recommended the concept of *monetised deficit. Monetised deficit* is the increase of net RBI credit to central government.[6] Rakshit (1987) argued that in an open economy, even the monetised deficit is not a proper indicator to rely on to understand the increase in reserve money due to the budgetary operation. According to him "...If the government borrows from the reserve bank in order to repay some foreign loan, the amount of high powered money remains unaltered, the fall in foreign exchange reserves being offset by rise in government securities on the asset side of the Reserve Bank's balance sheet. Indeed, when the government takes loans from the domestic market in order to make payments abroad, the reserve money registers a decline; opposite is the effect of financing the domestic expenses of the government through borrowing from external sources. Hence, even apart from the *budget deficit*, the excess of net external borrowing by the government over its payment abroad raises the amount of reserve money into the system." Apart from this, impact of *budget deficit* also depends on the Reserve bank policy with respect to the maintaining of cash reserve ratio, ceiling on bank credit and distribution of credit.[7]

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[4]Even if the budget deficits as officially defined are controlled, but tax revenues are inadequate to finance current and capital expenditures, the deficit financed through 'open market borrowing' would have to increase. To the extent that such borrowing is not a draft on the private sector savings, it too could result in an increase in money supply, through the mechanism of a refinancing facility on government securities offered by the central bank for example. Further, to the extent that the budget deficits finance productive capacity in industry and productivity enhancing infrastructure in agriculture, and thereby relax supply constraints in the system, they should result in output increases rather than inflation."(Editorial titled "And now, the primary deficit", Economic and Political Weekly: 1996, March 16)

[5]A fraction of the new issue of government securities is taken up by the Reserve Bank of India when the demand for these securities are inadequate among public and financial institution. This also adds to the reserve money into the system.

[6]RBI's holding of *ad hocs*, dated government securities, 91 days Treasury bills and government's currency liabilities constitute the net RBI credit central government, the measure of monetised deficit in India.

[7]"...diversions of bank loans to sectors where cash transaction predominate tends to reduce the supply of money through a rise in the demand for currency. By the same logic a larger allocation of plan expenditure in favour of Rural Employment Generation or similar programmes will be attended with a smaller money multiplier for a given level of deficit financing."(Rakshit, 1987).

Traditional measure of *budget deficit* and its expanded form, the *monetised deficit*, excludes part of the resource gap of the government, which is financed through borrowing outside RBI. Thus, in recent years, emphasis has been given to contain the *fiscal deficit*, which is the net borrowing requirement of the government[8]. Conventional measurement of fiscal deficit is defined as the difference between total government receipts (non-debt creating) and the total government expenditure net of repayment of previously incurred debt. The most widely accepted definition of fiscal deficit is the following:

> "*Fiscal Deficit as conventionally defined on cash basis, measure the difference between total government cash outlays, including interest outlays but excluding amortization payments on the outstanding stock of public debt, and total cash receipts, including tax and nontax revenue and grants but excluding borrowing proceeds. In other words, not all outlays related to public debt servicing is included in the measure of deficit: interest payments are added to non-debt-related expenditures but amortization payments are excluded. On the other hand, current revenues are recorded as government income while proceeds from borrowing are not. In this manner, fiscal deficits reflect the gap to be covered by net government borrowing including direct borrowing from the central bank*".
>
> - Tanzi et al: 1988

From the methodological point of view, inclusion of net lending and debt servicing as a part of the government expenditure and foreign grants as a part of the revenue may give an incorrect picture of fiscal stance of the government. With regard to the foreign grants, it can be said that they are discretionary in nature and cannot be considered as a constant and steady source of government revenues. However, grants are included in the government revenue as a constant source of finance on the ground that the current expenditure they finance could not take place if the grants are not forth coming (Blejer and Cheasty, 1991).

The point to be noted here is that the definition of fiscal deficit considered interest payment as a part of the government expenditure but repayment of principal is not. The economic rationale behind such a classification is that unlike interest payment, repayment of outstanding debt does not represent new income to asset-holders and therefore leave demand

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[8]Along with fiscal deficit, other important deficit indicators introduced to assess the budgetary performance of the government are *primary deficit* and *revenue deficit*. In India, *primary deficit* is an indicator to assess the impact of current year's discretionary fiscal action on indebtedness of the government. *Primary Deficit = Fiscal Deficit - Interest payments*. *Revenue deficit* as a concept has received immense attention in recent years. Boskin (1988) argued that conventional deficit does not measure government dissavings. Government dissavings is reflected in the revenue deficit. *Revenue deficit* is defined as the difference between the revenue earning of the government and revenue / current expenditure government. In the context of structural adjustment programme, as a policy of demand management, reduction of both fiscal and primary deficit assumed paramount importance. Among the economists, there have been arguments for and against the adoption of these indicators to evaluate the budgetary performance of the government.

pressure unchanged and thus can be excluded from the government expenditure. However, under an unsustainable debt situation, the amortized debt may not be voluntarily reinvested in new government bonds. Under such circumstances government might have to generate larger tax revenues to finance the deficit or they can consider the amortization as a part of the government expenditure and the resulting deficit would correspond to the government's gross borrowing requirement.

Another methodological limitation of the fiscal deficit is that it is cash based one instead of accrual deficits. Cash based deficit shows the disbursement of cash for government outlays and revenue in terms of cash received within a year. The accrual deficit tries to capture the net resource requirement of the government as consequence of its policy announcement within a fiscal year irrespective of the fact that whether the transaction has actually taken place or not. For example, while estimation of accrual deficit makes provision for the depreciation of fixed capital as an outlay. In practice countries often prolong beyond 365 days the period over which transaction authorized in a given budget document may be carried out. (The extension is known as a "complementary period"). Thus in any fiscal year, transactions that change the measured deficit of the previous year can continue to take place alongside transactions determining the current year's deficit[9].

In India, gross fiscal deficit is defined as the excess of the sum total of revenue expenditure, capital outlay and net lending over revenue receipts and non-debt creating capital receipts including the proceeds from disinvestment. Thus,

Gross Fiscal Deficit = Revenue Expenditure + Capital Outlay +Net Lending - (Revenue Receipts + Non-debt creating Capital Receipts).

[9] From the macroeconomy point of view, this measurement of government deficit is argued to have limitation in measuring the excess demand generated from the budgetary operation of the government (Tanzi et al, 1988). It is pointed out that different taxes and expenditure affects demand differently and thus for a given level of deficit composition of budget is important. It is further noted that tax revenue is an endogenous variable and mobilization of taxes depend on factors affecting the shape of macroeconomy. Finally excess demand generated from the deficit not only depends on the size of the deficit but also on the manner in which it is financed.

This definition of fiscal deficit is also not free from the limitations of measurement discussed above[10].

Methodological limitations apart, it should be noted that in India, a reliable measure of total public sector deficit[11], the ideal measurement of deficit to capture the macroeconomic impacts, is not constructed due to paucity of data on intra-public sector transactions and the data at subnational (local) government. Therefore the second best alternative measure of deficit which can capture the macroeconomic impacts in India is the combined gross fiscal deficit of Centre and States, which is around 10 per cent of GDP in the year 1999-00. But as the market borrowing programmes of State Governments is under the control of Central Government, fiscal deficit at the subnational governments may not have similar impact on macro variables as that of Central governments' deficit. Thus, we adhere to fiscal deficit figure of Central Government for our study based on the availability of best possible data, partial nature of other concepts of deficit and the relevance of the measure in analysing the macroeconomic impacts of fiscal policy stance.

1.2 Alternative Paradigms on Macroeconomic Effects of Fiscal Deficit

It is important to recall in this context that diametrically opposite views exist in theoretical literature on the macroeconomic effects of fiscal deficit. Since Adam Smith's *Wealth of Nations* and David Ricardo's *Principles of Political Economy and Taxation*, the macroeconomic effects of the levels of deficit and it's alternative modes of financing public expenditure on the economic activity has been a matter of debate. The issue of macroeconomic impacts of tax financing versus bond financing of deficit equally has been re-debated since Barro (1974) published his seminal article titled *'Are Bonds Net Wealth?'*. There exist three alternative paradigms, which analyses the macroeconomic effects of fiscal deficits: Neoclassical, Keynesian and Ricardian. The Neoclassical paradigm envisions the economic agents as far-sighted and rational who make intertemporal decisions with respect to

[10] According to Gulati (1994), one has to be very careful, in including the items like 'disinvestment proceeds' as a component of non-debt creating capital receipts and transfer payment and receipts by the government. He argued that in a situation when the government is selling of equity in public sector undertakings and not making any fresh investment in such undertakings, the amount thus realised would legitimately be considered in the nature of government receipts that should be taken to raise not reduce fiscal deficit because such receipts itself takes on the nature of borrowing, in the sense that amount thus received, like other amounts the government borrows, goes towards the financing of current government expenditure (for detailed discussion, see Gulati (1994, 1991), Khudrakpam (1996)).

[11] Public Sector Deficit comprises of the deficits of the Central Government, State Governments, Local Governments and Public Sector Enterprises. It is to be noted that local governments generally do not have budget deficit as they do not have exclusive borrowing powers.

consumption and income within a finite horizon (their own life cycle), thus fiscal deficits raise total lifetime consumption by shifting taxes to subsequent generations. A second major assumption of Neoclassicals is that markets are clearing, such that economic resources are typically fully employed. That is, if the economy operates at the full employment level, increased consumption necessarily implies decreased savings and interest rates must then rise to bring capital markets into balance. Thus, persistent fiscal deficits *crowd out* private capital accumulation (Berheim, 1989, Diamond, 1965).

Diamond (1965) first applied *Overlapping Generations Model* to analyse the macroeconomic impacts of public debt. His study noted that in a situation of long run equilibrium path, setting budget deficits shift taxes to future generations. Given the time path of the government expenditure, households will experience a positive net wealth effect that stimulates consumption and private savings. However, as private savings do not rise enough to offset the decline in government savings, national savings decline. In a closed economy context, the study noted that real interest rate would go up and act as detriment of investment. And in a small open economy, capital inflow will be induced and hence, through an appreciation of the exchange rate, a deterioration of the current account deficit, be it through the retardation of domestic capital accumulation or through growing foreign indebtedness, future living standards will be affected adversely. However, Diamond's model did not permit private domestic agent's access to international capital markets, which makes his model more suitable to less developing countries, where government is sole agent with international creditworthiness than the applicability to developed market economies integrated to an international financial system (Buiter, 1990).

The Keynesian paradigm differs from the Neoclassical paradigm in two fundamental ways. First, it envisions that a significant proportion of economic agents is either myopic and/or liquidity-constrained and second, these agents have very high propensity to consume out of their current disposable income. This assumption guarantees that aggregate demand is responsive to changes in disposable income. The assumption allows for the possibility that economic resources are underemployed at the moment of deficit financing. A deficit financed tax cut will then unreservedly increase consumption and through the multiplier process, national income. As the economy is moving to a higher growth path, investment is activated too. Keynesian paradigm thus believes that appropriately timed deficits have beneficial consequences through stimulating both consumption and national income, savings and capital formation. (Eisner, 1984, Berheim, 1989). As to the future burden of the debt, Eisner (1984)

even goes so far as to state: "Extra taxes in the future, if there are to be any, may then readily be paid out of higher future income". Blanchard (1985) here cautioned that deficits, instead of being suddenly enlarged, increase slowly over time. The initial current fiscal stimulus is small, then, but it is anticipated to be larger and thus to lead to high short-term real rate of interest later. As a result, the long-term rate of interest increases, leading to a decrease in aggregate demand, which could more than offset the fiscal expansion, at least initially. Under these circumstances, fiscal expansion temporarily could have perverse effects on output.

Apart from the two diametrically opposite views on the impact of levels and financing modes of deficit on the macroeconomy held by Neo-classicals and Keynesians, Ricardian paradigm envisions that rational economic agents can see through the intertemporal veil and realize that deficits merely postpone taxes to future generations. Berheim (1989) pointed out that this foresight gives rise to a "Say's law" for deficits: the demands for bonds always rise to match government borrowing. This also implies that economic agents have infinite life span and successive generations are linked through voluntary, altruistically motivated resource transfers. Under these assumptions, consumption is determined as a function of *dynastic resources* (that is, the total resources of a taxpayer and his descendants) and since deficits merely shift the payment of taxes to future generations, they leave *dynastic resources* unaffected.

Barro (1974) resuscitated Ricardian proposition that an increase in the bond-financed deficit can have no effect on aggregate demand because it will be offset by an equivalent increase in the savings of private sector in anticipation of increased future taxes to be levied by government to repay the borrowing. Thus, Ricardian Equivalence Theorem states that it is irrelevant whether a given budget deficit is financed by tax increase or by debt issue (Barro: 1974). In other words, the Ricardian Equivalence Theorem (RET) amounts to the statement that government's fiscal impact is summarised by the path of its expenditure. Given its path, rearrangements of the timings of taxes- as implied by budget deficits- have no first order impact on the economy. In this respect, the role of RET in public finance is analogous to that of the Modigliani- Miller (1958) theorem in corporate finance (Barro, et al: 1998).

The important restatement of RET theorem under the rubrics of debt neutrality and ultrarationality explained that the effect of public spending is fully measured by the size and content of real public spending, regardless of how this spending is financed (Buiter, 1990). This issue of differential incidence of tax financing and bond financing on macroeconomy has

also resurfaced in Vickrey's writings as *public debt illusion*[12]. The neoclassical paradigm is viewed as the finite version of Ricardian Equivalence model. Keynesian paradigm pays little attention to the intertemporal nature of the decision making by economic agents, which is a point of departure from the other two paradigms. Keynesians were concerned about the 'transitory' budget deficit while other two, the permanent budget deficit (Berheim, 1989)[13]. Although, the theoretical explanation of the link between fiscal deficit and macroeconomic activity differs across paradigms, it is noted across paradigms that the macroeconomic effects of fiscal deficit depends not only on the *levels* of deficit and also on the financing pattern of deficit, which forms the theoretical framework of our study.

1.3 Theoretical Framework of the Study

The macroeconomic impact of fiscal deficit broadly depends on how it is financed. Government can finance deficits by seigniorage and through the creation of debt, both internal and external. Excessive use of any financing mode of fiscal deficit results in the macroeconomic imbalances, viz., seigniorage financing leads to inflationary pressures in the economy; domestic debt financing leads to a credit squeeze through higher interest rates or when interest rates are fixed, through credit allocation and ever more stringent financial repression- and the crowding out of private investment and consumption. Excessive financing of deficit through external debt may lead to current account deficit and appreciation of the real exchange rate leading to a balance of payment crisis (if foreign reserves are run down) or an external debt crisis (if debt is too high) (Easterly and Klaus Schmidt, Hebbel, 1993).

The fiscal deficit financing identity is the analytical starting point for evaluating the macroeconomic effects of fiscal deficit[14]. This is an essential tool in understanding both the linkage between monetary and fiscal policies and the macroeconomic consequences of fiscal deficits. The fiscal deficit can be defined and linked with changes in government net debt as follows:

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[12] Vickrey, 1961.

[13] Transitory Deficit emanates from the cyclical factors, which is linked to the economic activity, which has got only temporary effects on budget balance. While Permanent Deficit emanates from the structural factors, which are permanent in nature. The major structural factors could be compositional shift in the public expenditure, growing revenue deficits, interest payments or the rise in the cost of borrowing in relation to the real rate of growth of the economy.

[14] The intertemporal government budget constraint is one way of showing the linkage between fiscal deficits and alternative sources of deficit financing.

$$\Delta D_g = [C_g + I_g - T] + r.D_{g-1} \quad (1.1)$$

where $\Delta D_g = [D_g - D_{g-1}]$

which is the change in the government debt between current and previous period.

C_g = Government Consumption Spending

I_g = Government Investment Spending

T = Tax revenue and other non-debt creating receipts

r = Nominal Rate of Interest

The RHS of the equation (1.1) measures the fiscal deficit. To finance the existing fiscal deficit, Government can resort to seigniorage financing or bond financing. To start with, let us suppose government resorts to seigniorage to finance the fiscal deficit. The immediate result of this move is captured in the change in the money supply. Effect of deficit on the money supply can be captured from equation (1.2) for the changes in the monetary base [M_b]:

$$\Delta M_b = [\Delta D_{gc}] + e.\Delta FOREX \quad (1.2)$$

where $\Delta M_b = M_b - M_{b-1}$

ΔD_{gc} = change in the debt held by Central Bank

ΔFOREX= Forex – Forex $_{-1}$[change in foreign exchange reserves]

e = nominal exchange rate measured in terms of domestic currency per unit of foreign currency;

A change in debt held by the central bank (ΔD_{gc}) equals the overall change in debt (ΔD_g) minus the change in the debt held by the public (ΔD_{gp}), which is expressed in equation (1.3).

$$\Delta D_{gc} = \Delta D_g - \Delta D_{gp} \quad (1.3)$$

ΔD_g = overall change in debt

ΔD_{gp} = change in the debt held by the public

Substituting the expression for ΔD_{gc}, equation (1.2) can be rewritten as:

$$\Delta M_b = [\Delta D_g - \Delta D_{gp}] + e.\Delta FOREX \quad (1.4)$$

Rearranging the equation (1.4) the resulting expression yields:

$$\Delta D_g = \Delta M_b + \Delta D_{gp} - e.\Delta FOREX \quad (1.5)$$

The equation (1.5) is the fundamental equation, which captures the changing financing modes of fiscal deficit and its consequent impact on macroeconomy. This shows that there are three ways to finance the deficit, which is equal to the change in the government's debt (ΔD_g): (i). by an increase in the monetary base, ΔM_b ; (ii) by an increase in bond financing; ΔD_{gp} or (iii) by a loss of foreign reserves at the central bank, e. Δ FOREX. In short, to finance the fiscal deficit the government will have to print money, borrow from the public, or run down foreign exchange reserves. As mentioned above, each of these sources of deficit financing can cause a particular kind of macroeconomic problem.

1.4 Objectives of the Study

Based on the various theoretical paradigms and theoretical framework discussed in this chapter to trace out the macroeconomic effects of fiscal deficit, the objectives of the study can be put in the following lines.

1) *Analyse whether the increase in fiscal deficit leads to 'direct' crowding out of private investment;*

2) *Analyse whether high fiscal deficit leads to 'financial' crowding out via the transmission mechanism of rise in real rate of interest in the economy.*

3) *Examine whether in the financially deregulated regime, shift in the financing pattern of fiscal deficit towards bond financing is creating an upward pressure on the rate of interest in India.*

4) *Analyse whether fiscal deficit results in creation of seigniorage in the economy.*

5) *Analyse whether fiscal deficit can always have a tryst with inflationary pressures in the economy; directly or via the conduct of monetary policy.*

1.5 Data and Methodology

Relevant data for the study is drawn from Reserve Bank of India Handbook of Statistics, 2000 and 2001, National Account Statistics (NAS) Back series 1970-2000 and NAS 2001 and 2002 of Central Statistical Organisation and various issues of Economic Survey of India. We have two data sets: (i) data on yearly basis for a period between 1970-71 and 1999-2000 and (ii) high frequency data for a period from April 1994 to September 2001. The former sets the picture of macroeconomic effects of fiscal deficit over last three decades while the latter delves deep into the impact of fiscal deficit in the financially deregulated regime.

The methodology used in the study is Hsiao's asymmetric vector autoregressive framework. We have used VAR methodology because it avoids the imposition of potentially spurious a priori constraints. Furthermore, as noted by Fisher (1981), Genberg, Salemi and Swaboda (1987) and McMillin and Koray (1989), VARs are well suited to examine the channels through which a variable operates since few restrictions are imposed on the way the system's variables interact. Since the objective of the study is to examine the macroeconomic channels through which fiscal deficit operates in India, VAR model is considered for the purpose of econometric estimation.

In particular, the Hsiao's asymmetric vector autoregressive model we have used in the study has got an advantage of judicious parameterization using Akaike's Final Prediction Error (FPE), in addition to causality detection and solving simultaneity bias. That is, the asymmetric VAR methodology doesnot permit every variable enters every equation with equal lag length as in the case of symmetric VAR models. The practical disadvantage of symmetric models with large number of parameters to be estimated is that it quickly eats up the degrees of freedom in the estimation procedure. And often a substantial number of parameters hardly differ from zero. Moreover, Ahking and Miller (1985) has shown that imposing equal lag lengths to all variables doesnot have any basis in theory and can distort the estimates and lead to misleading inferences concerning causality, if lag structure differ across variables (Sturm: 1998). To overcome this problem, Hsiao (1981) suggests an asymmetric vector autoregressive approach that starts from univariate autoregression and sequentially adds lags and variables using Akaike's Final Prediction Error (FPE) criterion, which is often referred as VAR-FPE model. The order in which variables enter the equation in the VAR-FPE model is guided by *specific gravity criterion* of Caines, Keng and Sethi (1981). The order of integration and cointegration of variables are detected wherever required to overcome the methodological pitfalls of *spurious* relationship between the variables.

1.6 Chapter Scheme

Apart from the introduction, Chapter 2 analyses the trends in fiscal deficit and related macroeconomic variables. Chapters 3 and 4 analyse the impact of fiscal deficit on private capital formation directly and also through the transmission mechanism of rate of interest. Chapter 4 also includes an analysis of fiscal deficit on real rate of interest in the deregulated financial regime. Chapter 5 analyses whether fiscal deficit creates seigniorage and Chapter 6 analyses whether fiscal deficit is associated with the inflationary pressures in the economy.

Chapter 6 also includes an analysis of link between fiscal deficit and changes in reserve money and in turn fiscal deficit and inflation in the context of financially deregulated regime. Chapter 7 summarizes the findings of the study and draws conclusions.

Chapter 2

Fiscal Deficit and Macroeconomic Activity: Intertemporal Variations

In the last chapter we have discussed the importance of the concept of fiscal deficit in reflecting the resource gap of the government, and also developed a theoretical framework to analyze the macroeconomic impact of fiscal deficit. The impact of fiscal deficit on selected macroeconomic variables is investigated using econometric tools in the subsequent chapters. In the present chapter, we examine the trends in fiscal deficit vis-à-vis selected macroeconomic variables. Though the simple trend analysis will not provide a definite answer to the exact nature of relationship between fiscal deficit and macroeconomic variables, such analysis would provide indications regarding their movement of macro variables in relation to fiscal deficit. This chapter is divided into five sections. In section 2.1, we analyse the trends in fiscal deficits of the central government and examine the financing pattern of deficit. Section 2.2 examines the trends in private capital formation, while section 2.3 and section 2.4 look into the link between rate of interest and money supply vis-à-vis fiscal deficit. Section 2.5 summarizes the findings of the chapter.

2.1 Trends in Deficits of the Central Government of India

It has been mentioned in the last chapter that in recent years, the focus of policy makers have been given to control the levels of fiscal deficits, revenue deficits and primary deficits instead of conventional budget deficits. As mentioned, the gross fiscal deficit, which is the net borrowing requirement of the government, as percentage of GDP increased from 3.08 per cent of GDP in 1970-71 to the peak of 8.47 per cent in 1986-87 and then declined to 5.35 per cent in 1999-2000 (Table 2.1). It remained around 7 per cent of GDP during 1987-88 to 1990-91. However from 1990-91 onwards, government has been able to contain the growth of fiscal deficit, reflected in its decline to 5.35 per cent of GDP in the year 1999-2000. At the same time, primary deficit, which is fiscal deficit excluding interest payments, has increased from 1.76 per cent in 1970-71 to a peak of 5.49 per cent in 1986-87 and then onwards declined to 0.74 per cent of GDP in 1999-2000. Primary deficit has remained much lower in the 1990s, compared to earlier decades, which reflects the rising interest burden of the Central Government and also a decline in fiscal deficit.

Budget deficit, which is the conventional budgetary deficit of the Central Government, reflects deficit financing through the issue of ad hoc Treasury Bills by Reserve Bank of India. A

high ratio of budget deficit may have implications in the conduct of monetary policy, as deficit would induce money supply and thereby may hamper the monetary policy objective of price stability. As noted from Table 2.1, budget deficit has shown wide fluctuations. During the mid eighties, budget deficit sharply rose and reached a peak of 2.65 per cent in 1986-87. During the nineties, budget deficit sharply declined and following the decision to phase out 91-day ad hoc Treasury Bills with effect from April 1st, 1997, the conventional budget deficit is eliminated. The figures noted since 1996-97 in Table 2.1 is the Ways and Means Advances resorted by Central Government to correct the temporary mismatch of the government exchequer.

Apart from the conventional budget deficit, the monetary implication of the Central Government's budgetary operations is reflected in the level of the monetised deficit[1]. Monetised deficit, which is the net RBI credit to central government, has been brought down in recent years through active open market operations (OMO). Monetised deficit was 0.49 per cent of GDP in 1970-71. It increased to a peak of 2.84 per cent in 1989-90 and then declined to 0. 67 per cent of GDP in 1998-99. The decline in monetised deficit during the 1990s was due to the flexible use of interest rate through OMO. The use of OMO to signal the RBI's stance regarding monetary conditions and management of liquidity has emerged as an important feature of monetary management during the late nineties (RBI, 1999).

Central Government incurred revenue deficit (difference between revenue expenditure and revenue receipts)[2] in 1971-72 and 1972-73 and has been continuously under revenue deficit since 1979-80. The ratio of revenue deficit as per cent of GDP since 1979-80 continued to increase to 3.26 per cent in 1990-91. Unlike other measures of deficit, no secular tendency to decline has been noted in revenue deficit in the nineties. In 1993-94 and 1998-99, the ratio of revenue deficit to GDP was all time high at 3.81 per cent of GDP. As can be seen from Figure 2.1, the share of revenue deficit in total fiscal deficit has increased steadily, reaching a peak of 69.10 per cent in 1999-2000. As revenue expenditure by nature is current consumption expenditure, and does not create tangible assets capable of generating financial returns, diversion of borrowed resources to finance the revenue deficit implies reduced availability of resources for capital expenditure meant for productive capital investment.

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[1] Budget deficit and monetised deficit are correlated, with correlation coefficient at 0.423.However, as we have noted monetised deficit is a larger concept than monetised deficit.

[2] Revenue expenditure is for consumption activities of government, which does not result in the creation of productive assets while revenue receipts mainly include tax revenues and interest and dividends on investments made by the government.

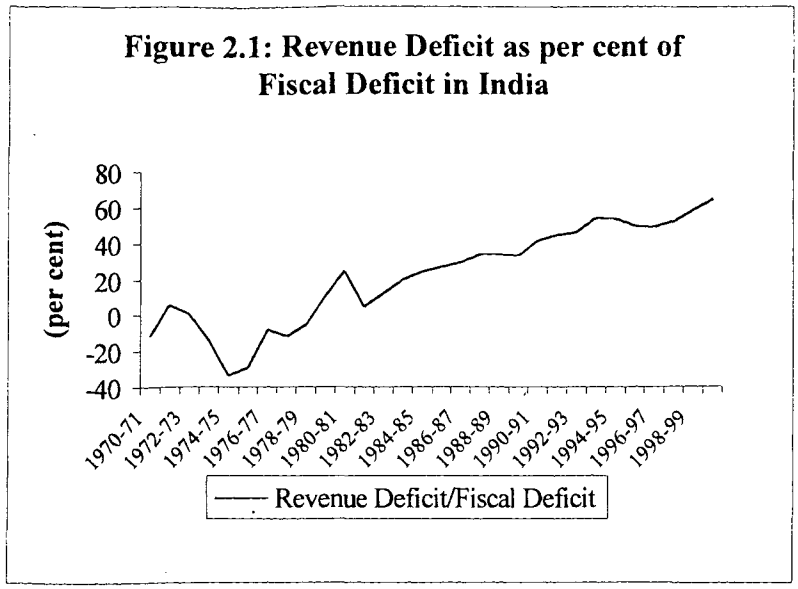

Table 2.1:Trends in different concept of deficits in India: as percent of GDP

Year	*Gross fiscal deficit*	*Primary deficit*	*Revenue Deficit*	*Monetised Deficit*	*Budget Deficit*
1970-71	3.08	1.76	-0.36	0.49	0.62
1971-72	3.53	2.16	0.20	1.19	1.06
1972-73	4.04	2.60	0.03	2.24	1.61
1973-74	2.64	1.30	-0.36	0.96	0.50
1974-75	2.97	1.68	-0.99	0.68	0.93
1975-76	3.64	2.16	-1.06	-0.35	0.44
1976-77	4.24	2.58	-0.33	0.91	0.15
1977-78	3.62	2.00	-0.42	-0.26	0.92
1978-79	5.18	3.38	-0.27	1.99	1.37
1979-80	5.29	3.39	0.57	2.19	2.01
1980-81	5.77	3.96	1.42	2.47	1.72
1981-82	5.14	3.24	0.23	1.90	0.83
1982-83	5.64	3.55	0.69	1.79	0.88
1983-84	5.94	3.75	1.16	1.80	0.65
1984-85	7.09	4.66	1.72	2.47	1.53
1985-86	7.86	5.16	2.12	2.23	1.91
1986-87	8.47	5.49	2.50	2.28	2.65
1987-88	7.63	4.46	2.58	1.85	1.64
1988-89	7.34	3.95	2.49	1.54	1.34
1989-90	7.33	3.68	2.45	2.84	2.18
1990-91	7.85	4.07	3.26	2.59	2.00
1991-92	5.56	1.49	2.49	0.84	1.05
1992-93	5.37	1.22	2.48	0.57	1.65
1993-94	7.01	2.74	3.81	0.03	1.28
1994-95	5.70	1.35	3.06	0.21	0.09
1995-96	5.07	0.86	2.50	1.67	0.83
1996-97	4.88	0.53	2.39	0.14	0.96
1997-98	5.84	1.53	3.05	0.85	-0.06
1998-99	6.45	2.02	3.81	0.67	-0.01
1999-2000	5.35	0.74	3.45	-0.29	0.04

Source: Handbook of Statistics on Indian Economy, RBI, 2001

purposes. In other words, increasing share of revenue deficit in total fiscal deficit implies crowding out the capital outlay by the government, which was intended to spend on the investment purposes.

Table 2.2: Fiscal Deficit and its Decomposition (in per cent)

Year	*Revenue Deficit*	*Capital Outlay*	*Net Lending*	*Disinvestment Proceeds*	*Gross Fiscal Deficit (Rs crores.)*
	(a)	(b)	(c)	(d)	(a)+(b)+(c) -(d)
1970-71	-11.58	66.90	44.67	0	1408
1971-72	5.79	64.68	29.53	0	1727
1972-73	0.69	44.75	54.57	0	2179
1973-74	-13.68	58.22	58.57	0	1733
1974-75	-33.23	70.81	62.42	0	2302
1975-76	-29.25	74.28	55.00	0	3029
1976-77	-7.84	49.18	58.65	0	3802
1977-78	-11.68	60.95	50.73	0	3680
1978-79	-5.11	42.35	62.77	0	5710
1979-80	10.86	38.16	50.99	0	6392
1980-81	24.55	37.03	38.43	0	8299
1981-82	4.52	48.45	47.02	0	8666
1982-83	12.31	43.90	43.79	0	10627
1983-84	19.49	40.14	40.37	0	13030
1984-85	24.26	38.74	37.00	0	17416
1985-86	26.94	35.02	38.04	0	21858
1986-87	29.52	35.15	35.33	0	26342
1987-88	33.79	34.37	31.85	0	27044
1988-89	34.00	33.16	32.83	0	30923
1989-90	33.44	33.14	33.43	0	35632
1990-91	41.59	27.18	31.23	0	44632
1991-92	44.77	31.38	32.22	8.36	36324
1992-93	46.24	33.90	24.75	4.88	40173
1993-94	54.29	21.96	23.67	-0.08	60257
1994-95	53.77	25.81	30.14	8.80	57703
1995-96	49.35	23.40	29.57	0.60	60243
1996-97	48.93	21.27	30.48	0.57	66733
1997-98	52.23	19.71	29.09	1.03	88937
1998-99	59.09	15.46	29.47	5.18	113349
1999-2000	64.55	17.99	14.14	1.65	104717
2000-01	69.10	21.47	9.44	2.23	111972

Source: Handbook of Statistics on Indian Economy, RBI, 2001

Due to the increase in the share of revenue deficit in total fiscal deficit, the share of capital outlay declined from 66.90 per cent in 1970-71 to 17.99 percent in 1999-2000[3] (Table 2.2). This decline in capital outlay has adverse consequences on the productive capital formation of the country. The share of net lending also declined during the 1980s and 1990s.

[3] Capital Outlay consists of capital expenditure on acquisition of assets and loans and advances to state Governments, while capital receipts consist of debt-creating components and non-debt creating components. Non-debt creating components are recovery of loans disbursed in the past and disinvestment proceeds. The debt-creating components include the market borrowings and external borrowings, which are not included in the computation of fiscal deficit.

The share of net lending in total fiscal deficit increased from 44.67 per cent in 1970-71 to 62.77 per cent in 1978-79, except for the year 1972-73 when the share declined to as low as 19.53 per cent (Table 2.2). Between 1981-82 and 1999-2000, the share of net lending in total fiscal deficit declined from 47.02 to 9.44 percent. Disinvestment proceeds appear in Indian fiscal scenario only in the nineties. However, as can be seen from Table 2.2, disinvestment proceeds has been erratic and negligible during most of these years.

The financing pattern of fiscal deficit is shown in Table 2.3. The fiscal deficit is financed through issuance of bonds, seigniorage financing, financing through adhoc Treasury Bills, external financing and financing through other internal liabilities[4]. It is evident from the table that over the years, Government resorted more to internal financing than to external financing. The share of external financing, which was 23.56 per cent in 1970-71, declined to 0.83 per cent in 1999-2000. The share of external financing was highest in 1975-76 at 35.39 per cent. It was around 10 per cent of the gross fiscal deficit for most of the years in the eighties. The share of external financing of fiscal deficit sharply rose to 14.92 per cent and 13.24 per cent in the years 1991-92 and 1992-93. Since then, it exhibited considerable decline (to around 1 per cent of gross fiscal deficit) in the late nineties.

Market borrowing has emerged as the most important source of financing of fiscal deficit during the 1990s. From around 10 per cent in 1970-71, it tended to reach a peak of 35.49 per cent in 1982-83. Thereafter a phase of declining trend set in and reaches a low of 17.93 per cent in 1990-91. Thereafter its share sharply rose to 70.77 per cent in 1999-2000. The rationale behind the market borrowing by the Central Government was to create and widen the investor's base for government securities outside the captive market by attractive rates of interest and thereby to reduce government's dependence on monetisation of deficit. The deregulation of interest rate made market borrowing more expensive because of the sharp rise in the interest rates on government securities. When government's ability to monetise the fiscal deficit became limited, especially after doing away with automatic monetisation of deficit through adhoc Treasury bill in April 1st, 1997, government has been compelled to resort to high cost market borrowing to finance the fiscal deficit. The share of other liabilities, which hovered around 30-40 per cent of gross fiscal deficit for most of the years, declined to 25.21 per cent in 1999-2000.

[4] Other internal liabilities include small savings, public provident fund, other accounts (relating to insurance and pension funds and special deposits and accounts), reserve funds and deposits, special floating and other loans and special securities issued to the Reserve Bank of India (RBI).

Table 2.3: Financing pattern of Fiscal Deficit (as per cent of Fiscal Deficit)

Fiscal year	Internal Finance					External Finance	Fiscal Deficit Rs. crores
	Market Borrowing	*Other Liabilities*	*Conventional Deficit (91-day TB)*	*Monetised Deficit*	*Total*		
(1)	(2)	(3)	(4)	(5)	(6) [= (1) + (2) + (3) + (4)]	(7)	(8) [= (6)+(7)]
1970-71	10.22	45.92	20.30	15.83	76.44	23.56	1409
1971-72	17.26	32.54	30.11	33.70	79.91	20.09	1727
1972-73	27.69	6.20	49.46	68.90	83.34	16.66	1759
1973-74	27.24	128.85	18.93	36.41	175.01	-75.01	1733
1974-75	20.89	23.93	31.26	22.93	76.07	23.93	2303
1975-76	15.05	37.47	12.08	-9.54	64.61	35.39	3029
1976-77	22.23	47.88	3.42	21.47	73.53	26.47	3801
1977-78	32.19	32.27	25.37	-7.06	89.84	10.16	3681
1978-79	28.95	37.95	26.37	38.35	93.27	6.73	5710
1979-80	31.30	21.50	38.06	41.46	90.86	9.14	6392
1980-81	32.28	22.44	29.85	42.79	84.56	15.44	8299
1981-82	33.61	39.11	16.16	37.02	88.88	11.12	8666
1982-83	35.49	37.09	15.58	31.68	88.16	11.84	10627
1983-84	30.99	47.87	10.87	30.31	89.73	10.27	13030
1984-85	23.51	46.65	21.50	34.77	91.66	8.34	17416
1985-86	22.35	46.71	24.32	28.32	93.37	6.63	21857
1986-87	21.00	39.96	31.36	26.92	92.32	7.68	26342
1987-88	21.68	46.12	21.51	24.25	89.30	10.70	27044
1988-89	27.22	46.58	18.25	21.03	92.04	7.96	30923
1989-90	20.78	42.21	29.73	38.77	92.72	7.28	35632
1990-91	17.93	49.52	25.42	33.04	92.87	7.13	44632
1991-92	20.67	45.53	18.87	15.16	85.08	14.92	36325
1992-93	9.15	46.96	30.65	10.60	86.76	13.24	40173
1993-94	47.36	26.03	18.19	0.43	91.58	8.42	60257
1994-95	34.84	54.58	1.67	3.69	91.08	8.92	57704
1995-96	54.92	28.27	16.28	32.96	99.47	0.53	60243
1996-97	29.99	45.78	19.76	2.90	95.52	4.48	66733
1997-98	36.54	63.25	-1.02	14.52	98.77	1.23	88937
1998-99	60.86	37.63	-0.18	10.40	98.31	1.69	113349
1999-2000	70.77	25.21	3.19	-5.30	99.17	0.83	108898

Source: Handbook of Statistics on Indian Economy, RBI, 2000 and 2001

Monetisation of fiscal deficit, which was as around 36 per cent in the first half of eighties, was gradually brought down to around 15 per cent except in 1995-96, when it increased to 32.96 per cent (Table 2.3). This decline in monetised deficit during the nineties was due to the deliberate attempt of the government to recourse to bond financing of fiscal deficit. Increasing recourse to bond financing is reflected in the increase in the share of market borrowing during the 1990s. The recourse to bond financing of fiscal deficit during the 1990s may have exerted upward pressure on rates of interest, which in turn may have crowded out interest sensitive component of private spending, viz., private investment. As mentioned in chapter 1, each specific mode of financing of the fiscal deficit may impart a macroeconomic effect.

Table 2.4: Structural and Cyclical Fiscal Deficit: as per cent of GDP

Year	*Structural Deficit*	*Cyclical Deficit*	*Actual Deficit*
1970-71	2.38	0.88	3.26
1971-72	3.21	0.52	3.73
1972-73	3.97	0.31	4.28
1973-74	2.17	0.62	2.79
1974-75	2.37	0.78	3.15
1975-76	3.41	0.43	3.84
1976-77	4.40	0.08	4.48
1977-78	3.83	0.00	3.83
1978-79	5.82	-0.34	5.48
1979-80	6.21	-0.62	5.59
1980-81	5.83	-0.05	5.78
1981-82	5.08	0.06	5.14
1982-83	5.64	0.01	5.65
1983-84	5.85	0.09	5.94
1984-85	7.07	0.02	7.09
1985-86	7.88	-0.02	7.86
1986-87	8.61	-0.15	8.46
1987-88	7.79	-0.15	7.64
1988-89	7.35	-0.01	7.34
1989-90	7.34	-0.01	7.33
1990-91	7.8	0.04	7.84
1991-92	5.55	0.01	5.56
1992-93	5.37	0.00	5.37
1993-94	7.03	-0.02	7.01
1994-95	5.68	0.02	5.70
1995-96	5.05	0.02	5.07
1996-97	4.87	0.01	4.88
1997-98	5.83	0.01	5.84
1998-99	6.42	0.02	6.44
1999-2000	5.36	-0.01	5.35

Note: The figures pertaining to 1970-71 to 1979-80 relates to old GDP series.
Source: RBI (1999) and RBI (2002)

While looking at the link between fiscal deficit and macroeconomic activity, it is imperative to analyse the nature of fiscal deficit. Fiscal deficit can be both structural and cyclical in nature[5]. In the context of India, estimates have shown that structural deficit is

[5] Cyclical deficit is linked to the changes in economic activity, which has got transitory effect on the budget balance; while structural deficit is linked to the structural changes in the economy due to discrete monetary and fiscal policies. For detailed discussion on structural and cyclical deficit, see Tanzi (1988), IMF (2001), Noord (2000), Giorno, et al (1995), Patnaik, et al (1999).

predominant; and the cyclical component of fiscal deficit though present, is not significant[6]. The RBI estimates of structural and cyclical fiscal deficit given in Table 2.4 confirms the predominance of structural fiscal deficit in India.

It can be seen that over the period 1980-81 to 1999-2000, the cyclical fiscal deficit has ranged between a deficit of 0.01 per cent of GDP and a surplus of 0.15 per cent of GDP as against the actual deficit of the Central Government, which ranged around 6-8 per cent of GDP. Given the small size of the automatic stabilizer, counter-cyclical measures would have to depend upon discretionary fiscal actions[7] (RBI, 2002). After analysing the trends, composition and magnitude of fiscal deficit in relation to GDP, now we turn to examine the trends in fiscal deficit vis-a-vis selected macro variables discussed in the first chapter, viz., public and private capital formation, rates of interest, seigniorage, money supply and rate of inflation. It is mentioned that high fiscal deficit pushes up rate of interest, crowd out private capital formation, creates seigniorage and in turn generate inflationary pressures in the economy. The following sections delve deep into the intertemporal trends in each of these macrovariables vis a vis fiscal deficit.

2.2. Fiscal Deficit and Private Capital Formation

Fiscal deficit arises due to the higher growth of expenditure in relation to the growth of non-debt creating receipts of the government. This growth in expenditure surpassing growth in revenue receipts can happen either due to higher growth of revenue expenditure or due to the higher growth of capital expenditure or a combination of both. It can be seen from

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[6] This result is obtained by RBI, adopting OECD methodology for decomposing fiscal deficit into structural and cyclical components. The OECD methodology distinguishes between discretionary budget changes and built-in-stabilizer as a prelude to define the structural budget balance. The first step to calculate the cyclical and structural fiscal deficit is to estimate the structural revenues and structural expenditures; that is, revenues and expenditures that would have prevailed, had the actual output been at its potential level. The cyclical and structural fiscal deficit is derived as follows:

Cyclical Deficit = [Built-in-Budget Balance] * [Actual Output – Trend Output]

$= [(g_0.E_gY) - (r_0.E_r.Y)] * [(Y_t - Y_t^*)]$

Structural Deficit = [Base Year Budget balance] + [Balance arising out of discretionary policy induced revenue and expenditure] + [Fiscal Drag].

$= [G_0 - R_0] + [Gdt - Rdt] + \{[(g_0.E_gY) - (r_0.E_r Y)] * [Y_0 (e^n - 1)]\}$

where $g_0 = G_0/Y$ = base year expenditure/actual output; $E_g Y$ = expenditure elasticity; $r_0 = R_0/Y$ = base year receipts/actual output; $E_r.Y$ = revenue elasticity; Y_t = Actual Output; Y_t^* = Trend Output; $Gdt = G_t - G_{at}$ = actual expenditure – expenditure responsive to change in output; $Rdt = R_t - R_{at}$ = actual receipts– receipts responsive to change in output; base year Y_0 = real potential GDP – real actual GDP; e^n = exponential rate of growth of trend output.

[7] The major discretionary fiscal policy actions could be the expenditure and tax reforms and policies relating to rising cost of borrowing, which can result in the compositional shift of expenditure pattern from developmental to non-developmental (and vice versa), shift in expenditure towards current revenue expenditure (or vice versa), growing revenue deficit and rising rate of interest in relation to the rate of growth of economy.

Table 2.5 that decadal rate of growth of capital expenditure of the Central government was always lower than that of revenue expenditure. However, the difference between the growth of revenue and capital expenditure was highest during the decade of 1990s. Also, the growth of capital expenditure was lowest during the 1990s at 7.98 per cent. In India, between 1970-71 and 1999-2000, the trend growth rate of capital expenditure has been only 11.75 per cent as compared to the trend rate of growth of revenue expenditure at 16.41 per cent. The decline in the growth of capital expenditure during the 1990s was due to the cut in capital expenditure to control the fiscal deficit. It can be seen from Table 2.6 that capital expenditure to GDP ratio, which increased from 5.46 per cent of GDP in 1970-71 to 7.09 percent in 1986-87 declined to 2.66 per cent in 1999-2000.

Table 2.5: Growth Rates of Revenue Receipts and Expenditure

Year	*Revenue Expenditure*	*Capital Expenditure*	*Total Expenditure*	*Revenue Receipts*
1970-80	15.90	13.34	14.86	14.41
1981-90	19.10	13.46	17.14	16.31
1991-00	14.76	7.98	13.23	14.83
1970-99	16.41	11.75	14.91	14.96

Source: calculated from Handbook of Statistics on Indian Economy, RBI, 2001

On the contrary, revenue expenditure to GDP ratio showed an increasing trend during this period. This decline in capital expenditure has adversely affected the public capital formation in India[8]. A steady decline in the public investment GDP ratio is visible from Table 2.8.

If we look at the movement of gross capital formation to GDP ratio, it can be seen that gross investment/GDP ratio increased steadily from 16.74 per cent in 1970-71 to a peak of around 25 per cent in the late eighties (Table 2.7). During the early 1990s also, gross investment-GDP ratio exceeded more than 25 per cent in the year 1990-91, 1992-93 and

[8] In the context of India, for the estimation of capital formation, the economy is divided into three broad institutional sectors, viz., public sector, private corporate sector and household sector. The household sector is conceived as the 'residual' sector embracing all economic entities other than the units of public and private corporate sector. In other words, the capital formation in household sector is derived by deducting the share of capital formation in organised public sector and private corporate sector from the global estimates of capital formation. The sources of data used in the estimation of household share are varied and divergent, and as a result, the estimates contain indeterminate sources of errors. In the light of these data problems, it should be noted that the dissaggregation of private investment data is not entirely reliable for the same reason that investment in household sector is derived as a residual, so any estimation errors, both upward and downward bias in estimation of private corporate sector, gets correspondingly reflected in the estimation of investment by the household sector.

1995-96. However, a decline in gross capital formation-GDP ratio is noted in late 1990s (Table 2.7). More or less public investment showed a steady increase from 6.76 per cent of GDP in 1970-71 to 11.87 percent in 1986-87. However from 1987-88 onwards, it tended to decline and in 1998-99 it became 6.37 per cent of GDP, which was even lower than the level of the same in 1970-71. Investment in the household fluctuated mostly between around 7 to 8 per cent of GDP except in the late 1980s when it crossed more than 10 per cent mark. It is also to be noted that household investment also declined during the 1990s from 11.25 per cent in 1990-91 to 6.51 per cent in 1996-97 and then onwards it tended to increase[9]. The private corporate investment as a percentage of GDP increased during the last half of 1980s after remaining stagnated at around 2.5 per cent during the 1970s.

Table 2.6: Trends in Revenue Receipts and Expenditure as per cent of GDP

Year	*Revenue expenditure*	*Capital expenditure*	*Total Expenditure*	*Revenue Receipts*
1970-71	6.85	5.46	12.31	11.69
1971-72	8.11	5.98	14.08	13.02
1972-73	8.41	6.15	14.56	12.95
1973-74	7.28	5.24	12.52	12.03
1974-75	7.33	5.50	12.82	11.89
1975-76	8.38	6.49	14.87	14.43
1976-77	9.22	6.00	15.22	15.07
1977-78	8.96	6.30	15.26	14.34
1978-79	9.70	7.34	17.04	15.67
1979-80	9.77	5.92	15.69	13.68
1980-81	10.02	5.81	15.84	14.11
1981-82	9.14	5.85	14.99	14.16
1982-83	9.96	6.40	16.36	15.48
1983-84	10.14	6.05	16.19	15.54
1984-85	11.28	6.49	17.77	16.25
1985-86	12.20	6.74	18.95	17.03
1986-87	13.13	7.09	20.22	17.56
1987-88	13.03	6.23	19.26	17.62
1988-89	12.83	5.93	18.77	17.43
1989-90	13.21	6.54	19.74	16.93
1990-91	12.93	5.12	18.05	16.52
1991-92	12.60	4.58	17.18	16.01
1992-93	12.39	4.50	16.89	14.74
1993-94	12.59	4.50	17.08	15.23
1994-95	12.06	3.79	15.85	15.78
1995-96	11.77	3.54	15.31	14.18
1996-97	11.62	3.78	15.40	13.73
1997-98	11.85	4.13	15.98	15.30
1998-99	12.31	2.79	15.10	15.90
1999-2000	12.73	2.66	15.39	15.23

Source: Handbook of Statistics on Indian Economy, RBI, 2001

[9] The trend in decrease/increase in household investment rates can be a statistical artifact, likely due to the overestimation/underestimation of private corporate investment (see Little and Joshi, 1994).

During the 1990s, it showed more or less an increasing trend till 1997-98, though it declined to 6.40 per cent in 1999-2000[10]. As a percentage of GDP, the private corporate investment gained momentum in the 1990s and reached the peak of 9.34 per cent of GDP in 1995-96, while the public investment to GDP ratio declined from 9.92 per cent in 1990-91 to 7.06 per cent in 1999-2000. The decline in the public sector investment during the 1990s can be attributed to the burgeoning fiscal crisis of 1990s. The growth of private corporate investment crossed over the public investment in relation to GDP since 1995-96 despite a marginal decline thereafter. Thus it becomes clear that with the decline in fiscal deficits, the public

Table 2.7: Gross Capital Formation in India and its major components: As per cent of GDP

Year	*Gross Capital Formation*	*Public*	*Private Corporate*	*Household*
1970-71	16.74	6.76	2.44	7.56
1971-72	17.91	7.38	2.60	7.92
1972-73	17.10	7.60	2.65	6.85
1973-74	17.62	7.91	2.66	7.05
1974-75	19.38	7.86	3.73	7.79
1975-76	20.06	9.91	2.75	7.40
1976-77	20.19	10.39	1.56	8.24
1977-78	19.76	8.43	2.47	8.85
1978-79	21.89	9.76	2.20	9.94
1979-80	22.58	10.61	2.69	9.28
1980-81	19.75	8.90	2.58	8.28
1981-82	23.65	10.63	5.75	7.27
1982-83	22.90	11.31	5.71	5.88
1983-84	20.81	10.24	3.40	7.16
1984-85	22.92	11.07	4.43	7.43
1985-86	25.09	11.44	5.55	8.11
1986-87	24.65	11.87	5.36	7.42
1987-88	23.52	10.13	3.68	9.70
1988-89	25.24	10.14	4.11	10.98
1989-90	25.18	10.16	4.31	10.72
1990-91	25.55	9.92	4.39	11.25
1991-92	23.23	9.34	6.00	7.89
1992-93	25.22	9.07	6.84	9.31
1993-94	20.82	8.08	5.50	7.25
1994-95	22.82	8.50	6.74	7.58
1995-96	25.88	7.47	9.34	9.07
1996-97	21.48	6.82	8.14	6.51
1997-98	22.33	6.44	8.14	7.75
1998-99	21.16	6.37	6.60	8.19
1999-2000	22.71	7.06	6.40	9.25

Source: National Account Statistics, new Series, CSO, Government of India (2001).

[10] This initial growth reflected the state-led inward oriented development strategy manifested in rapid industrialization centred on heavy, capital-intensive industries.

investment-GDP ratio declined. However the private corporate sector investment showed a long run increasing trend over the years, which has not suffered due to the decline in the fiscal deficit. The gross capital formation as a percentage of GDP tended to decline since mid eighties due to the decline in the investment by the household.

The structure of gross capital formation is shown in Table 2.8. It is noted that share of public capital formation has declined from 48.16 per cent in 1986-87 to 31.09 per cent in 1999-2000; though it had shown an increase from 40.39 per cent in 1970-71 to the peak of 51.46 per cent in 1976-77. It is evident from the table that there had been a decline in the public capital formation especially in the late 1990s while the share of private corporate investment has shown an increase. The analysis of the structure of gross capital formation

Table 2.8: Structure of Gross Capital Formation in India

Year	*Public Sector*	*Private Corporate Sector*	*Household Sector*
1970-71	40.39	14.58	45.15
1971-72	41.23	14.54	44.24
1972-73	44.43	15.48	40.09
1973-74	44.88	15.11	40.02
1974-75	40.54	19.26	40.21
1975-76	49.41	13.73	36.87
1976-77	51.46	7.73	40.81
1977-78	42.68	12.52	44.79
1978-79	44.56	10.03	45.41
1979-80	47.00	11.92	41.08
1980-81	45.05	13.05	41.90
1981-82	44.96	24.31	30.73
1982-83	49.38	24.94	25.69
1983-84	49.23	16.34	34.43
1984-85	48.28	19.31	32.41
1985-86	45.58	22.12	32.30
1986-87	48.16	21.74	30.10
1987-88	43.08	15.65	41.27
1988-89	40.19	16.29	43.53
1989-90	40.34	17.10	42.56
1990-91	38.80	17.17	44.03
1991-92	40.23	25.82	33.95
1992-93	35.95	27.14	36.91
1993-94	38.79	26.40	34.81
1994-95	37.25	29.54	33.21
1995-96	28.87	36.10	35.03
1996-97	31.77	37.92	30.31
1997-98	28.83	36.46	34.71
1998-99	30.12	31.18	38.70
1999-2000	31.09	28.18	40.73

Source: National Account Statistics, New Series, CSO, 2001

revealed that the public sector played a significant role in the investment process. It also showed that the share of private capital formation has slowly increased from 14.58 per cent in 1970-71 to a peak of more than 30 per cent of the total investment in the nineties.

Household investment, which was 40-45 per cent of the gross capital formation in the seventies, has declined to around 30 per cent in eighties; though late eighties witnessed a reversal in trend in household investment to 40 per cent (Table 2.7). However, the household investment in the nineties has shown a decline, which is in concomitant with the general declining trend of investment.

It is evident from the Table 2.9 that gross capital formation and gross fiscal deficit are correlated having correlation coefficient of 0.98. At the same time, the correlation coefficient between private capital formation and gross fiscal deficit is 0.874. However, within the private capital formation, the correlation of household investment with gross fiscal deficit is as low as 0.692 and private corporate investment is 0.941. From the correlation coefficients, *prima facie*, there appears to be a possibility of obtaining a relationship between both private corporate investment and fiscal deficit and also a relationship between public investment and private corporate investment, which is investigated econometrically in the subsequent chapters.

Table 2.9: Correlation Matrix of Fiscal Deficit and Capital Formation

Macrovariables	*Gross capital formation*	*Public-total*	*Gross Fiscal Deficit*	*Private Corporate*	*Private-Total*	*Household*
Gross Capital Formation	1.000					
Public-Total	0.990	1.000				
Gross Fiscal Deficit	*0.980*	*0.982*	*1.000*			
Private Corporate	0.982	0.953	*0.941*	1.000		
Private-Total	0.874	0.868	*0.868*	0.847	1.000	
Household	0.674	0.684	*0.692*	0.623	0.944	1.000

Source: (Basic Data), NAS, New series, CSO, 2001

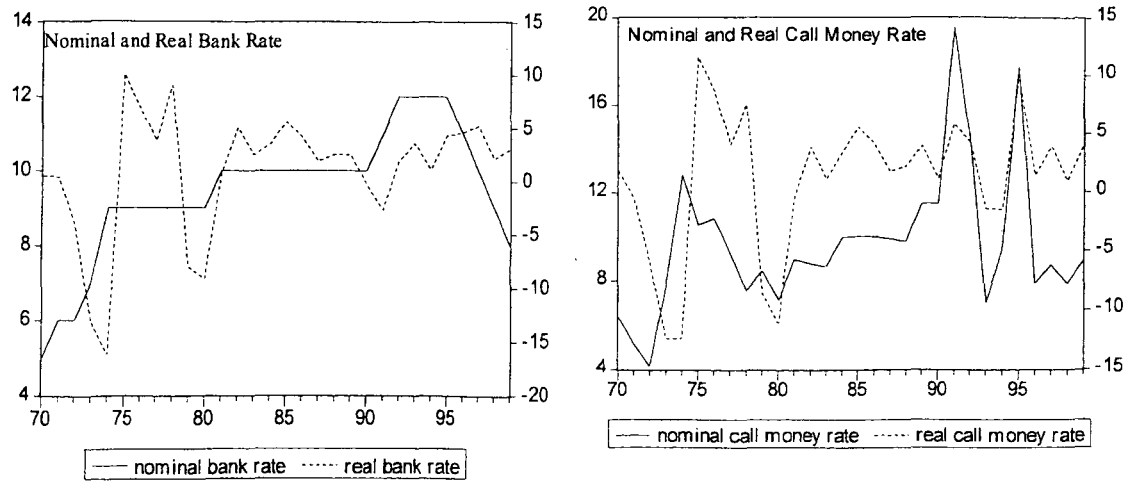
2.3 Fiscal Deficit and Rate of Interest

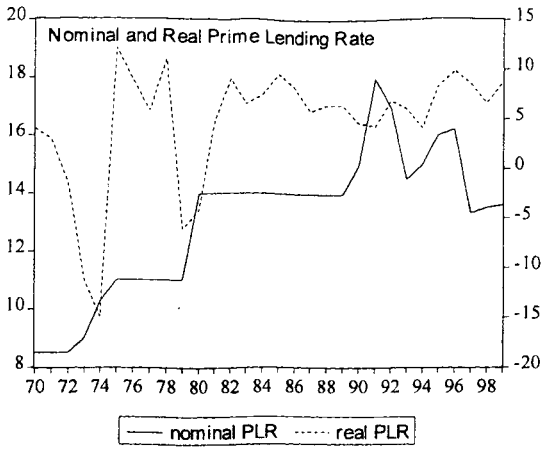
Having analysed the movement of fiscal deficit and gross capital formation by public and private sectors, in this section we analyse the movement of fiscal deficit and rates of interest. This analysis assumes importance because theoretically, high fiscal deficit financed through domestic borrowing would induce rise in real rate of interest because increasing demand for funds by the government would create a shortage of funds in the financial market and to get the market equilibrium restored, the cost of funds, i.e., the rate of interest has to increase. The relationship between fiscal deficit and rate of interest assumes added importance

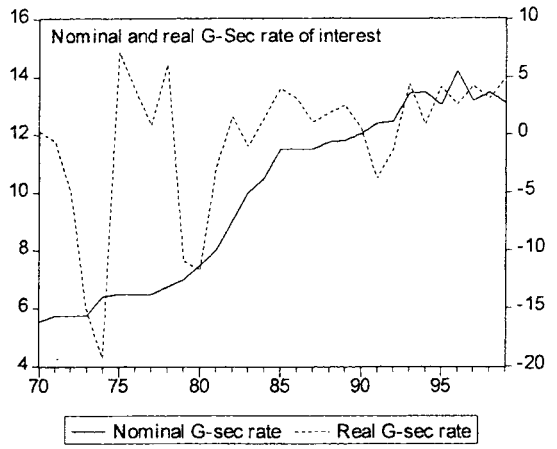
because rates of interest also determine investment demand. So, if increase in fiscal deficit pushes up the rate of interest, that may adversely affect the private capital formation. .

In India, the major rates of interest are call money market rate, bank rate, lending rates, prime lending rate of term lending institutions and gross redemption yield of Government of India Securities. The selected nominal and real rates of interests are shown in Figure 2.2. The real rates of interest are calculated by using Fisher equation, which defines nominal interest rate as a combination of real rate of interest and inflationary expectations. The point to be noted here is that though the nominal rate of interest of all the rates of interest except government securities showed a non-varying trend over the years in India, it has not been so in case of the real rate of interest series adjusted for the inflation (Figure 2.2). Figure 2.2 suggested that nominal bank rate has shown a stepwise increase till mid-nineties and each increase in the rate is sustained over a period of time before further rise. The real bank rate showed considerable variations over the period. The nominal and real call money market rate of interest showed considerable variations over the period between 1970-71 and 1999-2000. Prime lending rate has showed a distinct two-phased variation. In the administered interest rate regime, nominal prime lending rate has shown a step-wise increasing trend. But in the financially deregulated regime since 1992, nominal PLR has shown fluctuating pattern. Similar trend is noted for government security rate also. It showed that nominal government security rate steadily increased over a period of time and reached the peak of 14 per cent in 1996-97 and then shown a declining trend.

Figure 2.2: Movement of Selected Real and Nominal Rates of Interest in India







The statistical properties of nominal rates of interest, both short and long term, for the period 1970-71 to 1999-2000 shown in Table 2.10 revealed that among the short run rates, call money market rate remained highly volatile with standard deviation of 3.14. The maxima and minima of call money market rate are respectively 19.57 per cent and 4.15 per cent. While bank rate showed a sticky trend with a mean value of 9.44 per cent and maximum value was attained at 12 per cent and minimum value at 5 per cent. Among all the rates, the bank rate had shown least variation in the series, with Standard Deviation at 1.72, followed by PLR (2.49), Government security rate (3.00) and call money rate (3.14). Over the period between 1970-71 and 1999-2000, Jarque-Bera test statistic showed that all rates except call money market rate is normally distributed[11].

The summary statistics of two sub periods, viz., pre and post financially deregulated regime, revealed that call money market seemed to be more volatile in the post deregulated regime with standard deviation of 4.72 compared to 3.06 in the administered regime. Jarque-Bera statistics showed that call money market rate in nominal terms exhibited a normal distribution in the post financially deregulated period though it was not normally distributed in the pre-deregulated regime.

[11] Jarque-Bera is a test statistic for testing whether the series is normally distributed. The test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as with 2 degrees of freedom. The reported Probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null—a small probability value leads to the rejection of the null hypothesis of a normal distribution.

Table 2.10: Summary Statistics of Nominal Rate of Interest

Summary Statistics	*1970-71 to 1999-2000*				*Administered Regime 1970-71 to 1991-92*				*Deregulated Regime 1992-93 to 1999-2000*			
	short run		long run		Short run		long run		Short run		long run	
	Call Money rate	Bank rate	G-sec Rate	PLR	Call Money rate	Bank rate	G-sec rate	PLR	Call Money rate	Bank rate	G-sec rate	PLR
Mean	9.59	9.44	9.87	13.10	9.49	9.00	8.62	12.40	11.26	10.78	13.19	15.20
Median	9.06	10.00	11.00	14.00	9.53	9.50	7.75	14.00	8.87	11.00	13.17	15.00
Maximum	19.57	12.00	14.20	18.00	19.57	11.00	12.38	18.00	19.57	12.00	14.20	18.00
Minimum	4.15	5.00	5.53	8.50	4.15	5.00	5.53	8.50	6.99	8.00	12.38	13.30
Standard Deviation	3.14	1.72	3.03	2.49	3.06	1.57	2.56	2.54	4.72	1.48	0.55	1.67
Skewness	1.42	-0.74	-0.17	-0.40	1.35	-1.35	0.23	-0.02	0.86	-0.82	0.14	0.31
Kurtosis	5.65	3.54	1.40	2.50	6.75	3.74	1.36	2.36	2.07	2.30	2.66	1.81
Jarque-Bera	20.13	3.19	3.36	1.05	19.57	7.20	2.68	0.379	1.43	1.20	0.07	0.68
Probability	4E-05	0.2025	0.186	0.59	6E-05	0.027	0.263	0.827	0.49	0.549	0.964	0.71

Source: (Basic Data) Handbook of Statistics on Indian Economy, RBI, 2001

The mean and median of nominal bank rate is higher in the post-deregulated regime compared to earlier regime. The low value of standard deviation around one showed that nominal bank rate showed a sticky trend over the period of time, and standard deviation for nominal bank rate showed a less varying trend in the post-deregulated period than the administered regime. The nominal bank rate series has shown a normal distribution in both sub-periods of analysis, with kurtosis around 3.

The maxima and minima for the nominal government security rate of interest (G-Sec) in the administered regime were found to be 12.38 and 5.53 with standard deviation of 2.56. But in the deregulated financial regime the gap between the maxima and minima came close, but rates have increased to maxima of 14.2 and minima of 12.38 with a standard deviation of only 0.55. Jarque-Bera statistics showed that nominal G-Sec rate exhibited a normal distribution in the post financially deregulated period and administered regime. The nominal Prime Lending Rate in the deregulated period showed higher values of maxima at 18.00 and minima at 13.50 when compared to administered regime with maxima and minima of values 18.00 and 8.50 respectively. The statistics showed that nominal PLR is normally distributed.

Table 2.11: Summary Statistics of Real rates of Interest

Real rates: Summary Statistics	*1970-71 to 1999-2000*				*Administered Regime 1970-71 to 1991-92*				*Deregulated Regime 1992-93 to 1999-2000*			
	short run		long run		Short run		Long run		short run		long run	
	Call Money rate	Bank Rate	G-sec rate	PLR	Call Money rate	Bank rate	G-sec Rate	PLR	Call Money rate	Bank rate	G-sec rate	PLR
Mean	1.26	1.05	-0.43	4.64	0.74	0.25	-1.64	3.65	3.06	2.58	2.13	7.03
Median	2.07	2.50	1.25	6.50	2.08	2.20	0.70	5.85	3.89	3.10	3.10	6.90
Maximum	11.65	10.10	7.18	12.10	11.65	10.10	7.18	12.10	10.03	5.20	4.89	9.80
Minimum	-12.37	-16.20	-19.27	-14.95	-12.37	-16.20	-19.27	-14.95	-1.50	-2.70	-3.79	4.10
Standard Deviation	6.09	5.96	6.29	6.28	6.74	6.78	6.89	7.04	3.67	2.40	2.97	1.98
Skewness	-0.86	-1.35	-1.57	-1.74	-0.75	-0.95	-1.20	-1.33	0.45	-1.14	-0.98	-0.27
Kurtosis	3.33	4.57	4.82	5.47	2.67	3.27	3.58	3.93	2.56	3.64	2.68	1.87
Jarque-Bera	3.82	12.22	16.46	22.67	2.17	3.36	5.57	7.24	0.37	2.09	1.53	0.58
Probability	0.148	0.002	0.0002	0.00002	0.339	0.187	0.062	0.027	0.830	0.352	0.465	0.75

Source: (Basic Data) Handbook of Statistics on Indian Economy, RBI, 2001

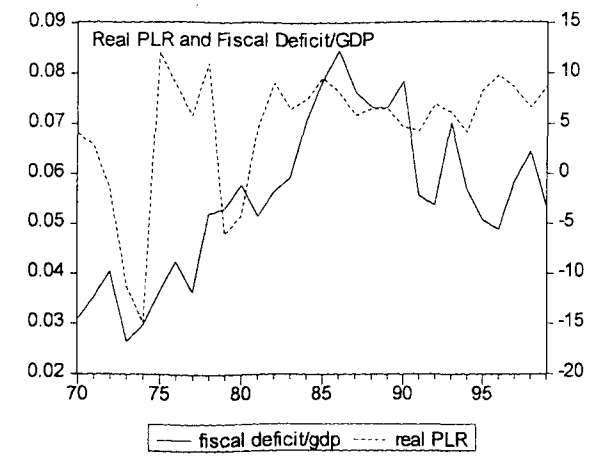
The real rate of interest refers to the ex-post rate measured by the difference between the nominal rate of interest and rate of inflation. The nominal rate of interest showed only marginal variation over the years. But the rates increased over the years. The real interest rate showed wide fluctuations reflecting the wide variations in inflation. Standard Deviation showed that the variation in all real rates of interest exhibit similar pattern at around 7 in the administered regime and around 2-3 in the deregulated financial regime (Table 2.7). Jarque Bera statistics revealed that only short run real rates of interest- viz. real call money market rate and real bank rate are normally distributed in the administered regime, while long run real rates of interest are not. But in the deregulated interest rate regime, statistics showed that all rates are normally distributed. It is clear from Figure 2.3 that neither the nominal rate of interest nor the real rate of interest remained constant over the period between 1970-71 and 1999-2000, though real rates of interest showed greater fluctuations.

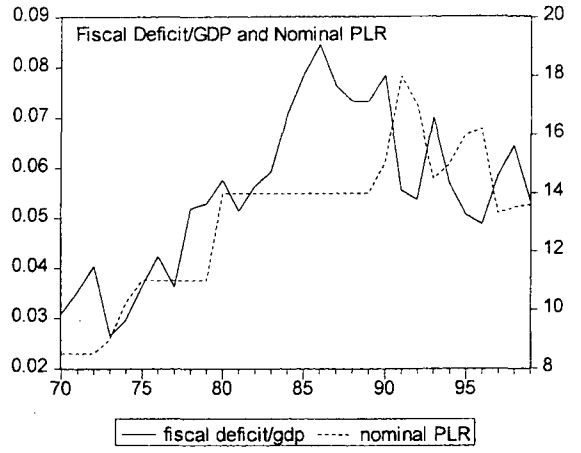
Table 2.12: Correlation Coefficient of Fiscal Deficit and Rates of Interest

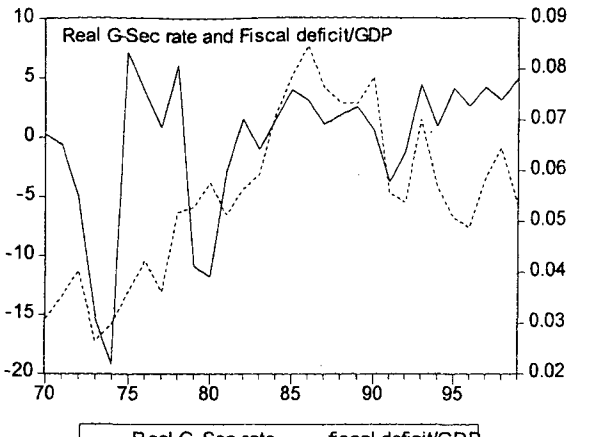
Variables	*Correlation coefficient*
Nominal Call money rate	0.148
Nominal Bank rate	0.390
Nominal G-Sec rate	0.752
Nominal PLR	0.539
Real Call money rate	0.207
Real Bank rate	0.262
Real G-Sec rate	0.389
Real PLR	0.336

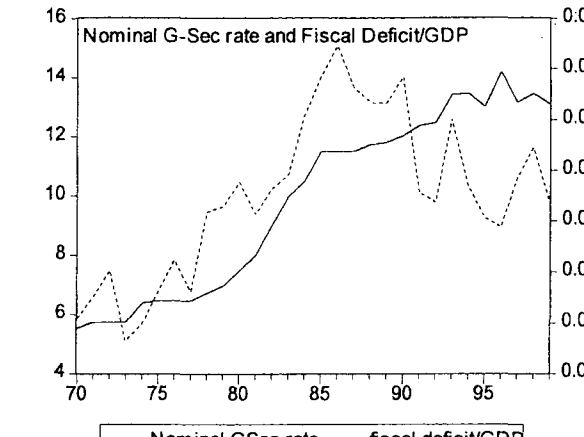
Source: (Basic Data) Handbook of Statistics on Indian Economy, RBI, 2001

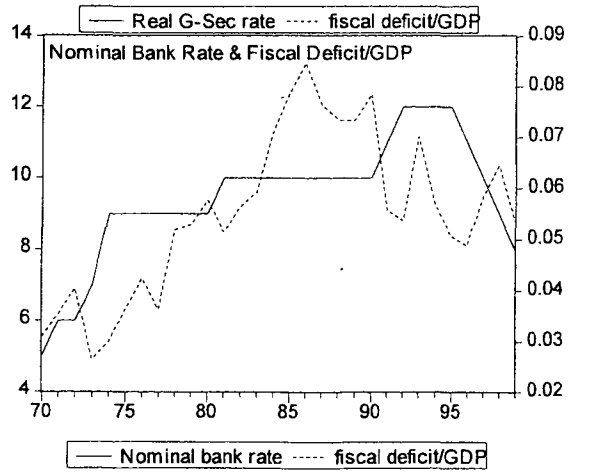
Figure 2.3: Movement of Selected Real and Nominal Rate of Interest with Fiscal Deficit

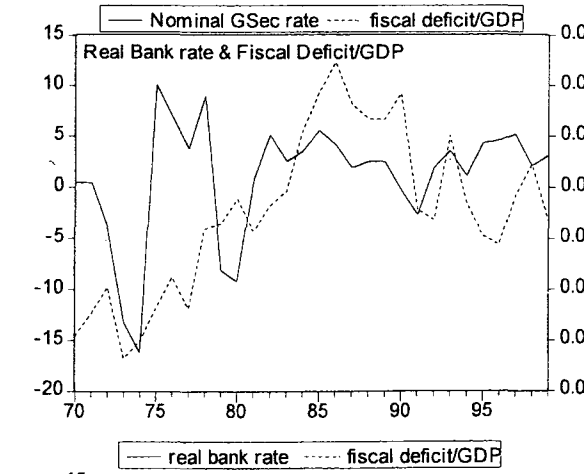


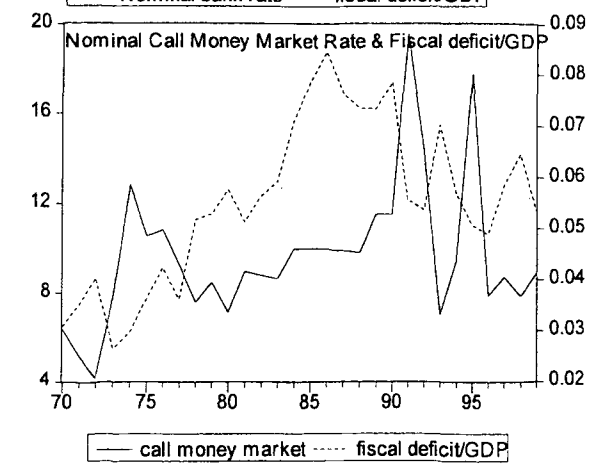


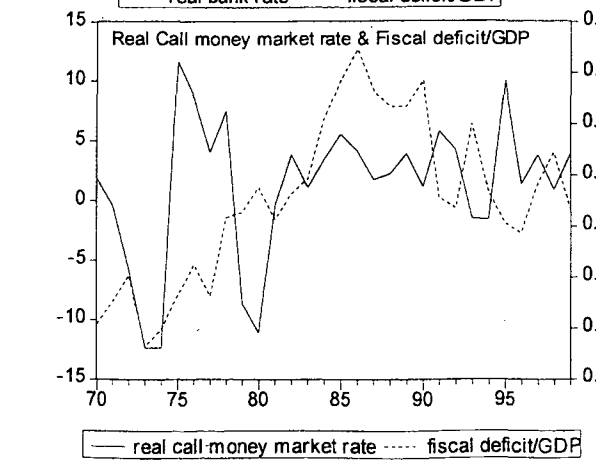












Having analysed the co-movements of short run and long run rates of interest, in nominal and real terms, we examine the co-movement of both nominal and real rates of interest in relation to the movement of fiscal deficit-GDP ratio. Figure 2.3 shows the comovement of selected rate of interest with fiscal deficit. Figure 2.3 showed the comovement of fiscal deficit with selected real and nominal rates of interest in India. The movement of fiscal deficit and various rates of interest does not reveal a definite pattern especially in the case of call money rate, bank rate and government security rate. The correlation matrix from Table 2.12 revealed that fiscal deficit and rate of interest are in general weakly correlated. The exception to this general trend is noted for the correlation coefficient of fiscal deficit and nominal rate of interest on government security at 0.752 and nominal Prime Lending Rate at 0.539, which is also visible from their intertemporal movement with fiscal deficit. However, the real rate of interest on dated securities of government and real Prime Lending Rate were found weakly correlated to fiscal deficit at 0.389 and 0.336 respectively. The weakest correlation coefficient was between fiscal deficit and nominal call money market rate, at 0.148. The correlation with real call money market rate was also weak, but slightly better than the nominal rate, at 0.207. The econometric investigation of the link between fiscal deficit and rate of interest will be analysed in Chapter 4, for a period between 1970-71 and 1999-2000 and also in the deregulated financial regime since 1993. The theoretical and empirical issues related to this link between deficits and rates of interest will also be addressed in Chapter 4.

2.4 Fiscal Deficit, Seigniorage and Inflation

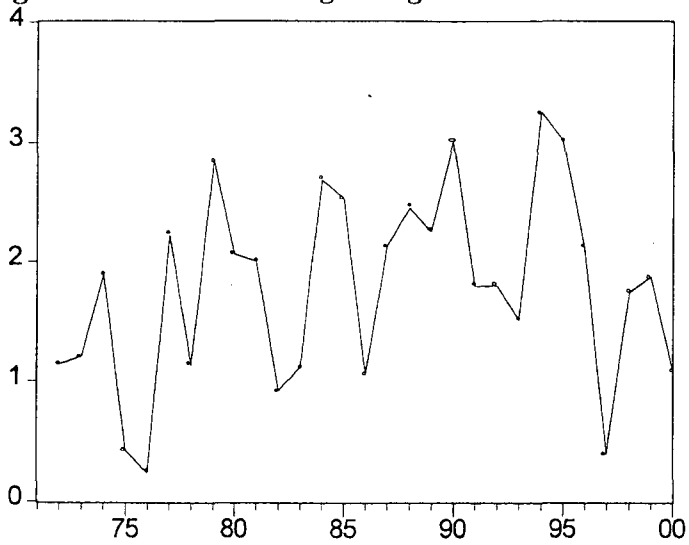
Apart from gross capital formation and rate of interest, further important effects of fiscal deficit may be on the creation of seigniorage, money supply and inflation. The relationship between fiscal deficit, seigniorage and inflation depends largely on the mode of financing the deficit, in particular, whether seigniorage is preferred to other available modes of financing fiscal deficit. Also, it is noted that although a relationship is detected between seigniorage and fiscal deficit, money creation and inflation can be non-linearly related (Easterly, Rodriguez and Schmidt, 1994)[12]. On the otherhand, Sargent and Wallace's (1985) *Unpleasant Monetary Arithmetic* (UMA) answered in affirmative the link between deficits

[12] Easterly, et al (1994) noted that the rate of inflation and seigniorage forms a (non-linear)"Laffer-curve" relationship, with seigniorage falling off at some point because of elastic response of money demand. Econometric estimation of the quadratic equation statistically forms the Laffer curve can be shown as: $S/Y = \alpha + \beta \pi - \pi^2$
where S/Y is seigniorage revenue as a ratio of GDP and π is the rate of inflation.

and inflation[13]. The theory of UMA explained the "tight money paradox"; when the fiscal position forces a government to finance its deficit through the inflation tax, any attempt to reduce the inflation rate today will require a higher inflation rate tomorrow.

However it is also argued that the conduct of monetary policy via monetisation of deficit doesnot cause inflationary pressures, when the economy is demand-constrained (Patnaik, 2001). The analysis whether fiscal deficit generates inflation in the economy has to be analysed in three-fold procedure. First, we have to examine whether fiscal deficit creates seigniorage in India and second, analyse whether seigniorage created is transformed into rise in money supply and finally, analyse whether the rise in money supply is translated into inflationary pressures in the economy (Gupta, 1982).

Figure 2.4: Trends in Seigniorage Creation in India



Following Gupta (1981), the first step is to analyse the link between fiscal deficit and seigniorage. Seigniorage is estimated as change in reserve money as a percentage of GDP. A detailed discussion on derivation of seigniorage revenue and its estimation is undertaken in Chapter 5. In brief, seigniorage is the extra resource that is obtained by printing money. With H as high-powered money and P as the price level, seigniorage is given by $(H_t / P_t = (H_t - H_{t-1}) / P_t$. In other words, the monetization of fiscal deficits provides the governments with a source of revenue. This process of creating high-powered money is called seigniorage (Gupta, 1992). It is noted from Figure 2.4 that there have been wide fluctuations in seigniorage revenue over the period from 1970-71 to 1999-2000. The seigniorage creation has increased from around 1

[13] Theoretical literature is inclusive of a bi-directional link between inflation and fiscal deficit also through Oliver-Tanzi effect, which embodied that inflation affects deficits through raising nominal interest payments.

per cent in the seventies and eighties to around 3 per cent in the early nineties. During the late nineties, dependence on seigniorage revenue declined considerably[14].

Table 2.13 Sources of Reserve Money as percentage of GDP (per cent)

Year	**Reserve Bank's Claims on**			*Net Foreign Exchange Assets of RBI*	*Government's Currency Liabilities to the RBI*	*Net Non-Monetary Liabilities of RBI*	*Reserve Money*
	Government (Net)	*Commercial & Cooperative Banks*	*Commercial Sector*				
1970-71	8.72	1.40	0.29	1.16	0.84	1.89	10.51
1971-72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1972-73	10.13	0.85	0.49	1.04	0.84	2.25	11.10
1973-74	9.46	1.10	0.85	1.02	0.76	2.18	11.01
1974-75	8.44	1.17	0.84	0.50	0.68	2.15	9.49
1975-76	8.28	1.57	0.88	1.10	0.66	3.16	9.33
1976-77	8.61	1.56	1.00	2.88	0.63	3.81	10.87
1977-78	7.49	0.91	0.93	4.44	0.58	3.63	10.72
1978-79	8.51	1.01	1.13	4.91	0.55	3.38	12.73
1979-80	10.22	0.99	1.27	4.44	0.49	3.76	13.66
1980-81	10.55	0.88	1.18	3.26	0.43	3.28	13.01
1981-82	11.60	1.02	1.13	1.55	0.39	3.61	12.07
1982-83	11.81	0.46	1.63	0.92	0.36	2.95	12.24
1983-84	12.12	0.63	1.63	0.74	0.33	2.32	13.12
1984-85	12.06	0.64	1.61	1.23	0.31	3.11	12.75
1985-86	13.80	0.42	1.55	1.33	0.34	3.82	13.62
1986-87	14.60	0.47	1.49	1.47	0.38	4.10	14.29
1987-88	14.85	0.61	1.57	1.48	0.39	3.90	15.00
1988-89	14.17	0.93	1.73	1.39	0.35	3.85	14.73
1989-90	15.11	0.93	1.90	1.24	0.32	3.60	15.91
1990-91	15.62	1.21	1.66	1.40	0.28	4.75	15.43
1991-92	14.39	0.19	1.70	2.88	0.26	4.20	15.23
1992-93	13.17	0.74	1.41	3.03	0.24	3.75	14.84
1993-94	11.56	0.22	1.18	5.98	0.23	3.03	16.14
1994-95	10.05	0.86	1.13	7.40	0.24	2.91	16.76
1995-96	10.27	1.44	1.00	6.27	0.20	2.73	16.44
1996-97	9.12	0.16	0.82	6.96	0.21	2.58	14.68
1997-98	8.92	0.14	0.87	7.65	0.21	2.85	14.93
1998-99	8.68	0.75	0.70	7.85	0.22	3.44	14.75
1999-2000	7.58	0.86	0.78	8.48	0.22	3.58	14.32

Source: Report on Currency and Finances & HandBook of Statistics on Indian Economy (Reserve Bank of India-Various Issues)

It is important in this context to understand the role of fiscal policy in creating seigniorage revenue in India. Historically the change in reserve money[15] in India is attributed to the conventional *budget deficit* of the government or *deficit financing* (monetisation of

[14] In certain years, when seigniorage revenue which was around 2.5 per cent was comparable to the direct tax-GDP ratio in India.

[15] Reserve Money = Net RBI credit to government + RBI credit to commercial sector and other banks + Net FOREX assets of RBI + Government's currency liabilities to the public – RBI's net non-monetary liabilities.

fiscal deficit)[16]. However, it is evident from Table 2.13 that in 1970-71, the net RBI credit to the government as per cent of GDP was 8.72 per cent, which increased to 13.80 per cent in 1986-87. In nineties, though it declined from 15.62 per cent in 1990-91 to 7.58 per cent in 1999-2000, the reserve money as per cent of GDP has not declined simultaneously. On the other hand, it remained constant around 15 per cent of GDP during the same period, and it was even higher than the levels in seventies and eighties.

The factor which contributed to this trend of no significant decline of reserve money, despite the decline in net RBI credit to the government is due to the increasing share of net foreign exchange assets of RBI in reserve money creation. The net FOREX assets of RBI has increased from1.66 per cent of GDP in 1990-91 to 8.48 per cent of GDP in 1999-2000; which was higher than the levels in seventies and eighties at around 1 per cent of GDP for most of the years (Table 2.13).

It is evident from Table 2.14 that share of net RBI credit to Central Government declined from 82.95 per cent in 1970-71 to 52.89 per cent in 1999-2000; while the share of net foreign exchange assets of RBI has shown an increasing trend from 10.99 per cent in 1970-71 to 59.18 per cent in 1999-2000. This increased share of net FOREX assets in reserve money may have adverse implications on the macroeconomic policy management. For instance, under capital flows in a flexible exchange rate regime, the nominal exchange rate appreciation leads to the deterioration of international competitiveness. So to prevent the real appreciation of the exchange rate and to preserve external competitiveness, Central bank intervenes in Forex market and then sterilise the incremental liquidity thus generated, thereby keeping the monetary expansion under control. This process has however quasi- fiscal costs associated with it as it imposes the danger of raising the real interest rate, which can further induce the capital flows and further depreciation. However, it is reflected that the impact of monetisation of deficit on reserve money may not be negligible, as outstanding net RBI claims to government is still 8.68 per cent of GDP.

[16] Ex-post to Chakravarty Committee Report, government has made a clear distinction between the overall budget deficit and deficit financing, since their implications on money supply could be entirely different. The overall budget deficit denoted the gap between the expenditure and the receipts under revenue and capital accounts taken together and this budgetary gap was met by the sale of Treasury Bills (of 91-day maturity period). This conventional budget deficit had been phased out since 1997-98. On the other hand, deficit financing refers to the increment during the year in the net RBI credit to the government (see Rakshit, 1993).

Table 2.14: Sources of Reserve Money Creation: Shifting Composition.

Year	Reserve Bank's Claims on			*Net Foreign Exchange Assets of RBI*	*Govt's Currency Liabilities*	*Net Non-monetary liabilities*	*Reserve Money*
	Government (Net)	*Commercial & Cooperative Banks*	*Commercial Sector*				
1970-71	82.95	13.31	2.74	10.99	7.96	17.96	100
1972-73	91.26	7.65	4.41	9.36	7.60	20.27	100
1973-74	85.88	10.00	7.74	9.26	6.92	19.80	100
1974-75	88.93	12.37	8.83	5.29	7.19	22.60	100
1975-76	88.69	16.84	9.40	11.84	7.11	33.88	100
1976-77	79.22	14.33	9.17	26.53	5.80	35.04	100
1977-78	69.87	8.46	8.72	41.42	5.42	33.89	100
1978-79	66.86	7.93	8.88	38.56	4.29	26.52	100
1979-80	74.85	7.24	9.33	32.51	3.57	27.50	100
1980-81	81.08	6.73	9.06	25.07	3.29	25.24	100
1981-82	96.11	8.42	9.33	12.82	3.21	29.89	100
1982-83	96.56	3.77	13.32	7.48	2.95	24.08	100
1983-84	92.37	4.82	12.39	5.63	2.49	17.71	100
1984-85	94.57	5.03	12.65	9.67	2.46	24.38	100
1985-86	101.34	3.09	11.36	9.80	2.46	28.05	100
1986-87	102.13	3.26	10.39	10.25	2.66	28.70	100
1987-88	99.06	4.05	10.46	9.88	2.59	26.04	100
1988-89	96.22	6.31	11.76	9.47	2.36	26.12	100
1989-90	94.96	5.86	11.95	7.82	2.00	22.60	100
1990-91	101.22	7.85	10.77	9.09	1.85	30.78	100
1991-92	94.48	1.27	11.15	18.93	1.71	27.55	100
1992-93	88.74	5.01	9.51	20.41	1.62	25.29	100
1993-94	71.61	1.35	7.30	37.08	1.44	18.78	100
1994-95	59.95	5.13	6.72	44.14	1.41	17.34	100
1995-96	62.44	8.73	6.10	38.13	1.23	16.62	100
1996-97	62.10	1.06	5.56	47.41	1.46	17.59	100
1997-98	59.74	0.92	5.84	51.23	1.38	19.10	100
1998-99	58.82	5.11	4.71	53.19	1.48	23.32	100
1999-2000	52.89	5.99	5.45	59.18	1.52	25.02	100

Source: Report on Currency and Finances & HandBook of Statistics on Indian Economy (Reserve Bank of India- Various Issues)

Figure 2.5 revealed that fiscal deficits and monetised deficits as per cent of GDP moved in tandem over the period from 1970-71 to 1999-2000. Both showed a declining trend in the 1990s after reaching the peak in mid-eighties. The movements of fiscal deficit and revenue generated from the creation of reserve money can be analysed from the direct estimates of the monetisation of government debt (Table 2.15). The degree of monetisation was calculated as the ratio of net credit to the government by the Central bank to the government's net borrowing requirements. Table 2.15 showed that though the monetised deficit as per cent of GDP has declined over the years, the degree of monetisation has not declined steadily; instead it observed a fluctuating trend.

Figure 2. 5: Fiscal Deficit and Monetised Deficit

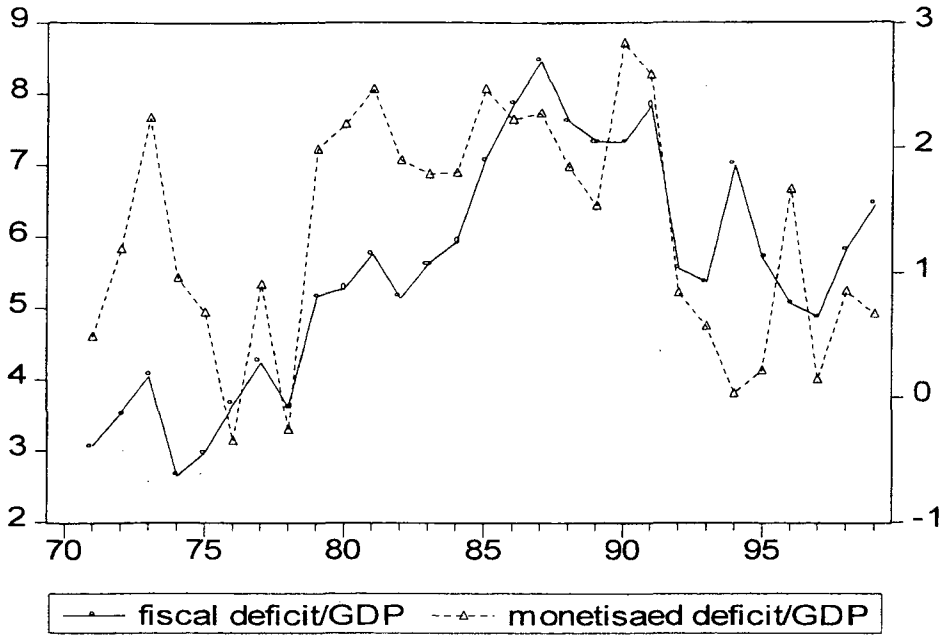


Figure 2.6: Fiscal Deficit/GDP and Monetisation

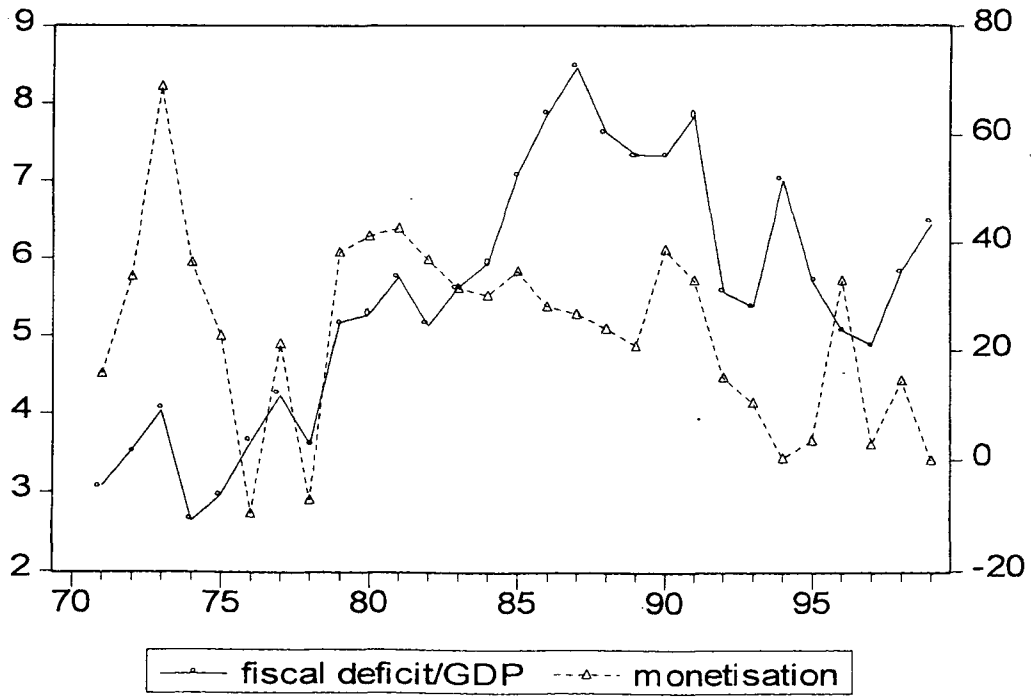


Table 2.15: Fiscal Deficit and Monetised Deficit as per cent of GDP and Degree of Monetisation

Year	*Fiscal deficit-GDP ratio*	*Monetised Deficit - GDP ratio*	*Degree of monetisation*
1970-71	3.08	0.49	15.83
1971-72	3.53	1.19	33.70
1972-73	4.04	2.24	68.90
1973-74	2.64	0.96	36.41
1974-75	2.97	0.68	22.93
1975-76	3.64	-0.35	-9.54
1976-77	4.24	0.91	21.47
1977-78	3.62	-0.26	-7.06
1978-79	5.18	1.99	38.35
1979-80	5.29	2.19	41.46
1980-81	5.77	2.47	42.79
1981-82	5.14	1.90	37.02
1982-83	5.64	1.79	31.68
1983-84	5.94	1.80	30.31
1984-85	7.09	2.47	34.77
1985-86	7.86	2.23	28.32
1986-87	8.47	2.28	26.92
1987-88	7.63	1.85	24.25
1988-89	7.34	1.54	21.03
1989-90	7.33	2.84	38.77
1990-91	7.85	2.59	33.04
1991-92	5.56	0.84	15.16
1992-93	5.37	0.57	10.60
1993-94	7.01	0.03	0.43
1994-95	5.70	0.21	3.69
1995-96	5.07	1.67	32.96
1996-97	4.88	0.14	2.90
1997-98	5.84	0.85	14.52
1998-99	6.45	0.67	0.00
1999-2000	5.35	-0.29	0.00

Source: computed from Handbook of Statistics on Indian Economy, RBI, 2001

Table 2.16 Correlation Matrix of Fiscal Deficit & Seigniorage

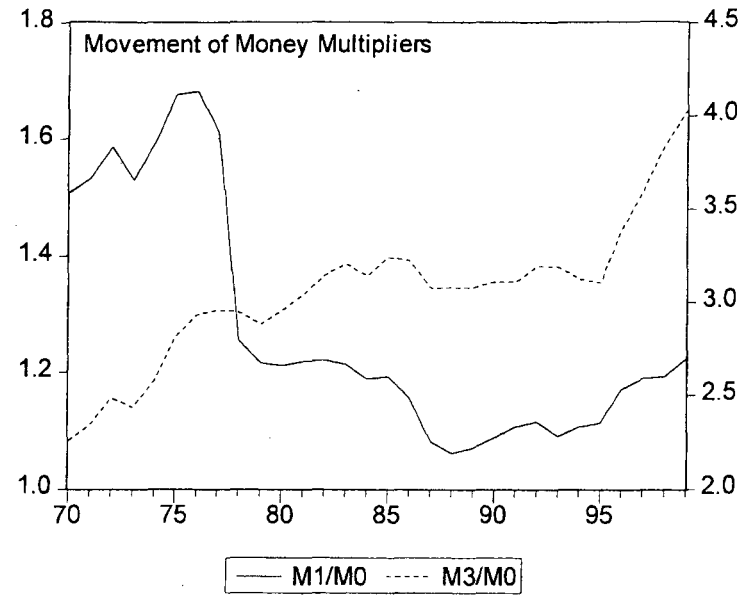
	Fiscal deficit	*Seigniorage*
Fiscal Deficit	1	0.496
Seigniorage	0.496	1

Source: computed from Handbook of Statistics on Indian Economy, RBI, 2001

The simple correlation exercise between seigniorage and fiscal deficit as per cent of GDP showed that both are correlated with coefficient at 0.496. As mentioned, seigniorage itself cannot spillover into the money supply. Thus, one has to examine the transmission mechanism in which fiscal deficit (via seigniorage) affects money supply in India. Assuming a stable relationship between the monetary base and the deficit, if the money multipliers are stable, we can derive a stable relationship between money supply and deficit (Gupta, 1992). The money multipliers are defined as M1/M0 or M3/M0; which are the ratios of narrow

money and broad money to monetary base respectively. The value of money multipliers is given in the Table 2.17.

Figure 2.7 Movements of Money Multipliers



It is revealed from the Table 2.17 that M3/M0 figures are higher than M1/M0 figures. The extent of variability is more for M3/M0 than M1/M0. The M3/M0 ranged between 1.21 to 4.32 during the period between 1970-71 and 1999-2000 while M1/M0 ranged between 1.09 to 1.68. It is deciphered from the Figure 2.7 that neither of the two multipliers has been constant over the period. As the two money multipliers have not been constant over time, we may anticipate that even if the relationship between the seigniorage and the budget deficit was a stable one over the period, it may not be when we examine with respect to money supply. The movement of money supply and fiscal deficit has shown no concomitant trend (Figure 2.7), but it is difficult to decipher at this point the exact money supply reaction to fiscal deficit, which would be empirically verified in the Chapter 6.

Table 2.17 Money Multipliers of Indian Economy

	M1/M0	*M3/M0*
1970-71	1.51	2.26
1971-72	1.53	2.34
1972-73	1.59	2.48
1973-74	1.53	2.43
1974-75	1.59	2.58
1975-76	1.68	2.81
1976-77	1.68	2.93
1977-78	1.61	2.96
1978-79	1.26	2.95
1979-80	1.22	2.88
1980-81	1.21	2.95
1981-82	1.22	3.04
1982-83	1.22	3.15
1983-84	1.21	3.21
1984-85	1.19	3.14
1985-86	1.19	3.24
1986-87	1.16	3.22
1987-88	1.08	3.08
1988-89	1.06	3.08
1989-90	1.07	3.08
1990-91	1.09	3.11
1991-92	1.11	3.11
1992-93	1.11	3.2
1993-94	1.09	3.19
1994-95	1.10	3.12
1995-96	1.11	3.1
1996-97	1.17	3.39
1997-98	1.19	3.6
1998-99	1.19	3.84
1999-2000	1.22	4.02

Source: Handbook of Statistics on Indian Economy, RBI, 2001

Figure 2.8: Fiscal Deficit and Money Supply as per cent of GDP

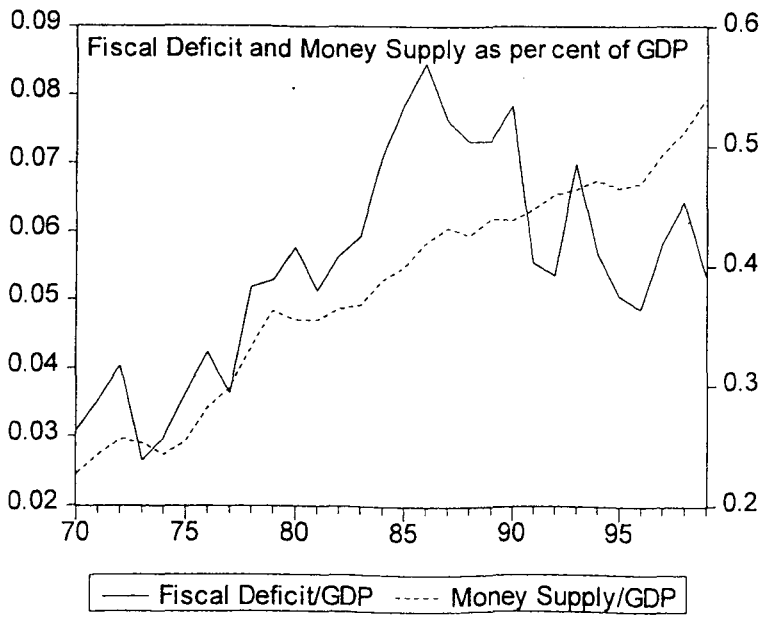


Figure 2.9: Fiscal Deficit/GDP and Rate of Inflation in India

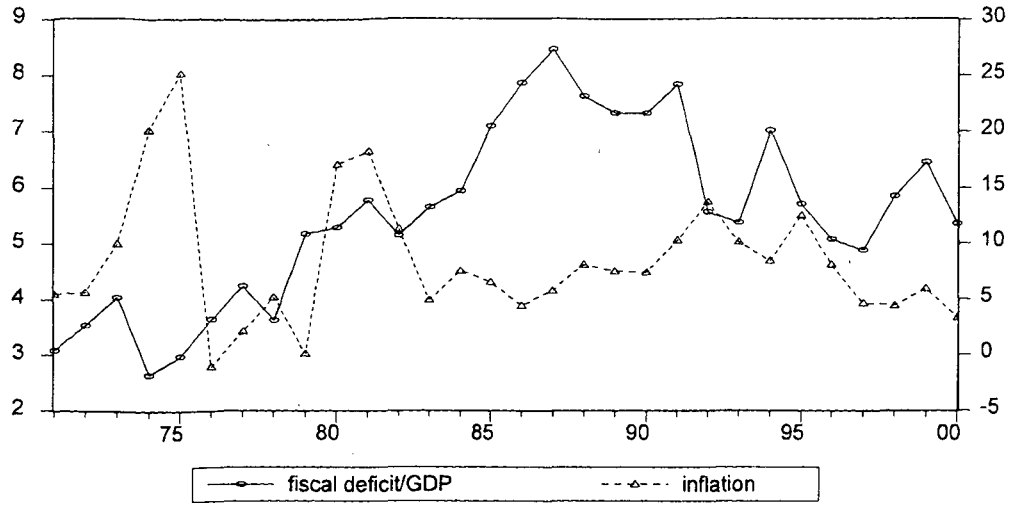


Table 2.18: Correlation matrix of Fiscal deficit, money supply and inflation

	Fiscal deficit	*Money supply*	*Inflation*
Fiscal deficit	1		
Growth of Money Supply	0.179	1	
Inflation	-0.194	-0.277	1

Source: (Basic Data) Handbook of Statistics on Indian Economy, RBI, 2001

The correlation matrix shown in Table 2.18 revealed that the correlation coefficient of fiscal deficit and money growth is weak at 0.179, while the fiscal deficit and inflation are weakly correlated and negative at –0.194. The econometric investigation to ensure this prima facie evidence of weak relationship between fiscal deficit, money supply and inflationary expectations would be discussed in Chapter 6.

2.5: Summary

The present chapter dealt with two analysis: firstly, the trends in deficit and its financing pattern over the years and secondly, the movement of fiscal deficit in relation with the selected macroeconomic variables viz., private capital formation, rate of interest, seigniorage, money supply and rate of inflation. The movement of the fiscal deficit showed that there has been a sharp increase in the fiscal deficit to GDP ratio during the 1980, especially mid 1980s. The composition of fiscal deficit showed that increasing share of it is diverted to revenue expenditure. The decline in capital formation has tremendous adverse impact on gross capital formation in India. The gross capital formation as a per cent of GDP declined during the nineties due to the decline in the capital formation in the public sector. Increasing fiscal deficit was contained during the nineties through the drastic cut in capital expenditure.

The analysis of financing pattern of fiscal deficit during the same period showed that Central Government has resorted more to open market operations (OMO) in recent years, bringing down the monetisation of deficit. This shift in the financing pattern of fiscal deficit away from seigniorage financing to bond financing may have impact on the rate of interest. Third, the recourse to external financing of fiscal deficit has become negligible over the years. The movement of fiscal deficit and rates of interest (real and nominal) did not reveal a definite pattern. Though the correlation coefficients between fiscal deficit and government security rate appeared to be higher than other rates, viz. call money rate, real PLR, bank rate showed a weak correlation with fiscal deficit.

The movement of seigniorage revealed that government resorted to seigniorage financing of fiscal deficit during the 1970s and 1980s, while the relative importance of seigniorage as a mode of financing of fiscal deficit has declined in recent years. The money multipliers estimated for the period between 1970-71 and 1999-2000 revealed wide fluctuations. Prima facie an unstable money multiplier implies a possibility of weak relationship between seigniorage and money supply and in turn weak relation between money supply and deficit. Thus it requires to be examined whether creation of seigniorage tends to an increase in money supply in the economy. On the basis of these preliminary data analysis and tentative conclusions drawn, subsequent chapters will investigate the exact nature of relationships between these variables and fiscal deficit econometrically.

Chapter 3

Fiscal Deficit, Capital Formation and Crowding Out

In recent years, in the context of macroeconomic management in India, it has often been argued that continuous pressure on market borrowing arising out of high fiscal deficit led to an increase in the real rate of interest, which in turn crowded out private investment[1]. Also, the persistence of high fiscal deficits and ever increasing debt service payments is considered as one of the major constraint for the Government at any level to undertake the necessary expenditures for productive capital formation[2]. In other words, high fiscal deficit is affecting capital formation in the economy both by reducing private investment through an increase in interest rate and also through reduction in public sector's own investment arising out of ever-increasing share of debt servicing obligation in total government expenditure.

The investment vacuum, if any, created by fiscal deficit would also depend on the nature of relationship between public and private investment. If the relationship between the two is complementary, then decline in public investment would lead to a decline in private investment even if the change in interest rate effect is controlled[3]. In this chapter we examine the nature of relationship between public and private investment. The analysis covers a period between 1970-71 and 1999-00.

This chapter has been divided into five sections. Section 3.1 defines the scope of the analysis. In section 3.2, a summarized view of theoretical and empirical literature is presented. In section 3.3, a theoretical model is derived for private investment and the determinants of private investment are discussed. Section 3.4 discusses the econometric results while section 3.5 summarizes the major findings of the chapter and draws conclusions.

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[1] It has also been argued that the financing of public investment- whether through taxes, issuance of debt or seigniorage- will lower the resources available to the private sector and in turn would depress the private capital formation in the economy (Modigliani 1961; Khan and Reinhart, 1990).

[2] Due to the sharp increase in the debt-GDP ratio, and recent deregulation of interest rate and consequent high cost market borrowing, the interest payment-GDP in total government expenditure increased from 1.33 per cent in 1970-71 to 4.61per cent in 1999-00.

[3] Fiscal policy thus can affect capital formation through three channels; via public investment, via fiscal deficit and via rate of interest. In this chapter we examine the first two channels and following chapter looks into the third channel via rate of interest.

3.1 Definition of Crowding Out and Scope of the Study

Theoretical literature identifies two variants of crowding out in an economy – real and financial[4]. The *real* crowding out occurs when the increase in public investment displaces private capital formation, which is also termed as *direct* crowding out[5]. The phenomenon of partial loss of private capital formation in the economy, due to the increase in the interest rates emanating from the pre-emption of real and financial resources by the government through bond-financing of fiscal deficit is termed as *financial crowding out*. The *financial* crowding out occurs due to the upward pressures on rate of interest induced by the debt financing of fiscal deficit (interest rate effect). The phenomenon of financial crowding out is separately examined in chapter 4.

The taxonomy of crowding out was discussed in detail by Buiter (1990). According to Buiter, *direct* crowding out (or crowding in) refers to substitution or complementary relationships between public and private spending that occur not through changes in prices, interest rates or required rate of return by changes in public sector activity, but through public sector consumption/investment being an argument in private utility functions and through the public sector capital stock being in argument in private sector production functions[6]. Buiter defined *indirect* crowding out as the consequences of public actions that affect private behaviour either by altering budget constraints or by influencing the prices faced by private

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[4] Blinder and Solow (1973) in his seminal paper "*Does fiscal policy matter?*" discuss three levels of crowding out at theoretical level. The first level of crowding out occurs when public investment displaces private investment broadly on a *dollar-for-dollar* basis. This level of crowding out occurs irrespective of the mode of financing the deficit. The second level of crowding out, as Blinder and Solow (1973) puts, is an integral part of Keynesian tradition. It is based on the notion that deficit spending *not accompanied by new issuances of money* carries with it the need for government to float debt issues which compete with the private debt instruments in financial markets. The resulting upward pressure on interest rates will reduce any private expenditure, which is interest rate sensitive. In other words, this financial side effect of crowding out occurs via rate of interest (that is, bond financing of deficit causes market rate of interest to rise and in turn crowds out private investment). As discussed by Blinder and Solow (1973), there is no theoretical controversy over this second level of crowding out; the only contested issues are empirical. The rationale for third level of crowding out is that any government deficit requires the issuance of some sort of debt instrument –outside money or interest bearing bonds – and this increase in private wealth will have further reverberations in the economy. In other words, debt financing of deficit simultaneously results in the creation of bonds, which is considered as net wealth in the private sector. It is a matter of debate whether bonds are considered as net wealth in the context of India, and this third level of crowding out is beyond the scope of the study.

[5] Real crowding out is important to analyze in the context of developing countries like India because of the large share of public investment in gross capital formation and moreover, the nature of public investment (whether infrastructure or non-infrastructure) itself can affect private investment differently.

[6] Buiter, 1990, page 34.

agents, viz. rate of interest. As mentioned, the crowding out occurs via interest rate changes are referred to as *financial* crowding out[7] in this chapter.

This study is different from the existing studies on crowding out in India for three reasons. Firstly, the study bridged the lacuna of *partial analysis status* of financial crowding out in India by analyzing not only whether private investment is interest rate sensitive, but also whether the rise in interest rate is deficit-induced[8]. This two-fold analysis is significant because even if private investment is interest rate sensitive, this aspect by itself does not mean occurrence of financial crowding out[9] if rate of interest is not deficit induced. Secondly, while analysing the real (direct) crowding out, it is important to analyse whether the infrastructure and non-infrastructure mix of public capital formation has differential impacts on private capital formation. Thirdly, the study has taken care of certain acute methodological deficiencies of existing studies on *crowding out* debate. Most of the studies assumed the respective timeseries as stationary and proceeded the analysis by applying ordinary least squares. Earlier studies have failed to address that time series may contain unit root and be non-stationary at levels, which can lead to spurious regression results, which would yield inconsistent estimates. The problems of simultaneity and *adhoc* specification of lag structure are eliminated by applying Hsiao's asymmetric vector autoregressive framework.

3.2 Theoretical and Empirical Literature: A Synoptic View

Any analysis of investment can be done at different levels of aggregation, viz., firm, industry and the macro economy. Given the focus of the study, which intends to examine whether public investment crowds out private investment, the analysis is confined to

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[7] Kotlikoff (1984) also pointed out that 'financial crowding out' is advanced in literature through the testing of causal link between fiscal deficit and rate of interest. He further pointed out that much of the concern with 'financial crowding out' revolve round the transaction of selling bonds to finance fiscal deficit. As argument goes, a government's sale of bonds, regardless of its use of the proceeds, raises the total supply of bonds in the market. The greater supply of bonds, according to this view, means a lower bond price, that is, a higher interest rate, which reduces (crowds out) the private investment.

[8] The existing studies on *crowding out* are completely dichotomized. One set of studies looked into the link between public investment and private investment directly without incorporating the macroeconomic channel of crowding out phenomenon via the deficit-induced interest rate mechanism [(Erenburg, S J (1993), Aschauer, D A (1989), Erenburg, S J and Wohar, M E (1995), Khan M S and M S Kumar (1990), Sunderarajan and Takur (1980)]. Another set of studies looked into the link between budget deficit and rate of interest and concluded the evidence of crowding out if rate of interest is deficit linked, without further analysing whether private investment is interest rate sensitive [(Paul Evans (1985), Tanzi (1985), Basil Dalamagas (1987), Mustaq Ahamad (1994), Kulkarni and Erickson (1996), Cebula (1990), Correia and Luakas Stemitsiotis (1995) and Ostrosky (1979)].

[9] This is because the adhoc configurations of demand and supply of loanable funds in the market is affected by myriad factors and these factors may have their respective role in the determination of rate of interest. But from the perspective of crowding out hypothesis, what is relevant is the extent to which the rate of interest is induced by the fiscal deficit operations of the government and in turn the extent to which such increase in the rate of interest adversely affect the level of private capital formation.

aggregate macro economy level analysis of the determinants of private investment. At the aggregate level, theories on investment can be broadly categorised into three: neoclassical accelerator models, financial theories on investment and the theories of uncertainty.

In the early accelerator theory, investment is related linearly to past changes in output (Clark, 1917). According to accelerator principle, the size of capital stock desired by entrepreneurs depends on the aggregate demand, which in turn is represented mostly by the level of output. Later, flexible accelerator models were introduced, where adjustment to capital stock to the desired level is not instantaneous, but involves delivery lags due to the delayed response to the changes in aggregate demand. The neo-classical theory of investment, which followed, viewed that investment spending depends on the user cost of capital and is geared to maintaining the optimal capital stock and an associated level of output. Jorgenson's neoclassical theory on investment relies on the theory of profit maximising firm subject to a production function. The production function links the capital stock to the relative prices between capital and output. Once these relative prices are kept constant or if technology requires that capital and labour used in fixed proportions (in which case the elasticity of substitution is zero) then with constant returns to scale, the desired capital stock is proportional to the demand for output, which implies Jorgenson's model boils down to Clark's simple accelerator model, and rate of interest is not a determinant of investment. However, accelerator and relative price of capital models have together formed the foundation of numerous empirical models, which incorporate the demand-side (aggregated demand proxied by output) and the supply-side factors (cost of capital) in a single expression.

In the late 1950s, financial theories were developed based on the premise that investment decisions are determined by the availability of internal funds and access to external funds (Modigliani and Miller, 1958, Meyer and Kuch, 1957). These financial theories of investment looked into the implications of corporate financing through alternate routes viz. debt versus equity and internal versus external funds on the capital formation and in turn established a strong relationship between real and financial variables in the economy. Tobin's Q theory also falls in this stream, where investment is considered to be positively related to the value of Q, which is the ratio of market value of capital to its replacement cost (Brainard and Tobin, 1968). All 'q' models are based on static expectations. A recent study by Alberto, Alesina (2002) estimated the effects of fiscal policy on business investment in q theory framework. Using a panel of OECD countries, the study found a sizable negative effect of fiscal spending – and in particular wage component - on investment. The results showed that

an increase of one percentage point in the ratio of primary spending to GDP leads to a decrease in investment as a share of GDP of 0.15 percentage points on impact and a cumulative fall of 0.74 percentage points after five years. This effect was found particularly strong when fiscal expenditure increases occur in the government wage bill: in this case, the decrease in the investment to GDP ratio is 0.48 on impact and 2.56 cumulatively after five years. Also, the study found that increases in taxes reduce profits and investment, but the magnitude of the effects on the revenue side is smaller than those on the expenditure side.

The recent theories on investment, emanating from the poor empirical performance of neo-classical and Tobin's Q models in the context of developing countries, focussed on *irreversibility and uncertainty* as determinants of investment (Dixit and Pindyck, 1994, Pindyck and Solimano, 1994). These theories are based on the dual assumptions that *investment decisions are inherently irreversible* and *investment returns are uncertain.* The existence of sunk costs (that is, irreversible investment) implies that investment today carries an additional cost in the loss of option to invest tomorrow. This 'real options' view of investment gives a significant role to *uncertainty;* corporate investment tends to postpone or reduce the level of investment when greater is the level of uncertainty. These recent theories on investment suggest that macroeconomic environment arising from change in policy regarding interest rates; exchange rates and the inflationary pressures in the economy affect investment decision.

Table 3.1: Selected Empirical Evidences on Crowding Out

Study	***Period and Country***	***Model***	***Variables Selected***	***Results***
Cebula (1978)	1949-1976 US and Canada	ISLM	Capacity Utilisation, Lagged domestic investment, budget deficit	Budget deficit crowd out private investment in Canada and US.
Blejer and Khan (1984)	1971-1979 24 developing countries	Flexible Accelerator Model	Output, Real bank Credit, Real Public Investment	It is not the level, but the change in public investment that crowd out private investment.
Miguel D Ramirez (1994)	1950-1990 Mexico	Flexible Accelerator Model	Public Investment, Flow of Credit, Exchange Rate	Public Investment Crowds In Private Investment
K Krishnamurty (1985)	1975-1990 India	Sectoral Model	Public Infrastructure Investment etc.	Infrastructure investment crowds in private investment in almost all sectors.
Nemat Shafik (1992)	1970-1988 Egypt	Neoclassical Model	Rate of Interest, Markup (WPI/Wage), Private Credit, Public Infrastructure, GDP.	Public Investment Crowds Out Private Investment. Rate of interest determines private investment.
Greene and Villanueva (1991)	1975-1987 23 developing countries	Neoclassical Model	GDP, Public gross capital formation, debt ratio etc.	Gross public capital formation crowds in private investment.
Sunderrajan and Takur (1990)	1960-1978 India and Korea	Neoclassical (Jorgenson)	Public investment, capital stock, rate of interest, capital stock.	Evidence of crowding out in India. Complementary relationship between public and private investment in Korea.

Table 3.1: Selected Empirical Evidences on Crowding Out (Contd...)

Study	*Period and Country*	*Model*	*Variables Selected*	*Results*
B K Pradhan, D K Ratha and Atul Sarma (1988)	1960-1990 India	Computable General Equilibrium (CGE) Model	Interest rate, modes of financing public investment, money creation, market borrowing, taxation and mark up.	The extent of crowding out varies with the different modes of financing the public investment.
Mohanty (1995)	1960-1990 India	RET (Ricardian Equivalence Theorem)	Real Disposable Income, Capital stock, public debt, government expenditure, interest payments.	Direct crowding out impact of government expenditure on private consumption. Government consumption and transfer payments have positive while public investment and interest payments have negative impact on private consumption.
Karen Parker (1995)	1974 –1994 India	Accelerator Model	Interest rate, public investment, credit rate, real effective exchange rate, WPI inflation, index of industrial production, GDP	Public investment crowds out private investment. Public Infrastructure crowds in private investment.
K L Gupta (1990)	1960-1985 10 Asian countries	RET	Transitory and permanent income, taxes, transitory and permanent government expenditure.	RET is rejected for Sri Lanka, India, Indonesia and Philippines among 10 Asian countries. Evidence of Crowding out in all Asian countries except India.
Sankar (1997)	1960-1994 India	Accelerator model	Private corporate investment =f{public infrastructure investment, public noninfrastructure investment, ratio of public infrastructure to noninfrastructure investment, bank rate}	Infrastructure investment crowds in private corporate investment
Ostrosky (1979)	1950-1975 US	ISLM	Capacity utilization rate, average profit rate, net change in the government debt etc.	Investment is affected by the net change in the debt, and hence crowding out.
Feldstein (1984)	1950-1982 Australia	Intertemporal CGE Model	Government deficit, government expenditure etc.	Increase in debt financed proportion of government deficit crowds out private investment.
Tun Wai and Chong (1982)	1965-1975 five countries of same development pattern	Flexible Accelerator Model	Public Investment, Quantity of Credit, Private Sector Output	Public Investment crowds out Private Investment. Quantity of Credit is also a significant factor.

Based on the micro-foundations of these investment theories, the empirical studies on investment found that private corporate investment is associated with public (infrastructure) investment, aggregate demand, and availability of financing, price and exchange rate stability and cost of investment. The empirical studies on link between private investment and public investment are summarized in Table 3.1. Many authors have tested the relationship between public investment and private investment and found contradictory results. Ramirez (1994), Greene and Villanueva (1990), Buiter (1977), Aschauer (1989), Erenburg (1993) found that public investment and private investment have a complementary relationship. These studies

showed that increase in public capital formation stimulate aggregate demand and in turn increases private investment. Another link for the existence of this complementary relationship is that a higher stock of public capital, in particular infrastructure may increase the return of private investment projects. Contrary to the complementary relationship, another set of studies showed that public investment might also act as a substitute for private investment. This substitutability can arise when private sector utilises the public capital for its required purposes rather than expand private capacity[10] (Blejer and Khan, 1984: Aschauer, 1989; Cebula, 1978; Shafik, 1992; Parker, 1995; Ostrosky, 1979; Tun Wai and Chong, 1982; Kulkarni and Balders, 1998).

In the context of developing countries including India, there are only few studies that looked into the link between public investment and private investment. Sunderrajan and Takur (1980) conducted the study on crowding out for two countries viz. India and Korea in a neoclassical framework. The study found that public investment exerts a short term crowding out effect on private investment and hampers the growth of national income; this effect is found to be larger in the case of India than in Korea. Krishnamurty (1985) found that a rise in public investment resulted in crowding out of private investment, but led to higher growth. Pradhan, et al (1990) examined the question of complementarity between public and private investment in India under different modes of allocation and financing of public investment in a 18 sector computable general equilibrium framework. The study noted that though public investment crowds out private investment, in terms of its effect on total investment and economic growth, the economy is better off with increased public investment. Kulkarni, G K and Balders, J U (1998) analyzed the phenomenon of crowding out in Mexican economy for the period 1970-1996 in terms of interest rate effect, price level effect and exchange rate effect. The study gave evidence of link between budget deficit and interest rate, but did not examine the link between interest rate and private investment.

To establish the evidence of financial crowding out, one ought to examine if increase in fiscal deficit increases rates of interest; even if the private investment is found interest rate sensitive. If fiscal deficit does not induce increase in the rates of interest, mere interest sensitivity of private investment does not mean financial crowding out. The present study does a two-fold analysis of crowding out debate in India by examining the relationship

[10] Alternately, higher private investment can result in lower public capital formation; for instance, firms might construct physical infrastructure such as roads, bridges themselves thereby allowing the public sector to withhold from this investment. In other words, there exists a forward and backward linkage between private and public investment.

between fiscal deficit and interest rates after analyzing the linkage between interest rates and private investment.

3.3 Modeling Private Investment in India

Though the neoclassical-flexible accelerator model has been the most widely accepted general theory of investment behaviour, the application of these models in the context of developing countries posed certain challenges due to the key assumptions of the models such as perfect capital markets and little or no government investment (Greene and Villanueva, 1991). With the relatively significant role of government in the capital formation and other certain structural and institutional factors peculiar to developing countries, the standard models of investment could not be directly adapted to developing countries. However certain studies (for instance, Sunderrajan and Takur (1980), Tun Wai and Wong (1982), Shafik (1992), Blejer and Khan (1984)) attempted to incorporate features of standard accelerator and neo-classical models of investment through relaxation of basic assumptions underlying these models. Furthermore, even if standard models could be directly adapted to developing countries, severe data constraints arise when attempts are made to implement them empirically (Blejer and Khan, 1984).

The present chapter attempts to develop a model for private investment focusing on fiscal policy and tries to derive an explicit relationship between the principal policy instruments –variations in public expenditure (in particular, public investment in infrastructure and non infrastructure), the level of fiscal deficit and variations in bank credit to commercial sector along with real rates of interest – and private capital formation. In the process, model allows an assessment of possibility of *crowding out* phenomenon, financial and real, that may occur[11].

Theoretically, gross investment in private sector is defined equal to net investment in private sector plus depreciation of the previous capital stock. While net investment in private sector is defined as the difference between the desired stock of capital in period t and the actual stock in the previous period $t-1$.

$$I_{pvt} = \Delta KP_t + \delta KP_{t-1} \qquad (3.1)$$

[11] The chapter attempts to derive the model in line with the existing attempts on modeling private investment in the context of developing countries using neo-classical-flexible accelerator models, for instance Blejer and Khan, 1984 and Tun Wai and Wong (1982).

where I_{pvt} = Gross Private Investment

$\Delta KP_t = N_{pvt}$ = Net Private Investment

δ = rate of depreciation

$$N_{pvt} = \Delta KP_t = \beta(KP_t^* - KP_{t-1}) \tag{3.2}$$

where KP_t^* = desired stock of capital in private sector

KP_{t-1} = actual stock of capital in private sector in the previous period.

β = coefficient of adjustment, $0 \leq \beta \leq 1$

Substituting equation (3.2) in (3.1), we get:

$$I_{pvt} = \beta(KP_t^* - KP_{t-1}) + \delta KP_{t-1} \tag{3.3}$$

In the standard lag-operator notation, equation (3.3) can be rewritten as:

$$I_{pvt} = [1-(1-\delta)L]KP_t \tag{3.4}$$

where L is the lag operator, $LKP_t = KP_{t-1}$.

Now, we specify a partial adjustment function for gross investment, as follows:

$$\Delta I_{pvt(t)} = \beta(I^*_{pvt(t)} - I_{pvt(t-1)}) \tag{3.5}$$

where $I^*_{pvt(t)}$ is the desired level of private investment. In the steady state, desired private investment is given by[12]:

$$I^*_{pvt} = [1-(1-\delta)L]KP_t^* \tag{3.6}$$

Combining the equations (3.5) and (3.6), and solving for $I_{pvt(t)}$ yields the equation as follows:

$$I_{pvt(t)} = \beta[1-(1-\delta)L]KP_t^* + (1-\beta)I_{pvt(t-1)} \tag{3.7}$$

We know that in the accelerator models, desired stock of capital can be assumed to be proportional to the output expectations in the economy.

$$KP_t^* = \alpha Y_t^* \tag{3.8}$$

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[12] This equation requires that $KP^*_{t-1} = KP_{t-1}$. This equality would generally hold in the steady state.

where Y_t^* is the expected output in the economy[13].

Substituting equation (3.8) in equation (3.7), we get:

$$I_{pvt(t)} = \beta\alpha[1-(1-\delta)L]Y_t^* + (1-\beta)I_{pvt(t-1)} \qquad (3.9)$$

The *beta coefficient* in the equation, which captures the response of private investment to the gap between desired and actual investment, which in turn is assumed to vary systematically with the economic factors that influence the ability of private investors to achieve the desired level of investment. We hypothesize that the response of private investment depends on the availability of financing (cost and quantity of credit), uncertainties in an open macroeconomy and the level of public sector investment[14].

With regard to availability of financing, a hypothesis emerged in recent years that, in contrast to developed countries, one of the principal constraints on investment in developing countries is the quantity, rather than cost of the financial resources. This view is associated with McKinnon (1973) in his controversial work on *Money and Capital in Economic Development*. Mc Kinnon (1973) was the first to challenge the conventional wisdom intrinsic in the Keynesian and neoclassical models that investment is interest rate sensitive and low interest rate would promote investment spending and economic growth in developed and developing countries[15] (Molho, 1986). Similarly, the movements in exchange rate can also cause changes in private investment, which reflects the uncertainties in the open macroeconomy, with surge of capital flows.

The phenomenon of real crowding out is incorporated in the model through the link between level of public investment and private investment. In the context of developing countries, it is a matter of debate whether public investment crowds out or crowds in private investment. In broad terms, crowding out phenomenon is expected if the public sector investment utilises scarce physical and financial resources that would be otherwise available

[13] We follow the assumption of Blejer and Khan (1984) that private sector investment depends on output expectations of the economy, not in the private sector alone. Blejer and Khan (1984) also noted that private sector output is proportional to total output.

[14] Blejer and Khan (1984) hypothesized that beta coefficient depends on (i) the stage of economic cycle, (ii) the availability of financing and (iii) the level of public sector investment. While Tun Wai and Wong (1982) hypothesized beta coefficient depends positively on the change in the bank credit to the private sector and net capital inflow to the private sector.

[15] Shaw (1973) also challenged the conventional wisdom that low interest rates are adopted in the countries as a way of promoting economic growth. A detailed discussion of various rationale for a policy of low interest rates is given in Shaw (1973, pp 92-112).

to the private sector, or if it produces marketable output that competes with private output (Blejer and Khan, 1984). The non-homogeneous nature of public investment receives attention in this context; that the public investment, which is infrastructure in nature, can attract private investment while public investment in non-infrastructure may or may not crowd in private investment. Theoretically, this relationship remains ambiguous.

On the basis of the arguments above, we can assume the reaction coefficient beta depends on monetary and fiscal policies; in particular, availability of credit to private sector (ΔC_{pvt}), rate of interest (i_r), real exchange rate (e_r), and public investment (I_{pub}). Thus,

$$\beta = f\{\Delta C_{pvt}, i_r, e_r, I_{pub}\} \tag{3.10}$$

A linear regression model for private investment can thus be constructed assuming equations (3.9) and (3.10) are linear.

$$I_{pvt} = a + b_1 I_{pvt(-1)} + b_2 I_{pub} + b_3 i_r + b_4 \Delta C_{pvt} + b_6 e_r + b_7 Y^* + v_t \tag{3.11}$$

Now we turn to discuss the nature of link between each of these explanatory variables with private investment.

3.3.1 Private Investment and Output Expectations

The output expectations as a determinant of private investment emanates from the accelerator theories of investment. In consistent with the flexible accelerator models of investment behaviour, a priori we expect that lagged private corporate investment is determined by the output expectations in the economy, which in turn is represented most closely by the level of output gap. The concept of output gap is synonym to the concept of capacity utilisation of an industry or firm. Like 'capacity utilisation', it is also a measure of the intensity with which national economy makes use of its resources. The economy-wide measure of 'capacity utilisation' or the *output gap* index can be defined as

OG=[(Actual GDP-Potential GDP)/Potential GDP] *100 (3.12)

This is also known as the 'economic activity index' (Congdon: 1998; Tanzi, 1985). It can be seen from the equation (3.12) that 'output gap' or the index of economic activity is defined as the difference between the actual and trend/potential level of national output as a percentage of trend/potential output.

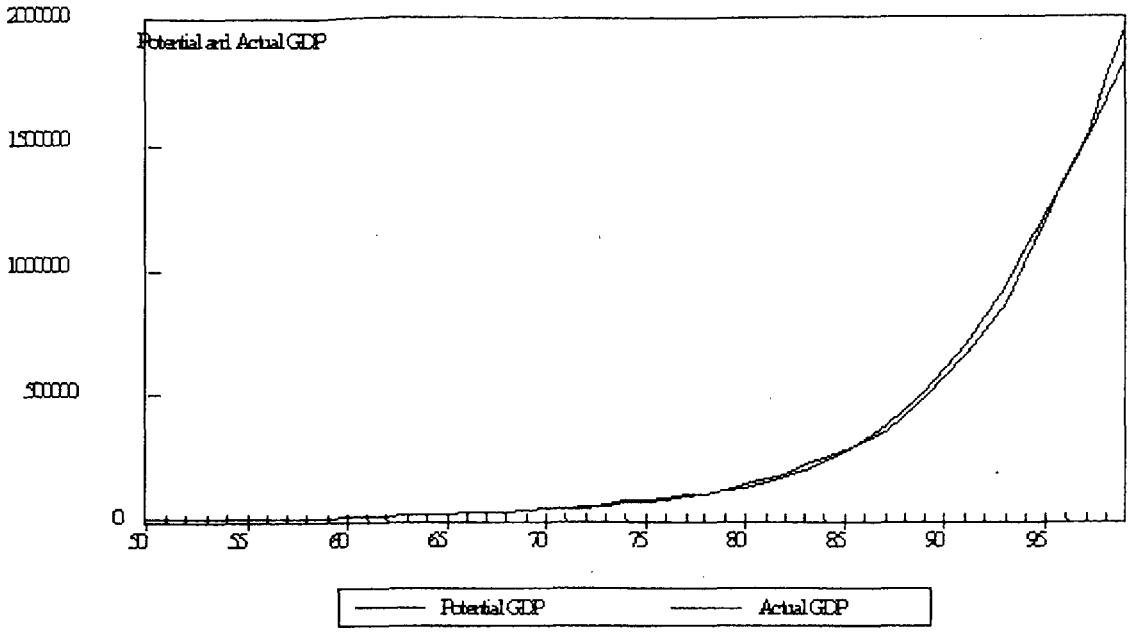
Definitionally speaking, potential level of output would be higher than the actual as the resource utilisation is maximum at potential level. However, it is argued that cyclical factor such as recession or boom could cause the actual to be below or above the potential output respectively (Tanzi: 1985). The major problem of estimation of 'output gap' lies on the estimation of potential level of output.

Theoretically, the 'production function method' estimates the trend/potential output by determining the quantity and productivity of inputs, viz., labour and capital[16]. The relative importance of the two inputs are determined by assuming that their return is determined by their marginal products and their share in the national output is equal to their quantity multiplied the return (Adams and Coe: 1990, Congdon: 1998). Trend output estimation through 'production function method' requires data on labour force and capital stock. If data on one of these series or both are not available, one has to search for other methods of estimation of trend output.

One of the most commonly used methods of estimation of trend output is the moving average method. Another method known as 'trend through peaks' developed by Klein with Wharton Econometric Forecasting Associates (hereafter TTP). The steps involved in estimation are delineated below. First step is to plot the data on GDP adjusted for price fluctuations and identify the peaks. Secondly, it is assumed that identified peaks in the series are the points where resources in the economy are used at 100 per cent of their capacity. Third step is to intrapolate between the major peaks including the first and last observation. The strong assumptions beneath the TTP method itself deterred us from using it as a tool for estimating potential output.

[16] It is called 'production function method,' as production is represented as the functions of inputs.

Figure 3.1: Movement of Actual and Hodrick-Prescott Filtered Potential Output in India



The Hodrick-Prescott filter (HP filter) is yet another method for the derivation of the potential output. The idea of this filter is to decompose a non-stationary time series such as actual output into a stationary cyclical component and a smooth trend component (Y_t and Y_t^* denote the logarithms of actual and trend/potential output respectively) by minimising the variance of cyclical component subject to a penalty for the variation in the second difference of the trend component. This results in the following constrained least square problem

$$Min \sum_{t=1}^{T} (Y_t - Y_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(Y_{t+1}^* - Y_t^*) - (Y_t^* - Y_{t-1}^*)]^2 \qquad (3.13)$$

The first term in the equation is a measure of fit. The second term is a measure of smoothness. The *Langrange* multiplier λ is associated with the smoothness constraint and must be set apriori. As a weighting factor, it determines how smooth the resulting output series is. The lower the λ, the closer potential output follows actual output. We have used the HP filter method for the calculation of potential level of output. The Figure 3.1 traces the path of actual and potential output in India. The series showed a smooth increasing trend over the period 1950-51 to 1999-00.

3.3.2 Private Corporate Investment and Price Vs Quantity of Credit

Theoretical literature argued that both price and quantity of credit have a bearing on investment. It is important in this context to examine whether principal constraint on investment in developing countries is the quantity or the cost of financial resources (McKinnon, 1973). It is noted that one of the principal constraints on investment in developing countries is the quantity, rather than the cost, of financial resources and it would be legitimate to hypothesize that private investor in a developing country is restricted by the level of bank financing (Blejer and Khan, 1984). The variable 'availability of credit' is the first difference of outstanding credit from the banking sector to the commercial sector. This variable is included in our study to understand whether it is the credit that gets rationed in the investment decisions in India. It is to be noted that moral hazards and adverse selection problems can lead to credit rationing since the riskiness of investments cannot be identified apriori (Stigliz and Weiss, 1981).

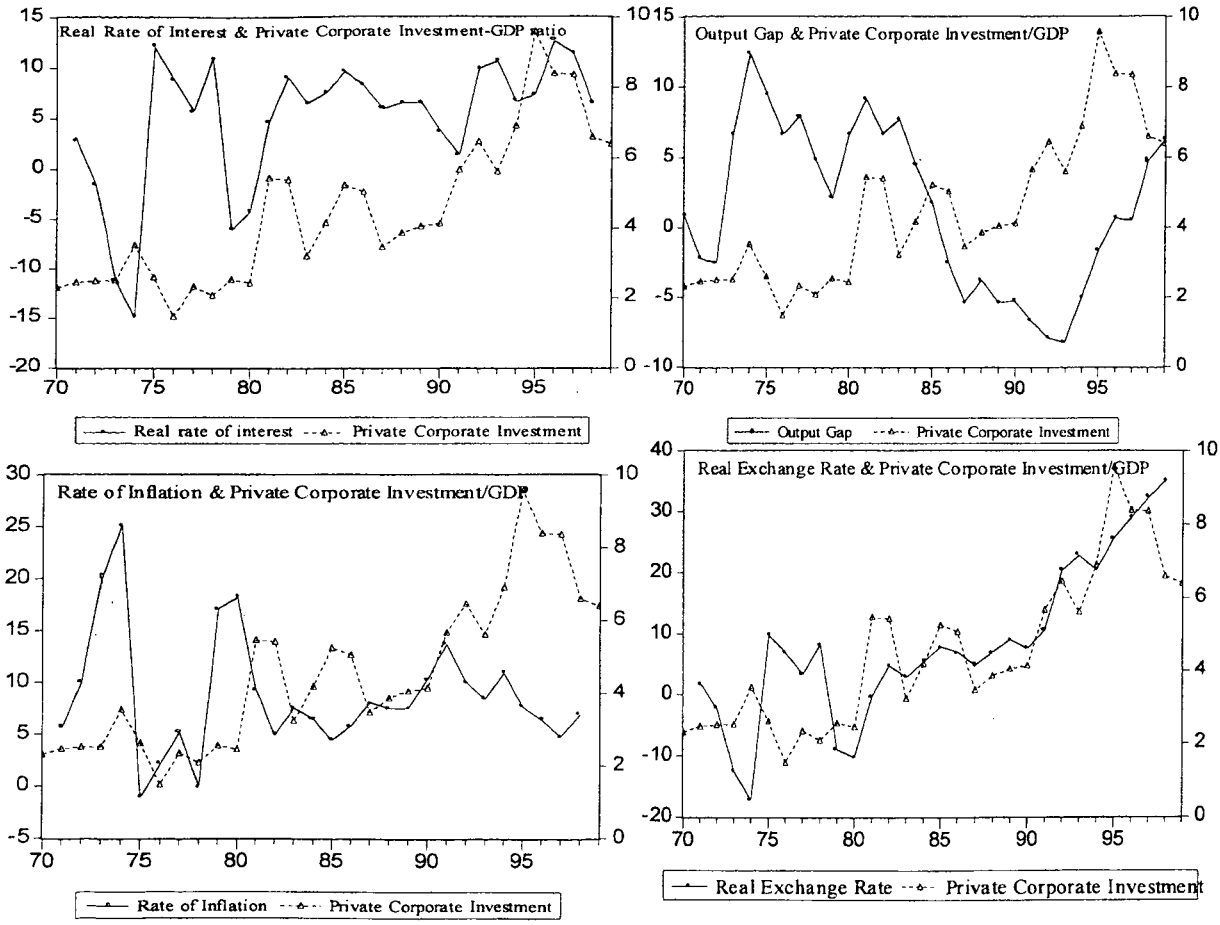
In order to analyse whether there is any impact of the cost of funds, i.e., the impact of rate of interest on private corporate investment, the study encountered the problem of selection of appropriate interest rates among the plethora of available interest rates in the financial market. We have selected the real Prime Lending Rate from the spectrum of rates of interest in India due to its relevance in determining the investment process in the economy[17].

3.3.3 Private Corporate Investment and Macroeconomic Uncertainties

Dixit and Pindyk (1994) have shown in their study that irreversible investments in the private sector would be postponed when there are macroeconomic uncertainties in the open economy about changing external economic conditions or the scope and duration of key stabilisation and structural adjustment policy reforms. In consistent with the theories, the macroeconomic fluctuations of an open economy can be captured through the real exchange variations in an economy. The macroeconomic uncertainties arising from the external financing constraints which reflects in foreign exchange reserves or debt-service ratio do not appear to have impact on private capital formation in India, unlike some other developing countries mainly because of the fact that Indian economy has not been open to foreign capital and trade flows until late nineties. Moreover, the financing pattern of fiscal deficit in India showed that it comprises mostly the internal liabilities. External debt financing of fiscal

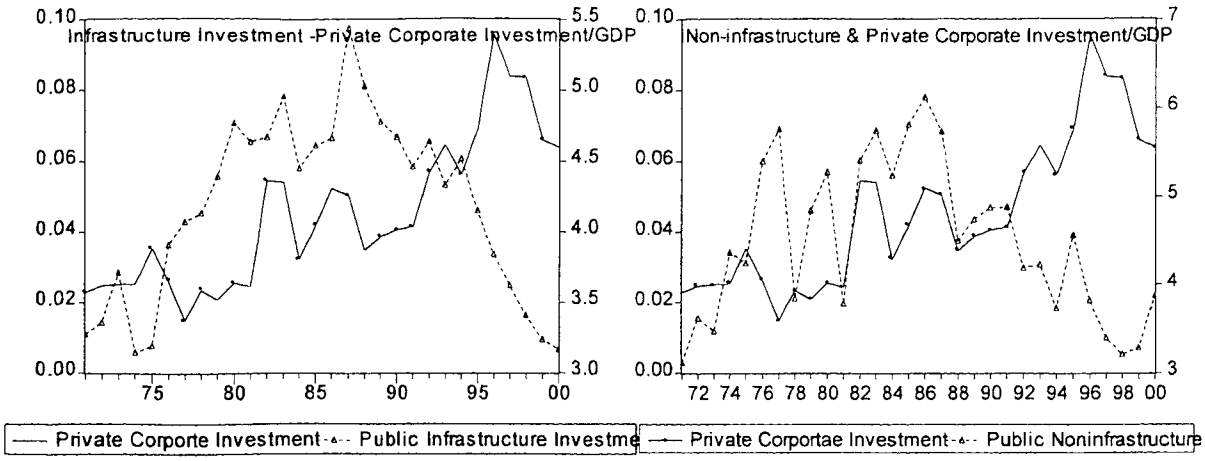
deficit has been highly negligible in India over the years of the period under concern. The overall external debt GDP ratio is also maintaining a moderate level. Thus, private investment disincentives in India cannot be associated with an external debt overhang as it happens in heavily indebted developing countries. Therefore external debt overhang theories[18] of disincentive effect on investment efficiency can be insignificant in the context of India[19]. However, to capture the macroeconomic uncertainties, we have used real effective exchange rate as a determinant of investment.

Figure 3.2: Plots of Comovements of Private Corporate Investment and its Potential Determinants



[18] For details on external debt overhang theories, please see Krugman (1988), Sachs (1988), Husain (1992). Krugman's hypothesis argued that when a country is unable to fully service its debt, actual payments tend to depend on the country's economic performance. He further argued that the existence of a heavy debt burden then depresses the return on investment and weakens the incentive to invest, since the part of the profits will need to be diverted towards debt servicing and amortization. When such disincentives becomes important, debt reduction is the appropriate policy action than private investment decisions. Yet another competing explanation for the fall in investment have also been offered by Krugman (1988), with very different policy implications. It argues that the debt crisis is a liquidity issue as opposed to a solvency issue. According to this view, lucrative private investment opportunities are available in debtor countries, but some sort of market failure associated with debt crisis has prevented creditors from lending any further (Krugman, 1988). Thus external debt overhang theories literature captures two types of investment inefficiency – a disincentive effect caused by the existence of future debt burden and a liquidity effect arising from a shortage of current resources available for investment.

[19] Dixit and Pindyk (1994) analysed the detrimental effects of price uncertainties on private capital formation.



3.4 Econometric Estimation of the Model

As it is a time series analysis, before estimating the model in a multivariate timeseries framework by using Hsiao's [1981] asymmetric vector autoregressive framework, we undertake the pre-tests of integration and cointegration. We have used Hsiao's methodology because it has got an advantage of judicious parametrisation of lag structure using Akaike's Final Prediction Error, when compared to Sims-Granger framework of causality. Also, this VAR-FPE approach does not infect the model with spurious restrictions on variables.

3.4.1: Checking for Stationarity of Series: Unit Root Tests

Figure 3.2 plots the private corporate investment and its potential determinants during the period between 1970-71 and 1999-2000. Prima facie, it is difficult to understand whether these macro series are stationary or not. Thus, we undertake unit root test. Testing of unit root involves the testing of order of integration of the data series. A series X_t is said to be integrated of order d, denoted by

$$X_t \sim I_t (d) \qquad (3.13)$$

If it becomes stationary after differentiating d times and thus X_t contains d unit roots. Using the augmented Dickey Fuller (ADF) methodology[20], the fundamental regression equation to

[20] One of the major problem of the ADF test is that the selection of appropriate lag length. Including too many lags reduces the power of the test to reject the null hypothesis since the increased number of lags require the estimation of additional parameters and loss of degrees of freedom. On the other hand, too few lags will not capture the actual error process, which would fail to give a proper estimate of □ and its standard error (Enders: 1995). The approach suggested for the selection of appropriate lag length is to start with a relatively long lag length and pare down to the model by the usual t-test and / or F-test. Thus, one can estimate the equation using a lag length of n*. If the t-statistics is insignificant in the lag n*, repeat the procedure until the lag is significantly different from zero.

test unit roots is,

$$\Delta y_t = \alpha_0 + \alpha_{1t} + \gamma y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad (3.14)$$

The null hypothesis of unit root is accepted if $\gamma = 0$. If the null hypothesis $\alpha_1 = \gamma = 0$ is rejected, the series is trend stationary.

The unit root test results of private corporate investment and its a priori determinants are presented in the Table 3.2. All the variables are integrated of order one.

Table 3.2: Unit root test results for private corporate investment and its a priori determinants

Macrovariables	*Lags*	*t-statistics*	*Mc Kinnon Critical Value*	*Order of integration*
Private Corporate Investment	0	-4.854067	-4.3226	I ~ (1) c, t* at 1%
Public Investment	0	-3.290360	-4.3226	I ~ (1) c , t* at 1%
Real rate of interest	0	-5.743169	-4.3226	I ~ (1) c,t at 1%
Output Gap	0	-6.500505	-4.3226	I ~ (1) c,t at 1%
Rate of Inflation	0	-5.735325	-4.3226	I ~ (1) c ,t at 1%
Real Effective Exchange Rate	0	-4.686083	-4.3226	I ~ (1) c,t at 1%
Public Infrastructure Investment	2	-1.59811	-2.6560	I ~ (1) c,t at 10%
Public Noninfrastructure Investment '	0	-3.623654	-4.3226	I ~ (1) c,t at 10%
Fiscal Deficit	0	-5.213464	-4.3226	I ~ (1); c, t*.

Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

3.4.2 Testing for Cointegration: Johansen's Maximum Likelihood Approach

Having established that macrovariables are non-stationary and have same order of integration at I ~ (1), we proceed to test whether the linear combination of these macroseries is stationary, that is, they are cointegrated. Cointegration is a test for equilibrium between non-stationary variables integrated of same order. We employ co-integration test to determine whether the simple Granger causality test is appropriate. In case of multivariate models, Johansen's cointegration test, based on trace and the eigen value tests, is superior to Engle – Granger methodology, for three reasons. First, the Johansen and Juselius method tests for all the number of cointegrating vectors between the variables. These tests are based on the trace statistic test and the maximum eigen value test. Second, it treats all variables as endogenous, thus avoiding an arbitrary choice of dependent variable. Third, it provides a unified framework for estimating and testing cointegrating relations within the framework of a vector error correction model[21].

[21] Gonzalo (1994) also pointed out that the Johansen maximum likelihood procedure for cointegration is a better technique compared to single equation methods and alternative multivariate methods.

Before endeavoring Johansen's FIML approach to cointegration, we need to ascertain the nature of intercept and trend in the underlying VAR model and choose the order of VAR. The order of VAR is detected using the model selection criteria of AIC, SBC and Log Likelihood method, setting the sample to maximum order of 3. The Schwarz Bayesian Criteria (SBC) suggests a VAR of order 1, while Akaike Information Criteria (AIC) and Log Likelihood of order 2 (Table 3.3).

Table 3.3: Selection of Order of VAR Model: Prelude to Cointegration

Order	*LL*	*AIC*	*SBC*	*LR Test*	*Adjusted LR Test*
3	-323.58	-483.58	-499.52	-	-
2	-411.68	-481.58	-528.97	$\chi^2(36)$=176.19(0.000)	54.21(0.026)
1	-451.27	-487.27	-509.92	$\chi^2(72)$=255.37(0.000)	78.58(0.279)
0	-682.59	-682.59	-682.59	$\chi^2(108)$=718.021(0.00)	220.9296(0.00)

Since we have a short timeseries data, we cannot afford the risk of over-parameterization and therefore chose 1 as the order of VAR as per the SBC criteria. According to Ho and Sorensen (1996), when Johansen's cointegration procedure is applied to small samples, the precision of the estimator is much better when the lag length is short. Next important step is to ascertain the nature of intercept and trend. It is proved that most of the series under consideration are trended, but it seems unlikely that there will be a trend in cointegrating relation between the variables. Using deterministic or non-deterministic trends in data, the maximum Eigen value test and λ- trace test suggested that the rank (number of cointegrating vectors) is two[22] (see Appendix A 3.1 for details on methodology).

Table 3.4: Cointegration tests based on Johansen's Maximum Likelihood Method

Maximum Eigen value Test					**Trace Test**				
Ho	*H1*	*Statistics*	*CV 95 %*	*CV 90%*	*Ho*	*H1*	*Statistics*	*CV 95 %*	*CV 90%*
r=0	r=1	69.93	39.83	36.84	R = 0	R ≥ 1	140.82	95.87	91.4
r=1	r=2	33.43	33.64	31.84	R ≤ 1	R ≥ 2	70.89	70.49	66.23
r=2	r=3	23.75	27.42	24.99	R ≤ 2	R ≥ 3	37.46	48.88	45.7
r=3	r=4	11.59	21.12	19.02	R ≤ 3	R ≥ 4	13.71	31.54	28.78
r=4	r=5	1.92	14.88	12.98	R ≤ 4	R ≥ 5	2.11	17.86	15.75
r=5	r=6	0.20	8.07	6.50	R ≤ 5	R = 6	0.2	8.07	6.5

Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

In the maximum eigen value test, the null hypothesis r= 0 is tested against the specific alternative that r =1; r ≤ 1 against r =2 etc. In the trace test, the null hypothesis is that the number of cointegrating vectors is less than or equal to r, where r is 0,1, 2 etc. In each case, the null hypothesis is tested against a general alternative. If there is any divergence of

[22] The result of model without trends is reported in the Table 3.4.

results between these two tests, evidence from maximum eigen value test is more reliable in case of small samples (Banerjee et al, 1993). Table 3.4 presents the results. In case of maximum eigen value test, with the null hypothesis of no cointegration (r=0) among the variables, the maximum eigen value statistic is 69.93, which is above the 95 per cent critical value of 39.83 hence it rejects the null hypothesis r = 0 at 5 per cent level of significance in favour of alternative, that there is one cointegrating vector, r =1. Similarly, $r \leq 1$ cannot be rejected at 5 per cent level of significance, though $r \leq 1$ can be rejected at 10 per cent level of significance. Hence we concluded that there are two cointegrating relationships among the variables such as private investment, public investment, output gap, real rate of interest, real effective exchange rate and availability of credit to private sector[23].

In case of trace test also, the null hypothesis of no cointegration (r = 0) is rejected at the 5 per cent of significance in favour of the general alternative, $r \geq 1$, as the trace statistic is 140.82, which is above the 95 per cent critical value of 95.87. The trace test also rejects the hypothesis of $r \leq 1$ at 5 per cent level as the statistic of 70.89 is above the 95 per cent critical value of 70.49. But the trace test fails to reject the hypothesis $r \leq 2$ at 5 per cent level, as the statistic of 37.46 is not above the 95 per cent critical value of 48.88. Thus, both maximum eigen value test and trace test suggested that there are two cointegrating relations[24].

3.4.3 Optimal Parametrisation and Causality Detection

As the macrovariables are tested for the order of integration and cointegration, the next task that follows the logical order is to detect the direction of the causality between the variables. Granger [1969] has defined causality as X_t is a Granger cause of Y_t (denoted as $X_t \Rightarrow Y_t$) if Y_t can be predicted with accuracy by using past values of X_t rather than by not doing so, other information being identical.

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[23] Here lies an important econometric question, is it better to have one or many cointegrating vectors among the group of the system variables? The existence of many cointegrating vectors may indicate that the system under examination is stationary in more than one direction and hence it is stable. As discussed by Dickey, Jansen and Thorton (1994) ,"the more cointegrating vectors there are, the more stable the system... it is desirable for an economic system to be stationary in as many directions as possible". From the angle of policymaking, the existence of more than one long run cointegrated relationship between a set of variables has significant policy implications. In the framework of cointegrated series, policy makers could determine their targets on one variable seeking to stabilize effectively the long run level of some other variables.

[24] This cointegration test suggests that Granger causality test must have an error correction representation in autoregressive process in estimating causality. Granger (1988) pointed out that cointegration is concerned with the long run whereas causality refers to short run forecastability. The inclusion of *error correction term* allows for detection of short run causal impacts through the lagged changes in the independent variable and the long run causal impact through the error correction term.

The appropriate parametrisation of the model manifests the critical part of Granger-causality test, as the results depend on the lag length chosen. Arbitrary or adhoc parametrisation can lead to econometric problems. Under parametrisation may lead to estimation bias and over parametrisation results in the loss of degrees of freedom and thus the power of the test[25].

Hsiao's (1981) method is one of the alternatives to unconstrained Sims type symmetric VAR[26]. Hsiao's procedure starts from univariate autoregression and sequentially adds lags and variables using Akaike's [1969] Final Prediction Error criterion. This Asymmetric VAR model using FPE criterion to select the appropriate lag specification takes care of *parametrically prolific* symmetric VAR models. An advantage of Hsiao (1981) Asymmetric VAR is that along with the appropriate parametrisation, we can detect the causality of the variables also in the autoregressive framework. Asymmetric VAR models permit more flexibility in modeling dynamic system. In Asymmetric VAR, each equation has the same explanatory variables, but each variable may have different number of lags. Hsiao noted that

> *FPE criteria is appealing since it balances the risk due to the bias when a lower order is selected and the risk due to the increase of variance when a higher order is selected.*

And by combining Final Prediction Error criterion and Grangers' (1969) definition of causality, a practical method for identification of the system of equations was suggested (see Appendix A 3.2 for detailed methodology).

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[25] On the basis of parametrisation, Vector Autoregressive modeling can be of two types. The first type of VAR model is standard Sims-type VAR model in which every variable enters every equations with the same lag length. This is Symmetric VAR model since it employs symmetrical lag specifications. The second type is Asymmetric VAR model. Asymmetric VAR model is defined as VAR where each variable may have a unique number of lags. The advantage of asymmetric VAR over symmetric VAR is that the latter employs the same lag length for each variable, exhausts considerable degrees of freedom and consequently often estimates many statistically insignificant coefficients.

[26] Litterman (1986) used Bayesian Vector Autoregressive model, which another alternative to symmetric VAR. Hsiaos' [1981] Asymmetric VAR has an advantage against Littermans' Bayesian VAR. Litterman imposes Bayesian prior restrictions on VAR coefficients. Since these prior restrictions are almost always based on forecasting performance instead of economic theory, parameter estimates from Bayesian VARs are likely to be biased. Bias may be acceptable in forecasting, but biased structural parameters estimates are undesirable if the goal is to answer questions about macroeconomic structure and the channels of operation of a macrovariable (Keating, 2000).

The final prediction error (FPE) of fitting one dimensional autoregressive process for private corporate investment is computed with upper bound of lag length (L^*) assumed equal to 5 in all the models discussed in the chapter. Firstly, we have considered private corporate investment as controlled variable, holding the order of its autoregressive operator to one, we sequentially added the lags of the manipulated variables such as public investment, real rate of interest, output gap, availability of credit to private sector and exchange rate upto the L^* of 5 and found respective order which gives the smallest FPE.

Table 3.5: Public Investment –Private Investment Model: Results: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable

Controlled Variable	*Manipulated Variables*					*Optimum lags of Manipulated Variable*	*Final Prediction Error*	*Causality Inference*
I_{pvt} (1)				-	-	-	0.01202	-
I_{pvt} (1)	I_{pub}	-	-			1	0.01113	$I_{pub} \Rightarrow I_{pvt}$
I_{pvt} (1)	I_{pub}	C_{pvt}	-			1	0.01393	$\Delta C \neq I_{pvt}$
I_{pvt} (1)	I_{pub}	C_{pvt}	O_g			1	0.01513	$Og \neq I_{pvt}$
I_{pvt} (1)	I_{pub}	C_{pvt}	O_g	$(i_r - \pi_t)$		1	0.01427	$(i_r - \pi_t) \Rightarrow I_{pvt}$
I_{pvt} (1)	I_{pub}	C_{pvt}	O_g	$(i_r - \pi_t)$	$(e_r)_t$	1	0.01632	$(e_r)_t \neq I_{pvt}$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

The order in which variable enter into the equation is as per the *specific gravity criteria* (Caines, Keng and Sethi, 1981; details in Appendix A 3.3). As per the specific gravity criteria, the explanatory variables sequenced as follows: public investment, credit availability to private sector, output gap, real interest rate and finally real effective exchange rate. The results showed that private corporate investment is sensitive to real rate of interest and public investment. The macroeconomic instability in the open economy arising from fluctuations in exchange rate adjusted for inflationary expectations, output gap and the availability of credit to private sector are found insignificant in determining the private corporate investment. The econometric results are provided in Table 3.5, showed the interest rate sensitivity of private corporate investment and also the link between public investment and private corporate investment.

In addition to detection of causality, the sign of the causal relationship between private corporate investment and other macrovariables is also of great significance in understanding the mechanism of crowding out phenomenon. The evidence of cointegration

implies the error correction modeling of private corporate investment, which combines both the long run information and short run dynamics in the equation.

$$I_{pvt} = \underset{(-1.506)}{-2.516} + \underset{(1.085)}{0.380}\ \Delta I_{pvt\,(t-1)} + \underset{(1.97)^*}{0.837}\ \Delta I_{pub\,(t-1)} + \underset{(0.167)}{1.98E\text{-}06}\ \Delta C_{pvt} -$$

$$\underset{(-2.247)^*}{-0.024}\ \Delta i_{r(t-1)} + \underset{(0.0177)}{0.0045}\ \Delta (e_r)_{(t-1)} + \underset{(0.069)}{0.001}\ \Delta (O_g)_{t-1} + \underset{(0.167)}{0.232}\ D_{91} - \underset{(-0.263)}{0.095}\ ecm_{(-1)}$$

$R^2 = 0.51$
$DW = 1.92$

*The figures in parentheses denote t-statistics and * denote 1 per cent level of significance.*

The equation showed that public investment and real rate of interest affect private capital formation in India. There is no evidence of direct crowding out of private corporate investment by public investment; instead it is observed that one per cent increase in public capital formation increased private capital formation in the corporate sector by 0.84 per cent. The estimated equation reinforced the rejection of McKinnon hypothesis that cost of the credit does not matter for the capital formation in the private corporate sector in the context of developing countries. The confirmation of no financial crowding out can be detected only after checking whether real interest rate rise is induced by fiscal deficit operations of the government, which would be dealt in the next chapter. Before going into discussion on these issues, it is imperative to analyse the link between private corporate investment and public investment based on the non-homogeneity of public capital formation in India.

3.4.4: Non-Homogeneity of Public Investment

The public capital formation in India is of non-homogeneous in nature and can broadly divided into infrastructure and non-infrastructure investment. Table 3.4 provides the components of public capital formation based on the type of economic activity. It is noted that the public investment in agriculture has shown a sharp decline.

The public sector investment in agriculture power, water supply, electricity, gas, transport and communication constituted around 50 per cent of the total domestic capital

formation in public sector. The public investment is marginal in the sectors of construction, mining and quarrying, trade, finance, insurance and business services in India[27].

Table 3.6: Distribution (%) of Gross Domestic Capital Formation in Public Sector by Economic Activity (per cent)

	Agri, forestry & Fishing	*Mining , quarrying*	*Manu factur ing*	*Electric ity, gas, water supply*	*constru ction*	*Trade, hotels, restarua nts*	*Transport, storage & communic ation*	*Finance, insurance , real estate, business services*	*Communit y, social, personal services*	*GDCF in Public Sector Rs crores*
1970-71	11.92	2.88	14.94	21.86	0.69	6.82	17.44	1.75	21.72	2919
1971-72	11.84	2.84	16.39	19.20	0.59	4.34	17.06	2.11	25.62	3411
1972-73	13.55	3.82	17.50	17.57	0.67	-4.70	20.54	1.99	29.06	3875
1973-74	11.94	4.26	20.74	14.70	0.97	4.53	15.21	1.99	25.65	4924
1974-75	10.67	4.80	26.00	16.29	1.62	5.41	15.97	1.67	17.57	5753
1975-76	9.62	6.70	18.65	18.68	0.88	15.39	13.70	1.48	14.90	7746
1976-77	11.98	7.47	19.69	17.80	0.95	13.27	11.64	1.85	15.35	8822
1977-78	15.53	7.79	19.84	23.06	1.85	-2.25	13.22	1.95	19.01	8101
1978-79	14.28	6.16	18.40	20.58	1.76	4.56	12.69	1.94	19.63	10165
1979-80	13.90	6.62	21.89	21.12	1.04	1.43	12.45	1.99	19.56	12137
1980-81	15.63	7.55	9.66	24.38	2.41	-0.25	15.03	2.31	23.28	12106
1981-82	12.02	8.97	18.59	21.95	1.74	2.74	12.36	1.94	19.69	16986
1982-83	11.24	13.17	17.55	22.34	0.68	0.54	12.76	1.99	19.73	20138
1983-84	11.60	13.09	16.17	22.43	-0.07	2.45	11.92	2.65	19.76	21264
1984-85	10.46	11.12	17.39	20.68	1.01	4.11	13.09	2.59	19.55	25600
1985-86	9.40	12.97	19.16	22.42	0.91	0.40	11.43	2.75	20.56	29980
1986-87	8.33	12.11	16.07	25.76	0.15	-0.59	14.60	3.29	20.30	34772
1987-88	9.79	12.13	15.03	29.27	0.69	-6.70	13.75	4.80	21.25	33757
1988-89	8.58	11.86	12.89	26.32	-0.15	-0.74	15.32	5.58	20.36	40136
1989-90	7.23	13.46	11.78	25.33	0.17	3.77	16.36	5.24	16.66	46405
1990-91	6.83	12.25	13.46	25.93	0.65	2.74	14.99	4.55	18.61	53099
1991-92	6.34	10.74	14.76	30.21	0.65	-2.89	15.99	5.60	18.60	57633
1992-93	6.52	9.96	12.97	24.75	0.70	1.99	19.33	4.41	19.36	63997
1993-94	6.94	8.94	6.92	25.26	1.08	4.91	22.55	4.29	19.10	70834
1994-95	6.80	16.79	7.20	22.84	0.90	2.17	17.99	4.35	20.95	88206
1995-96	7.43	12.54	14.12	23.43	0.68	-4.32	19.26	5.12	21.73	90977
1996-97	7.60	6.69	15.48	25.47	0.86	-1.72	18.51	5.49	21.62	95967
1997-98	6.88	7.32	11.72	26.16	1.02	2.40	18.48	5.91	20.13	100653
1998-99	6.59	6.30	13.15	25.85	0.67	0.40	17.22	6.16	23.67	114505
1999-00	6.13	6.20	12.35	22.07	0.92	5.35	16.80	4.71	25.48	137670

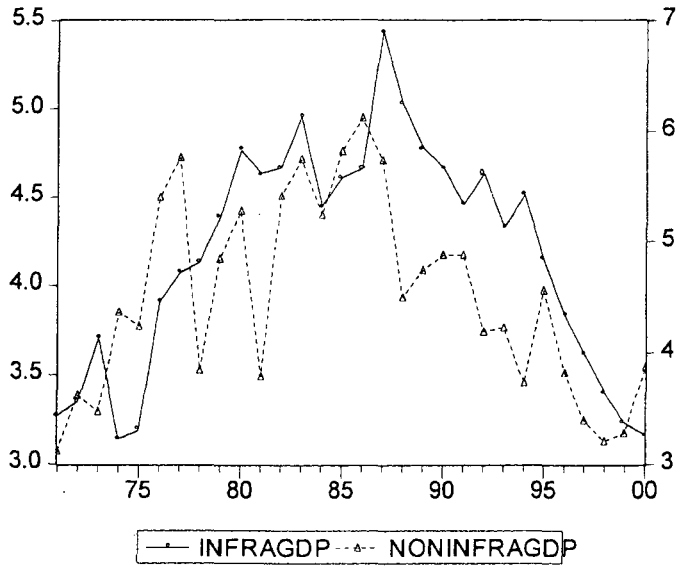
Source: National Account Statistics, New Series, CSO, 2001 and 2002

Given the sectoral composition of public investment in India, now we can broadly categorize the public capital formation into infrastructure and non-infrastructure investment. In the study, public infrastructure investment is defined as the aggregate of capital formation

[27] The gross capital formation in public sector grew at a rate of 13. 65 per cent over the period between 1960-61 and 1999-2000. The trend growth rate of capital formation in power and water supply surpassed the overall growth rate of capital formation in public sector over the same period at 15.37 per cent, while public investment in finance, insurance and business services has shown a marked growth rate of 23.53 per cent and mining at 18 per cent. The growth rate of public investment in agriculture and allied activities, manufacturing, transport and communication marked around 12 per cent over the last four decades.

in agriculture, electricity, water supply, oil and transport and communication. While the public non-infrastructure is defined as capital formation in manufacturing, mining and quarrying, trade, hotels and restaurant, finance and insurance etc[28]. Based on the nature of investment, it is deciphered from Figure 2.2 that gap between both series widened between mid eighties and mid nineties; and both series showed a declining trend too. The decline in public capital formation is more in case of non-infrastructure investment than infrastructure investment since eighties. It is important in this context to analyse the heterogeneity of public investment - whether it implies that different types of public investment likely to have conflictive or mutually reinforcing effects on private capital formation; public investment in infrastructure prima facie tend to attract private investment while public investment in non-infrastructural activities where public enterprises do what private firms too can do- might have substitution effects.

Figure 3.3: Trends in Infrastructure and Non-infrastructure Investment-GDP Ratio



Taking into consideration the non-homogeneity of public capital formation, we analysed the buoyancies of both infrastructure and non-infrastructure investment in the public sector for various years along with the buoyancy estimates of private capital formation. The estimates presented in Table 3.7 suggested that over the period between 1970-71 and 1999-00, buoyancy of total private investment (1.17) was greater than total public investment (0.98). Over the years, the buoyancy of public investment declined from 1.31 in 1970-1980 to 0.71 in 1990-1999, while the buoyancy of private investment reached a peak of 1.48 in 1980-1990 and declined to 1.11 in the subsequent decade. Within the public investment, public infrastructure investment has shown a steady increase in the buoyancy from 0.98 in 1970-80

[28] Karen Parker (1995) categorized infrastructure and non- infrastructure investment in similar manner.

to 1.11 in 1990-1998. Within the private investment, private corporate investment has shown a steady increase in buoyancy from 0.93 in 1970-1980 to 1.35 in 1990-1998 while the buoyancy of investment in households sector increased from 1.21 in 1970-1980 to 1.64 in 1980-90 and then declined to 0.95 in 1990-1999. The decline in the public investment has reflected in the decline in the gross capital formation from 1.22 in 1970-1980 to 0.97 in 1990-1999.

Table 3.7: Buoyancy Estimates of Different Components of Capital Formation

Year	*Public*	*Infrastructure*	*Non-infrastructure*	*Private Corporate*	*Household*	*Total Private*	*Total*
1970-1980	1.31	0.98	1.04	0.93	1.21	1.14	1.22
1980-1990	0.99	1.04	0.95	1.05	1.64	1.48	1.14
1990-1999	0.71	1.11	1.09	1.35	0.95	1.11	0.97
1970-1999	0.98	1.00	0.96	1.36	1.06	1.17	1.09

Source: computed from NAS, New series, CSO, 2001

Now we turn to econometrically investigate the link between private corporate investment with the infrastructure and non-infrastructure public capital formation. The model specified is same as above in case of public investment model, but with separate inclusion of infrastructure and non-infrastructure investment instead of aggregate public investment. The unit root tests revealed that both infrastructure and non-infrastructure investment are integrated of order one. Johansen's full information maximum likelihood method of cointegration based on maximum eigen value tests and trace tests revealed that there are two cointegrating equations when public infrastructure investment is included instead of public investment[29] (Table 3.6).

Table 3.8: Cointegration tests based on Johansen's Maximum Likelihood Method: Unrestricted Intercept & No Trends in VAR Model of Private & Infrastructure Investment

Maximum Eigen value Test					**Trace Test**				
Ho	*H1*	*Statistics*	*CV 95 %*	*CV 90%*	*Ho*	*H1*	*Statistics*	*CV 95 %*	*CV 90%*
R=0	R=1	67.95	39.83	36.84	R = 0	R ≥ 1	132.35	95.87	91.40
R=1	r=2	31.92	33.64	31.02	R ≤ 1	R ≥ 2	64.39	70.49	66.23
R=2	r=3	18.80	27.42	24.99	R ≤ 2	R ≥ 3	32.47	48.88	45.70
R=3	r=4	11.93	21.12	19.02	R ≤ 3	R ≥ 4	13.66	31.54	28.78
R=4	r=5	0.99	14.88	12.98	R ≤ 4	R ≥ 5	1.74	17.86	15.75
R=5	r=6	0.75	8.07	6.50	R ≤ 5	R = 6	0.75	8.07	6.50

Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

Subsequent to the pretests of integration and cointegration, we proceeded to the detection of causality with simultaneous optimal parametrisation of the model using Hsiao's asymmetric vector autoregressive model. The results moved in tandem with the public

[29] The order of cointegrating VAR is one and the rank is detected to be two for both using deterministic and non-deterministic trends in the model.

investment model. The optimal lag structure is tested to be one for the controlled and all the manipulated variables as per the parameterization criteria of Final Prediction Error (FPE) in public infrastructure-model. The specific gravity criterion of sequencing the variables into the equation suggested that output gap and public infrastructure investment entered the equation prior to the variables that capture the cost and quantity of credit. The results suggest that public sector capital formation in infrastructure and real rate of interest proved to be the effective causal factors of private corporate investment while the macroeconomic instabilities in both domestic and external front were found not the causal variables of the private capital formation in the corporate sector.

Table 3.9: Private Investment- Public Infrastructure Investment Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable

Controlled Variable	***Manipulated Variables (MV)***					***Optimum lags of MV***	***FPE***	***Causality Inference***
I_{pvt} (1)	-	-	-	-	-	-	0.01202	-
I_{pvt} (1)	O_g	-	-	-	-	1	0.01284	$Og \neq I_{pvt}$
I_{pvt} (1)	O_g	$I_{pubinfra}$	-	-	-	1	0.01256	$I_{pubinfra} \Rightarrow I_{pvt}$
I_{pvt} (1)	O_g	$I_{pubinfra}$	C_{pvt}	-	-	1	0.01474	$C_{pvt} \neq I_{pvt}$
I_{pvt} (1)	O_g	$I_{pubinfra}$	C_{pvt}	$(i_r - \pi_t)$	-	1	0.01433	$(i_r - \pi_t) \Rightarrow I_{pvt}$
I_{pvt} (1)	O_g	$I_{pubinfra}$	C_{pvt}	$(i_r - \pi_t)$	$(e_r)_t$	1	0.01580	$(e_r)_t \neq I_{pvt}$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

The evidence from the equation inclusive of error correction term and a dummy for stabilization and structural adjustment reforms since 1991 (D 91) revealed that public infrastructure investment crowds in public investment; the magnitude of the effect is also substantial, that one per cent rise in public infrastructure investment crowds in 0.90 per cent of private corporate investment. The rate of interest is also found to be a significant variable in determining the private investment. The estimated coefficient value of error correction term of 0.386 is found insignificant, however, it suggested that the system corrects its previous period's disequilibrium by 38 per cent.

$$I_{pvt} = \underset{(-1.52)}{-3.75} + \underset{(1.46)}{0.46}\, I_{pvt(t-1)} + \underset{(1.804)^*}{0.895}\, \Delta I_{pubinfra\,(t-1)} + \underset{(0.299)}{3.79E\text{-}06}\, \Delta C_{pvt} -$$

$$\underset{(-2.28)^*}{-0.02}\, \Delta i_{r(t-1)} + \underset{(0.911)}{0.0098}\, \Delta (e_r)_{(t-1)} + \underset{(0.961)}{0.016}\, \Delta (O_g)_{t-1} + \underset{(1.487)}{0.394}\, D_{91} + \underset{(0.925)}{0.386}\, ecm_{(-1)}$$

$R^2 = 0.46$
DW= 1.92
The figures in parentheses denote t statistic and * denote 1 % level of significance.

Now we turn to analyse the link between public noninfrastructure investment and private investment in India. Theoretically, considerable ambiguity remains in the direction of magnitude of public non-infrastructure investment and private capital formation, especially in the context of developing countries. If government invests in the sectors, which are of competing in nature with private firms, it may lead to crowding out of private investment. At the same time, private firms operate in a *level playing field* provided by the government in the investible sectors and government continue investing in non-infrastructure projects like manufacturing, finance and insurance, business services etc. a healthy co-existence of private and public sector investment can be apriori expected. It is therefore important to econometrically investigate whether public non-infrastructure investment have mutually reinforcing effects on private corporate investment or substitution effects.

Table 3.10: Cointegration tests based on Johansen's Maximum Likelihood Method: Unrestricted Intercept & No Trends in VAR Model of Private & Non-Infrastructure Investment

Maximum Eigen value Test					**Trace Test**				
Ho	***H1***	***Statistics***	***CV 95 %***	***CV 90%***	***Ho***	***H1***	***Statistics***	***CV 95 %***	***CV 90%***
r=0	R=1	66.91	39.83	36.84	R = 0	R ≥ 1	137.41	95.87	91.40
r=1	R=2	38.26	33.64	31.02	R ≤ 1	R ≥ 2	70.50	70.49	66.23
r=2	R=3	20.04	27.42	24.99	R ≤ 2	R ≥ 3	32.24	48.88	45.70
r=3	R=4	11.21	21.12	19.02	R ≤ 3	R ≥ 4	12.20	31.54	28.78
r=4	R=5	0.91	14.88	12.98	R ≤ 4	R ≥ 5	0.99	17.86	15.75
r=5	R=6	0.83	8.07	6.50	R ≤ 5	R = 6	0.08	8.07	6.50

Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

The pretest of Johansen's Full Information Maximum Likelihood estimates based on maximum eigen value test and trace test for public non-infrastructure and private corporate investment model showed that there are at the most two cointegrating vectors as the rank is detected two[30]. Then we proceeded to optimal parametrisation and causality detection, that results are shown in Table 3.9. The analysis showed that public non-infrastructure investment is found insignificant in determining private investment in India. The cost of credit rather than quantity of credit is found significant when we included public noninfrastructure investment instead of public investment.

[30] The order of cointegrating VAR is detected to be one and the models estimated on the basis of inclusion and exclusion of deterministic trends showed that the rank is two.

Table 3.11: Private Investment- Public Non-infrastructure Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable.

Controlled Variable	***Manipulated Variables***					***Optimum lags of Manipulated Variable***	***Final Prediction Error***	***Causality Inference***
I_{pvt} (1)	-	-	-	-	-	-	0.01202	
I_{pvt} (1)	$I_{pubnoninfra}$		-	-	-	1	0.01348	$I_{pubnoninfra} \neq I_{pvt}$
I_{pvt} (1)	$I_{pubnoninfra}$	Og				1	0.01354	$Og \neq I_{pvt}$
I_{pvt} (1)	$I_{pubnoninfra}$	Og	C_{pvt}	-	-	1	0.01567	$C_{pvt} \neq I_{pvt}$
I_{pvt} (1)	$I_{pubnoninfra}$	Og	C_{pvt}	$(i_r - \pi_t)$	-	1	0.01548	$(i_r - \pi_t) \Rightarrow I_{pvt}$
I_{pvt} (1)	$I_{pubnoninfra}$	Og	C_{pvt}	$(i_r - \pi_t)$	$(e_r)_t$	1	0.01705	$(e_r)_t \neq I_{pvt}$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

The evidence from equation with error correction term also revealed that cost of credit is a significant determinant of private investment. The coefficient of error correction term is found significant in the model, with the value of -0. 918 suggests that the system needs to adjust downward by 92 per cent to restore long run equilibrium.

$$I_{pvt} = \underset{(0.711)}{0.1005} + \underset{(0.761)}{0.307}\,\Delta I_{pvt(t-1)} + \underset{(1.093)}{0.388}\,\Delta I_{pubnoninfra} + \underset{(0.115)}{2.67E\text{-}06}\,\Delta C_{pvt} -$$

$$\underset{(-2.402)^*}{0.021}\,\Delta i_{r(t-1)} - \underset{(-0.367)}{0.005}\,\Delta (e_r - \pi_t)_{(t-1)} + \underset{(0.556)}{0.012}\,\Delta (O_g)_{t-1} + \underset{(0.418)}{0.086}\,D91 - \underset{(-1.93)^*}{0.918}\,ecm$$

$R^2 = 0.457$
DW= 2.09
The figures in parentheses denote t statistic and * denote 1 % level of significance.

As discussed in the beginning of the chapter, fiscal policies can affect private investment through three channels: via public investment, fiscal deficit and rate of interest. The above models of public (infrastructure and non-infrastructure) investment showed that there is no evidence of *direct crowding out* of private corporate investment by public investment. But the confirmation of no *financial* crowding out can be detected only after checking whether real interest rate rise is induced by fiscal deficit operations of the government, which would be dealt in the next chapter. If the real rate of interest is not induced by fiscal deficit, then no evidence for the occurrence of financial crowding out though private corporate investment is interest rate sensitive. Now we turn to look into the possibility of fiscal deficit directly (not via investment expenditure we discussed in the above models) crowding out private investment.

Table 3.12: Cointegration tests based on Johansen's Maximum Likelihood Method: Unrestricted Intercept & No Trends in VAR Model of Private Investment and Fiscal Deficit

Maximum Eigen value Test					Trace Test				
Ho	***H1***	***Statistics***	***CV 95 %***	***CV 90%***	***Ho***	***H1***	***Statistics***	***CV 95 %***	***CV 90%***
r=0	r=1	88.39	39.83	36.84	R = 0	R ≥ 1	182.16	95.87	91.4
r=1	r=2	42.10	33.64	31.02	R ≤ 1	R ≥ 2	93.77	70.49	66.23
r=2	r=3	28.28	27.42	24.99	R ≤ 2	R ≥ 3	51.66	48.88	45.70
r=3	r=4	11.84	21.12	19.02	R ≤ 3	R ≥ 4	23.38	31.54	28.78
r=4	r=5	7.41	14.88	12.98	R ≤ 4	R ≥ 5	11.54	17.86	15.75
r=5	r=6	4.13	8.07	6.50	R ≤ 5	R = 6	4.13	8.07	6.50

Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

We know that the variables under consideration are integrated of order one (Table 3.2). As the next step, now we turn to apply Johansen and Juselius (1990) cointegration analysis which is based on trace test statistics and maximum eigen value statistics in identifying the number of cointegrating vectors. It is clear from Table 3.12 that the null of no cointegration is rejected by both statistics because either statistic is larger than the critical value. The null of one or two cointegrating vectors is also rejected in the same regard. However, the null of at most three cointegrating vectors cannot be rejected in favour of r = 4. After detecting the number of cointegrating relations to be three, now we turn to sequential causality tests based on Hsiao's autoregressive framework of VAR-FPE method.

Table 3.13: Fiscal Deficit Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable

Controlled Variable	***Manipulated Variables***					***Optimum lags of Manipulated Variable***	***Final Predictio n Error***	***Causality Inference***
I_{pvt} (1)	-	-	-	-	-	-	0.012021	
I_{pvt} (1)	f_d	-	-	-	-	1	0.011802	$f_d \Rightarrow I_{pvt}$
I_{pvt} (1)	f_d	*Og*	-	-	-	2	0.011933	$Og \neq I_{pvt}$
I_{pvt} (1)	f_d	*Og*	C_{pvt}	-	-	1	0.014863	$C_{pvt} \neq I_{pvt}$
I_{pvt} (1)	f_d	*Og*	C_{pvt}	$(e_{r-})_t$	-	1	0.016227	$(e_r)_t \neq I_{pvt}$
I_{pvt} (1)	f_d	*Og*	C_{pvt}	$(e_{r-})_t$	$(i_{r-}\pi_t)$	1	0.015519	$(i_{r-}\pi_t) \Rightarrow I_{pvt}$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data): National Account Statistics, New Series, CSO, 2001 and 2002, and Handbook of Statistics on Indian Economy, RBI, 2001

The results of VAR-FPE causality showed that fiscal deficit determines the private capital formation in India. Fiscal deficit affects private capital formation via the leverage of public investment activities through capital expenditure. The equation with error correction term showed that fiscal deficit and private investment are positively related, which in turn negates the occurrence of crowding out. This result reinforces that preferential access of public sector to domestic financial resources in order to finance the deficit does not crowd out private investment in India. It is noted that to the extent public expenditure is in investment

activities, in particular, infrastructure investment, such as power, transport and communication, it could be complementary to private investment rather than crowding out. Also, these investments by government can enhance the profitability and productivity of private investment, which could provide a demand and supply side stimulus to private investment. The rate of interest is found significant in determining private investment in fiscal deficit model too.

$$I_{pvt} = \underset{(-0.616)}{-0.605} + \underset{(1.778)^*}{0.481}\,\Delta I_{pvt\,(t-1)} + \underset{(2.26)^*}{0.583}\Delta DEF_{(t-1)} + \underset{(0.088)}{1.01E\text{-}06}\,\Delta C_{pvt\,(t-1)} -$$

$$\underset{(-2.235)^*}{-0.022}\,\Delta i_{r(t-1)} - \underset{(-0.0374)}{0.0009}\,\Delta (e_r)_{(t-1)} - \underset{(-0.5122)}{0.0069}\,\Delta (O_g)_{t-1} + \underset{(1.248)^*}{0.388}\,\mathbf{D91} - \underset{(0.387)}{0.138}\,\mathbf{ecm}_{(-1)}$$

$R^2 = 0.556$
DW= 1.93;
The figures in parentheses denote t statistic and * denote 1 % level of significance.

The coefficient of error correction term of -0.138 showed that the system has to adjust 13 per cent downward to restore the long run equilibrium, however the coefficient is found insignificant.

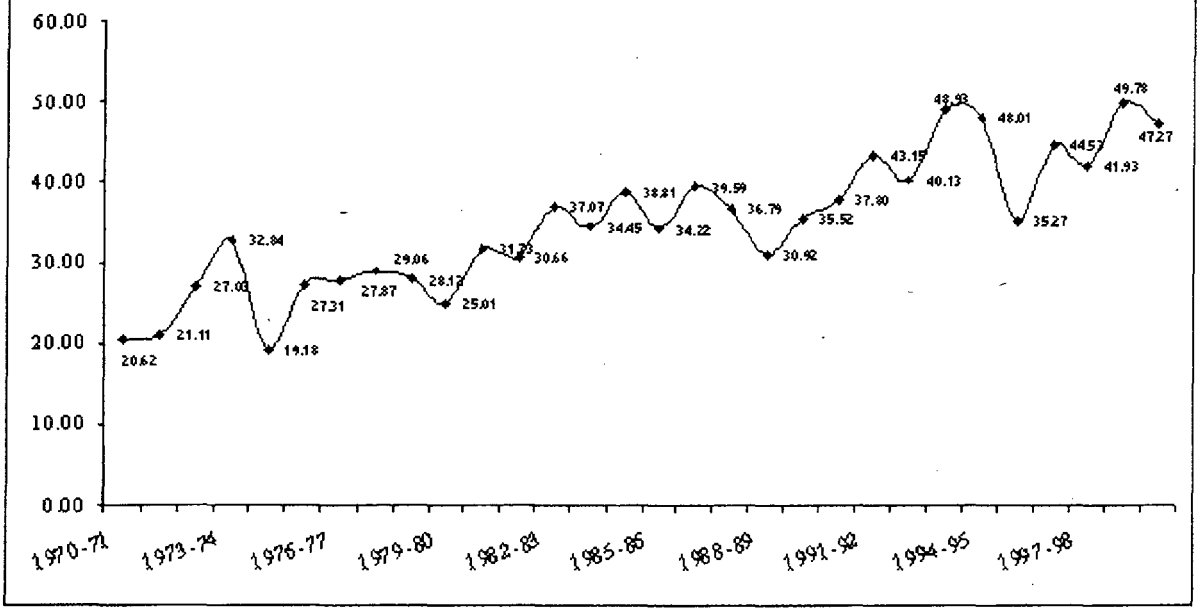
3. 5: Summing Up

The results of all the four models suggest that there is no evidence of *direct* crowding out of private capital formation by public investment in India. Furthermore, in determining private capital formation, rate of interest is found significant, which reinforced the invalidity of McKinnon hypothesis that it is the quantity of credit and not the cost of credit that matters for private investment in developing countries like India[31]. The evidence of no crowding out and the sensitivity of private investment to rate of interest need further explanation. One of the plausible reasons for no crowding out in the context of India can be explained from the pattern of savings in the economy, especially that of the households, which has moved in favour of financial assets. As can be seen from Figure 3.4, the share of financial savings in gross domestic savings has increased from 20.62 per cent in 1970-71 to 48.93 per cent in 1993-94 and then to 49.78 per cent in 1998-99 immediately after a dip to 35.27 per cent in 1995-96. This compositional shift in the savings in India towards financial assets could

[31] This result of rate of interest being a significant determinant of private investment is in confirmation with the certain studies on crowding out in the context of developing countries including India. For instance, Shafik (1992) in the context of Italy and Parker (1995) in the context of India.

moderate the crowding out effects as it increases the loanable funds in the economy and thereby imparting less pressure on rate of interest[32].

Figure 3.4: Share of Financial savings in Gross Domestic savings



The increase in the financial resources raised through capital markets during eighties in addition to the bank credit to private sector give an indication that private corporate sector, on the aggregate, did not face a shortage of investible resources, which can be another reason for no evidence of crowding out[33]. Though there is no evidence of *direct crowding out* of private corporate investment by public investment; while confirmation of no *financial crowding out* can be detected only after analysing whether real interest rate rise is induced by fiscal deficit operations of the government, which would be dealt in the next chapter. If the real rate of interest is not induced by fiscal deficit, then no evidence for the occurrence of *financial crowding out* though private corporate investment is interest rate sensitive.

[32] It is often argued that one of the principal constraints on investment in the developing countries where prices are administratively controlled is the *credit rationing* and therefore it would be legitimate to hypothesize that private investors in developing countries is restricted by the *level of banking* (Blejer and Khan, 1984).

[33] The financing of private corporate investment through corporate debentures increased from 696 million US dollars in mid-eighties to 3500 million US dollars by mid nineties, and equity financing of private corporate investment increased from 77 million US dollars in the late eighties to around 5000 million US dollars by mid-nineties. Moreover, financing of private corporate sector through commercial bank borrowing also increased from 9473 million US dollars in 1984-85 to 16,146 million US dollars by 1994-95 (see for details, Parker, 1995).

Appendix

A 3.1: Johansen- Juselius Full Information Maximum Likelihood Procedure of Cointegration

Johansen-Juselius tried to develop a methodology as follows to study the longrun relationship among non-stationary variables. Let us define z_t as 'n' potentially endogeneous variables and model z_t as an unrestricted VAR of k lags,

$z_t = A_1 z_{t-1} + \text{----------} + A_k z_{t-k} + u_t$ where $u_t \sim IN(0\ \Sigma)$ ---------- (i)

where z_t is (n x 1) and each of the Ai is an (n x n) matrix of parameters[34].

The equation (i) can be reformulated into a vector error correction (VECM) form:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \text{-------} + \Pi z_{t-k} + \mu_t \text{ ----------} \quad (ii)$$

where $\Gamma_i = -(I - A_1 - \text{-------} - A_i)$, $(I - A_1 - \text{.....} - A_k)$.

and $\Pi i = -(I - A_1 - \text{.....} - A_k)$.

The equation (ii) contains information on both the short run and long run adjustment to changes in z_t, via the estimates of $\hat{\Gamma}_i$ and $\hat{\Pi}$ respectively. As shown in Johansen (1988), $\Pi = \alpha\beta'$, where α represents the speed of adjustment to disequilibrium, while β is a matrix of long run coefficients such that the term $\beta' z_{t-k}$ represents up to n-1 cointegrating relationships in the multivariate model which ensure that the z_t converge to their long run steady state solution.

Assuming that z_t is a vector of non-stationary I(1) variables, then all the terms in (ii) which involve Δz_{t-i} are I(0). We need to have u_t as I~(0) for existence of long run relationship. This can happen only when Πz_{t-k} is stationary, which can be met in three

[34] This type of VAR-model is to estimate dynamic relationships among jointly endogenous variables without imposing strong a priori restrictions (such as particular structural relationships and/or exogeneity of some of the variables). The system is in reduced form with each variable in zt is regressed on only lagged values of both itself and all other variables in the system. Thus OLS is an efficient way to estimate each equation comprising (i) since right hand side of each equation in the system comprises a common set of (lagged and thus predetermined) regressors (Harris, 1995).

instances: when all variables in zt are in fact stationary. The second instance when there is no cointegration, that is, Π is an (n x n) matrix of zeros. The third way for Πz_{t-k} to be $I \sim (0)$ is when there exists upto (n-1) cointegration relationship: $\beta` z_{t-k} \sim I(0)$. In this instance, $r \leq (n-1)$ cointegration vectors exist in β (that is, r columns of β form r linearly dependent combinations of variables, each of which is stationary, together with (n-r) nonstationary vectors (that is, n-r columns of β form $I \sim (1)$ common trends.). Only the cointegrating vectors enter equation (ii), otherwise Πz_{t-k} would not be $I \sim (0)$, which implies that (n-r) columns of α are effectively zero. The problem of estimating the number of cointegrating vector in a multivariate system boils down to estimating the rank of Π matrix.

- Rewriting equation (ii) as:

$$\Delta z_t + \alpha\beta` z_{t-k} = \Gamma_1 \Delta z_{t-1} + \ldots\ldots\ldots + \Gamma_{k-1} \Delta z_{t-k+1} + u_t \text{ -------} (iii)$$

It is possible to correct for short run dynamics by regressing Δz_t and z_{t-k} separately on the right hand side of equation (iii). That is, the vectors R_{0t} and R_{kt} are obtained from:

$$\Delta z_t = P_1 \Delta z_{t-1} + \ldots\ldots\ldots\ldots + P_{k-1} \Delta z_{t-k-1} + R_{0t} \text{ ----------} (iv)$$

$$z_{t-k} = T_1 \Delta z_{t-1} + \ldots\ldots\ldots\ldots + T_{k-1} \Delta z_{t-k-1} + R_{kt} \text{ ----------} (v)$$

which can then be used to form residual (product moment) matrices.

$$S_{ij} = T` \sum_{i=1}^{T} R_{ij} R`_{jt} \; i, j = 0, k \text{ ----------} (vi)$$

The maximum likelihood estimate of β is obtained as the eigen vectors corresponding to the *r* largest eigen values from solving the equation:

$$\left| \lambda_{skk} - S_{k0} S_{00}^{-1} S_{0k} \right| = 0 \text{ ----------} (vii)$$

which gives the *n* eigen values $\hat{\lambda}_1 > \hat{\lambda}_2 > \text{----------} > \hat{\lambda}_n$

and the corresponding eigen vectors $\hat{V} = (\hat{v}_1, \ldots\ldots\ldots, \hat{v}_n)$.

Those r elements in $\hat{V}$ which determines the linear combinations of stationary relationships can be denoted by $\hat{\beta} = (\hat{v}_1 \ldots\ldots \hat{v}_r)$, that is, these are cointegration vectors. This is because the eigen values are the largest squared canonical correlations between the 'level' residuals R_{kt} and the difference residuals R_{0t}, that is, we obtain estimates of all the distinct $\hat{v}'_i z_t (i = 1,2,\ldots\ldots,r)$ combinations of the I(1) levels of z_t which produce high correlations with the stationary $\Delta z_t \sim$ I (0) elements in equation (3) , such combinations being the cointegration vectors by virtue of the fact that they must themselves be I(0) to achieve a high correlation. Thus the magnitude of $\hat{\lambda}_i$ is a measure of how strongly the cointegration relations $\hat{v}'_i z_t$ (which we can denote as $\hat{\beta}_i' z_t$) are correlated with the stationary part of the model. The last (n-r) combinations obtained from solving (vii) that is, $\hat{v}'_i z_t$ (I=r+1,….,n), indicate the non-stationary combinations, and theoretically these are uncorrelated with the stationary elements in (ii). Consequently, for the eigen vectors corresponding to the non-stationary part of the model, $\hat{\lambda}_i = 0$ for i=r+1,….,n. So for example, Johansen (1992) points out that the test that r=1 is really a test that $\hat{\lambda}_2 = \hat{\lambda}_3 = \ldots\ldots\ldots = \hat{\lambda}_n = 0$, where as $\hat{\lambda}_i > 0$.

The values of Likelihood Ratio (LR) test statistic is used for the hypothesis that number of cointegrating vectors is not greater than r. One can use two LR tests. These are LR test based on maximum eigen value (λ_{max}) and LR test based on trace ((λ_{trace}) of the stochastic matrix. These are defined as follows:

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$$

where λ_i = estimated values of the characteristic roots (also called eigen values) obtained from the estimated π matrix.

T = the number of usable observations.

A 3.2: Hsiao (1981) Autoregressive Model of Causality Detection

Vector Auto Regression models can be written in general form as

$$y_t = \alpha + \psi(L)\, y_t + \mu_t \quad \text{---------- (i)}$$

where y_t is vector of model variables

that is, (first difference of (I_{pub}), (O_g) (i_r), (ΔC_{pvt}), (e_r)

α is vector of constants

μ_t is vector of white noise error terms

$\psi(L)$ is vector of polynomials in the lag operator, L

where $\varphi_{ij} = \sum_{t=1}^{k} \varphi_{i_j\, i} L^i$ where L is the lag operator

μ_t and ν_t are white noise error terms.

To choose the order of lags in $\psi_{ii}(L)$ and $\psi_{ij}(L)$ by the minimum FPE is equivalent to applying an approximate F test with varying significance levels [for details, see Hsiao [1981].

Akaikes' definition of Final Prediction Error criteria is expressed as

$$FPE_y(m,n) = \frac{T+m+n+1}{T-m-n-1} * \frac{\sigma^2 y(m,n)}{T}$$

where T is the number of observations, m and n are the order of lags of the variables under the concern , private corporate investment [y] and determinants[x_s] respectively and

$$\sigma^2 y(m,n) = \sum_{t=1}^{T} (y_t - \hat{\psi}^m{}_{ii}(L) y_t - \hat{\psi}^n{}_{ij}(L) x_{s_t} - \hat{a})^2$$

where superscripts m and n denote the order of lags in $\psi_{11}(L)$ and $\psi_{12}(L)$. And $\psi^m{}_{11}(L)$, $\psi^n{}_{12}(L)$ $x_{s\,t}$ and $\hat{a}$ are the least square estimates. The causality can be detected as follows: If FPE y (m, n) < FPE y (m, 0) then $x_{(s)t}$ Granger causes y_t, denoted by $x_{(s)t} \Rightarrow y_t$.

A 3.3: Causality Analysis and Multivariate Autoregressive Modeling using Specific Gravity Criteria (Caines, Keng and Sethi, 1981)

Caines, et al (1981) suggested the following procedure for multivariate autoregressive modeling for stationary processes:

(i). For a pair of stationary processes (X, Y) construct bivariate AR models of different orders, then compare the multivariate final prediction errors of these models, and choose the model of order k possessing minimum FPE to be the optimal model for the pair of processes (X, Y).

(ii). Construct bivariate AR (k) models (both causal models and non-causal (independent) models] for (X, Y) and apply the stage wise causality detection procedure to determine the endogeneity, exogeneity or independent relations between X and Y.

(iii). If a process, say X, has n multiple causal variables, $y^1, y^2, \ldots, y^n$, we rank these multiple causal variables according to the decreasing order of their specific gravities.

(iv). For each caused (endogenous) process, X, we first construct the optimal univariate AR model using FPE criterion, then we include X's multiple causal variables, one at a time, according to their causal ranks and use FPE criterion to determine the optimal orders of the model at each step.

(v). Pool all the optimal univariate AR models constructed in (iv) and estimate the system.

Chapter 4

Fiscal Deficit and Rate of Interest Link in India: An Analysis of Financial Crowding Out

In the last chapter, no evidence of *direct* crowding out of private investment in India was established. The absence of direct crowding out does not necessarily imply the absence of *financial* crowding out. It is mentioned earlier in chapter 3 that *financial* crowding out may occur due to the upward pressures on the rate of interest induced by the debt financing of fiscal deficit. In other words, even if public sector investment does not crowd out private investment, private capital formation in the economy may suffer due to the increase in the interest rates arising due to the pre-emption of real and financial resources by the government to finance the increasing fiscal deficits. In this chapter, we examine whether fiscal deficit affects interest rate. It is all the more important to examine such a link in the present context, as it has already been noted in chapter 3 that the rate of interest is a significant determinant of private investment. If increase in fiscal deficit increases the rate of interest, it would imply financial crowding out.

Theoretically, an analysis of the link between fiscal deficit and interest rate assumes importance mainly for the following three reasons (Correia, et al: 1995): Firstly, as mentioned earlier, if the increase in fiscal deficit leads to an increase in the rate of interest, it may lead to a decline in the interest-sensitive components of private spending, such as investment. Secondly, if such a relationship was verified, a reduction of budget balances could moderate upward pressure on interest rates and could therefore provide monetary policy additional degrees of freedom in the interest rate management[1]. And thirdly, in the context of growing integration of financial markets, an increase in the domestic interest rate due to the rise in the deficit can be spread globally.

In this chapter we examine the link between fiscal deficit and interest rate in India. It is well known and also discussed earlier (Chapters 2 and 3) that Indian financial system was characterised by administered interest rate structure till recently. The process of financial deregulation since 1991 has been aimed at making the financial sector market-oriented to

[1]In a large number of industrial countries, actual fiscal imbalances prevent monetary policy from properly managing interest rates. Thus in order to stimulate economic activity, the setting of both monetary and fiscal policies needs to be reassessed within a comprehensive framework of sound and stable fiscal balances over the medium term (Correia, et al: 1995).

improve allocative efficiency[2]. The moot question is that, as rate of interest was administered until the recent deregulation, how could a functional relationship be justified between deficit and the administered interest rate. Even if it is assumed that administered rate of interest truly reflects the market signals; there is a need to establish such a relationship empirically. The task of establishing such a relationship is ambiguous. However, contrary to the popular belief that administered rate of interest in developing countries is insensitive to market perceptions, the literature revealed that administered rate of interest does accommodate market signals, and in order to analyse that, literature suggested to examine the intertemporal movement of rate of interest and its variability (K L Gupta, 1984). The analysis of intertemporal movements in the selected rates of interest adjusted for inflationary expectations in Chapter 2 showed that the rates of interest in India, though administered, has shown variations over the years and real rates of interest remained positive in substantial number of years.

Thus, the present chapter examines whether the intertemporal changes in the rates of interest is influenced by the movement of fiscal deficit. Also, in order to examine the exact nature of this relationship in an unadministered interest rate regime, the present study uses the high frequency monthly data of fiscal deficit and rate of interest for the period between April 1994 to September 2001 and examines the relationship between the two. The decade of 1990s characterizes deregulation of interest rate in general and in government securities in particular as a part of the financial liberalization that has been underway.

This chapter is divided into five different sections. Section 4.1 discusses various theoretical paradigms on the relationship between fiscal deficit and interest rates and critically evaluates the empirical literature. Section 4.2 discusses the theoretical model of rate of interest in an open-economy framework, while Section 4.3 deals with econometric methodology adopted and reports the results obtained. Section 4.4 discusses the link between fiscal deficit and rate of interest in the deregulated financial regime and Section 4.5 sums up the chapter.

[2] The major highlights of financial liberalization are interest rate deregulation, a phased reduction of cash reserve requirement and statutory liquidity ratio, simplifying directed credit programmes, development of money markets etc. The administered interest rates were simplified since 1992-93. A small number of fixed rates for priority sector loans were retained, while large commercial borrowers faced a floor-lending rate. In 1993-94, the markets for commercial paper and certificate of deposit was deregulated, allowing companies to access credit at market terms that were considerably below the minimum lending rate. In October 1994, the minimum lending rate was eliminated. The deregulation of interest rates has been accompanied by the introduction of new instruments like 14-day and 182-day auction Treasury Bills in addition to the 91-days and 364-days auction Treasury Bills. It is to be noted that 182-day Treasury bill was reintroduced in mid-1999.

4.1 Alternative Theoretical Paradigms and Empirical Literature

At theoretical level, an extensive debate has developed to explain the link between deficit and interest rate. There are three different theoretical paradigms, viz., neo-classical, Keynesian and Ricardian, under which this relationship can be viewed and empirically tested. According to the neoclassical view, rise in deficit leads to an increase in the rate of interest and in turn crowds out private investment. Whereas the Keynesians visualise that although increase in the deficit leads to an increase in the rate of interest, such an increase stimulates savings and capital formation. In between the neoclassical and Keynesian view, there exists the central observation of Ricardian Equivalence Theorem which argued that deficits merely postpone taxes and therefore tax-financing and debt financing of deficit have equal impact on the economy and thus deficit does not have any impact on interest rate (Barro, 1974).

Table 4.1: Selected Empirical Evidences on link between fiscal deficit and rate of interest

Author Period Country	*Model*	*Macrovariables*	*Results*
Paul Evans (1985) 1858-1950 US	ISLM Model in 2SLS	Real rate of interest =f {pubexp/GDP, deficit/GDP, money stock/GDP, expected inflation}	Deficit does not have impact on rate of interest.
Mustaq Ahmed (1994) 1970-1991 Pakistan	ISLM in OLS	Real interest rate = f {gov.exp., gov. deficit, change in money stock, expected inflation}	No variable except inflation is significant. Monetary & fiscal policy variables do not have any impact.
Tanzi, Vito (1985) 1960-1984 US	Neo-classical	Nominal interest rate =f{GAP, expected inflation, money supply, government deficit, gov. exp, trade balance}	Sensitivity of rate of interest to fiscal deficit has come down in the recent years of study, in 1980-84 time span.
Erol Balkan & Umit Erol (1985) 1960-1984 UK	ISLM in 2SLS	Real rate of inflation =f {gov. deficit, gov. exp.,trade balance, expected inflation, money supply}	Significant and positive impact of government deficit on real rate of interest.
Cebula, Richard (1990) 1973-1993 US	Loanable Funds model In cointegration	Nominal longrun rate of interest =f{budget deficit-GDP ratio, capital flow/gdp, expected inflation, short run rate of interest, percentage change in real GDP}	Deficit Granger causes rate of interest.
Correia, Jose & Luakas Stemitsiotis (1995) 1970-1993 10 OECD countries	Loanable Funds model in 2SLS	Long run rate of interest = f{short run rate of interest, expected inflation, deficit/GDP}	Deficit affects longrun rate of interest.
Gupta, K L (1990) 1960-1985 10 Asian countries	RET in OLS	Private real percapita consumption = f{transitory and permanent income, taxes, transitory and permanent gov. exp}	RET is rejected for Sri Lanka, India, Indonesia, Philippines among 10 countries.
Kulkarni & Erick (1996) 1960-1988 India	Accelerator model in OLS	Short run rate of interest =f {lagged short run rate of interest, inflation based on CPI, exchange rate, budget deficit}	Deficit does not affect rate of interest.

Many authors have empirically tested this relationship and found contradictory results. Evans (1985), Tanzi (1985), Dalamagas (1987), Ahamad (1994), Kulkarni and Lee (1996)

found no positive link between rate of interest and deficit. While Cebula (1990), Correia and Stemitsiotis (1995), Ostrosky (1979) did find evidence for the link between deficit and rate of interest. The common analogy of latter set of studies is that, in a growth economy with accumulation, increasing budget deficits may create over the long term a shortage of funds available for investment. If this potential imbalance between the supply of funds and intended investment is not met, long-term rate of interest react as economic agents anticipate the shortage of funds. The former set of studies, which observed no link between interest rate and fiscal deficit emphasises that in the context of global integration of financial markets, the supply of funds curve is infinitely elastic. Also, some studies under this category, tried to explain their findings under the paradigm of Ricardian Equivalence Theorem (hereafter RET).

It is to be noted that the empirical literature on fiscal deficit and interest rate link is largely confined to developed countries. To start with, in the context of US, Tanzi (1985) examined the relationship between fiscal deficit and interest rate. He observed that for the period between 1960 and 1984, the sensitivity of interest rate to fiscal deficit came down over the years. Tanzi pointed out that the plausible explanation beneath this phenomenon is the growing global integration of financial markets in recent years and correspondingly increasing flow of global capital to finance the domestic deficit. On the basis of the multivariate Loanable Funds Model (which incorporates the effect of term structure of rate of interest)[3], Cebula (1990) and Correia, et al (1995) showed that deficit, inflation, short run rate of interest, percentage change in GDP and capital flows Granger cause nominal long term rate of interest and hence crowd out private investment. In the study of Correia, et al (1995), which was, based on cross-country data of 10 OECD countries; there was evidence of crowding out as rate of interest was positively linked to the deficit. Further, Cebula (1997) examined the direction of causality between long term interest rates and structural budget deficits in the US for a period between 1973 and 1991 and found that there is bi-directional causality between rate of interest and the deficit.

In the context of developing countries, studies are few on the link between budget deficit and interest rate. In the context of Pakistan, Ahmad (1994) found that there is no link between rate of interest and deficit. In India, paucity of data on market rate of interest might

[3] The advantage of Loanable Funds model is that in addition of capturing the monetary and fiscal variables like real deficit, real money stock, government spending, expected inflation rate etc., it also captures the term structure of interest rates. In other words, loanable funds model framework allows the combination of the characteristics of the term-structure with the fiscal and monetary policy variables influencing the interest rate.

be the reason for no specific studies on the causal relationship between the deficit and interest rates. However, as seen in the Chapter 3, there is literature, which examined the question of crowding out phenomenon, which is one of the possible end results of the deficit-induced increase in the rate of interest. For instance, as mentioned earlier in Chapter III, studies by Sunderrajan and Takur (1990) and Pradhan, et al (1990) and Parker (1995) addressed the issue of crowding out between public and private investment in India, but these studies failed to establish the macroeconomic link of deficit and interest rate through which the crowding out phenomena should theoretically be operating.

4.2 Theoretical Framework of Rate of Interest model

Although, the focus of the recent study is to examine the relationship between fiscal deficits and interest rates, an appropriate model specification is extremely important as other macroeconomic variables may also affect the movement of rate of interest. Thus, this relationship ideally be tested in a multivariate framework. Before, we discuss and specify an appropriate theoretical model for econometric estimation, let us discuss apart from fiscal deficits what are the other possible macroeconomic links, which may affect the movement of rates of interest.

4.2.1. Money Supply and Interest Rate.

The unsettled relationship between money supply and rate of interest effect is reviewed extensively by Nachane, et al (1997). These are mainly unanticipated monetary announcement effect, Keynesian liquidity effect, financial effect, price expectations effect (Fisher effect) and income effect. Due to unanticipated monetary announcement effect, permanent higher money growth rate induces an increase in expected inflation and a resulting increase in interest rates to reflect an inflation premium. (Girton and Nattress, 1985). According to the Keynesian "liquidity effect," income and prices are slow to react as the money supply increases and thus the monetary system experiences excess liquidity at unchanging nominal income levels. Contemporaneous with the liquidity effect there runs the financial effect. As per the financial effect, as the growth of money increases, banks find themselves saddled with excess reserves and these excess reserves have to be temporarily parked in short term market securities. This temporary spurt in the demand for short-term marketable securities, lowers short term interest rates. When money supply increases with the rise in income, the demand for money rises. As a result the real balance of the economy decreases, finally pushing up the nominal rate of interest.

Price expectation effect (Fisher Effect) manifests that when money supply increases, the expected inflation increases and thereby the nominal rate of interest also increases. All five effects will be present in any given situation though their duration, strength and timing are largely an empirical matter and will vary from situation to situation.

The relationship between monetary expansion and interest rate has been obscure in the empirical literature. While Mishkin (1982) found that the interest rate and money growth surprises have a significant positive correlation, Makin (1983) found that it is negative and significant. Makin explained these contradictory findings as a result of the different method used to measure interest rates. Makin implied that his *period-average* short term rate of interest is responding to the initial liquidity effect, while Mishkin's *end-of-period* short term rate of interest measure is sampled after the Fisher effect begins to dominate. Grier (1986) also showed that lagged money surprises have a significant positive impact on rates.

4.2.2. Nominal Rate of Interest and Expected Inflation

Fisherian theory predicts that the nominal rate of interest will tend to change at the same rate as changes in expected inflation. Thus it manifests one-to-one relationship between the expected inflation and the nominal rate of interest. According to Fischer equation, a one- percent increase in the expected rate of inflation in turn causes a one percent increase in the nominal rate of interest. Only a few studies in the context of US by Feldstein (1976), Gibson (1970) have found coefficients close to unity. But Sargent (1976), Shiller (1979) and John (1981) have observed that these findings of "coefficients close to unity" are limited to a particular period of US history, till early seventies. Furthermore, even a unit coefficient would contradict superneutrality hypothesis; that an increase in inflation will not affect real interest rates in the longrun.

Robert Lucas (1980) finds no empirical support for the hypothesis, which he calls one of the central implications of the quantity theory of money. Beginning with Irving Fisher (1930), most of the empirical investigations have found out that fully anticipated inflation has less than a unit effect on nominal rate of interest, and thus reduces the real rate of interest even in the longest of the runs. Fama (1975) concluded: ... one ... *cannot reject the hypothesis that all variation through time in one-to-six month nominal rates of interest mirrors variation in correctly assessed one-to-six month expected rates of purchasing power*. Fama's conclusion rests on two assumptions: (a) there is a constant expected real rate of interest. (b). All relevant information

about future inflation is fully incorporated in the expected-inflation component of the market rate of interest. Both assumptions are contradicted by evidence by Carlson (1977). Carlson pointed out that variations in short-term interest rates are not good predictors of variations in inflation rates. Further more, both of the key assumptions are of dubious validity. First, evidence has been presented that expected short-term real interest rates do have notable variation.

4.2.3 Nominal Rate of Interest and Nominal Exchange Rate

Under the scenario of large capital flows in a flexible exchange rate regime, the nominal exchange rate appreciation leads to the deterioration of international competitiveness. So to prevent the real appreciation of the exchange rate and to preserve external competitiveness, central bank intervenes in Forex market to sterilise the incremental liquidity thus generated, thereby keeping the monetary expansion under control. This process has however quasi- fiscal costs associated with it as it imposes the danger of raising the real interest rate, which can further induce the capital flows. Another explanation is that an increase in the exchange rate of the last year would make the domestic currency less valued in the international market, and therefore would attract the demand for domestic financial assets from abroad. This may lead to increase in interest rate.

On the basis of the above discussion on the possible ways through which the movement of rates of interest may get affected, the theoretical model for the study is derived from an extended version of Sargent's (1969) seminal paper '*Commodity Price Expectations and the Interest Rate*'. The extended version of Sargent's model is flexible enough to incorporate the macroeconomic link that may operate in the determination of interest rates. Sargent expressed nominal rate of interest as a combination of three components: the equilibrating rate of interest, spread between market rate of interest and equilibrating real rate of interest and the spread between nominal rate of interest and market rate of interest. It can be expressed as follows.

$$r_{n(t)} = r_{e(t)} + [r_{m(t)} - r_{e(t)}] + [r_{n(t)} - r_{m(t)}] \qquad (4.1)$$

In equation (4.1) $r_{n(t)}$ is the nominal rate of interest, $r_{e(t)}$ is the real rate of interest which equilibrates desired savings and desired investment; $r_{m(t)}$ is the nominal rate of interest adjusted for the expected rate of inflation. Each of the three specific components is determined in turn by specific macroeconomic variables. So the next step is to identify the determinants of each of the

three terms in equation (4.1)[4]. One of the significant determinants of the first term, $r_{e(t)}$, which is the real rate of interest that equilibrates desired savings and desired investment, is the deficit of the government[5].

$$r_{e(t)} = \alpha + \beta_1 (def_t) + \mu_t \qquad (4.2)$$

The determinant of the second term, [$r_{m(t)} - r_{e(t)}$], is determined by the rate of growth of money supply[6]. In the open economy model, real exchange rate also determines the spread between the market rate and the equilibrium real rate of interest. Assuming linearity, we thus have:

$$r_{m(t)} - r_{e(t)} = \lambda + \beta_2 (\Delta M_3)_t + \beta_3 (e_r)_t + \delta_t \qquad (4.3)$$

Where, $(\Delta M_3)_t$ = changes in money supply,

$(e_r)_t$ = real effective exchange rate

The last term of equation (4.1) is assumed to depend linearly and positively on the inflationary expectations.

$$r_{n(t)} - r_{m(t)} = \theta + \beta_4 (\pi_t^e) + \upsilon_t \qquad (4.4)$$

Where, π_t^e = *Expected Rate of Inflation*

Now by substituting equation (4.2), (4.3) and (4.4) in equation (4.1) we get equation (4.5)

$$r_{n(t)} = \varphi + \beta_1 (def_t) + \beta_2 (\Delta M_3)_t + \beta_3 (e_r)_t + \beta_4 (\pi_t^e) + \omega_t \qquad (4.5)$$

---

[4] The derivations of determinants of each term in the model are drawn from Gupta and Moazzami (1996). But as the objective of their study was to test the validity of alternative paradigms of link between deficit and rate of interest – Neoclassical, Keynesian and Ricardian Equivalence Theorem - across countries and to distinguish between the short term and long impact of deficits on rate of interest, we have not drawn heavily on the derivations of the determinants of the model; rather we improvise the specification according to our purpose to undertake the impact of fiscal deficit on rate of interest in the context of India, irrespective of the paradigm-specific details and dichotomy of transitory and permanent effects of deficits on rate of interest.

[5] The other determinants of term (i) in Gupta-Moazzami model constituted government consumption expenditure, national income, private consumption expenditure, private savings etc, which we omit in our specification due to multicollinearity problems and moreover, these explanatory variables are not required for our analysis as we have not gone into testing of validity of each of the alternative paradigms of fiscal deficit and rate of interest in the context of India; rather our prime concern was to assess the role of fiscal deficit on rate of interest to understand the transmission channel of crowding out phenomenon.

[6] For details, see Sargent (1969).

According to equation (4.5), rate of interest is a function of fiscal deficits, change in money supply real effective exchange rate and expected inflation. The above theoretical derivation is econometrically estimated.

4.3 Econometric Estimation of Rate of Interest Model and Results

As a prelude to the estimation, unit root test is undertaken to avoid spurious results. The results of unit root shown in Table 4.2 revealed that all variables are integrated of order one except the bank rate, which is integrated of order two. Another point to be noted here is that the unit root results showed that there is no significant trend and drift (c and t) for all variables except money supply.

Table 4.2: Unit root test results for rate of interest and its a priori determinants

Macrovariables	*Lags*	*t-statistics*	*Mc Kinnon Critical Value*	*Order of integration*
Call money market rate- nominal	0	-6.663420	-2.6486	I ~ (1); no c, t.
Call money market rate – real	0	-5.935151	-2.6486	I ~ (1); no c, t.
Bank rate – nominal	0	-6.896447	-2.6522	I ~ (2); no c, t.
Bank rate – real	0	-5.869601	-2.6486	I ~ (1); no c, t.
Prime Lending rate – nominal	0	-4.883530	-2.6486	I ~ (1); no c, t.
Prime Lending rate – real	0	-5.995186	-2.6486	I ~ (1); no c, t.
Government security rate –nominal	0	-6.431330	-2.6486	I ~ (1); no c, t.
Government security rate – real	0	-5.995584	-2.6486	I ~ (1); no c, t.
Δ Money supply	0	-5.973117	-4.3382	I ~ (1); c* t*
Expected Inflation	1	-3.028138	-2.6522	I ~ (1); no c, t.
Real Exchange Rate	0	-5.448386	-2.6486	I ~ (1); no c, t.
Fiscal Deficit	0	-5.213464	-4.3226	I ~ (1); c, t*.

Note: c* t* denotes significance at 1 percent level. with drift © and trend (t).
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

Having checked the unit roots, the next logical task is the selection of appropriate interest rate from the available spectrum of interest rates in India for an elaborate analysis of link between rate of interest and fiscal deficit. The major rates of interest are call money market rate, bank rate, prime lending rate of term lending institutions and interest rate on dated securities of Government of India. As analysed in chapter 2, among these rates of interest, call money market rate has exhibited large volatility and the bank rate appeared to be non-varying in nature, which intuitively can be opted out in analyzing the link between fiscal deficit and rate of interest. We have selected prime lending rate and rate of interest on dated securities of government of India to analyze whether there is any link between fiscal deficit and these rates of interest. Prime Lending Rate is all the more important as it is a significant determinant of private investment behaviour, and to establish whether there exists any financial crowding out in India, we need to analyse whether fiscal deficit has any role in

exerting pressure on prime lending rate. The redemption yield on dated securities of India is selected on the ground that shift from seigniorage financing to bond financing of deficit in India can have some pressure on rate of interest, especially the rate of interest on bonds or securities. Both these rates of interest are adjusted for inflationary expectations and the real rate of interest is used for analysis. As analyzed in chapter 2, real rates of interest shows much variability than the nominal rate of interest.

Having selected the relevant rates of interest for the analysis, the next task is to transform these rates of interest into ex ante real rate of interest. According to Fisher hypothesis, nominal rate of interest (γn) is given by

$$\gamma^n = \gamma^r + \pi^e \qquad (4.6)$$

where γ^r is the real rate of interest and π^e is the expected rate of inflation. The real rate of interest in any period, thus, is postulated to evolve as a deviation between nominal rate of interest and the expected inflation. Recently, Correia, et al (1995) used the low frequency component of consumer price changes as generated by Hodrick-Prescott [HP] filter to model *expected* inflation. We use HP filter for computing expected inflation[7].

Using HP filter, how to capture expected inflation from the observed series[8]? Let us assume that observed inflation π contain both expected π^e and unexpected components π^u.

$$\pi = \pi^e + \pi^u. \qquad (4.7)$$

The HP filter decomposes observed inflation into a stationary cyclical component and a smooth trend component (π and π^e denote the logarithms of observed and expected inflation respectively) by minimising the variance of cyclical component subject to a penalty for the variation in the second difference of the trend component. This results in the following constrained least square problem.

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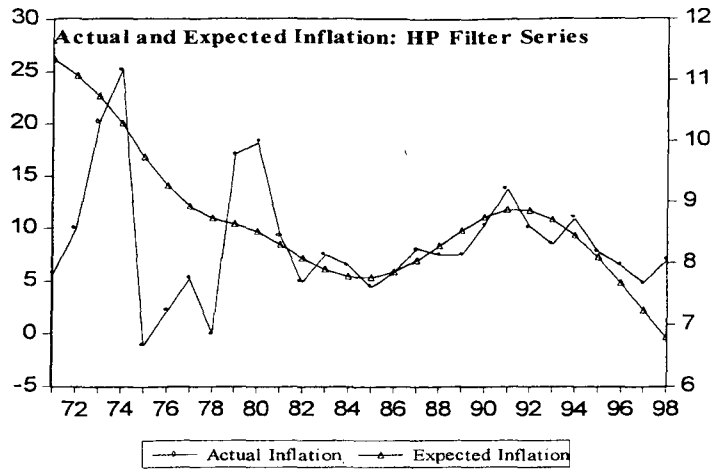
[7] Apart from HP filter method, various other econometric methods have also been employed to construct appropriate proxies for the market's expectations of future inflation. Tanzi [1985] used surveys of inflationary expectations such as Livingston index to generate series on expected inflation in the context of US. Autoregressive models have also been used to generate series of expected inflation.

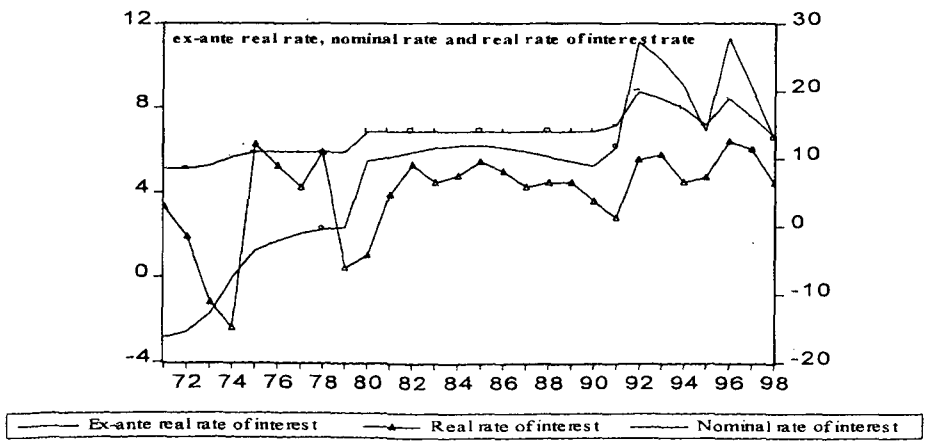
[8] HP filter has good mathematical properties in order to extract the unobservable variable of expected inflation out of the observed series. The expected inflation series computed using HP filter contains both forward and backward looking information on inflation rates, which makes it relevant in rational expectations framework.. Past information is necessary to adjust prices from a disequilibrium position, while information regarding future trends is also required because rational economic agents look forward in time to form expectations about the future inflation rate (Correia, et al, 1995).

Figure 4.1: Plot of Actual Rate of Inflation and Hodrick-Prescott Filtered Expected Inflation Series in India.



The ex ante real rate of interest is derived by subtracting the expected rate of inflation from the nominal rate of interest. Taking Prime Lending Rate, the plots of real and ex ante real rate of interest over the last three decades are shown in Figure 4.2. Ex ante real rate of interest and nominal rate of interest showed a sticky non-varying nature over the time period, though the real rate of interest, which is the difference between nominal rate of interest and nominal rate of inflation showed considerable variations in the intertemporal scale, which motivated the study to use the real rate of interest for the analysis.

Figure 4.2: Plot of Real and ex ante real rate of interest in India



Ex ante real rate of interest of dated securities of government is also obtained through similar procedure. Now we turn to analyse the link between fiscal deficit and rate of interest along with other relevant parameters. As discussed in section 4.2, the real rate of interest $(R-\pi)_t$ model is specified for India in an open economy macro-framework where interest rate is determined by fiscal, monetary and external factors. The determinants identified are expected

rate of inflation (π^e_t), growth of money supply (ΔM_{3t}), fiscal deficit (def)t and exchange rate $(e_r)_t$. The optimal parameterization of variables through final prediction criteria suggested that the controlled and manipulated variables take the lag structure one in real interest rate model. Before analyzing the causal relationship in Hsiao's autoregressive framework, we tested the series for cointegration. We used Johansen full information maximum likelihood test of cointegration for this purpose by identifying the order of VAR as one and including a linear deterministic trend. The results of cointegration in Johansen's maximum likelihood method are given in Table 4.3. We consider the null hypothesis that the variables are not cointegrated so that the rank, (r=0) against the alternative of one or more cointegrating vectors (r>0). The cointegration relationships are estimated based on maximum eigen value test and λ-trace test. If the calculated value exceeds the critical value, it is possible to reject the null hypothesis of no cointegrating vectors and accept the alternative of one or more cointegrating vectors. Since the statistics exceeded the critical values at 90 and 95 level of confidence, we rejected the null hypothesis of r = 0, 1, and 2. Since the maximum eigen value of r=3 of 5.3574 does not exceed the critical values of 11.03 and 9.28, the null hypothesis of r=3 cannot be rejected. The results of trace test also confirms that there are 3 cointegrating vectors.

Table 4.3: Cointegration tests based on Johansen's Maximum Likelihood Method: Fiscal deficit, Prime Lending rate, Money supply, Real effective exchange rate and Expected Inflation.

Maximum Eigen value Test					**Trace Test**				
Ho	***H1***	***Statistics***	***CV 95 %***	***CV 90%***	***Ho***	***H1***	***Statistics***	***CV 95 %***	***CV 90%***
R=0	r=1	144.1214	29.95	27.57	R = 0	R ≥ 1	202.6287	59.33	55.42
R=1	r=2	30.5250	23.92	21.58	R ≤ 1	R ≥ 2	58.5073	39.81	36.69
R=2	r=3	21.4711	17.68	15.57	R ≤ 2	R ≥ 3	27.9823	24.05	21.46
R=3	r=4	5.3574	11.03	9.28	R ≤ 3	R ≥ 4	6.5112	12.36	10.25
R=4	r=5	1.1538	4.16	3.04	R ≤ 4	R ≥ 5	1.1538	4.16	3.04

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

After estimating the number of cointegrating vectors, we turn to analyse the causal relationship between fiscal deficit and prime lending rate along with certain other relevant macrovariables in Hsiao's autoregressive framework. As per the specific gravity criteria for ordering the variables in model, the monetary variables entered the equation prior to the entry of fiscal variables in the prime lending rate of interest model (Table 4.4). The results reinforced the absence of financial crowding out in India, as fiscal deficit is found insignificant in determining the real prime lending rate of interest. Instead, the results showed that real prime lending rate is affected by the expected inflation, change in money supply and the exchange rate in an open economy macromodel. Quite contrary to the crowding out debate, that

is, deficit-induced rise in the rate of interest displaces private investment, our analysis proved no significant relationship between interest rate and deficit though private corporate investment is found interest rate sensitive in India (reference to chapter three).

Table 4.4: Real Long Run Rate of Interest Model: Hsiao [1981] Detection of Optimal Lags of he Manipulated Variables and FPE of the Controlled Variable (PLR)

Controlled Variable	*Manipulated Variables*				*Optimum lags of Manipulated Variable*	*Final Prediction Error*	*Causality Inference*
$(PLR-\pi)_t$	-	-	-	-	-	3.287602	
$(PLR-\pi)_t$	$(e_r)_t$	-	-	-	1	3.235383	$(er)_t \Rightarrow (PLR-\pi)_t$
$(PLR-\pi)_t$	$(e_r)_t$	π^e_t	-	-	1	3.208523	$\pi^e_t \Rightarrow (PLR-\pi)_t$
$(PLR-\pi)_t$	$(e_r)_t$	π^e_t	ΔM_{3t}	-	1	3.173645	$\Delta M_{3t} \Rightarrow (PLR-\pi)_t$
$(PLR-\pi)_t$	$(e_r)_t$	π^e_t	ΔM_{3t}	(def)t	1	3.452459	$(def)t \neq (PLR-\pi)_t$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

Now we turn to undertake an analysis using the redemption yield on dated securities of government instead of prime lending rate to understand whether the results vary. We tested the variables for cointegration by identifying the optimal order of VAR is equal to one and including a linear deterministic trend. The results showed that there are two cointegrating vectors since the statistics according to maximum eigen value test of 11.8667 does not exceed the critical value of 21.12 and 19.02 at 95 per cent and 90 per cent confidence level. The trace test also showed that there are two cointegrating vectors since the statistics of r=2 at 17.2902 doesnot exceed the critical values of 31.54 and 28.78 respectively at 95 and 90 per cent confidence level.

Table 4.5: Cointegration tests based on Johansen's Maximum Likelihood Method: Fiscal deficit, Redemption Yield rate on dated securities of government, Money supply , Real effective exchange rate and Expected Inflation.

Maximum Eigen value Test					**Trace Test**				
Ho	*H1*	*Statistics*	*CV 95 %*	*CV 90%*	*Ho*	*H1*	*Statistics*	*CV 95 %*	*CV 90%*
R=0	r=1	139.5804	33.64	31.02	R = 0	R ≥ 1	186.7459	70.49	66.23
R=1	r=2	29.8753	27.42	24.99	R ≤ 1	R ≥ 2	47.1655	48.88	45.70
R=2	r=3	11.8667	21.12	19.02	R ≤ 2	R ≥ 3	17.2902	31.54	28.78
R=3	r=4	5.3018	14.88	12.98	R ≤ 3	R ≥ 4	5.4235	17.86	15.75
R=4	r=5	0.12169	8.07	6.50	R ≤ 4	R ≥ 5	0.12169	8.07	6.50

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

After testing for cointegration, we turn to analyse the causal relationships between the macrovariables in Hsiao's vector autoregressive framework. The results showed that long-term government security yield rate is determined by inflationary expectations and exchange rate fluctuations in the open economy (Table 4.6). In this model also, fiscal deficit is not found to be a significant variable in determining the real rate of interest. But, unlike in the

case of prime lending rate, changes in money supply is found insignificant in the determination of government bond yield rate. Now we turn to analyse whether the link between fiscal deficit and rate of interest holds good in the deregulated financial regime in India in the next section.

Table 4.6: Real Long Run Rate of Interest Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable (G-Sec rate)

Controlled Variable	*Manipulated Variables*				*Optimum lags of Manipulated Variable*	*Final Prediction Error*	*Causality Inference*
$R_{g\text{-sec (t)}}$	-	-	-	-	-	38.72348	
$R_{g\text{-sec (t)}}$	π^e_t				1	38.57239	$\pi^e_t \Rightarrow R_{g\text{-sec (t)}}$
$R_{g\text{-sec (t)}}$	π^e_t	$(e_r)_t$			1	36.31501	$(e_r)_t \Rightarrow R_{g\text{-sec (t)}}$
$R_{g\text{-sec (t)}}$	π^e_t	$(e_r)_t$	$(def)_t$		1	41.38736	$(def)t \neq R_{g\text{-sec (t)}}$
$R_{g\text{-sec (t)}}$	π^e_t	$(e_r)_t$	(def)t	$(\Delta M_3)_t$	1	45.67922	$\Delta M_{3t} \neq R_{g\text{-sec (t)}}$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

4. 4: Analysis of Link between Fiscal Deficit and Rate of Interest in Deregulated Financial Regime

This section examines whether in the financially deregulated regime, shift in the financing pattern of fiscal deficit away from seigniorage and external debt financing to bond financing has the probability of creating an upward pressure on the rate of interest in India. As we are using high frequency data, another problem encountered was the selection of appropriate interest rate from the available spectrum of interest rates in deregulated financial regime. As short-term rates are always considered as reference rate, the imperative is to select the appropriate short-term interest rates, which acts as the reference rate in the market[9]. The selected short-term interest rates are shown in Table 4.7. Most of these rates tended to decline since 1996-97.

Theoretically, a reference rate is defined as the price of a short-term low risk instrument in a free liquid market. It is revealed from the Table 4.7 that the call money market rate, one of the short-term rates of interest, has exhibited large volatility. Call money rate fluctuated within a wide range of 3.80 to 16.28 since 1992-93. Another short rate, viz., the bank rate appeared to be non-varying in nature. Long term rates of interest, as mentioned above, are opted out as a reference rate. The bond yield rate on Government securities of less

[9] In the analysis of fiscal deficit and rate of interest link in India using annual data in the above section, we did not use a "reference rate of interest", instead we tried to analyse the link using all relevant rates of interest and found that there is no link between these rates of interest and fiscal deficit. Moreover, the concept of 'reference rate' is all the more relevant in the financially deregulated regime.

than five year maturity period increased from 12.46 in 1992-93 to 13.75 per cent in 1995-96, with a dip in 1994-95 to 11.91. And since 1995-96, the interest rate on short term Government security showed a distinct declining trend. A potential short-term low risk rate of interest is the 91-day and 364-day auction Treasury Bill rates which exhibited a non-volatile and non-sticky trend.

Table 4.7: Movement of Selected Short term Rates of Interest in India.

(per cent per annum)

Interest Rates	*1992-93*	*1993-94*	*1994-95*	*1995-96*	*1996-97*	*1997-98*	*1998-99*
Call money rate	14.42	6.99	3.80	16.10	16.28	8.69	7.83
91-day auction TB	10.46	11.09	7.33	11.90	12.97	7.96	7.33
364day auction TB	11.42	11.04	9.97	11.94	13.12	10.09	7.98
Bank rate	11	10	11	13	13	12	11.50
Bond yield rate >5years	12.46	12.63	11.91	13.75	13.69	12.01	11.86

Source: RBI Annual Report (various issues).

The implicit cut-off yield rates of various auction day Treasury Bills are given in the Table 4.8. It is to be noted that 182 day auction Treasury Bills were introduced in November 1986, but auction was not held for 182 day TB from April 28,1992 to May 25, 1999. While 14-day auction Treasury Bills were introduced on June 6, 1997. It is revealed from the Table 4.8 that the implicit cut-off yield rate of 91-day auction Treasury Bill fluctuated between 7.33 and 12.97 per cent over the period 1992-93 to 1999-2000.

Table 4.8: Implicit Cut-off Yield of Auction-Treasury Bills

(percent per annum)

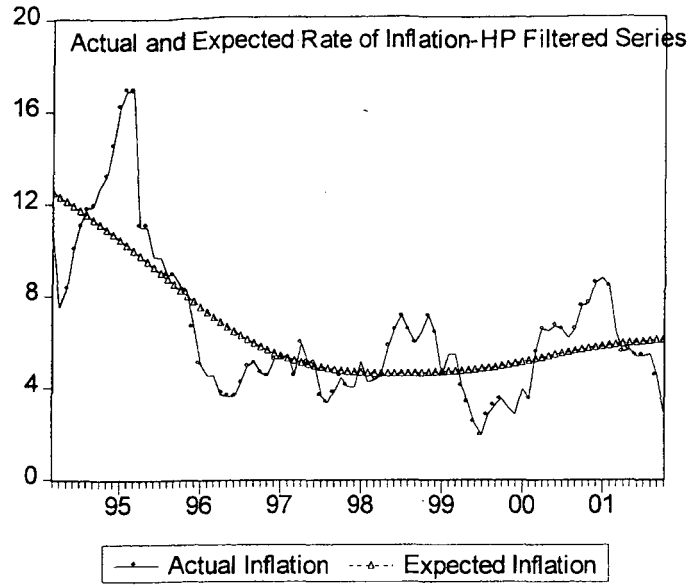
Interest rate	*1992-93*	*1993-94*	*1994-95*	*1995-96*	*1996-97*	*1997-98*	*1998-99*	*1999-00*
91-day TB	10.46	11.09	7.33	11.6	12.97	7.96	7.33	8.79
364 day TB	11.42	11.04	9.97	11.73	13.12	10.09	7.98	10.07
14-day TB	-	-	-	-	-	4.94	7.3	8.34
182-day TB	8.77	-	-	-	-	-	-	9.69

Source: RBI (1999).

As we discussed in the earlier section, in order to analyse whether there is any impact of rising fiscal deficit on the real rate of interest, the first step is to calculate the ex ante real rate of interest. As we have already selected the Treasury bill rate[10] as the reference rate from the spectrum of short-term rate of interest in India, the next task is to transform the Treasury Bill rate into ex ante real rate of interest. Using Fisher equation the nominal rate of Treasury Bill is transformed into real rate of interest, the details of HP methodology involved in this procedure is discussed in the above section. The HP filtered expected rate of inflation along with the nominal rate of inflation using the high frequency data in the deregulated financial regime is plotted in Figure 4.3.

[10] Weighted rate of interest of 91 and 364 day Treasury Bills with corresponding amount of borrowing done via the auction of 364 days Treasury bills and 91-day treasury bills as the weights.

Figure 4.3: Plot of Actual Rate of Inflation and Hodrick-Prescott Filtered Expected Inflation Series in India.

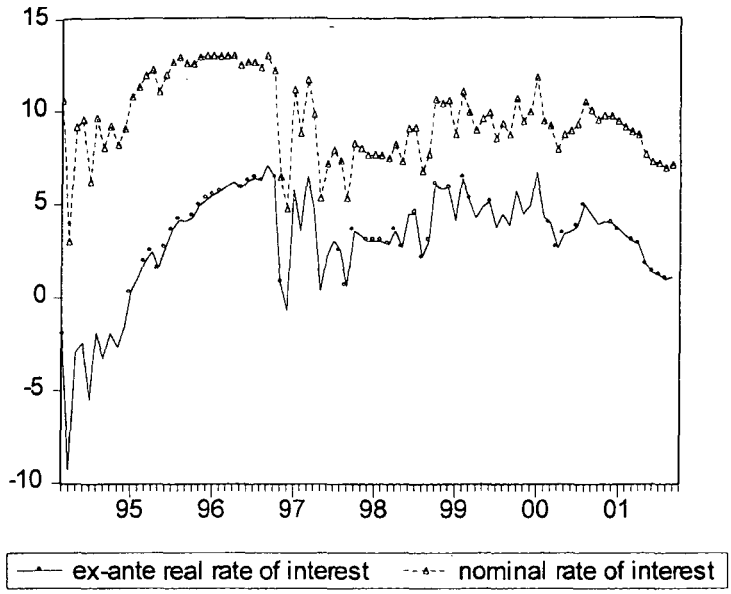


The series of expected inflation generated through HP filter method depicted in Figure 4.3 showed a declining trend in India over the period between 1993-94 and 1999-2000. This is in concomitant with the trends in the price environment in India after the macroeconomic stabilisation programme. The inflation rate though started to decline from the peak rate of 16.6 per cent in mid-1991, remained high at 10.1 per cent in 1992-93 and 8.4 per cent in 1993-94. The consequent increase in the rate of inflation to 10.9 per cent in 1994-95 is mainly due to the pressures emerged from the faster rate of growth of money supply, following the steady capital inflows. Since 1995-96, Indian economy presents a characteristically different price environment with a consistent declining trend in the rate of inflation. The rate of inflation declined to 7.7 per cent in 1995-96, 6.4 per cent in 1996-97 and further to 4.8 per cent in 1997-98. Again, in 1998-99, the inflation rate pushed up to 6.9 per cent due to negative supply shock, which though reversed to nearing 2 per cent rate in 1999-2000. This period has also coincided with the global trend of low inflation.

The *ex ante* real rate of interest is derived by subtracting the expected rate of inflation from the nominal rate of interest. The plots of *ex ante* real rate of interest and nominal rate of interest in the financially deregulated period of India are given in Figure 4.4. Two distinct phases of financially deregulated regime of interest rate are evident from the Figure 4.4. In the first phase, the relative spread of nominal rate of interest from ex ante real rate of interest is widened. But in the second phase, the gap between nominal realized rate of interest and the *ex ante* real rate of inflation is significantly narrowing down. This trend in closing gaps between

the two rates is due to the recent declining trend in the expected inflation in India. As noted, the analysis of deregulated financial regime covers a period from April 1994 to September 2001 based on the availability of monthly data on fiscal deficit.

Figure 4.4: Plot of Nominal and ex ante real rate of interest in India: Deregulated Financial Regime



Figures 4.5: Plots of Ex ante Real Rate of Interest and Fiscal Deficit in Deregulated Financial Regime

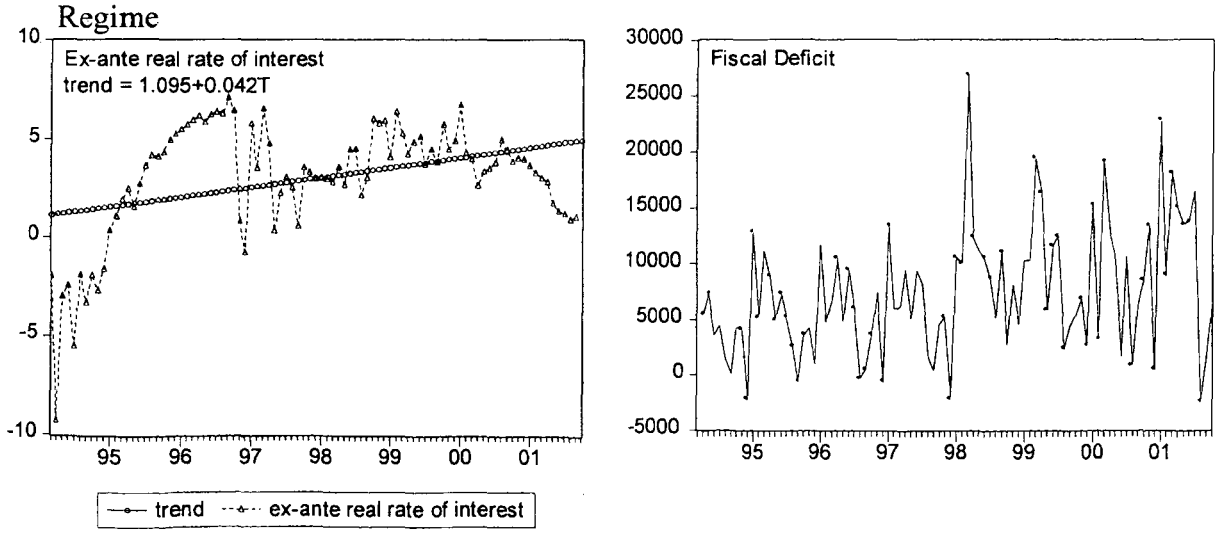


Figure 4.5 plots the ex ante real rate of interest and fiscal deficit series in the deregulated financial regime of India. Prima facie, both series look like stationary series. But it is difficult to understand at this point whether ex ante real rate of interest and fiscal deficit are trend stationary or difference stationary.

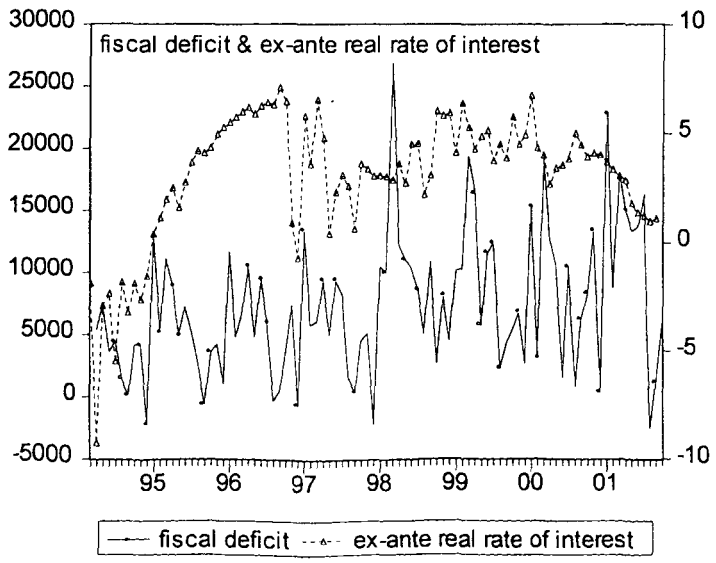
The unit root test results of ex ante real rate of interest and fiscal deficit are presented in the Table 4.9. The series of fiscal deficit and ex ante real rate of interest are found stationary at levels with drift and trend. It is not surprising that the series of fiscal deficit is stationary at levels, as the fiscal deficit variable has already undergone difference process at the level of data transformation of outstanding debt into deficit. Prima facie, a structural break is anticipated in the series of ex ante real rate of interest towards the end of 1996. But the statistical tests showed that there is no structural break. The comparison of trend growth rates of the sub samples before and after the *break* was not significantly different from each other. The macroseries of real effective exchange rate, change in money supply and expected inflation were also found to be stationary. The plot of co-movement of *ex ante* real rate of interest and fiscal deficit are given in Figure 4.6.

Table 4.9: Unit root test results for ex ante real rate of interest and fiscal deficit

Macrovariables	*Lags*	*t-statistics*	*McKinnon Critical Value*	*Order of integration*
Ex ante real rate of interest	0	-3.463413 (* at 5 %)	-3.4597	I ~ (0) with c*, t*
Fiscal deficit	0	-8.658305 (* at 1 %)	-4.0625	I ~ (0) with c*, t*
Δ money supply	0	-10.1906 (* at 1 %)	-4.0636	I ~ (0) with c*, t*
Real effective exchange rate	18	-3.708120 (* at 5%)	-3.4730	I ~ (0) with c*, t*
Expected Inflation	0	-3.439650 (* at 10 %)	-3.1554	I ~ (0), with c*, t*

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

Figure 4.6: Co-movement of fiscal deficit and ex ante real rate of interest in the deregulated financial regime of India.



The final prediction error (FPE) of fitting one dimensional autoregressive process for fiscal deficit (DEF) and rate of interest (TB) are computed with upper bound of lag length (L^*) assumed equal to 15. Firstly, we have considered real rate of interest as controlled variable, holding the order of its autoregressive operator to three, we sequentially added the lags of the manipulated variables upto the L^* of 15. In this treatment of real rate of interest as the manipulated variable we found that $FPE_{DEF}(m^*,n^*) > FPE_{DEF}(m^*,0)$ which implies fiscal deficit doesnot Granger-causes rate of interest.

Table 4.10: Results: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variable and FPE of the Controlled Variable

Controlled Variable	*Manipulated Variables*				*Optimum lags of Manipulated Variable*	*Final Prediction Error*	*Causality Inference*
$(i_r - \pi^e_t)$ [1]	-	-	-	-	3	0.01767	
$(i_r - \pi^e_t)$ [1]	(def)t	-	-	-	1	0.01797	(def)t $\neq (i_r - \pi^e_t)$
$(i_r - \pi^e_t)$ [1]	(def)t	ΔM_{3t}	-	-	1	0.01839	$\Delta M_{3t} \neq (i_r - \pi^e_t)$
$(i_r - \pi^e_t)$ [1]	(def)t	ΔM_{3t}	$(er)_t$	-	1	0.01887	$(er)_t \neq (i_r - \pi^e_t)$
$(i_r - \pi^e_t)$ [1]	(def)t	ΔM_{3t}	$(er)_t$	π^e_t	1	0.01718	$\pi^e_t \Rightarrow (i_r - \pi^e_t)$
(def)t [1]	-	-	-	-	-	65.1195	
(def)t [1]	ΔM_{3t}	-	-	-	1	61.7521	$\Delta M_{3t} \Rightarrow (def)_t$
(def)t [1]	ΔM_{3t}	π^e_t	-	-	1	62.7259	$\pi^e_t \Rightarrow (def)_t$
(def)t [1]	ΔM_{3t}	π^e_t	$(i_r - \pi^e_t)$	-	1	64.5149	$(i_r - \pi^e_t) \Rightarrow (def)_t$
(def)t [1]	ΔM_{3t}	π^e_t	$(i_r - \pi^e_t)$	$(er)_t$	1	68.2164	$(er)_t \neq (def)_t$

Note: Figures in the parentheses denotes the lag length of controlled variable.
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

To examine whether there exists reverse causality between fiscal deficit and real rate of interest, we repeated the experiment, keeping fiscal deficit as the controlled variable and sequentially added the lags of manipulated variables to the set. Table 4.10 presents the results of Hsiao autoregressive modeling of causality detection. The results showed that in the context of recent financial liberalisation and deregulation of interest rates, deficit does not induce rise in rate of interest. Rather, the direction of causality runs from real rate of interest to deficit. This result is in conformity of the recent trend in Indian public finance where the share of non-interest expenditure in total expenditure is on the decline. This is due to the sharp increase in interest payment obligation arising out of the rising cost of servicing the internal debt. The reason beneath this can be attributed to interest rate deregulation, where the high interest rate fuelled the accumulation of more debt through increase in interest payments and the consequent debt-deficit spiral. It is also found that in the deregulated financial regime, rate of interest is primarily determined by the inflationary expectations in the economy.

4.5 Conclusion

Econometric estimation in Chapter 3 revealed that private corporate investment is interest rate sensitive, but as the transmission channel of financial crowding out is via rate of interest, it became imperative to analyse whether rise in rate of interest is fiscal deficit induced. Thus, in this chapter we have examined whether there is any evidence of financial crowding out for both administered and deregulated interest regime. In both the regime, quite contrary to the popular belief that increase in fiscal deficit induces a rise in the rate of interest, no significant relationship between the two is established. The relationship between the two in the deregulated regime was based on monthly data of fiscal deficits and rates of interests. For the administered interest rate regime, the study examined the link between fiscal deficits and major short and long run rates of interests. However, in the case of deregulated regime, the relationship is examined between the monthly fiscal deficits and the Treasury bill rate. The Treasury bill rate is empirically found to be the reference rate for the market in the deregulated regime. Thus, an analysis of the link between the reference rate and fiscal deficits was considered sufficient to arrive at the conclusion regarding the relationship between other interest rates and fiscal deficits.

The overwhelming conclusion drawn from the multivariate vector autoregressive analysis for the period between 1970-71 and 1999-00 revealed that both short term and long term rates of interest are affected by the expected inflation and real exchange rate fluctuations. The change in money supply is also found significant in some models of short run and long run rate of interest. As the results from this chapter showed that there is no significant positive relationship between fiscal deficits and rates of interest, no evidence for financial crowding out is reinforced in Indian context.

The Hsiao autoregressive modeling of Granger-causality test conducted between fiscal deficit and real rate of interest for the deregulated regime revealed that contrary to the neoclassical paradigm, direction of causality runs from real rate of interest to deficit. This result is in conformity of the recent trend in Indian public finance where the share of non-interest expenditure in total expenditure is on the decline because of the sharp rise in interest payment. One of the principal reasons for the sharp increase in interest payment obligation is the rising cost of servicing the internal debt. The reason beneath this can be attributed to interest rate deregulation, where the high interest rate fuelled the accumulation of more debt through increase in interest payments and the consequent debt-deficit spiral. Also, it is empirically found that inflationary expectations determine rate of interest in the deregulated financial regime in India.

Chapter 5

Fiscal Deficit, Seigniorage and the Conduct of Monetary Policy

This chapter examines whether existence of high fiscal deficit can always have a tryst with the conduct of monetary policy. The prime mechanism in which fiscal deficit plays a role in the transmission mechanism of monetary policy is via seigniorage. The creation of seigniorage or *high-powered money* through monetisation of fiscal deficits can lead to high rates of monetary growth causing higher rates of inflationary pressures in the economy. If these assertions were true, the implications of fiscal deficit for the conduct of monetary policy would be serious.

The analysis of the effects of fiscal deficit on the conduct of monetary policy is a multifold procedure by examining the interlinkages between fiscal deficit, seigniorage, money supply and inflation in an iterative manner. It is to be noted that even if a positive functional relationship exists between seigniorage and fiscal deficit, it does not naturally ensure a link between deficits and money supply. In other words, there is no simple relationship between the growth of high-powered money and the growth of money supply and therefore, between money supply and fiscal deficit (Gupta, 1992). The behaviour of money multipliers can to a great extent determine the extent of relationship between seigniorage and money supply. If money multipliers are stable, there may be a relationship between seigniorage and money supply and in turn, money supply and deficit[1]. When it comes to the relationship between seigniorage, fiscal deficit, money supply and inflation, it should be noted that apart from the generally agreed principle of increased money supply caused by the monetisation of deficit can lead to higher rates of inflation, it is also argued that fiscal deficit contribute directly to such inflationary pressures (Gupta, 1992). The present chapter analyses whether the fiscal deficit affects seigniorage and the following chapter analyses the subsequent link between fiscal deficit, money supply and inflationary pressures in the economy.

This chapter is divided into following sections. Section 5.1 interprets seigniorage financing of deficit. A critical review of theoretical and empirical literature on the link between fiscal and monetary policy in general and fiscal deficit, seigniorage and money supply in particular is analysed in Section 5.2. Section 5.3 specifies the model and discusses econometric results. Section 5.4 draws conclusions.

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[1] For a detailed discussion on the link between seigniorage and money supply and the behaviour of money multiplier in India see Section 2.4.

5.1 Interpreting Seigniorage Financing of Deficit

It is mentioned in Chapter 2 that monetisation of fiscal deficits provide government with a source of revenue. This process of creating high-powered money is called seigniorage. Seigniorage is an important implicit tax levied by government and it consists of the amount of real resources appropriated by the government by means of base money creation[2] (Agenor and Montiel, 1996). In the context of developing countries (especially in the absence of well developed capital markets and external borrowing), seigniorage financing of deficit might be followed in pursuit of growth through capital formation and this printing of money increases the general price level and thus reduces the real value of monetary unit (Tanzi, 1978). This reduction can be seen as a kind of tax on those who are holding money. The genesis of this inflationary finance dates back to Keynes[3] (1923).

In the theoretical literature, the case for or against seigniorage finance has been argued on the basis of the welfare cost of this means of financing public expenditure as compared with alternative means. Bailey (1956) in his article '*The Welfare Costs of Inflationary Finance*' argued that on the basis of welfare criterion, revenue from tax system is preferred to seigniorage financing of deficit. He pointed out that a substantial volume of resources could not be continuously appropriated through seigniorage finance without increasing an already high ratio of welfare costs to the government budget[4]. Those who opposed deficit financing have followed Bailey's contention that the ratio of welfare cost to government revenue becomes quite high, if this mode of financing the deficit is adopted[5]. Aghveli (1977), on the other hand, argued that since additional normal tax revenue may not be available to

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[2] Dornbusch and Fischer (1990) explain explicitly the theoretical manner in which seigniorage finance operates. When the government finances a deficit by creating money, it in effect keeps printing money period after period, which it uses to pay for the goods and services it buys and is absorbed by the public. The public chooses to absorb this increase in nominal holdings because real income growth aside, the rise in holdings would be used to offset the effects of inflation. Thus the government finances itself through seigniorage or the inflation tax that the public adds to its holdings of nominal balances to maintain the real value of money balances constant and inflation thus acts like a tax. The government can thus spend more resources and the public less as if the government had raised taxes to finance the extra spending.

[3] See Keynes (1923), pp. 37-60.

[4] Bailey (1956) argued against seigniorage financing of deficit on the basis that this source of finance arises from the redistributive and disruptive aspects of inflation such as hardship involved for people whose income and wealth are fixed in money terms and the misallocation of resources that may result from the heightened uncertainties concerning future relative and absolute prices. He pointed out that there is no evident numerical way to compare the costs of these disruptive and redistributive aspects and explains that inflationary finance has been employed at such tremendous costs because the costs in this form of finance are largely hidden as compared to other forms of taxation where the costs of administration and compliance are evident.

[5] Bailey (1956) computed the total collection costs of normal tax revenues (that is, welfare costs, compliance costs and direct administrative costs etc) which amounted to about 70 per cent of the revenue collected. This figure seems low for developing countries.

developing countries to finance growing public expenditure needs, it may be academic to compare alternative revenue sources.

In such a case, the relevant comparison should be between the total cost of inflationary finance and benefits derived from additional government expenditure. In the context of developing countries, Aghveli (1977) tried to derive the optional rate of monetary expansion for the case when the government resorts to deficit financing to generate additional investment. In the analysis, he compared the total cost of seigniorage finance and its benefits derived from the additional government expenditure. In a simple neoclassical growth model, he incorporated a case in which government is forced to resort to deficit financing as the main source of its capital expenditure. His results showed that while higher rates of monetary expansion increase investment and contribute to future consumption, the consequent inflation imposes welfare costs by reducing the level of real balances held by the public[6].

It is often noted that the traditional argument against seigniorage finance implicitly assumes that the money created through this mode of financing is not used for the production of capital goods that can raise the rate of growth of real income[7]. Friedman (1971) argued for seigniorage finance based on the fact it allows government to appropriate a share of real income, since a given rate of inflation is logically equivalent to an explicit tax on real cash balances. He further argued that the proceeds from inflationary finance can be devoted to investment (Friedman, 1971). This argument of using proceeds from seigniorage finance to raise the rate of growth of real income of the economy through investing in capital goods is implicit in Mundell's theoretical framework for incorporating growth into the discussion of seigniorage finance. Mundell (1965) in his inflation-growth thesis argued that the possibility

[6] Aghveli (1977) constructed a model of the optimal rate of monetary expansion (and thus inflation) for those countries, which resort to deficit financing in order to supplement private capital formation. His model argued for a moderate case of inflation, by introducing the costs of inflationary finance along with the corresponding benefits of higher levels of consumption associated with higher rates of capital formation. However, the crucial assumptions of the model that government spending is used only for productive investment is not totally correct, since a significant part of increase in government spending can be in the form of non-productive consumption expenditure. Also, the model examines mainly the steady state solutions and thus some important dynamic considerations of the adjustment path of prices is neglected. Another unrealistic assumption of the model is constant private savings rate; which leads to the wrong conclusion that all seigniorage comes at the expense of private consumption without affecting private savings.

[7] Marty (1967) argued that if government use the revenue proceeds to induce a rise in the growth rate, the tax proceeds are equal to the stock of real cash balances multiplied by the sum of the rate of inflation and the rate of growth of real income induced by seigniorage finance.

of economic growth through seigniorage finance is extremely limited[8]. He argued that the inflation-growth link has little empirical significance even under conditions favourable to the argument. He showed that the maximum rate of growth achieved by deficit financing is rather small, while the welfare cost of inflation is quite large. In empirical terms, he revealed that even rapid inflation is likely to add less than 1.5 per cent to the growth rate and this maximum figure does not take into account the resource misallocation that always accompanies the inflation. Marty (1965) also proved the efficiency of seigniorage finance as a vehicle to induce economic growth. He argued against the traditional argument that seigniorage finance implicitly assumes that the tax receipts of the government are not used for the production of capital goods that raise the rate of growth of real income.

Much of these studies on inflationary finance have dealt only with the case in which inflation leaves the real revenue from the tax system unaffected. But Tanzi (1978) pointed out that in most cases, inflation brings about changes in real tax revenue and he developed a theoretical model for a situation in which the price elasticity of the tax system is unity and the average collection lag is significant[9]. Tanzi (1978) thus argued against inflationary finance, not from the angle of traditional argument based on welfare cost considerations, but by analyzing the relationship between seigniorage finance and the collection lag in tax revenue. Within the framework of Cagan model, he argued on the basis of empirical evidence that existence of lags in tax collection implies that a government's gains from the pursuit of inflationary finance are likely to be lower than commonly assumed. He further argued that if lags are long and the initial tax burden is high, the loss in revenue may be substantial and it may neutralize any gain coming from seigniorage financing of deficit.

5.1.1 Interpreting Seigniorage

Having discussed the theoretical arguments for and against seigniorage financing of deficits, now we turn to the technical explanation of seigniorage and how it is linked to fiscal

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[8] Mundell (1965) pointed out that "it is generally accepted that governments can squeeze some resources out of private sector by deficit finance and thereby generate extra government capital formation. To that extent that the extra resources are obtained at the expense of private consumption, additional social capital formation can result". He pointed out that when other sources of growth do exist, this argument is of too favourable to inflationary finance.

[9] Tanzi (1978) in his model showed that total government revenue - that is revenue from taxes and inflationary finance - at given rates of inflation depends on the values of the following: (I) the ratio of total tax revenue to national income at zero inflation (ii) the average collection lag of the tax system (iii) the ratio of money to income at zero inflation and (iv) sensitivity of the demand for money with respect to the rate of inflation. His model, applied to Argentina for period 1968-76 period, compared simulated and actual figures, showed that net gain from inflationary finance is likely to be significantly less than would be expected from traditional theory.

deficit. Seigniorage is defined as the change in the nominal stock of reserve money divided by GDP at current prices. This is the most commonly used definition of seigniorage. It can be expressed in the following equation:

$$S_1 = \frac{\Delta M_t}{Y_t} \tag{5.1}$$

Where S_1 = seigniorage revenue;

ΔM_t = change in reserve money; and

Y_t = GDP at current prices.

Equation (5.1) can be rewritten in the following form

$$S_{rev} = \frac{\Delta M_t}{M_t} * \frac{M_t}{Y_t}$$

$$S_{rev} = \mu_t * m_t \tag{5.2}$$

Where, $\mu_t = \Delta M_t / M_t$ and $m_t = {M_t}/{Y_t}$

As per equation (5.2), seigniorage is defined as the product of rate of growth of nominal reserve money (μ_t) and the reserve money per unit of GDP (m_t).

Apart from the definitions of seigniorage given in equation (5.1) and (5.2), seigniorage (S_2) can be decomposed further into two components: real change in the reserve money and inflation tax. Inflation tax is the erosion of value of reserve money held by the public. The change in reserve money in real term can be written as

$$S_2 = \frac{M_t - M_{t-1}}{P_t}$$

$$S_2 = \frac{M_t}{P_t} - \frac{M_{t-1}}{P_t} + \frac{M_{t-1}}{P_{t-1}} - \frac{M_{t-1}}{P_{t-1}}$$

$$S_2 = \frac{M_t}{P_t} + (M_{t-1} * \frac{\pi_t}{P_t}) - \frac{M_{t-1}}{P_{t-1}}$$

$$S_2 = \dot{m}_t + \pi_t * m_{t-1} \tag{5.3}$$

$$\text{where } \pi_t = \frac{(P_t - P_{t-1})}{P_{t-1}}, \quad \dot{m}_t = \frac{M_t}{P_t} - \frac{M_{t-1}}{P_{t-1}} \quad m_{t-1} = \frac{M_{t-1}}{P_t}$$

The equation (5.3) expresses seigniorage as the sum of increase in the real stock of money $\dot{m}$ and the change in real stock of money that would have occurred with a constant

nominal stock because of inflation (π t * m_{t-1}) (Agenor and Montiel,1996). The expression (π_t * m_{t-1}) of equation (5.3) is the inflation tax.

It is to be noted that inflation tax is not always equal to seigniorage. They are equal only in stationary state, that is, when m_t becomes zero. From equation (5.3), it becomes clear that inflation tax revenue is a component of seigniorage revenue. Inflation tax, as noted above, is the product of inflation rate (tax rate) and the real monetary base (tax base).

$$I_{tax} = \pi_t * m_{t-1} \qquad (5.4)$$

Using this theoretical framework, now we turn to estimate seigniorage and inflation tax in the context of India for the period between 1970-71 and 1999-00. As noted above, seigniorage and inflation tax are equal only in stationary state. In other words, seigniorage is defined as change in high-powered money to GDP while inflation tax is defined as the product of rate of inflation and high-powered money in period (t-1). Table 5.1 presents seigniorage, inflation tax and inflation rate for India during the period from 1970 to 2000. It can be seen from the table that there has been wide year-to-year fluctuations in the creation of seigniorage in India during the last three decades. The profile of seigniorage and inflation tax intertemporally showed that both these revenues as a ratio of GDP have increased over the decades (Table 5.1). The seigniorage revenue has increased from around 1 per cent of GDP in 1970 to 3 percent in 1990. Thus, as a source of revenues, it can be compared to that of direct taxes during various years. The direct tax-GDP ratio remained to be around 2 percent of GDP during the 1970s'and 1980s and 3 per cent in 1990s respectively. It should also be noted that government's dependence on seigniorage revenues remained considerable during the late 1970s and during the 1980s'. During the last half of 1990s' dependence on seigniorage declined considerably.

Table 5.1: Inflation tax, Seigniorage and Rate of Inflation

Year	*Inflation Tax*	*Seigniorage*	*Rate of Inflation*
1970-71	0.55	0.94	5.5
1971-72	1.00	1.14	5.6
1972-73	1.85	1.21	10.1
1973-74	2.37	1.89	20.1
1974-75	-0.10	0.43	25.2
1975-76	0.18	0.24	-1.1
1976-77	0.50	2.22	2.1
1977-78	0.01	1.13	5.2
1978-79	1.99	2.85	0.1
1979-80	2.10	2.06	17.1
1980-81	1.30	2.00	18.2
1981-82	0.55	0.92	11.3
1982-83	0.79	1.12	4.9
1983-84	0.77	2.68	7.5
1984-85	0.56	2.53	6.5
1985-86	0.71	1.06	4.4
1986-87	1.02	2.13	5.8
1987-88	0.95	2.45	8.1
1988-89	0.96	2.25	7.5
1989-90	1.41	3.01	7.4
1990-91	1.84	1.79	10.3
1991-92	1.34	1.80	13.7
1992-93	1.08	1.51	10.1
1993-94	1.49	3.25	8.4
1994-95	1.10	3.02	10.9
1995-96	0.91	2.12	7.7
1996-97	0.63	0.40	6.4
1997-98	0.89	1.74	4.8
1998-99	0.69	1.87	6.9
1999-00	0.75	1.09	5.2

Note: Inflation Tax is expressed as ratio of GDP. It is computed as (M_{t-1}* inflation rate)/GDP
Source: (Basic Data), Hand Book of Statistics on Indian Economy 2001, RBI.

Econometrically, the link between seigniorage and inflation tax can be estimated as follows.

$$S_{rev} = \alpha + \beta I_{tax} + \mu_t \qquad (5.5)$$

This equation translates in economic terms that seigniorage and inflation tax forms stochastic relationship rather than identity outside the stationary state. In India, the estimated equation for seigniorage and inflation tax revealed that one per cent increase in inflation tax leads to 0.136 per cent increase in seigniorage.

$$S_{rev} = 0.307 + 0.136\, I_{tax} \qquad R^2 = 0.243$$

$$(7.31)\ \ (2.999)^* \qquad DW = 1.11$$

*The figures in parentheses denote t-statistics and * denotes 1 per cent level of significance.*

As inflation tax is defined as the erosion of high-powered money held by the public, higher inflation implies higher erosion[10].

5.2 Seigniorage, Inflation and Fiscal Deficit

Having discussed the various definitions of seigniorage and estimating the quantum of seigniorage for the period between 1970-71 and 1999-00, in this section we turn to discuss the interlinkage between fiscal deficits, seigniorage and inflation.

5.2.1 A Theoretical Framework

Any analysis of the link between seigniorage, fiscal deficits and inflation can be done by using 'orthodox' or 'monetarist' model of inflation which focuses on the interaction between fiscal deficits, money creation and inflation[11]. The 'orthodox' or 'monetarist' view hold that primary reason for inflation in developing countries is the recourse to money creation by government faced with limited borrowing options for financing large fiscal deficits. Using Cagan's (1956) semilogarathmic function for demand for money, now we turn to discuss how fiscal deficit affects the money creation in an economy[12].

Consider Cagan's semilogarithmic function of demand for money[13]:

$$m_t = \frac{M_t}{P_t} = \exp(-\alpha \pi_t^{\,e}) \qquad (5.6)$$

where $\propto > 0$, m_t is real money, and π_t^e is expected rate of inflation, M_t represents real base money stock and P_t the price level.

Assume that the government cannot issue bonds to public and finances the fiscal deficit (def_t) entirely through seigniorage:

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[10] For detailed discussion, Dornbush (1999, p 464)

[11] The inflationary process in an economy can be analysed through 'new structuralist' model also. However, in the present context, the structuralist model is not applicable as it emphasizes that inflationary process in an economy is an outcome of the links between food bottlenecks, income distribution and social conflicts over the determination of real wages (Agenor and Montiel: 1996, p.298).

[12] The theoretical derivation in this section is based on Bruno and Fischer (1990) and Sargent and Wallace (1981) in Agenor and Montiel (1996).

[13] The demand for high powered money is assumed to be of the semilogarithmic (Cagan) form with unitary income elasticity. This is an empirically relevant specification: its essential property is that seigniorage revenue first increases and then decreases with correctly anticipated inflation (Bruno and Fischer, 1990).

$$def_t = \frac{M_t}{P_t} = \mu_t . m_t \qquad (5.7)$$

where def_t is fiscal deficit, μ_t is the rate of nominal money growth and m_t is the real balances held by public.

Combining (5.6) and (5.7) implies

$$def_t = \mu_t . \exp(-\alpha \pi_t^e) \qquad (5.8)$$

Equation (5.8) specifies how the fiscal deficit affects the equilibrium rate of growth of money stock, and hence the equilibrium inflation rate. But to the extent that the demand for real money balances is inversely related to the expected rate of inflation, the possibility of multiple solutions to equation (5.8) arises. In other words, a given amount of seigniorage can be collected at either a high or low rate of inflation.

Sargent and Wallace (1981) and Bruno and Fischer (1990) noted that there might be both high and low inflation equilibrium when government finances the deficit through seigniorage. The dual equilibria – a reflection of Laffer curve – imply that an economy may be stuck in high inflation equilibrium when, with same fiscal deficit as percent of GDP, it could be at a lower inflation rate. The existence of seigniorage Laffer curve implies that there are two steady-state rates of inflation that generate any given amount of seigniorage. The dual inflation equilibria (low inflation equilibrium and high inflation equilibrium) at any given amount of seigniorage is graphically plotted in Figure 5.1. Graphically, in the figure, the budget constraint is shown as the curve D. This curve depicts the positive relationship between the growth rate of monetary base (μ_t) and expected rate of inflation (π_t^e), showing the rate at which the money supply has to be increased to finance the fiscal deficit at each level of π_t^e. Since equation (5.8) indicates that $def_t = \mu_t$ when the expected inflation rate is zero, the deficit is measured by the distance between the origin and the intercept of the D curve on the μ - axis. Bruno and Fischer (1990) noted that the economy is always on this schedule since the government is arithmetically bound by its budget constraint.

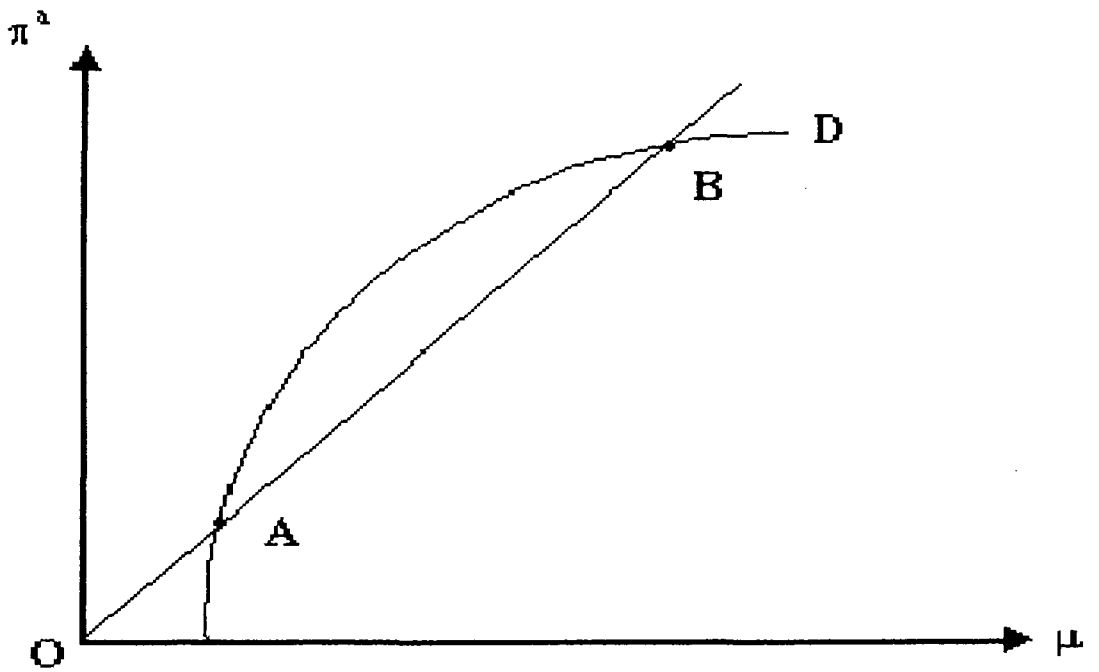
Differentiating equation (5.6) with respect to time yields, since $m_t \equiv \frac{M_t}{P_t} - m_t \pi_t$,

$$\mu_t - \pi_t = -\alpha \pi^e_t \qquad (5.9)$$

so that in the steady state

$$\pi = \pi^e = \mu \tag{5.10}$$

Figure 5.1: Seigniorage and Dual Inflation Equilibria



The steady state relationship shown in equation (5.10) can be represented by 45 ^{0} line in Figure 5.1. As depicted in the figure, D curve and 45 ^{0} line intersect twice. There are therefore two potential steady-state points, that is two inflation rate at which the fiscal deficit is financed through revenue from inflation tax: a low point equilibrium (point A) and a high inflation equilibrium (point B)[14]. The inflation rate that maximizes steady state seigniorage revenue is equal to $\pi^s = \frac{1}{\alpha}$ and the corresponding level of revenue is given by

$$def^s = \exp(-1)/\alpha \tag{5.11}$$

Assume now that the fiscal deficit that the government wishes to finance is fixed at an arbitrary level d`. Depending on the size of the fiscal deficit target, there may be zero, one or two equilibria. Because the government cannot obtain more than d` in the long run equilibrium, there is no steady state if d >d`. For d` =def^s or d`<0, there is a unique steady

[14] At point A the elasticity of the demand for real money balances is less than unity, while at point B it is greater than unity. (For details, see Evans and Yarrow, 1981 (cited in Agenor and Montiel, 1996)

state. If $0 < d` < def^s$, there are two equilibria or two steady states and the economy may be "stuck" at the high-inflation equilibrium (point B)[15].

5.2.2 Estimating Seigniorage Laffer curve

As discussed in the section above, seigniorage Laffer curve phenomenon depicts the non-linear relationship between revenue from money creation (μ_t) and the inflation rate (π_t). Easterly et al (1994) noted that econometric estimation of the following quadratic equation statistically confirms the seigniorage Laffer curve.

$$S_{rev} = \alpha + \beta_1 \pi_t + \beta_2 \pi^2_t + \nu_t \qquad (5.12)$$

where S_{rev} is seigniorage and π_t is the rate of inflation.
Estimated Seigniorage Laffer curve for India for the period between 1970-71 and 1999-00 is as follows[16]:

$$S_{rev} = 1.167 + 0.160\ \pi_t - 0.0069\ \pi^2_t \qquad R^2 = 0.16$$
$$(3.11)^* \quad (2.13)^* \quad (-2.25)^* \qquad DW = 2.03$$

*The figures in parentheses denote t-statistics and * denotes 1 per cent level of significance.*

The estimation showed that seigniorage revenue creation initially rises and eventually falls with the rise in the rate of inflation. The squared term of inflation is significant and negative, which confirms the operation of inverted-U seigniorage Laffer curve in the context of India.

5.2.3 Theoretical and Empirical Literature on Seigniorage and Fiscal Deficit

Apart from Cagen's model discussed above, other major hypotheses in the theoretical and empirical literature on the link between fiscal deficit and money are Unpleasant Monetary Arithmetic (UMA) theory of Sargent and Wallace (1981), Buchanan and Wagner hypothesis, the 'interest-targeting hypothesis' of Dornbusch and Fischer (1990) and the 'self-

[15] for details, Agenor and Montiel, 1996
[16] The result reported is adjusted for first order serial autocorrelation.

perpetuating' hypothesis of inflation induced deficits and deficits induced inflation or the Oliveria-Tanzi effect.

Sargent and Wallace (1981) explained in their *Unpleasant Monetary Arithmetic* (UMA) framework that if fiscal policy dominates monetary policy, then a series of government deficits forces the monetary authorities to monetise the deficit, when the private sector's demand for interest bearing government debt becomes a binding constraint on further bond-financed deficits. This leads to "tight money paradox"; when the fiscal position forces a government to finance its deficit through the inflation tax, any attempt to reduce the inflation rate today will require a higher inflation rate tomorrow. The dual assumptions beneath UMA framework are *fiscal policy dominance* and *demand for bonds have an upper bound.* The former assumption implies that fiscal policy dominates monetary policy while the latter implies that the real rate of interest on government bonds can exceed the growth rate of the economy eventually. These assumptions hold good in the context of developing economy like India, where the fiscal and monetary policies are co-ordinated, with fiscal authority being the first mover. The attraction for the hypothesis of fiscal dominance in the context of developing countries lies in the fact that in these countries including India, the capital markets being very shallow and the rate of interest being generally administered till recently, the scope for the absorption of government debt by the private sector is rather limited. Therefore, recourse to the monetary authority is the only option if development plans are to be pursued[17].

Fiscal dominance hypothesis of UMA implies that monetary policy cannot be manipulated independently (exogeneously) when the growth path of government expenditures and tax structure are both fixed. Moreover, Sargent and Wallace (1981) maintained that the only choice available to the Central Bank is not whether to monetise a government deficit but when- now or later (Darby, 1984). Under this co-ordination scheme of fiscal dominance, the ability of monetary authority to meet price stability would be lessened than in a monetary authority in the first co-ordination scheme, which implies that *tighter money now can mean higher inflation eventually.* Thus the key argument of Sargent and Wallace (1981) is that a permanently higher government deficit must eventually be monetised.

In SW model, real growth rate and real rate of interest are assumed to be constant for all the time. Also, it is assumed that monetary and fiscal policies initially imply steady state equilibrium where the real rate of interest exceeds the real growth rate. Given these

[17] See Gupta (1992).

assumptions, SW model show that any attempt to run a permanently higher fiscal deficit net of interest payments is simply not feasible unless the supply of base money is eventually increased. Without an eventual increase in the supply of base money, a permanent increase in the deficit would cause the ratio of interest bearing government bonds to national income to diverge to infinity, so at some point that ratio would outstrip the ratio of the total wealth to income, that is, the government would eventually be unable to command the resources needed to repay its debt.

Yet another dimension of this argument is embodied in Buchanan and Wagner (1977) proposition that the political pressures impacts monetary policy stance. They pointed out that monetary authorities are required to monetise the deficits due to political pressures to stabilise the interest rates, independent policy action is not an option. To quote Buchanan and Wagner (1977),

> *"(T)he (monetary) authority may be nominally independent of politics, but pressures will, nonetheless, be bought to bear on its operations. What is important for our purpose is that the indirect pressures on the monetary authorities and the direct pressures on politicians will tend to be mutually reinforcing and especially so in the direction of increase in money growth rates" (p. 117)*

They further pointed out that monetarist proposition that deficits are inflationary can result only when there is an increase in supply of money relative to supply of goods. That is, when deficits are financed by money creation, and if and only if, an increase in money supply is greater than increase in the supply of goods, then inflation would be the outcome. In other words, inflationary pressures result in the economy, only when productivity / economic growth does not increase as much as the increase in the money supply. Thus, they validates that inflation can be one possible consequence of budget deficits.

Dornbusch and Fischer (1990) put succinctly the possible links between deficits and money growth. This link between deficits and growth in money supply works out under a regime where monetary authorities aim at *interest rate targeting*. In such a policy regime of interest rate targeting, the monetary authorities are compelled to monetise deficits to defend the interest rate targets, resulting in the inflationary pressures in the economy. This is also known as *validation hypothesis*. This hypothesis is on the strong assumption that interest rate stability is the prime concern of the Central Bank than the growth of money. In other words, the hypothesis rests on the assumption that Central Bank favours nominal interest rate

stability over the rate of growth of money stock; which implies a direct link between Treasury (government) borrowing and the Central Bank's open market purchases. Under this scenario, Central Bank is said to *monetise the deficits* whenever it purchases a part of the debt sold by Treasury to finance the debt purchase. Under the scenario of 'interest rate targeting', concern over private capital market stability lead the Central bank to ease the credit control in an attempt to mitigate the pressure exerted by the increased government borrowing on rate of interest and therefore Dornbush and Fischer (1990) argued that Central Bank encourages money supply growth when deficits are high and viceversa when deficits are low.

The self-perpetuating hypothesis explained by Aghveli and Khan (1978) pointed out the an increase in Central Bank financing the deficit can lead to an increase in money supply and in turn create inflationary pressures in the economy. And at the same time, inflation can induce divergent effect on revenue and expenditure, which can lead to the widening of fiscal deficit, which is also known as Oliveria-Tanzi effect.

A set of studies tried to analyse the link between fiscal deficit and money supply by using Barro's (1978) model whether fiscal deficit is inflationary as suggested by Buchanan and Wagner (1977) hypothesis or whether Federal expenditure rather than federal deficits explain monetary policy better. In his paper, *Comment from an Unconstructed Ricardian*, Barro (1978) estimated a money supply function using annual data series for two subperiods, 1941-1976 and 1946-1976 for US economy. The explanatory variables of Barro model were nominal federal surplus divided by GNP deflator and expressed as relative to the trend value of real GNP; unemployment (to capture the cyclical effects) and real federal expenditure relative to normal. In Barro's model, regressor related to federal surplus will have a negative effect on money supply, as per Buchanan and Wagner hypothesis, that is, higher the federal surplus, lower the money supply and similarly, if federal deficit is incorporated in the model instead of surplus, the association between the two variables will be positive, that is, higher the federal deficit, higher the money supply. The results of Barro's model showed that Buchanan and Wagner hypothesis that deficits are inflationary is invalid.

According to Barro (1978), in US, the principal link from federal budget to money creation involves departures of federal expenditure from the normal rather than the federal surplus/deficit per se. Barro (1978) found no empirical evidence for B-W proposition of link between government deficits and growth of money supply in US. Barro concluded that the existence of any link between deficits and money supply is due to the deviation of public

spending from the normal path, and government deficit per se is not an important determinant of money growth.

Empirical evidences have shown that link between fiscal deficit and money supply/inflation is inconclusive. While some studies showed that deficits does not lead to growth of money supply (Niskanen, 1978; Barro, 1978; Hamburger and Zwick, 1981[18]; Dwyer, 1982; Dornbusch and Fischer, 1981; Ahking and Miller, 1985; Propapadakis and Seigel, 1987; Barnhart and Darrat, 1988; and Demopoulas, 1987); some studies found strong evidence for Buchanan-Wagner conjecture of significant link between fiscal deficit and inflation (Allen and Smith, 1983; Dutton, 1971; Frenkel, 1977; Sargent, 1973; Levy, 1981; Aghveli and Khan, 1977, 1978; Mcmillan and Beard, 1980; Hoffman, Low and Reinberg, 1983; Haan and Zelhorst, 1990; Darrat, 1986; Sarma, 1982 and Jhadav, 1994). The details of these models across developed and developing countries are presented in Table 5.2.and Table 5.3 and most of these studies are given in Appendix A 5.1. In the context of India, empirical literature validated the self-perpuating process of deficit-induced inflation and inflation-induced deficits (Sarma, 1982; Jhadav, 1994).

Table 5.2: Selected Empirical Evidences Against Deficit-Money Link

Author Period (Frequency) Country	***Econometric Model***	***Variables***	***Results***
Niskanen (1978) 1947-1976 (Annual) US	Single Equation Model	Deficit =F { Inflation} Expenditure = f { Inflation}	Federal Deficits (levels and first differences) donot impact on inflation, either through or independent of the rate of money growth.
Barro (1978) 1941-1976 & 1946-1976 (annual) US	Single Equation Model	Money Supply [M1/M3] =f { Money Supply (t-1), Unemployment rate, Real Federal Expenditure relative to normal, Nominal Federal Surplus/GNP deflator as relative to the trend value of real GNP}	Departure of federal spending from normal rather than federal surplus per se positively impact money creation (and hence rate of inflation).
Hamburger & Zwick (1981) 1954-74 & 1961-74 (annual) US	Single Equation Model	Estimated Barro's function. Instead of Barro's federal surplus variable, they used *Federal Deficit* variable. Instead of Barro's real federal expenditure relative to normal, they used *real federal expenditure*.	Supports Barro's hypothesis that government expenditure rather than federal deficits increase money growth *for the period 1954-74.*
Dwyer (1982) US	VAR model	Xt = { first differenced price level, level of nominal income, nominal money, interest rate on 3-months Treasury bills, nominal government debt held by the Federal Reserve and the nominal quantity of government debt held by public}	No evidence of deficit leading to rising money supply, interest rates and prices.

[18] For the sub-period 1954-74.

Table 5.3: Selected Empirical Evidences for Deficit-Money Link.

Author Period (Frequency) Country	Model	Model & Variables	Results
Hamburger & Zwick (1981) 1954-76 & 1961-74 (annual) US	Single Equation Model ; Barro's model	Estimated Barro's function. Instead of Barro's federal surplus variable, they used *Federal Deficit* variable. Instead of Barro's real federal expenditure relative to normal, they used *real federal expenditure.*	For the period 1961-74, study supports deficit impacts money supply; hence validates Buchanan Wagner conjecture.
Allen & Smith (1983) 1954:1 to 1980:4 (quarterly) US	Single Equation Model; Barro's model	Estimated Barro's Model Instead of Barro's Federal Surplus variable, *Real trend value of change in Federal DEBT* is used. Instead of Barro's Money Supply variable, *Monetary Base* is used.	Positive & Significant impact of debt on monetary base.
Mcmillan & Beard (1980) 1953:1-1976:4 (quarterly, seasonally adjusted) US	Iterative Three Stage Least Square Method; Estimated Linear Variant of ISLM model.	Federal Reserve behaviour is treated as exogeneous so that effect of fiscal policy on money supply is entirely due to private sector response. Federal Reserve is made endogenous by incorporating a reaction function into ISLM model ,so that the effect of fiscal policy on money supply is due to both private and Federal Reserve response.	Substantial impact of fiscal expansion on money supply
Hoffman, Low & Reinberg (1983) 1960-74 & 1977-80 (monthly)	Single equation model	Regressed Money growth on future and past deficits. (i) Examined the extent to which the Federal Reserve accommodates Treasury financing activities by effectively monetising newly issued debt, ie., Central Bank increases money supply to finance the deficit.	Strong relationship between deficits and money growth.
Ahking & Miller (1985) 1947:1 to 1980:111 (quarterly) US	Trivariate Autoregressive Model	Xt= { deficit, base money growth, inflation}	Bi directional Causality between deficit and inflation
Darrat (1986) 1960-1980 (quarterly) North African countries (Tunisia, Libya and Morocco)	Cointegration and Causality	Inflation = { Money supply, GDP, Foreign rate of interest}	Inflation is significantly a monetaryphenomenon, and partly due to external factors like foreign rate of interest.
Sarma (1982) 1979-80 (annual) India	3-sector Macroeconomic Model	Self-perpetuating process of deficit induced inflation & inflation induced deficits	Confirms the validity of inflation induced deficit hypothesis for India
Jadhav (1994) 1970-71 to 1987-88 (annual) India	4 sector-Macroeconomic Model	Self-perpetuating process of deficit induced inflation & inflation induced deficits.	Confirms the validity of inflation induced deficit hypothesis for India.

5.3 Towards Specification of a Model

On the basis of the theoretical and empirical literature discussed above, in this section, we specified a model for money creation or seigniorage for India, which is estimated for a period between 1970-71 and 1999-2000. As mentioned, the general assertion is that monetisation of fiscal deficits is one of the principal reasons for the creation of seigniorage in the economy. As seen from the review of literature, Barro's model, quantity theory-based models and eclectic models are used for specifying money function across countries. We opted out for strictly specifying the model using either Barro's money function or quantity theory-based models in the context of India, as both models are too narrow to explain the multiplicity of interactive objectives of monetary policy in India. As we discussed, Barro's model confined to the question whether fiscal deficit or public expenditure creates money creation in a single equation model; while quantity theory confines to price level and output[19].

The selection of potential regressors for the study emanates from an eclectic approach. Levy (1981) has used this methodology of not following the specific models (based on quantity theory of money) in determining money growth. The conduct of monetary policy is too complex a phenomenon to be analyzed with 'tidy' or precise models[20]. Moreover, in India, there is a revival in debate for reviving monetary activism (via monetisation of fiscal deficit) and redesigning the conduct of monetary policy (Rao, 2003). It is argued that monetisation of fiscal deficit is not inflationary when economy is demand-constrained (Patnaik, 2001) and that maximizing seigniorage revenue may, in fact, be optimal in a situation when budget constraint is hard (Rakshit, 2000). As McCallum (1997) emphasized, the key stumbling block for monetary policy formulation is the limited knowledge of the way the macroeconomy functions, results that are confined to a particular model are of limited use.

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[19] Barro's specification: $M = a + b\ Mt_{-1} + c\ SUR + d\ UN + e\ PUB$; where M is money, SUR is budget surplus (deficit), UN is unemployment rate and PUB is real expenditure relative to normal; and a – e are parameters.

Quantity theory-based models: $\log M = a + b \log P + c \log Y$ where M is money, P is price level, Y is output; and a, b and c are the parameters.

[20] Often 'tidy models' or 'precise' models focus too specifically on one dimension of the conduct of monetary policy, to the point that it becomes dominant and assume away some important features of the phenomenon in order to make the problem tractable and to achieve their ostensibly precise results. The drawback of 'tidy' or 'precise' models is that the results achieved through these models are at the cost of severe simplification of reality that limits their usefulness as a basis for either empirical testing or policy prescription. It is important to note that our analysis of money creation and implications have relied on eclectic paradigm to serve as a general analytic framework. Inclusion of all the determinants, which act on the conduct of monetary policy in a single model, which yields a precise solution, is impossible because variables are too numerous and their effects can be inconsistent intertemporally. Even if it were possible to produce a definitive money reaction function, the model would be so general and would not be operational in the sense of either being subject to empirical test or useful for policy prescription. In empirical literature on international finance, Dunning's (1979) eclectic paradigm is often used for modeling, integrating the existing strands of economic theory to explain the phenomenon.

Therefore we select a few of relevant variables, consistent with the theories as well as specific to the conduct of monetary policy in the context of India. A brief review of monetary policies of 1980s and 1990s in India can also give some basis to the model specification per se and therefore the appropriateness of the model specification to understand the probable link between fiscal and monetary policies.

In late eighties, the major focus of the monetary policy had been to contain the monetised deficit and in turn the creation of seigniorage. As mentioned in Chapter 2, monetised deficit remained to be one of the major components of reserve money during this period. Due to the unanticipated increase in the fiscal deficits, actual increase in the money supply was much higher than its projected increase. Efforts were made to reduce monetisation by trying to create a demand for government securities outside the captive market so that government's dependence on RBI support through monetisation declines. Other specific measures were doing away with automatic monetisation of deficits through ad hoc Treasury bills in the year 1997. Monetary policy of 1990s has undergone entirely new experiments in India[21]. For the first time, external sector became the main cause of expansion of money supply. RBI actively intervened in the FOREX market to stabilise the currency and regulated money supply through sterilization. In order to neutralize the expansionary impact of capital flows, RBI conducted open market operations extensively. With this policy initiative, there is growing debate on the autonomy of Central Bank in India[22].

New transmission channels of monetary policy opened up with the progressive dismantling of the administered interest rate structure and the evolution of a regime of market determined interest rate on government securities. As part of the financial sector reforms and because of the anticipated decline in the gross fiscal deficit (after the control of monetisation of fiscal deficit) of the Central Government, the Statutory Liquidity Ratio (SLR) on incremental deposit liabilities was reduced to 30 per cent from 38.5 per cent. With the reduction of SLR and other policy initiatives mentioned above, stage was set to introduce

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[21] With the changed institutional context of new economic policies and financial sector reforms, the upsurge of capital flows contributed to the sharp increase in FOREX reserve from $ 9.2 billion in March 1992 to $ 25.1 billion in March 1995, for the first time RBI endeavored into the reference of exchange rate stability in the conduct of monetary policy (Rangarajan, 2001).

[22] Central Bank autonomy implies the discretion to Central Banks to decide on the timing and nature of monetary policy intervention and further the transparency in relation to both objectives and strategies. There is growing literature on Central bank autonomy across countries (Fodder, 1999; Tonny, 1998; Mantijn and Hossein, 1999; Brumm, 2000, Tambakis, 1999; Xiang, Lin, 1999; Jonathan, 1998; Lockwood and John, 1998).

several financial sector reforms. The major policy initiatives have been to develop government securities market. The reform measures in this area included the introduction of 364 day Treasury Bills and 91-day Treasury Bills on auction basis, auctions of dated securities and Repo auctions.

The above discussion of monetary policies of 1980s and 1990s in India reinforced that apart from price stability, RBI deals with a range of interactive objectives in the conduct of monetary policy. Incorporating these policy concerns, we specify the following model for seigniorage for India:

$$M_t = \alpha + \beta_1 M_{(t-1)} + \beta_2 DEF_t + \beta_3 \pi^e_t + \beta_4 OGAP_t + \beta_5 REER_t + D93 + \mu$$

where M_t = seigniorage
DEF_t = fiscal deficit GDP ratio
π^e_t = inflationary expectations
$OGAP_t$ = output gap
$REER_t$ = Real effective exchange rate
D93 = dummy for financial deregulation

The fiscal deficit is expected to be positively related to monetary base. As discussed above, in the face of rising fiscal deficits, central bank may be forced to monetise a portion of it and in turn may create seigniorage and money supply. In other words, this variable will test the popular assertion that deficits contribute to growth in money creation. The inflationary expectations enter into monetary base equation to reflect the price stability objective of the Central bank. The inclusion of expected inflation rather than actual inflation is based on the assumption that central bank forms expectations of inflation and respond to those expectations. The output gap is included in the reaction function to reflect the concern of monetary authority with the cyclical fluctuations in the economy[23]. This variable is included in the monetary base model also to portray whether monetary policy is pro-cyclical or anticyclical in nature. The lagged monetary base or lagged money supply variable is included as a continuity variable. The coefficient of lagged variable of monetary base/money supply measures the extent to which the RBI follows a continuous policy rather than one characterized by abrupt changes. The variable real effective exchange rate is included in the

[23] In certain studies, unemployment rate variable is included instead of GAP (deviation of actual GDP from potential). Levy (1981) noted that unemployment rate is primarily an indicator of labour market tightness, and is a less comprehensive measure of economic utilization than the GNP GAP. We used output gap in the model and the variable is constructed as the deviation of actual from potential GDP expressed as ratio of actual GDP.

model to capture the impact of external sector with the surge of capital flows on the conduct of monetary policy. A dummy is introduced in the model to capture the effects of financial deregulation on the conduct of monetary policy.

5.3.3 Econometric Estimation and Results

The econometric estimation is done in four steps, as in the case of earlier chapters. As a first step, we verified the order of integration of the macrovariables since the causality tests are valid if the variables have same order of integration. We use ADF test to detect the presence of unit roots. The second step involves testing for cointegration using the Johansen Maximum Likelihood approach (Johansen, 1988; Johansen and Juselius, 1990, 1992). The Johansen-Juselius estimation method is based on the error-correction representation of the VAR model with Gaussian errors. The third step in the econometric estimation is to find out the causal relationship between the variables in Hsiao's vector autoregressive framework. And the final step in the econometric estimation is the error correction equation of the model which implies the changes in the dependent variable is a function of the level of disequilibrium in the cointegrating relationship, captured by the error correction term (ECM), as well as changes in the other explanatory variables to capture all short term relationships among variables.

Table 5.4: Unit root test results

Macrovariables	Lags	t-statistics	Mc Kinnon Critical Value	Order of integration
Seigniorage	0	-6.693876	-2.6486	I ~ (1); no c, t.
Fiscal Deficit	0	-5.213464	-4.3226	I ~ (1); c, t*.
Output gap	0	-5.083268	-2.6486	I ~ (1); no c, t.
Δ Money supply	0	-5.973117	-4.3382	I ~ (1); c* t*
Expected Inflation	1	-3.028138	-2.6522	I ~ (1); no c, t.
Real effective Exchange Rate	0	-5.448386	-2.6486	I ~ (1); no c, t.

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

The unit root test results showed that all variables are integrated of order one. After checking for unit roots, we turn to find out where the variables are cointegrated using Johansen Maximum Likelihood Method. The order of VAR in the cointegration tests is one and we include linear trends in the model. As seen from Table 5.5, maximum eigen value and likelihood trace tests detect one cointegrating vectors.

Table 5.5: Cointegration tests based on Johansen's Maximum Likelihood Method: Seigniorage Model

Maximum Eigen value Test					Trace Test				
Ho	*H1*	*Statistics*	*CV 95 %*	*CV 90%*	*Ho*	*H1*	*Statistics*	*CV 95 %*	*CV 90%*
R=0	R=1	39.9068	37.07	34.16	R = 0	R ≥ 1	84.7044	82.23	77.55
R=1	R=2	29.6282	31.00	28.32	R ≤ 1	R ≥ 2	44.7976	58.33	55.01
R=2	R=3	8.6560	24.35	22.26	R ≤ 2	R ≥ 3	15.1694	39.33	36.28
R=3	R=4	4.4103	18.33	16.28	R ≤ 3	R ≥ 4	6.5134	23.83	21.23
R=4	R=5	2.1032	11.54	9.75	R ≤ 4	R ≥ 5	2.1032	11.54	9.75

Note: Deterministic component used in this model is unrestricted intercepts and unrestricted trends.
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

After detecting the cointegrating relationships, now we turn to estimate the causality in Hsiao's autoregressive vector autoregressive framework. The order of one-dimensional autoregressive process of seigniorage is determined to be one, using the FPE criterion. The next step in the process is to examine the relative importance of the set of multiple causal variables for seigniorage in entering the model. The order in which the causal variables such as inflationary expectations, output gap, gross fiscal deficit and real effective exchange rate enter the model is determined by defining the specific gravities of the multiple causal variables. The specific gravity of a causal variable is the inverse of the FPE computed for the multivariate autoregressive model. In order of decreasing specific gravity, the causal variables of seigniorage are ranked and stage wise causality detection is applied to determine the causal relationships of the variables.

In other words, we first constructed the optimal univariate AR model using FPE criterion for seigniorage, which is determined to be one. Then we included the multiple causal variables of seigniorage, one at a time, according to their causal ranks and use FPE criterion to determine the optimal orders of the model at each step. As per the specific gravity criterion, fiscal deficit, output gap, real effective exchange rate and expected inflation entered the model sequentially. The optimal parameterization of these variables detected through FPE criterion is determined to be one for all the variables. Simultaneously, while getting the optimal ordered multivariable AR model of seigniorage against its causal variables, the stagewise causality detection has also been performed. The results showed that output gap, the proxy for economic activity and the fiscal deficit causes seigniorage in India, while inflationary expectations and real exchange rate do not cause seigniorage revenue (Table 5.6).

This result is in confirmation with the fact that fiscal deficit causes seigniorage in India, inspite of the attempts by the government to bring down the monetisation of defiict. The fiscal authority dominance in monetary stance is reflected in this causal relationship

between seigniorage and fiscal deficit. At the same time, inflationary expectations doesnot cause seigniorage in India. Inflationary expectation is included as the proxy to reflect the price stability objective of monetary authority; that is, to test whether the money creation by the Central Government is based on the inflationary expectations or not to maintain the price stability in the economy. The result of lack of causal relationship between seigniorage and inflationary expectations, and at the same time, the existence of causal relationship from fiscal deficit to seigniorage reinforces the fact that the prime objective of price stability is juxtaposed by the dominance of fiscal dominance in the monetary operations in India.

Table 5.6:Seigniorage Model: Hsiao [1981] Detection of Optimal Lags of he Manipulated Variables and FPE of the Controlled Variable (Seigniorage)

Controlled Variable	***Manipulated Variables***				***Optimum lags of Manipulated Variable***	***Final Prediction Error***	***Causality Inference***
$(Sei)_t$	-	-	-	-	-	0.295069	
$(Sei)_t$	(DEF_t)	-	-	-	1	0.200708	$(DEF_t) \Rightarrow (Sei)_t$
$(Sei)_t$	(DEF_t)	O_g	-	-	1	0.200619	$O_g \Rightarrow (Sei)_t$
$(Sei)_t$	(DEF_t)	O_g	$(e_r)_t$	-	1	0.216875	$(e_r)_t \neq (Sei)_t$
$(Sei)_t$	(DEF_t)	O_g	$(e_r)_t$	π_t	1	0.235352	$\pi_t \neq (Sei)_t$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

After estimating the causal relationship in Hsiao framework of AR model, we turn to estimate the error correction equation of seigniorage using the same variables, fiscal deficit, inflationary expectations, output gap, real effective exchange rate along with a dummy for financial deregulation since 1993 (d93). As seen in Hsiao AR model, the results from the error correction equation also showed that output gap and fiscal deficit are significant in determining the seigniorage revenue in India. The positive sign of outgap in determining seigniorage depicts that the monetary policy is pro-cyclical in India, that is, higher the economic activity, higher the creation of base money in the economy.

$$\Delta sei = 0.081 - 0.451\ \Delta sei(-1) + 3.78E\text{-}05\ \Delta DEF(-1) - 0.0059\ \Delta REER(-1) + 1.626\ \Delta \pi(-1) +$$
$$(-0.616) \quad (-2.491)^* \quad (2.115)^* \quad (-1.756)^* \quad (1.1198)$$

$$0.049\ ecm + 0.087\ \Delta og(-1) - 1.093\ D93.$$
$$(1.12) \quad (2.105^*) \quad (-1.790)^*$$

$R^2 = 0.505$

$DW = 2.12$

The figures in parentheses denote t-statistics and * denotes 1 per cent level of significance.

The results also showed that Central bank has tended to expand the seigniorage in response to the real exchange rate and in addition has tended to have continuity in its own previous actions rather than abrupt changes in policy. The result of real effective exchange rate determines seigniorage revenue in India is not surprising that especially in 1990s, under the surge of capital flows, RBI has undertaken cautious open market operation or sterilization in controlling the growth of money in Indian economy. The findings also reinforced that monetary policy is pro-cyclical in nature in India, which is reflected in the positive and significant association between output gap and seigniorage. The insignificant relationship between seigniorage and inflationary expectations appears to refute the prominent hypothesis that the Central Bank varies its monetary base in order to achieve its desired objective of price stability. The dummy for financial deregulation since 1993 is found significant, but have negative association with seigniorage. This result is in confirmation with the fact that Central bank has followed a deliberate open market operations policy to bring down the pressures on money supply coupled with the phasing out of ad hoc Treasury bills to reduce monetisation of deficit. To be specific, in post 1993 period seigniorage financing has been negligible and there has been a shift to bond financing of deficit.

5.4: Summary

This chapter analyzed the impact of fiscal deficit on the creation of seigniorage in India. As a prelude to the analysis of fiscal deficit and seigniorage, we have estimated the revenue generated by the government from seigniorage during the period between 1970-71 and 1999-2000 and compared it with the estimated inflation tax. It was estimated that seigniorage revenue has increased over the decades from 1 per cent of GDP in 1970s to 3 per cent of GDP in 1990, though the late nineties showed a tremendous decline in the revenue generated from seigniorage. As noted, inflation tax is not always equal to seigniorage. The econometric estimation showed that one per cent rise in inflation tax led to 0.6 per cent rise in seigniorage in India over last three decades. As inflation tax is defined as the erosion of high powered money held by the public, it is to be noted that high inflation implies high erosion.

Using Cagan's semi logarithmic function for demand for money, while explaining the link between seigniorage and fiscal deficit, *dual inflation equilibria*, was observed, which generate same amount of seigniorage revenue. This dual inflation equilibria (a low inflation equilibrium and a high inflation equilibrium) at a given amount of seigniorage give rise to the existence of a seigniorage Laffer curve. We have estimated *Seigniorage Laffer curve* for India

over the period between 1970-71 and 1999-2000, and found that the squared inflation term which give rise to the inverted U-curve phenomenon is negative and significant, thereby reinforcing the existence of a non linear relation between revenue from seigniorage (μ_t) and inflation rate (π_t).

The results from sequential autoregressive modeling of seigniorage for causality detection revealed that fiscal deficit causes seigniorage in India. This result reflects a situation of dominant fiscal authority forcing an accommodating monetary policy to monetise its financing requirements. The error correction equation revealed that fiscal deficit is a significant determinant of seigniorage along with output gap and real effective exchange rate. The positive sign of output gap in the equation depicts that the monetary policy is pro-cyclical in India. The results thus showed that there exists a link between deficits and seigniorage[24]. Now the question is whether fiscal deficit has any link with money supply and in turn inflation, which will be addressed in the next chapter.

[24] Instead of seigniorage, monetary base is also introduced in Hsiao's framework of AR model and we examined the causality between monetary base (high powered money or reserve money) with the same specification. In the process, the optimal lags of monetary base are found to be two as per FPE criterion, while all other variables have optimal lags at one. As per the specific gravity criterion of diminishing FPE, the order of variables entered the model as follows: first inflationary expectations, second fiscal deficit, third output gap and last real effective exchange rate. The results showed that fiscal deficit and output gap cause high powered money or reserve money in the economy, while inflationary expectations and real effective exchange rate donot create high powered money. As seigniorage model and reserve money model give same results of causality detection, we are not reporting these results of reserve money model in detail in the chapter. Moreover, it is not surprising that both models have shown similar results, as seigniorage is nothing but the change in the reserve money to GDP.

Appendix

A 5.1: Selected Empirical literature on Fiscal Deficit-Money Link

Niskanen (1978) found that federal deficits are not inflationary. He estimated a reaction function of the money supply in the context of US for the period 1947 to 1976 using annual data. His results showed that federal deficits (both absolute levels and first differences) do not exert any significant effect on inflation rate, operating either through the rate of growth of money supply or independent of it, and therefore the results are not consistent with Buchanen Wagner hypothesis of no impact of federal deficits on inflation.

Spaventa (1987) developed a theoretical study along the lines set by Sargent and Wallace (1981) and proved that the SW conclusion (tighter money now may cause higher inflation later), is not, in general limited to the case when the real interest rate exceeds the growth rate. He asserted that given the accumulated stock of public debt, a period of looser monetary policy may be necessary to stabilise the economy at far lower steady rates of monetary expansion than would otherwise be possible, especially if, initially, the real rate of interest exceeds the growth rate. Dutton (1971) tested empirically the self-perpetuating process that inflation results in a widening of budget deficits financed through the Central banking system, leading to further increase in money supply and further increases in prices in Argentina.

Aghveli and Khan (1977) developed a dynamic model of deficit financing and inflationary mechanism in a continuos time framework in the context of Indonesia. They found that rate of inflation tends to increase nominal expenditure faster than revenue, and the resultant budget deficit increases the money supply and induces further inflationary pressures. They argued that while high rates of monetary expansion would increase the government revenue from issuance of money, the resultant increase in inflation would reduce the real value of taxes, which adjust with a lag to price developments leading only to marginal increases in total government revenue. Aghveli and Khan (1978) examined the link between increases in money supply and inflation in four developing countries, viz., Brazil, Columbia, the Dominican Republic and Thailand through a model that explicitly introduced the link in the form of the reactions of the government deficit to inflation. The hypothesis they tested in their model is that while government expenditures rise concomitantly with inflation, while government revenues would tend to fall behind in real terms owing to collection lags. Then

the financing of this inflation-induced deficit would increase the money supply and generate further inflation. Thus, the increase in the supply of money would cause both inflation and would be the result thereof, a phenomenon that was confirmed by the causality tests between money supply and deficits.

Sargent and Wallace (1973) and Frenkel (1977) too recognised the significance of feedback relationship from inflation to the expansion in the money supply and they tested the role of fiscal operations in raising monetary stance. They argued that the expansion in money supply is itself a result of ongoing inflation, and while it is still a major factor in affecting the rate of inflation, there is evidence of feedback relationship. In other words, the expansion in the nominal stock of money increases the demand for goods and services and thus prices, but the inflation results in increased government deficits, which the authorities finance by further money creation.

Frenkel (1977), while addressing the issues of government revenue from inflationary finance and the endogeneity of money supply, pointed out that to understand the economics of inflation, one needs to examine the characteristics and determinants of money supply process rather than concentrating exclusively on the properties of the demand.

Dornbush and Fischer (1981) examined the link between budget deficits and inflation in the context of Finland, Guatemala, Ireland, Israel, Norway, South Africa and Sri Lanka in a theoretical model of aggregate demand and aggregate supply. Their macroeconomic model estimated the money supply functions incorporating budget deficit along with other variables like wage inflation, unemployment rate and changes in foreign assets. Their conclusion donot confirm to the accepted wisdom that budget deficits are the dominant source of money growth. Their evidence suggested that wage inflation is the significant determinant of money growth in almost all countries. They found a positive relationship between budget deficit and money growth only in Guatemala, Israel and Norway.

Hamburger and Zwick (1981) reexamined the relationship between budget deficits and money supply in US in Barro's framework over two periods: 1954-1976 and 1961-1974. They found that former period support Barro's conclusion that government expenditure and lagged unemployment rather than budget deficits affect growth of money stock. But the latter period, which was termed as "Keynesian period", suggested that budget deficits rather than government spending affect monetary growth, thus supported BW hypothesis. They

concluded that monetary policy is influenced by Federal Government's fiscal policy actions, measured either by expenditure or budget deficit.

In Barro's framework, Allen and Smith (1983) tried to analyse the link between deficit and money supply for US economy during the period 1954 to 1980. They used quarterly data for the study. In their study, monetary base was used as the explanatory variable instead of change in money supply (M1 and M3) and debt is used instead of deficit variable. The study concluded a positive and significant impact of the real trend value of the change in stock of government debt on the growth of the monetary base.

Levy (1981) estimated a reaction function of base money in the context of US. The variables included in the model were rate of interest, government debt, unemployment rate, expected inflation, potential GNP and the lagged base money. Levy found that monetary base expanded in response to government deficits. Other recent studies by Ahking and Miller (1985), Protopapadakis and Seigel (1987) and Barnhart and Darrat (1988) have tested the link between deficit, money and inflation and the direction of causality, if any. The countries covered in these studies are developed countries, which include Canada, France, Germany, Japan, UK and US. These studies reject the long run impact of budget deficit on money growth in the context of these countries, suggesting that fiscal and monetary policies are independent in these countries. However, Protopapadakis and Seigel (1987) found some weak evidence of debt on inflation in the short run.

In Ahking and Miller (1985) model, federal deficits, base money growth and inflation are specified in vector autoregressive framework for a period between 1947 and 1980 using US quarterly data. This framework is used to avoid apriori exogeneity assumptions and enabled the treatment of each variable as endogenous and also to relieve the burden of having to specify the structural relationships between deficits, money growth and inflation. The parametrisation of model is determined using Akaike's Final Prediction Error criteria. Ahking and Miller concluded that there exists a feedback (bi-directional causality) relationship between base money growth, government deficits and inflation for the period 1950s and 1970s and in all periods, government deficit and inflation cause growth in base money. Another point to be noted in their study is that the effect of government deficit on inflation is direct and independent of the effect of base money growth on inflation. In other words, their results do not support the view that government deficits are inflationary, only if they are monetsied.

George, Demopoulas, et al. (1987) examined the monetary policy objectives and the Central Bank financing of the government deficit in eight countries, viz. Belgium, France, Germany, Italy, Japan, Netherlands, UK and US under fixed and flexible exchange rates. They found that only Bundesbank of Germany and Fed of US donot accommodate the government deficit in either exchange rate regimes. Furthermore, the move to monetary targeting has seemingly reduced the degree of linkage of monetary policy to government deficits.

Another significant point to be noted is that among the various alternative hypotheses to explain inflation, monetarist explanation of inflation has been empirically tested extensively. According to monetarist approach to inflation, inflation occurs due to the excessive growth rates of nominal money supply over that of the real money demand. In other words, high inflation can be the outcome of high money supply growth, given the real money demand (Darrat (1986), Harberger (1977), Vogel (1974), Sheehey (1980), Saini (1982), Darrat (1982), Bhalla (1981)}.

Darrat (1986) empirically investigates the validity of monetarist approach to inflation in case of North African developing countries like Libya, Morrocco and Tunisia over the quarterly period, 1960 to 1980. The inflation model estimated by Darrat takes into account the role of foreign rate of interest on inflation rate along with the money supply. Also, appropriate lag structure was determined rather than assumed, which contributed to methodological improvement of monetarist models. The empirical results showed that the monetarist model adequately explained the process of inflation in North African countries.

Sarma (1982) tested the self- perpetuating hypothesis of inflation-induced deficits and deficit-induced inflation in the context of India for a period of 1961-62 to 1979-80, when budget deficits were mainly financed by RBI, in a simple dynamic model. His results confirmed the self-perpetuating hypothesis in the context of India. Rangarajan and Mohanty (1997) examined the various macroeconomic impact of fiscal deficit in India with special emphasis on the nature of relationship between fiscal deficit, monetary growth and external balance. They recognised the important link between money supply and fiscal deficit through the primary channel of monetary expansion, in turn through the reserve money and the money multiplier. The study found out that fiscal deficit result in widening of current account deficit in the Balance of Payments, although the outcome depended on how the deficit is financed. Further, they found that in case of monetary financing scenario, a deterioration in external sector resulted both in the short run and the long run.

Chapter 6

Fiscal Deficit, Money Supply and Inflation

It has already been noted in the last chapter that an analysis of the effects of fiscal deficit on the conduct of monetary policy is a multifold procedure. It examines the interlinkages between fiscal deficit, seigniorage, money supply and inflation in an iterative manner. Also, a relationship between high powered money or seigniorage and the fiscal deficit does not necessarily mean a stable relationship between high powered money and money growth and therefore, between money supply and fiscal deficit. The behaviour of money multipliers can to a great extent determine the relationship between seigniorage and money supply. In other words, if money multipliers are stable, there may be a relationship between seigniorage and money supply and in turn, money supply and deficit. The determination of money supply is, thus, a process of determination of sources of variations in reserve money and the money multiplier. This chapter analyses the relationship between money supply and fiscal deficit as well as between fiscal deficit and inflationary pressures in the economy.

The chapter is divided into five sections. Section 6.1 deals with money multipliers, while section 6.2 two discusses the estimation of money supply function in India. Section 6.3 discusses the link between fiscal deficit and inflationary pressures in the economy, while section 6.4 explores the link between fiscal deficit, reserve money and inflationary pressures in the deregulated financial regime, while section 6.5 concludes.

6.1 Money Multipliers in India

Since the money multipliers, M1/M0 and M3/M0, consist of the ratio of currency to demand deposits and that of bank reserves to demand deposits, it follows that the determinants of the money multiplier implies specifying the determinants of these ratios (Gupta, 1992). Since these ratios are the outcome of the portfolio behaviour of the non-bank public and banks, we need to specify models determining such behaviour. Once we have done that, we can combine the analysis of the previous chapter and these models, and examine the relationship between fiscal deficit and money supply. This is a huge task beyond the scope of the present study. So our approach, instead is to estimate the relationship between money and supply and fiscal deficits. This is also the approach, which has been commonly used in literature (Gupta, 1992, Dornbush and Fischer, 1981, Barro (1978), Levy (1981), Niskanen,

1978, Hamberger and Zwick, 1981, Demopoulos, et al, 1987). As noted, the mechanism through which fiscal deficit and seigniorage link spill over into fiscal deficit-money supply link is via money multipliers.

The evidence from Chapter 2 showed that money multipliers are not in general stable in Indian economy for the period 1970-71 and 1999-00. This prima facie evidence of variability in money multipliers intertemporally can be reinforced using the following analysis. Money multipliers estimated through regression method, specifying M1 and M3 in the double log function of reserve money (M0). The estimated beta coefficients from these equations show responsiveness of the narrow and broad money to reserve money, which in turn manifests money multipliers[1].

The supply of broad money (M3) and narrow money (M1) are linked to reserve money (M0). The double log regression shows that coefficients of reserve money have been below unity for the periods between 1970-79 and 1980-89 and above unity for the periods 1990-99. The β coefficients of the three subperiods revealed that money multipliers were not stable in India. The β coefficients were 0.41, 0.22 and 1.28 respectively for the period of 1970s' 1980s' and 1990s. These double log regressions performed for M1 and reserve money and M3 and reserve money are corrected for first order serial correlation by Cochrane-Orcutt two stage autoregressive transformation[2].

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[1] Ideally the money multipliers should be functionally related to behavioral factors, such as ratio of currency to deposits, and a policy variable, ie., cash reserve ratio. It has also been contended that money multiplier will depend on the demand for credit and hence on output, since the degree at which a given quantum of reserve money will translate into money supply will depend on the credit demand in the economy at that point of time (Rangarajan and Mohanty, 1997).

[2] As the DW value of initial exercise suggests the presence of first order autocorrelation, an autoregressive transformation is introduced to eliminate that first order Markov serial correlation in the errors of the form

$$e_t = \rho\, e_{t-1} + e_t^* \quad \text{---------- (i)}$$

where ρ is the coefficient of autocorrelation in errors and et* is a random term which fulfills the usual assumptions. Cochrane-Orcutt two-stage auto-regressive transformation is performed in the original OLS model by using the estimated value of ρ in performing the generalised differencing transformation of the regressand and regressors. Cochrane Orcutt two-stage autoregressive transformation essentially consists of three steps. In the first step, Ordinary Least Squares is performed to estimate the original model, say

$$LM3_t = \alpha + \beta_1 Lm0_t + \mu_t \quad \text{----------(ii)}$$

IF DW statistic indicates the presence of serial correlation in the errors, then the residuals (et) from the equation (ii) are used to perform the following regression.

$$et = \rho\, e_{t-1} + v_t \quad \text{---------- (iii)}$$

The estimated value of ρ is used to perform the generalised differencing transformation and a new regression is run on the transformed regressand and regressors, that is,

$$L\,M3r_t^* = L\,M3_t - \rho\, L\,M3_{t-1} \quad \text{----------(iv.a)}$$

$$L\,m0_t^* = L\,m0_t - \rho\, L\,m0_{t-1} \quad \text{----------(iv.b)}$$

The transformed equation is

$$L\,M3_t^* = b_0(1-\rho) + b_1\, L\,m0_t^* + v_t \quad \text{---------- (v)}$$

The errors v_t in equation (v) are assumed to be serially uncorrelated.

1970-79: lm3 = 1397.18 + 0.41 lm0 R^2=0.99 (6.1)
(0.05) (10.93)* DW =1.85

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

1980-89: lm3 = 668.56 + 0.22 lm0 R^2 =0.99 (6.2)
(0.02) (2.14)* DW = 2.30

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

1990-99: lm3 = -2.18 + 1.28 lm0 R^2 =0.99 (6.3)
(0.96) (6.97)* DW = 1.56

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

1970-79: lm1 = 5.92+ 0.41 lm0 R^2=0.96 (6.4)
(1.69* (1.19)* DW =2.4

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

1980-89: lm1 = 1.53 + 0.87 lm0 R^2 =0.99 (6.5)
(4.03)* (24.67)* DW = 1.5

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

1990-99: lm1 = -1.11 + 1.10 lm0 R^2 =0.99 (6.6)
(1.96)* (23.64)* DW = 1.6

*The figures in the parentheses denote t-values and * denote 1 per cent level of significance.*

The last three equations relate narrow money to reserve money, which gives the parameters of money multiplier as 0.41, 0.87 and 1.10 respectively for the three subperiods. The coefficients reflecting money multiplier for narrow money and broad money has not been found stable. The existence of unstable money multipliers, provides a prima facie evidence that there may be a lack of relationship between money supply and fiscal deficit. Next section econometrically estimates comprehensive money supply function to understand the link between fiscal deficit and money supply along with other relevant parameters.

6.2 Towards a Comprehensive Money Supply Function

The basic premise in which the money supply function presented in this chapter is that RBI responds to a spectrum of interacting objectives. Such a comprehensive money supply function can accommodate not only the price stability objective of RBI, but also a framework

to analyze the interaction between fiscal and monetary policy along with certain other relevant macro parameters. The scope for a comprehensive money supply function is all the more relevant in light of *Chakravarty Committee Report* (1985) to RBI. On the objectives of monetary policy in India, *Chakravarty Committee* recognized the existence of a multiplicity of objectives, not alone the objective of price stability. After referring to the importance of price stability as the appropriate objective, *Chakravarty Committee* noted that it "does not mean that other objectives are any less important or that the other instruments will not need to be utilised. To use monetary policy for stimulating growth would be a more maintainable objective. But that policy too can be counterproductive if you donot give adequate attention to the problem of price stability".

The specification of a comprehensive reaction function for monetary policy is relevant in the light of *Chakravarty Committee* recommendations on *monetary targeting*. It is to be noted that the concept of monetary targeting that Chakravarty (1985) used was very different from what was being advocated in other countries (Rangarajan, 2001). In the words of Chakravarty (1985), "The phrase monetary target is not necessarily to be equated with rigid targets. Only pure monetarists might view monetary targeting as being nothing other than an inflexible rule. What the committee has advocated is *monetary targeting with feedback.*" In practical terms, this implied that target ranges had to be modified in the light of the information available on expected output performance which might itself be a consequence of several factors, and there is a great deal of ignorance in India on what constitutes monetarism (Rangarajan, 2001). *Monetary targeting with feedback* necessarily implies the premise for modeling a money supply reaction function; which captures the complex interaction of the objectives of monetary policy and considers monetary policy within the context of the entire economy. Several published documents of RBI also refer to a wide range of economic concerns held by RBI, which reinforces the hypothesis that monetary policy is not conducted independently in India and it is intertwined with the borrowing requirement of Government, rate of interest movements, inflationary pressures and economic stability[3].

It is important to note that within the money reaction function, along with certain relevant macrovariables, this study intends to emphasise testing the co-ordination of fiscal and monetary policy; whether fiscal deficit leads to significant money creation in India. Recognizing the fact that government borrowing from Reserve Bank has been a major factor contributing to the increase in reserve money creation in India, and therefore money supply,

[3] Annual Reports of RBI (various issues), Report on Currency and Finance (various issues).

Chakravarty Committee paved the way for a historic agreement between Central government and RBI on the level of monetary expansion and the extent of monetisation of the fiscal deficit.

The prime question thus we try to analyze in a multivariate autoregressive framework is whether fiscal deficit create money supply in India. The RHS variables of the money supply model below are same as that of seigniorage model estimated in the previous chapter.

$$Ms = \alpha + \beta_1 Ms_{t-1} + \beta_2 DEF_t + \beta_3 \pi^e_t + \beta_4 OGAP_t + \beta_5 REER_t + D93 + \mu$$

where Ms = money supply
DEF_t = fiscal deficit
π^e_t = inflationary expectations
$OGAP_t$ = output gap
$REER_t$ = Real effective exchange rate
D93 = dummy for financial deregulation

Before delving into Hsiao's autoregressive framework of causality detection, pretest of cointegration is done in Johansen-Juselius maximum likelihood framework. The result of cointegration test is given in Table 6.1. The results showed that there exist two cointegrating vectors among money supply, inflationary expectations, real effective exchange rate, output gap and fiscal deficit. The results from Hsiao's autoregressive framework are given in Table 6.2. As per the FPE criterion, the order of one dimensional autoregressive process of money supply using FPE criterion is found to be one. In other words, we treat money supply as the only output of the system and assume inflationary expectations, real effective exchange rate, output gap and fiscal deficit as manipulated variables, which control the outcome of money supply.

Table 6.1: Cointegration tests based on Johansen's Maximum Likelihood Method: Money Supply Model

Maximum Eigen-value Test					**Trace Test**				
Ho	***H1***	***Statistics***	***CV 95 %***	***CV 90%***	***Ho***	***H1***	***Statistics***	***CV 95 %***	***CV 90%***
r=0	R=1	103.2083	37.07	34.16	R = 0	R ≥ 1	172.4211	82.23	77.55
r=1	R=2	43.6590	31.00	28.32	R ≤ 1	R ≥ 2	69.2127	58.93	55.01
r=2	R=3	12.7874	24.35	22.26	R ≤ 2	R ≥ 3	25.5537	39.33	36.28
r=3	R=4	7.2177	18.33	16.28	R ≤ 3	R ≥ 4	12.7663	23.83	21.23
r=4	R=5	5.5485	11.54	9.75	R ≤ 4	R ≥ 5	5.5485	11.54	9.75

Note: Deterministic component used in this model is unrestricted intercepts and unrestricted trends[4].
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

[4] The number of cointegrating vectors is found the same for other models with variations in the deterministic components and also with no trend and no intercept.

Using FPE criterion, we determine the optimal lag order of manipulated variables, assuming that the order of the lag operator on money supply is one (as specified initially as per FPE criterion). The order in which manipulated variables enter the equation is based on specific gravity criterion of Caines, et al (1981). According to specific gravity criteria, expected inflation and output gap entered the equation before real effective exchange rate and fiscal deficit entered the system last.

Table 6.2:Money Supply Model: Hsiao [1981] Detection of Optimal Lags of he Manipulated Variables and FPE of the Controlled Variable (Money Supply)

Controlled Variable	Manipulated Variables				Optimum lags of Manipulated Variable	Final Prediction Error	Causality Inference
$(Ms)_t$	-	-	-	-	-	0.0001690	
$(Ms)_t$	π_t	-	-		1	0.0001030	$\pi_t \Rightarrow (Ms)_t$
$(Ms)_t$	π_t	O_g	-		1	0.0000855	$O_g \Rightarrow (Ms)_t$
$(Ms)_t$	π_t	O_g	$(e_r)_t$		1	0.0000856	$(e_r)_t \neq (Ms)_t$
$(Ms)_t$	π_t	O_g	$(e_r)_t$	(DEF_t)	1	0.0000905	$(DEF_t) \neq (Ms)_t$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

The results showed that fiscal deficit does not cause money supply in India. At the sametime output gap (proxy for the economic activity cycles) and inflationary expectations cause money supply in India[5]. The real effective exchange rate is found not a causal variable of money supply. The following equation with error correction also showed that fiscal deficit is an insignificant variable in determining money supply in India.

$$\Delta(Ms)_t = 0.001563 + 0.877\ \Delta(Ms)_{t-1} + 0.132\ \Delta\ (DEF_{t-1}) + 0.001163\ \Delta\pi_{t-1} - 0.0009\ \Delta\ O_{g(t-1)} -$$
$$(0.463) \qquad (3.222)^* \qquad (0.562) \qquad (-3.64)^* \qquad (-0.95)$$
$$+ 1.91E\text{-}05\ \Delta(e_r)_{t-1} - 0.96\ ecm - 0.00085\ D93$$
$$(0.310) \qquad (-2.74)^* \quad (-0.187)$$

$R^2 = 0.44$

$DW = 2.06$

The figures in parentheses denote t-statistics and * denote 1 % level of significance.

The results showed that monetary policy stance is continuous as the lagged variable of money supply is significant and positive. The *endogeneity of money* in India is also established in these results. As defined in The *New Palgrave dictionary on Money*, the

[5] The reverse causality of money supply to prices and the level of output can be interesting to understand the hypothesis of *neutrality of money* in the context of India. *Neutrality of money* is a shorthand expression for the basic quantity theory proposition that it is only the level of prices in an economy, and the not the level of its real output that is affected by the quantity of money which circulates it (Patinkin, 1999). This argument dates back to David Hume in his 1752 essays "Of Money", and "Of Interest".

endogeneity of money consider that the stock of money in circulation is determined by one or all among the cluster of the variables -price level, interest rate or output[6]. In the Hsiao (1981) causality detection test, we identified that money supply is caused by inflation and output gap. Moreover, the equation with error correction reinforces that money is endogenous in India, as output gap is a significant determinant of money supply. This result is in confirmation with the Keynesian view that money supply is essentially endogenous. Further, the result that fiscal deficit does not cause money supply in India refutes the exogeneity of money supply in India[7].

6.3 Fiscal Deficit and Inflationary Pressures: Any Link in India?

The impact of fiscal deficit on inflationary pressures can be traced through two routes: direct route through recent *fiscal theories of price determination* and indirect route through monetarist theory, which we discussed in the above sections. Fiscal theories of price determination argued that there is an important class of policy rules which there exists a unique rational expectations solution that shows that the price level is independent of monetary policy but dependent strictly on fiscal policy[8]. This "fiscal theory of price level determination" breaks any link between money growth and inflation. The key fiscalist models were developed by Leeper (1991), Sims (1994), Woodford (1994) and Cochrane, J H (1998). The fiscalist literature that price level indeterminacy problems can be solved by having the central bank peg the nominal interest rate at a level consistent with the central bank's desired inflation rate, rather than by controlling the growth rate of the (base) money supply (Sims, 1994 and Woodford, M (1990).

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[6] The New Palgrave Dictionary of Money distinguishes the issue of *endogeneity or exogeneity of money* as follows: those who plug for the exogeneity view take one or all among the cluster of variables - price, rate of interest and output - as determined by the movements in the stock of money supply. Those who hold the endogeneity view consider that the stock of money in circulation is determined by one or all of the variables mentioned above. Thus the basic issue is about the direction of causality - money to other variables or other variables to money. In a dynamic context of macroeconomy, even if, the money is found exogenous, one has to distinguish between weak exogeneity and strong exogeneity. Weak exogeneity of money allows for feedback (bi-directional causality) from the endogenous to the exogenous variables over time, and strong exogeneity does not allow such a feedback (Hendry, Engle and Richard, 1983).

[7] The lack of stability in money multipliers in India over the period between 1970-71 and 1999-00 further refute the assumption of exogeneity of money. As money multipliers are not stable, the transmission mechanism of seigniorage-deficit link does not translate into money supply-deficit link, as there is no evident link between money supply and seigniorage.

[8] McCallum (2002) noted that these are dynamic general equilibrium models with infinitely lived households, money in the household utility function and rational expectations. He further noted that such models are ones in which it is common for Ricardian equivalence results to be obtained, which makes the fiscalist theory's claim more remarkable than if developed in a model of (e.g.) the overlapping generations type. Further McCallum pointed out that these models are developed in line with models explained by Sidrauski (1967).

The fiscal theory of price level determination was criticized by Buiter (1999) on the ground that these theories are fatally flawed, conceptually and logically. Later, McCallum (2002) provided an alternative mathematical solution to the fiscalist models of price determination, that yields a monetary explanation of the price level determination. McCallum's argument was not meant to deny that fiscal policy would in fact often have an enormous influence on the price level because the central bank chooses to accommodate fiscal tendencies, perhaps because of political pressures. But in that case, there is no basic dispute between fiscalists and monetarists. McCallum (2002) further argued that what is at issue is the fiscalist claim that price level is fiscally determined in cases in which the central bank refuses to accommodate and keeps monetary base on its predetermined path. It is to be noted here that McCallum's argument doesnot depend on the assumption that monetary base is constant. With growing monetary base, McCallum (2002) concluded that two competing equilibria would pertain to the question of whether price level explodes relative to the money base path – as fiscalist solution implies – or conforms to the money base path as in case of monetarist analysis.

6.3.1 Empirical Evidences on Monetarist Root of Inflation

The indirect route of fiscal deficit spill over to inflationary pressures in the economy is via growth of money. This route is broadly explained through the quantity theory of money. The quantity theory of money can be traced to David Hume's. As noted by Lucas (1996) in his Nobel Lecture, two of Hume's statements are what we now call the quantity theory of money: the doctrine that *changes in the number of units of money in circulation will have proportional effects on all prices that are stated in money terms, and no effect at all on anything real, on how much people work or on the goods they produce or consume*'[9].

A set of studies provides empirical evidences for existence of a correlation between money growth and inflation across countries. For instance, Cagan (1956) established a link

[9] This is the also called *Neutrality of Money. The concept of Neutrality of Money is based on the critical assumption that individuals are free of 'money illusion'.* The term 'money illusion' is used to describe any failure to distinguish monetary from real magnitudes. This term is coined by Irving Fischer, who defined it as "failure to perceive that the dollar, or any other unit of money, expands or shrinks in value". Neutrality of money is the simple expression of quantity theory of money. Sargent (1996) in his Nobel lecture succinctly put that Hume wrote on quantity theory of money in his *1752, Of Money and Of Interest*, before the invention of price indexes, and long before the invention of national income and product accounting, and his development of quantity theory was largely based on purely logical reasoning, though tested informally against his vast historical knowledge, and his belief in short run correlation between changes in money and changes in production was apparently based mainly on his everyday knowledge.

between money growth and inflation applying the monthly data to periods of hyperinflation in Germany, Greece, Hungary, Poland and Russia. Other studies which found link between money growth and inflation using annual data series were that of Klein (1956) in the context of Germany and Lucas (1980) in the context of US and Friedman and Friedman (1980) in context of selected countries like US, Germany, Japan, UK and Brazil. Some studies used quarterly data for analyzing the link between money supply and inflation, for instance, Hallman, Porter and Small (1991) studied the correlation for the period between 1955-1988 the dynamics of quarterly adjustment in inflation rates, adjustment of M_2 velocity to its long run equilibrium level (velocity gap) and the adjustment of GNP to its long run equilibrium level (output gap) in the US. Another study by Friedman and Schwartz (1982), used average-of-four years data of inflation and monetary growth in US and average-of-5.6 years in UK found that inflation depend almost entirely on money growth. These studies more or less converge to the point made by Friedman (1968) *inflation is always and everywhere a monetary phenomenon*, produced in the first instance by an unduly rapid growth in the quantity of money.

Lucas (1996) also noted that the central predictions of the quantity theory are that, in the long run, money growth should be neutral in its effects on the growth rate of production and should affect the inflation rate on a one-to-one-basis. Cross-country studies on evidence of link between money growth and inflation was provided by Lothian (1985) in 20 OECD countries using 14-year average inflation and money (m_1) growth rates. Like Lothian (1985), another cross country study by Duck (1993) using 33 country sample obtained regression coefficient of money growth and inflation close to unity. Rolnick and Weber (1977) also found close cross country correlation between long term inflation and money growth. Moroney (2002) developed a long run version of quantity theory of money growth, real GDP growth and inflation for 81 countries. He found that in countries marked by high money growth and inflation, the estimated coefficients of money growth is found close to one and in countries where there is relatively low money growth and inflation, the estimated coefficient of money growth is only 0.69, where quantity theory does not provide a complete explanation for the inflationary phenomenon.

As pointed out by Moroney (2002), many authors have recently rejected money growth as an explanation of inflation based on two streams of criticism. The first stream of critique argued that if demand for monetary aggregates is unstable, then money growth is an unreliable explanation for inflation in the economy (Cochrane (1998), Estrella and Mishkin

(1997), Baba, Hendry and Starr (1992)). The second stream of critique is related to econometric issues: that if money, output and the price level is not cointegrated, then there is no long run relationship between them. Hasan (1999) examined the relationship between monetary growth and inflation in China, using unit root and cointegration tests. He found that there existed a long run relationship between the general price level and money stock as well as inflation and monetary growth. His findings suggested a feedback relationship between inflation and monetary growth. The studies which find evidence for cointegration are Hoffman and Rasche (1991), Baba, Hendry and Starr (1992), Stock and Watson (1993), Hoffman, Rasche and Tieslau (1995), Swanson (1998), Carlson et al (2000), but the studies which found no cointegration between money supply, output and the price level are Stock and Watson (1989), Hafer and Jansen (1991), Friedman and Kuttner (1993), Thoma (1994). Most of these studies have not paid adequate attention to the inflationary potential of deficits.

Dornbusch (1998) criticized the conventional view that a large stock of public debt liabilities is a standing invitation to resort to inflation as a way to reduce its burden and hampers the exercise of a sound monetary policy by making monetary authorities less inclined to restrictive monetary policies because of their impact on the interest bill of the government. Drawing the historical experience of Germany (hyperinflation) and US (moderate inflation), Dornbusch (1998) stressed that unless the share of short term debt is negligible, as inflationary escape from the high debt is a feasible option only if interest rates somehow lag behind the dynamism of prices. It is argued that central banks are concerned with the size of interest bill of the government and thereby keep inflation expectations high in such situations. He further argued that the evidence is against such a view, among major industrial countries with a large public debt, central banks set their policies as if debt related constraints were absent. In line with these arguments of Dornbusch, the important question is whether the inflationary consequences of a large public debt according to *Unpleasant Monetary Arithmetic* an insignificant issue and as suggested by Winckler et al (1998), *Unpleasant Fiscal Arithmetic* of rules constraining the extent of budget deficits is an appropriate model for EMU and other countries. *Unpleasant Fiscal Arithmetic* thus visualize to reverse the order of adjustment, assumed in UMA, and to transfer the first mover advantage from fiscal agencies to the Central Bank authorities. By introducing strict fiscal policy rules, it obliges fiscal agencies to adjust to the anti-inflationary policy of the independent Central Bank and thus *Unpleasant Monetary Arithmetic* turns into *Unpleasant Fiscal Arithmetic* (Winckler, et al, 1998).

6.3.2 Modeling Inflation in the Context of a Developing Country

Inflation determination in the context of developing countries is complex. Existing models like Phillips Curve model, monetarist model, supply-side model or structuralist model alone cannot explain the inflationary phenomenon in the context of developing economies. As noted by Bhattacharya (1984), Philips curve model based on the Keynesian theory of aggregate demand is not strictly applicable to developing countries because organized labour market is only a minor segment of total labour market and in unorganized sector, wage rate has no direct relationship with labour productivity and therefore not a significant determinant of commodity price level. As we noted earlier, in the context of developing countries, monetarist model of inflation or the structuralist model of inflation cannot provide sole explanation[10]. Bhattacharya and Lodh (1990) also noted that the Rational Expectations model appear to be invalid for developing countries. He argued that, for expectations to be rational, there should be perfect information to all economic agents. But in developing countries, information is asymmetric. The presence of vast informal sector is a major obstruction to the free flow of information. The empirical studies on inflation based on Rational Expectations model in the context of developing countries is almost non-existent as the assumptions of homogeneous market or homogeneous production behaviour and perfect information appear to be practically irrelevant[11].

In the context of developing countries, studies by Siddique (1989), Saini (1982), Nachane and Nadkharni (1985), Dornbusch and Fischer (1981), Ramachandran (1983), Bhalla (1981), Aghveli and Khan (1978), Darrat (1986), Onis and Ozmucur (1990), Minhas (1987) broadly empirical experiments to determine the direction of causality between inflation and money supply, with some of these studies specifying structural models of inflation while others draw inferences about causality using data exploratory and diagrammatic

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[10] Monetarist argues that inflationary pressures are created in the developing economies due to the excess money supply. They argued that in a supply-constrained developing economy, because of supplyside bottlenecks, excess money supply cannot generate output through technological advancements and real resources cannot be augmented by a mere expansion of money supply (Bhattacharya and Lodh, 1990). They also ruled out the trade off between inflation and economic growth. On the other hand *supplyside* economists argued that inflation in a developing country is the result of structural disequilibrium in the growth process which cannot be cured by only monetary regulation. In pure *supply-side* models, inflation can occur without rise in money supply. But in modified *supplyside* model, money supply expands along with price level but the direction of causality need not flow from money to price, it could be the other way (Bhattacharya and Lodh, 1990). Bhattacharya and Lodh (1990) also noted that in *supplyside* school, there is trade off between growth and inflation, but the trade off occurs not due to Phillips curve type wage-unemployment relationship, but due to differential growth of output and demand between sectors.

[11] Bhattacharya and Lodh (1990) also observed that even government forecasts of budgetary transactions in India do not satisfy the criteria of *Rational Expectations*.

representations. Empirical evidences from India on inflation modeling showed that it is broadly based on elements of monetarist, supplyside model together rather than going strictly by either monetarist models or supply side models. The inflation models developed in the context of India by Ahluwaliah (1979), Bhattacharya (1984), Pandit (1978) and Bhalla (1981) combined the elements of structural, monetarist, Keynesian, cost-push theories and Lewis model[12].

Balakrishnan (1991) provided a comprehensive and coherent analysis of inflationary phenomenon in India within the framework of structuralist model for Indian economy for the period between 1950 and 1980, and he also compared the explanatory power of the model based on structuralist framework with that of a simple version of a model based on monetarist framework and find statistical evidence in favour of structuralist model. His results explained that it is because of excess demand, which causes inflation. In Bayesian econometric framework, Balakrishnan, Rao and Vani (1994) analyzed the price behaviour in the context of India and the statistical evidence favoured structuralist model to monetarist model.

Few of the studies on inflation model incorporated fiscal policy variable; Bhattacharya (1984) had stressed on the fiscal policy impact on inflation. Aghveli and Khan (1978) found a feedback relationship between money and prices in the context of Brazil, Columbia, Dominican Republic and Thailand. He explained his results in the structural model that monetary supply shock leads to increases in prices via the quantity theory mechanism, the increase in inflation leads to an increase in government expenditure (but not to a corresponding increase in revenues), thus creating a budget deficit, which is financed by money creation, which then leads to a further increase in prices and so on. Bhalla (1981) and Saini (1982) estimated augmented versions of monetarist models, by inclusion of additional variables into the monetarist model.

Dornbusch and Fischer (1981) estimated an equation derived from standard IS-LM-AS model, which includes budget deficit and money growth as causal factors of inflation. In three countries of their sample- Gautemala, Israel and Sri Lanka - monetary growth did not provide an adequate explanation for inflationary pressures in the economy. As for the budget deficit, it was found positive and significant in Israel. The results of Bhalla (1981) showed

[12] Bhattacharya (1984) stressed on the fiscal sector and inflationary phenomenon while Ahluwaliah (1979) stressed on primary sector to understand the inflationary pressures. Pandit (1978) and Bhalla (1981) in a mixed model of monetarist and structuralist approach, emphasis was given to sectoral prices at disaggregated level and international transmission of inflation respectively.

that in developing countries like India, Malaysia, Pakistan, Philippines, Sri Lanka Thailand and Taiwan, there existed some indirect effects of budget deficit on inflation through the coefficients of lagged monetary growth. Gupta (1992) in his cross country study of ten Asian countries showed that budget deficit has no impact on inflation in the context of India and South Korea, again which does not conform to a purely monetarist explanation to investment behavior in these countries. On the basis of this survey of literature, it is difficult to draw a convergence on the direct and indirect effects of deficit on inflation. The empirical evidences for direct effect of deficit on inflation in the context of developing countries is too scanty, while the evidences is mixed in case of indirect effects of deficit on inflation.

6.3.3 Specification of a Model

As rightly discussed in earlier studies on inflation model in the context of India, monetarist approach is highly inadequate to explain the inflationary phenomenon in India. In this section, we try to identify the key determinants of inflationary process in the context of developing countries, incorporating both demand side and supply side factors. The structure of the inflation model is derived from Lucas (1973), where he viewed aggregate price level as a result of interaction of aggregate supply and aggregate demand factors. The aggregate supply schedule depends on the deviation of actual output from potential output in the economy. We can start by specifying Lucas (1973) aggregate supply function:

$$\pi^*_t = p_t - p_{t-1} = \alpha + \beta_1 (y_t - y^*) \qquad (6.7)$$

where current inflation depends on the current output gap, and y* is the potential output.

As Lucas (1973) argued, the aggregate demand function is drawn up by the set of demand-shift variables like monetary and fiscal policies and variations in the external sector. The aggregate demand thus can be can be specified as follows:

$$y_t = y_{t-1} + \beta_2 m_t + \beta_3 I_r + \beta_4 DEF_t + \beta_5 reer \qquad (6.8)$$

where m_t is the rate of growth of money supply, I_r is the real rate of interest, DEF_t is fiscal deficit and $reer_t$ is real effective exchange rate.

Deducting y^* from both sides of the equation (6.8), and applying it to equation (6.7), we get

$$\pi^*_t = \alpha + \varphi_1 (y_t - y^*) + \varphi_2 m_t + \varphi_3 DEF_t + \varphi_4 reer_t + \varphi_5 I_r + \nu_t \qquad (6.9)$$

It is to be noted that the variable GAP (the deviation between potential output and actual output scaled to actual output) may not be a powerful variable to capture the supply side effects on inflation when compared to variable food grain prices in the context of India[13]. The studies on pricing and inflation in India noted that food grain prices are considered to be at the heart of inflationary process; apart from the obvious fact that food grains as a group have a large weight in the general price index, the change in the price of food grains is considered to be the most important determinant of the target adopted in a wage bargain by industrial workers (Balakrishnan, 1991). Chakravarty (1998) too highlighted the role of food grains in the inflation model of India. He noted that no models of inflationary process in India has found it possible to do without 'money'; as a statistically significant variable, it does suggest that money play a role, although certainly not an exclusive role, in determining the dynamics of price movements. The role of food grains production has been found important as well as the state of balance of payments. In the light of above discussions, we remodified the inflation equation using foodgrain prices instead of output gap as the supply side variable.

$$\pi^*_t = \alpha + \varphi_1 FGP_{t-1} + \varphi_2 m_t + \varphi_3 DEF_t + \varphi_4 reer_t + \varphi_5 I_r + \nu_t \text{ ---------- (6.10)}$$

Now we turn to a brief discussion of how each of these variables is linked to inflationary process. As discussed above, the foodgrain prices (proxy for supply side factor) are correlated positively to inflation and a priori we expect this link to be significant. The link of money supply translating into inflation is rooted in the monetarist argument of growth of money supply translating into prices. The transmission of deficit to inflationary process can be direct or indirect through money financing of deficit. The real effective exchange rate spills over to inflation via seigniorage. Interest rate affects inflation if the Central bank prefers inflation targeting; that is, pegging interest rates at certain level is very crucial for inflation targeting.

[13] where $\varphi_1 = \beta_1, \varphi_2 = \beta_1\beta_2, \varphi_3 = \beta_1\beta_3, \varphi_4 = \beta_1\beta_4, \varphi_5 = \beta_1\beta_5$. In order to find out the link between budget deficit and inflation, Gupta (1992) also derived his basic equation from Lucas (1973). But Gupta (1992) model is different from the present model, as it is a closed economy model with determinants of price as deficit, money supply growth rate and lagged price variables. Output gap is also omitted from the derivation in view of difficulties in the measurement (Gupta, 1992).

6.3.4 Econometric Estimation and Results

Before going into Hsiao (1981) causality detection procedure, we tested the data for cointegration using Johansen procedure. The order of VAR is detected using the model selection criteria of AIC, SBC and Log Likelihood method, setting the sample to maximum order of 3. The Schwarz Bayesian Criteria (SBC) suggests a VAR of order 1, while other criteria like AIC and log likelihood suggested a VAR of order 2. As in the case of previous models, we cannot afford the risk of overparametrisation as we have short time series data and thus decided to go by the decision of SBC to choose one as the order of the VAR for the cointegration. Using deterministic or non-deterministic trends in data, the maximum eigen value test and λ- trace test suggested that the rank (number of cointegrating vectors) is two (Table 6.3). The comovement of inflation with fiscal deficit, real rate of interest, real effective exchange rate, food grain prices, changes in money supply are plotted in Figure 6.1.

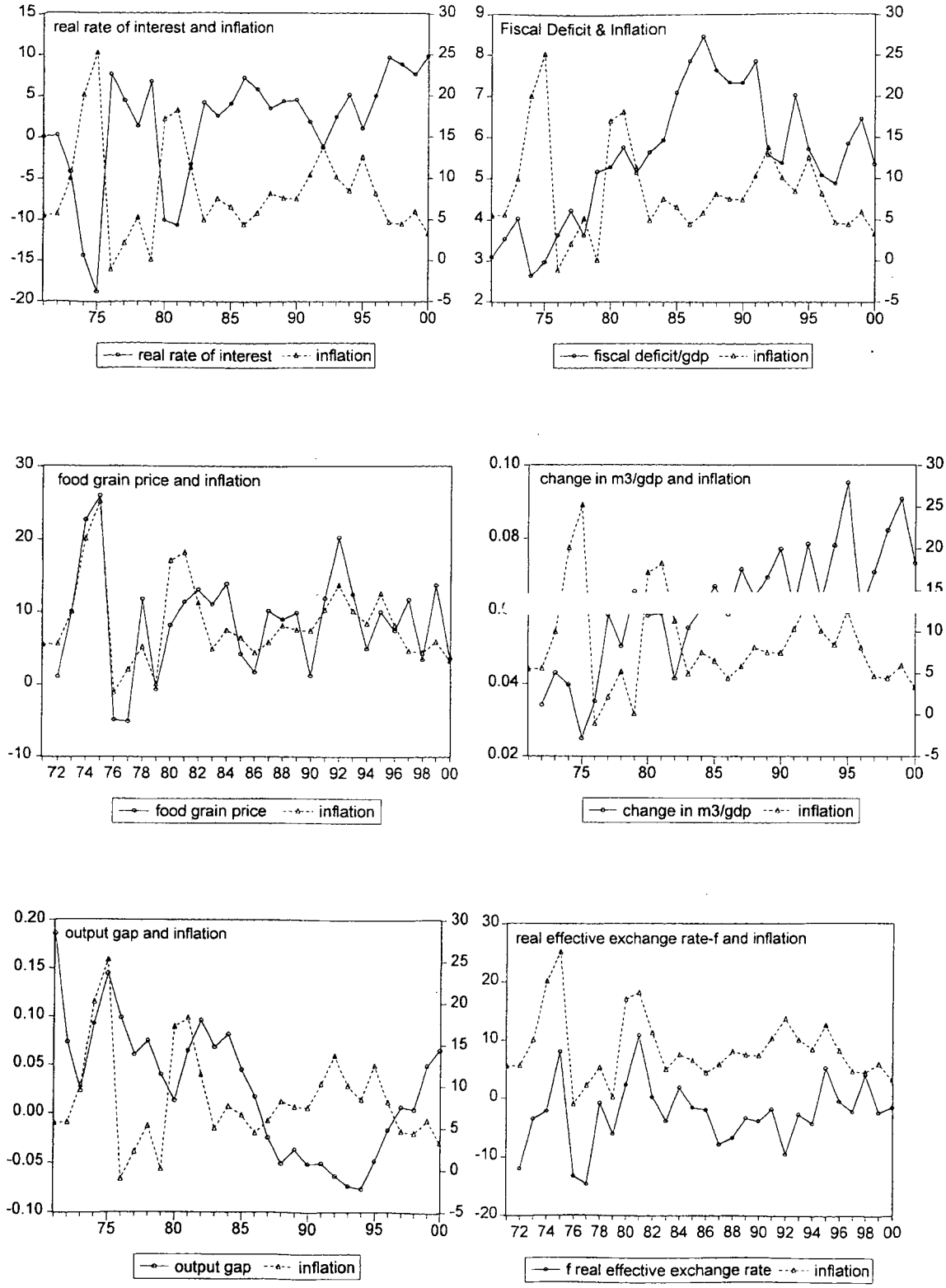
Table 6.3: Cointegration tests based on Johansen's Maximum Likelihood Method: Inflation Model

Maximum Eigen value Test					**Trace Test**				
Ho	***H1***	***Statistics***	***CV 95 %***	***CV 90%***	***Ho***	***H1***	***Statistics***	***CV 95 %***	***CV 90%***
R=0	r=1	104.9612	42.67	39.9	R = 0	R ≥ 1	195.5204	109.18	104.27
R=1	r=2	45.1291	37.07	34.16	R ≤ 1	R ≥ 2	90.5592	82.23	77.55
R=2	r=3	20.8552	31.00	28.32	R ≤ 2	R ≥ 3	45.4301	58.93	55.01
R=3	r=4	11.6906	24.35	22.26	R ≤ 3	R ≥ 4	24.5749	39.33	36.28
R=4	r=5	7.9091	18.33	16.28	R ≤ 4	R ≥ 5	12.8843	23.83	21.23
R=5	r=6	4.9752	11.54	9.75	R≤ 5	R ≥ 6	4.9752	11.54	9.75

Note: Deterministic component used in this model is unrestricted intercepts and unrestricted trends[14].
Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

[14] The number of cointegrating vectors is found the same for other models with variations in the deterministic components and also with no trend and no intercept.

Figure 6.1: Plots of Inflation and its a –priori determinants in India



Now we turn to causality procedure using Hsiao's sequential autoregressive modeling. The final prediction error (FPE) of fitting one dimensional autoregressive process for inflation is computed with upper bound of lag length (L^*) assumed equal to 5. Firstly, we

have considered inflation as controlled variable, holding the order of its autoregressive operator to one as per FPE criterion, we sequentially added the lags of the manipulated variables such as change in money supply, food grain prices, real rate of interest and real effective exchange rate upto the L^* of 5 and found respective order which gives the smallest FPE.

The order in which variable enter into the equation is based on *specific gravity criteria* (Caines, Keng and Sethi, 1981). The explanatory variables sequenced in the inverse order of their FPE as follows: food grain prices, change in money supply, real effective exchange rate, real rate of interest and fiscal deficit (Table 6.4). The results showed that food grain prices (proxy for supply side effect), change in money supply and fiscal deficit causes inflation.

Table 6.4:Inflation Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable (Inflation)

Controlled Variable	Manipulated Variables					Optimum lags of Manipulated Variable	Final Prediction Error	Causality Inference
$(\pi)_t$		-	-	-	-	-	36.83613	
$(\pi)_t$	fgp_t		-	-	-	1	36.01714	$Fgp_t \Rightarrow \pi_t$
$(\pi)_t$	fgp_t	Ms		-	-	1	35.44598	$Ms \Rightarrow \pi_t$
$(\pi)_t$	fgp_t	Ms	$(e_r)_t$		-	1	38.40948	$(e_r)_t \neq \pi_t$
$(\pi)_t$	fgp_t	Ms	$(e_r)_t$	$(i_r - \pi)_t$		1	40.00067	$(i_r - \pi)_t \neq \pi_t$
$(\pi)_t$	fgp_t	Ms	$(e_r)_t$	$(i_r - \pi)_t$	DEF_t	1	33.78777	$(DEF_t) \Rightarrow \pi_t$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

The equation with error correction term also revealed that inflation in India is not exclusively a monetary phenomenon, the supply side factors, proxied in food grain price is significant in determining inflation in India. In addition to change in money supply and food grain prices, real rate of interest and real effective exchange rate too found significant determinants of inflation[15].

[15] It is interesting to recall in this context the debate on *inflation targeting*, which has emerged as a part of new orthodoxy on monetary policy. The ingredients of new orthodoxy on monetary policy are delegation of monetary policy to an independent central bank, use of short term interest rates as the instrument of policy, inflation targeting and floating exchange rates (Alexandre, F et al, 2002). Fry, M, Julius D, Mahadeva L, Roger S and Stern G (2000) have done one of the broadest surveys of monetary policy frameworks and found that 61 out of 95 countries surveyed have used explicit inflation targets between 1990 and 2001; and India is one among those economies who adopted explicit inflation targeting since 1991 (cited in Mahadeva and Stern, 2002). The details of exact years in which these 95 countries have used explicit inflation targets are illustrated in tabular form in Mahadeva and Stern (2002) in a special edition of "Inflation Targeting" by The Manchester School. As set by Svenson (1997), inflation targeting is a regime in which the interest rate is set to achieve the monetary target value for the forecast of inflation rate at an appropriate horizon. Or it is a regime in which central bankers can be modeled as setting interest rates using all available information so as to optimize a welfare function that penalizes deviations from the inflation target. The inflation-targeting countries base their monetary policy explicitly on inflation forecasts, using them as effective targets. Thus inflation targeting uses the rule that set policy instrument (the nominal rate of interest) as a function of the deviation of the inflation forecast, for a defined horizon from the target.

$$(\pi)_t = 10.70 + 0.058\ (\pi)_{t-1} + 0.084\ fgp_{(t-1)} - 0.072(e_r)_{t-1} - 0.937\ i_r + 7.78\ (DEF_{t-1})$$
$$(5.691)^*\ (2.168)^*\ (-5.049)^*\ (23.737)^*\ (5.632)^*$$

$$+ 1.51\ E\text{-}05\ M_S + 0.462\ ECM$$
$$(2.594)^*\ (2.162)^*$$

$R^2 = 0.51$, DW = 1.92, The figures in the parentheses denote t-statistics and * denote 1 per cent level of significance.

Now we turn to analyze whether there is self-perpetuating process of inflation induced deficits and deficit induced inflation in the context of India for the period between 1970-71 to 1999-00.

Table 6.5:Fiscal Deficit Model: Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable (Deficit)

Controlled Variable	***Manipulated Variables***					***Optimum lags of Manipulated Variable***	***Final Prediction Error***	***Causality Inference***
(DEF_t)		-	-	-		-	0.000318	
(DEF_t)	π_t		-	-		1	7.19E-05	$\pi_t \Rightarrow (DEF_t)$
(DEF_t)	π_t	M_s		-		1	8.41E-05	$Ms \neq (DEF_t)_t$
(DEF_t)	π_t	M_s	$(i_r - \pi)_t$	$O_{g(t)}$		1	7.69E-05	$(i_r)_t \Rightarrow (DEF_t)_t$
(DEF_t)	π_t	Ms	$(i_r - \pi)_t$	$O_{g(t)}$		1	7.02E-05	$O_{g(t)} \Rightarrow (DEF_t)$
(DEF_t)	π_t	Ms	$(i_r - \pi)_t$	$O_{g(t)}$	$(e_r)_t$	1	7.43E-05	$(e_r)_t \neq (DEF_t)$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

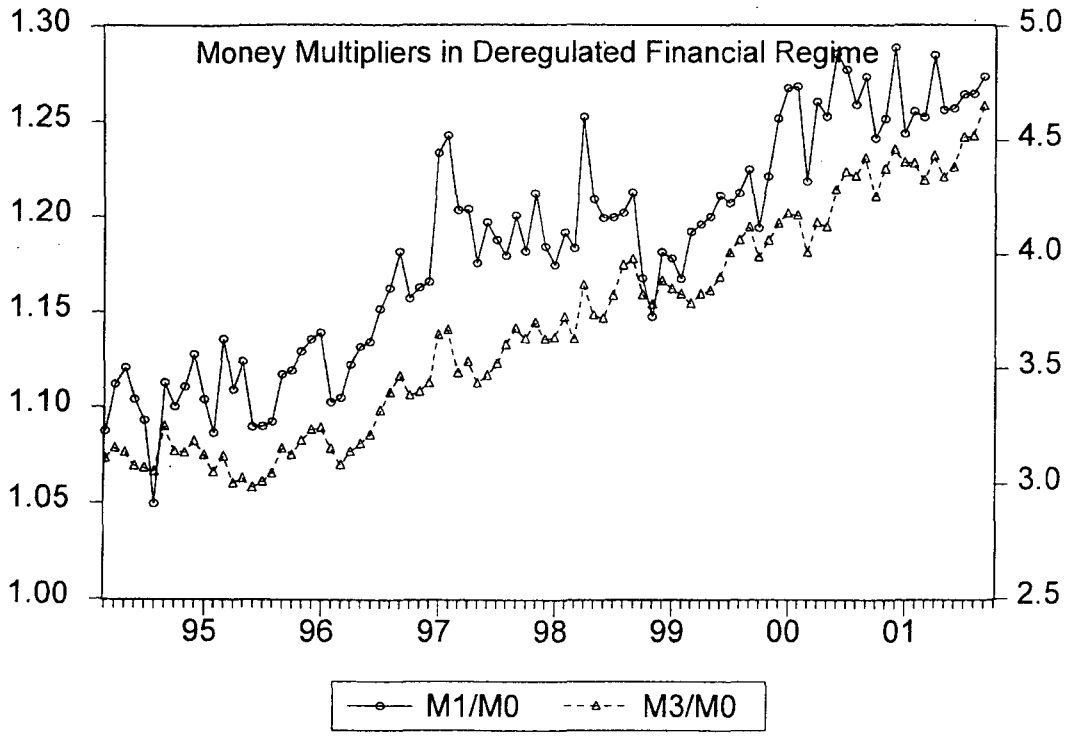
In the multivariate framework of Hsiao (1981) autoregressive modeling, we found that inflation induces deficit (Table 6.5). Thus evidence is provided on the fact that fiscal deficits were caused by the so-called Olivera-Tanzi effect, i.e., deficits were generated by inflation itself. Also, it is found that rate of interest and output gap are the other plausible determinants of fiscal deficit in India. This result is in confirmation with the existing literature that the three proximate macro-determinants of fiscal deficit are rate of interest, rate of inflation and output (Rao,2003; Tanzi, 1978, Aghveli and Khan, 1978)[16].

[16] Among the three macro-determinants of fiscal deficit, rate of interest, rate of inflation and output; it is noted that deficit will not disappear as a result of growth (Rao, 2003). An alternate solution might be decline in the interest rates. However, interest rates have already been lowered and unless there is a structural shift in the financing pattern of fiscal deficit, any further reduction seems unlikely. With neither growth nor interest rates being able to reduce deficit, inflation targeting-through the incorporation of optimal monetary policy rules-attains paramount importance (Rao, 2003).

6.4 Fiscal Deficit, Reserve Money and Inflation: Financially Deregulated Regime

This section explores the link between fiscal deficit, creation of reserve money and inflation in the deregulated financial regime in India. As data on GDP is not available on monthly basis, it is not possible to estimate high frequency data of seigniorage for the deregulated financial regime. However, as discussed in the earlier sections, the seigniorage per se cannot spill over into increase in money supply in the economy; the mechanism works through money multipliers. The trends in money multipliers calculated on monthly data basis showed that M3/M0 have shown greater variation than M1/M0 in the post-deregulated financial regime of India (Figure 6.2). It is also noted that M3/M0 is higher than M1/M0.

Figure 6.2: Trends in Money Multipliers in Deregulated Financial Regime in India



The extent of variability is more for M3/M0 than M1/M0. The M1/M0 ranged between 1.04 to 1.28 during the period between 1994:04 and 2001:09; while M3/M0 ranged between 2.98 and 4.65 during the same period. The movement of reserve money and fiscal deficit and money supply and fiscal deficit are shown in Figure 6.3 and Figure 6.4.respectively. Though changes in both series, reserve money and money supply have shown variations along with fiscal deficit, it is difficult to decipher at this point the exact reaction function of money to fiscal deficit in the financially deregulated regime, which needs empirical verification.

Figure 6.3: Co-movement of Changes in Reserve Money and Fiscal Deficit in Deregulated Financial regime

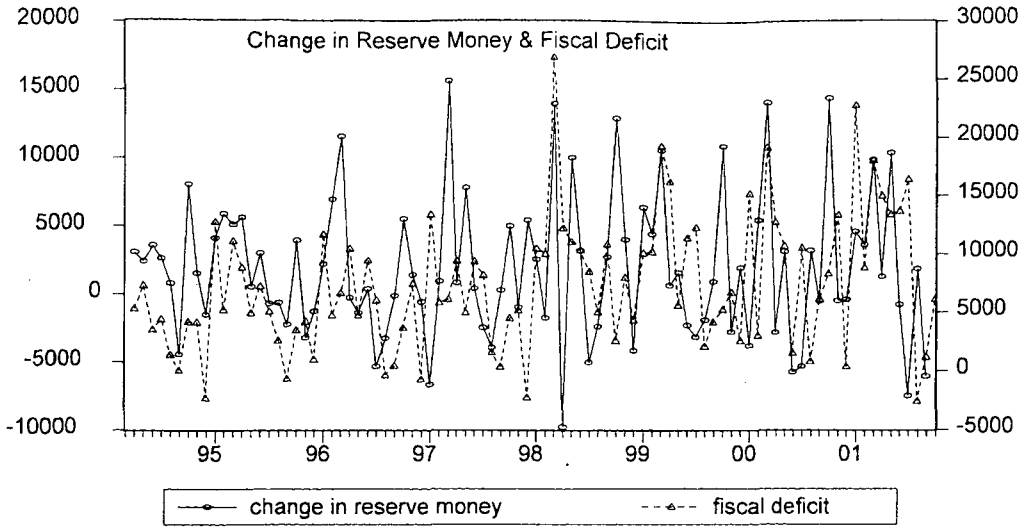
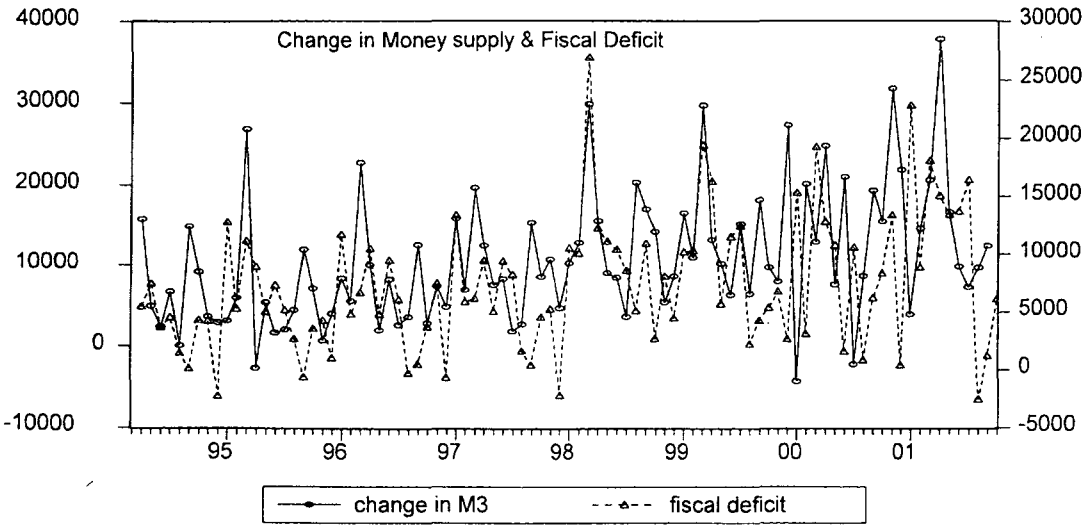


Figure 6.4: Co-movement of Changes in Money Supply and Fiscal Deficit in Deregulated Financial regime



The unit root tests revealed that changes in reserve money, money supply, real rate of interest, expected inflation, real effective exchange rate and fiscal deficit are stationary series in the high frequency data series of deregulated financial regime, and technically speaking, they are I ~ (0)[17]. The results are presented in Table 4.8.

Now we turn to estimate the sequential autoregressive model to understand whether there is any link between fiscal deficit and change in reserve money in the deregulated

[17]Using HP filter methodology, Output Gap is computed from Index of Industrial Production (IIP) as high frequency data of GDP is not available. Output gap is found to be I(0); with t-statistics –5.685646 (less than the Mc Kinnon critical value of –4.070 with drift and trend).

financial regime. Seigniorage is defined as change in reserve money to GDP ratio; as GDP monthly series is not available, the estimation of seigniorage-fiscal deficit link is not possible for high frequency data. Instead, the econometric investigation of link between change in reserve money and fiscal deficit in the multivariate framework is carried out. The results showed that in the deregulated financial regime, fiscal deficit does not affect change in reserve money. This result is in confirmation with the recent trend in the financing pattern of fiscal deficit. The monetisation of fiscal deficit (the net RBI credit to the government as per cent of GDP) has declined from 15.62 per cent in 1990-91 to 7.58 percent in 1999-00. Thus the shift in the financing pattern of fiscal deficit away from seigniorage financing to bond financing has considerably reduced the potential of fiscal deficit to create reserve money in the economy.

Table 6.6:Reserve Money Model in Deregulated Financial Regime: Hsiao [1981] Detection of Optimal Lags of he Manipulated Variables and FPE of the Controlled Variable (Reserve Money)

Controlled Variable	Manipulated Variables					Optimum lags of Manipulated Variable	Final Prediction Error	Causality Inference
$(Mr)_t$ [1]						1	3.01E+07	
$(Mr)_t$ [1]	O_g					1	2.88E+07	$O_g \Rightarrow (Ms)_t$
$(Mr)_t$[1]	O_g	$(e_r)_t$				1	2.94E+07	$(e_r)_t \Rightarrow (Ms)_t$
$(Mr)_t$[1]	O_g	$(e_r)_t$	π_t			1	2.99E+07	$\pi_t \neq (Ms)_t$
$(Mr)_t$[1]	O_g	$(e_r)_t$	π_t	(DEF_t)		1	3.05E+07	$(DEF_t) \neq (Ms)_t$
$(Mr)_t$[1]	O_g	$(e_r)_t$	π_t	(DEF_t)	$(i_r - \pi)_t$	1	3.12E+07	$(i_r - \pi)_t \neq (Ms)_t$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

The point to be noted here is that despite the decline in the monetisation of deficit, the reserve money as per cent of GDP has not declined simultaneously. On the other hand, it remained constant around 15 per cent of GDP during the nineties, and it was even higher than the levels in seventies and eighties. The factor which contributed to this trend of no significant decline of reserve money, despite the decline in net RBI credit to the government is due to the increasing share of net foreign exchange assets of RBI in reserve money creation. This trend is precisely captured in the results of sequential autoregressive model that real effective exchange rate is found to be a significant causal factor of reserve money creation in the deregulated financial regime. The significance of this result is that it is in conformity with the determinants of recent monetary stance in India; that for the first time, external sector became the main cause of expansion of money supply. RBI actively intervened in the FOREX market to stabilise the exchange rate and regulated money supply through sterilization. In order to neutralize the expansionary impact of capital flows, RBI conducted open market operations extensively. The net FOREX assets of RBI has increased from1.66 per cent of GDP in 1990-

91 to 8.48 per cent of GDP in 1999-00; which was higher than the levels in seventies and eighties at around 1 per cent of GDP for most of the years (Table 2.13 in chapter 2)[18].

Yet another significant result came out of Hsiao's sequential autoregressive modeling of reserve money creation in the deregulated financial regime of India is that *output gap* rather than *price expectations* constitute the significant causal factor of high powered money (Table 6.6) . This result is in confirmation with the recent trend of explicitly incorporating output trends (reflected in the deviations of output from target growth) into the monetary policy framework. Increasingly, monetary policy is viewed as an integral element of macroeconomic policy for economic growth and stability; rather than confining the monetary policies to the single objective of price stability[19]. The endogeneity of money in India is also reinforced in the results of deregulated financial regime.

Though fiscal deficit does not induce high powered money in the financially regulated regime, this result by itself is not sufficient to conclude that fiscal deficit does not have inflationary potential. These results only reflect the partial explanation that monetary roots of inflation may be insignificant in the deregulated regime. Therefore now we turn to analyse the whether the determinants of inflationary expectations in the deregulated regime contains direct fiscal roots.

[18] In chapter 2, orienting data exploration into these trends revealed that that share of net RBI credit to Central Government declined from 82.95 per cent in 1970-71 to 52.89 per cent in 1999-00; while the share of net foreign exchange assets of RBI has shown an increasing trend from 10.99 per cent in 1970-71 to 59.18 per cent in 1999-00 (Table 2.14). This increased share of net FOREX assets in reserve money had significant implications on the monetary management in India, which is aptly captured in the results of autoregressive causality tests in Hsiao framework (Table 6.6).

[19] There is a growing recognition worldwide in the 20th century that *money is not neutral. A*s visualized by Keynesians in the context of Great Depression, effective monetary and fiscal interventions is necessary to prevent macroeconomic failures (RBI, 2000). Also, there is a transition in the monetary policy stance worldwide from confining to single target objective of price stability to multiple interactive policy objectives such as overall economic growth and stability.

Figure 6.5: Co movement of Fiscal Deficit and Inflation in Deregulated Financial Regime

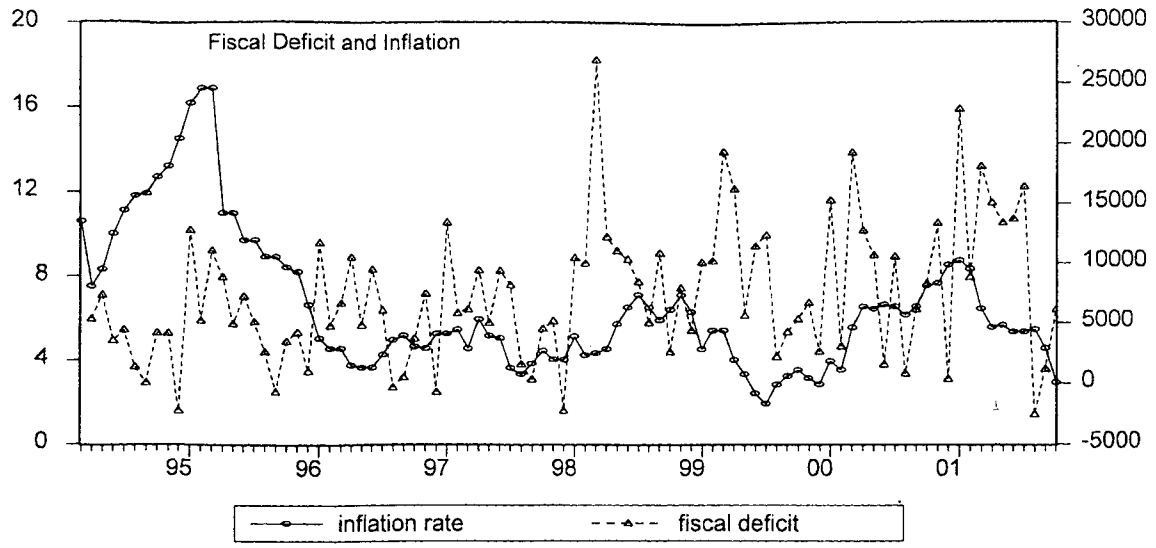


Table 6.7:Inflation Model in the Deregulated Financial Regime : Hsiao [1981] Detection of Optimal Lags of the Manipulated Variables and FPE of the Controlled Variable (Inflation)

Controlled Variable	Manipulated Variables					Optimum lags of Manipulated Variable	Final Prediction Error	Causality Inference
$(\pi)_t$		-	-	-	-	-	1.154851	
$(\pi)_t$	(DEF_t)					1	1.082512	$(DEF_t) \Rightarrow \pi_t$
$(\pi)_t$	(DEF_t)	$(e_r)_t$				1	1.02989	$(e_r)_t \Rightarrow \pi_t$
$(\pi)_t$	(DEF_t)	$(e_r)_t$	$(i_r - \pi)_t$			1	1.022427	$(i_r - \pi)_t \Rightarrow \pi$
$(\pi)_t$	(DEF_t)	$(e_r)_t$	$(i_r - \pi)_t$	Ms		1	1.016884	Ms $_t \Rightarrow \pi_t$
$(\pi)_t$	(DEF_t)	$(e_r)_t$	$(i_r - \pi)_t$	Ms	Og	1	1.0508633	Og $\neq \pi_t$

Source: (Basic Data), Handbook of Statistics on Indian Economy, RBI, 2001

The results of sequential autoregressive model showed that inflation is deficit induced in the deregulated financial regime also. The real rate interest and real effective exchange rate are also found causal variables in determining the rate of inflation in the deregulated financial regime. The evidence of Olivera-Tanzi effect that deficit itself is inflation-induced is also noted in the same period and self-perpetuating hypothesis of deficit-induced inflation and inflation-induced deficits is validated in the deregulated financial regime of India (Table 4.9).

6.5: Summary

The link between fiscal deficit and seigniorage does not necessarily translate into a relationship between seigniorage and money supply and hence between money supply and fiscal deficit. The stability of money multipliers is a necessary condition for the interlinkages between seigniorage, money supply and fiscal deficit. The econometric evidence from the double log regressions of monetary base with narrow money (M_1) and broad money (M_3) (corrected for first order autocorrelation using Cochrane Orcut procedure) revealed that

money multipliers were not stable in India over the last three decades. The existence of unstable money multipliers provided a prima facie evidence for lack of relationship between money supply and fiscal deficit.

Instead of confining to the quantity theory based model (where money is a function of only price level and output), we have developed a comprehensive reaction function for money supply in India taking into account of the existence of multiplicity of interactive objectives of monetary policy. The causality detection in the sequential vector autoregressive framework deciphered that inflation rate and output gap causes money supply; while fiscal deficit does not cause money supply in India. The result thus confirms to view that money is endogenous in the context of India.

As we found no link between money and deficit, the potential question arises is whether fiscal deficit is inflationary. It should be noted that apart from the generally agreed principle of increased money supply leading to higher rates of inflation, it is also argued that fiscal deficit contribute directly to inflationary pressures. We developed the structure of inflation model derived from Lucas (1973) where he viewed aggregate price level is a result of interaction of aggregate supply and aggregate demand factors. The results from Hsiao (1981) sequential autoregressive causality detection showed that money does cause inflation in India, although not an exclusively role. The supply side factors also found significant in the dynamics of price determination in India. Moreover, fiscal deficit does cause inflationary pressures in the economy. The reverse causality tests showed that fiscal deficit is in turn caused by inflation. Thus a self-perpetuating process of inflation induced deficits and deficit induced inflation is found in the context of India over the last three decades.

The analysis of deregulated financial regime revealed that fiscal deficit does not induce creation of reserve money; which is in conformity with the recent shift in the financing pattern of fiscal deficit away from seigniorage financing to bond financing. But the point to be noted here is that, despite the attempts to reduce the monetisation of deficit, the reserve money as per cent of GDP has not declined simultaneously. The factor which contributed to this trend of no significant decline of reserve money, despite the decline in net RBI credit to the government is due to the increasing share of net foreign exchange assets of RBI in reserve money creation. This trend is precisely captured in the results of sequential autoregressive model that real effective exchange rate is found to be a significant causal factor of reserve money creation in the deregulated financial regime. The significance of this result is that it is

in conformity with the determinants of recent monetary stance in India; that for the first time, external sector became the main cause of expansion of money supply through active intervention in the FOREX market to stabilize the exchange rate and regulated money supply through sterilization.

The *output gap* rather than *price expectations* is found to be the significant causal factor of high powered money in the deregulated financial regime. This result is in confirmation with the recent trend of explicitly incorporating output trends (reflected in the deviations of output from target growth) into the monetary policy framework. It also revealed the recent transition in the monetary policy from the single objective of price stability to an integral element of macroeconomic policy for economic growth and stability. The endogeneity of money in India is also reinforced in the results of deregulated financial regime. The self-perpetuating hypothesis of inflation induced deficits and deficit induced inflation is also validated in the context of deregulated financial regime.

Chapter 7

Conclusion

Fiscal deficit containment has been the raison d'être of macroeconomic adjustment in India, especially during the last two decades. Excessive fiscal deficit is often indicted for macroeconomic tribulations viz., rise in rate of interest, crowding out of private capital formation, creation of seigniorage, rise in inflation and balance of payment crisis. This study looked into the impact of fiscal deficit of the central government on selected macroeconomic variables in India, viz., private capital formation, rate of interest, seigniorage, money supply and rate of inflation over the period between 1970-71 and 1999-2000. It also examined some of these relationships exclusively for the deregulated financial regime using high frequency (monthly) data of fiscal deficit and selected macro variables.

As a prelude to the analysis of macroeconomic impacts of fiscal deficit, we surveyed the existing three macroeconomic paradigms discussing the impact of fiscal deficit, viz., Neoclassical, Keynesian and Ricardian Equivalence Theorem. The Neoclassicals envisioned that economic agents are farsighted and rational who make appropriate intertemporal decisions with respect to consumption and income within finite horizon, thus fiscal deficits raise total lifetime consumption by shifting taxes to future generations. This necessarily implies decreased savings and eventual crowding out of private capital formation through rise in rate of interest. While Keynesians argued that significant proportion of economic agents are myopic or liquidity-constrained and have high propensity to consume out of their current disposable income. This assumption implies that aggregate demand is responsive to changes in disposable income and Keynesians believed that an appropriately timed fiscal deficit can have beneficial consequences through stimulating national income, savings and capital formation.

Apart from these two diametrically opposite views lies the much-debated Ricardian Equivalence Theorem (RET). RET envisioned that rational economic agents can see through the intertemporal veil and realize that deficits merely postpone taxes to future generations. In the RET, increase in deficits will be offset by an equivalent increase in private savings in anticipation of future increased taxes to be levied by the government, to repay the borrowing. This implies that tax financing and bond financing of fiscal deficit can have no effect on aggregate demand. The important restatement of RET under the rubrics of debt neutrality and

ultra rationality explained that macroeconomic impact of fiscal deficit is measured wholly by the size and content of the deficit, regardless of the mode of financing fiscal deficit. It is to be noted that the macroeconomic effects of fiscal deficit depend not only on the levels of fiscal deficit but also on the modes of financing the deficit.

We derived the theoretical framework of the study from the intertemporal budget constraint, where fiscal deficit is defined and linked to its various modes of financing. As mentioned earlier, excessive use of any particular mode of financing the fiscal deficit has adverse macroeconomic consequences, viz., seigniorage financing of fiscal deficit can create inflationary pressures in the economy, bond financing of fiscal deficit can lead to rise in interest rates and in turn can crowd out private investment and the external financing of fiscal deficit can spill over to balance of payments crisis and appreciation of exchange rates. The study looked into the macroeconomic impact of fiscal deficit within this theoretical framework in the context of India.

As an orientating data exploration, Chapter 2 extensively delved into the trends in deficits and its financing pattern over the years and also the movement of fiscal deficit in relation to selected macroeconomic variables viz, private capital formation, rate of interest, seigniorage, money supply and inflation using simple statistical methods. The analysis showed that ratio of fiscal deficit to GDP has increased sharply over the years from 3.08 per cent in 1970-71 to the peak of 8.47 per cent in 1987-88 and then declined to 5.35 per cent in 1999-2000. With the burgeoning revenue deficit in gross fiscal deficit, the share of capital outlay in total fiscal deficit declined from 66.90 per cent in 1970-71 to 17.70 per cent in 1999-00. The decline in capital outlay had adversely affected the productive capital formation in the economy. The gross capital formation showed a declining trend in the public sector, especially since late eighties from 11.4 per cent of GDP in 1986-87 to 6.37 percent in 1998-99. Also the decline in capital formation got further accentuated as increasing fiscal deficit was contained through a drastic cut in central government's capital expenditure during the 90s.

The analysis of financing pattern of fiscal deficit over the last three decades revealed that monetisation of fiscal deficit has shown wide fluctuations and has been brought down through deliberate open market operations (OMO), especially in the deregulated financial regime. It is argued that a shift in the financing pattern of fiscal deficit from seigniorage financing to bond financing may exert upward pressures on rate of interest, which can crowd

out the interest-sensitive components of private spending. Also, the recourse to external financing of fiscal deficit has become negligible over the years, from around 35 per cent in mid-eighties to less than one per cent by the end of nineties. Among the various sources of finance, government's dependence on the market borrowing and other contractual liabilities in the public account (viz., small savings and provident funds) has increased heavily over the years.

The analysis of short run and long run rates of interest in the intertemporal scale adjusted for inflationary expectations showed that even in the administrated interest rate regime, all real rate of interest have shown considerable variations. The statistical properties of the rate of interest revealed that among all rates of interest, call money market rate remained highly volatile, while bank rate in nominal terms showed a sticky trend. The movement of fiscal deficit with real and nominal rates of interest does not reveal a definite pattern; and the correlation coefficients between the two revealed that fiscal deficit and rate of interest (real and nominal) are generally weakly correlated.

Apart from analysing the movement of gross capital formation and rates of interest vis-à-vis fiscal deficits, Chapter 2 delved into the data exploration for preliminary evidence of link between fiscal deficit, seigniorage, money supply and inflation. Seigniorage (defined as the ratio of change in reserve money/high powered money to GDP) has shown wide fluctuations over the last three decades. The seigniorage revenue has increased from around 1 per cent of GDP in seventies and eighties to 3 per cent in early nineties; though during the last half of the nineties, the revenue generated through seigniorage declined considerably.

It is interesting in this context to look into the role of fiscal policy in creating seigniorage revenue in India. The analysis showed that net RBI credit to the government (monetised deficit) as a percentage of GDP increased from 8.72 per cent in 1970-71 to 13.80 per cent in 1986-87 and then declined drastically to 7.58 per cent in 1999-00. Though the monetisation of fiscal deficit declined, the reserve money as a percentage of GDP has not declined simultaneously in the nineties, and it was even higher than the levels in seventies and eighties. Despite the decline in the net RBI credit to the government (monetised deficit), the factor that contributed to the trend of no decline in the reserve money creation was the increase in the net FOREX assets of RBI. Under the surge of capital flows in nineties, it has increased from 1.66 per cent of GDP in 1990-91 to 8.48 percent in 1999-2000.

Seigniorage *per se* cannot spill over into growth of money supply. The transmission through which seigniorage affects money supply is money multipliers. If the money multipliers are stable there is a possibility that creation of seigniorage will lead to an increase in money supply. The money multipliers (defined as ratios of narrow money to monetary base (M1)/M0) and broad money to monetary base (M3/M0)), are found to be not stable over the period of time, which in turn give an indication of the non-existence of the link between fiscal deficit and money supply. The correlation coefficient too suggested that both macro series are weakly correlated (correlation coefficient is 0.18). On the basis of the preliminary data exploration and tentative inferences drawn from Chapter 2, we investigated the exact nature of the relationship between fiscal deficit and the macro variables econometrically.

Chapter 3 looked into the link between fiscal deficit and private capital formation and the phenomenon of crowding out. As identified in theoretical literature, taxonomy of real (or direct) and financial (or indirect) crowding out is considered to be important in the present context. Real crowding out/in refers to the substitution/ complementary relationship between public and private spending that occur irrespective of the mode of financing of fiscal deficit. In other words, real crowding out occurs when public investment displaces private investment broadly on a *dollar-for-dollar* basis (Blinder and Solow, 1973). Financial (indirect) crowding out occurs as the consequences of government actions that affect private sector behaviour via changes in the rate of interest. Thus, the taxonomy of crowding out suggested that high fiscal deficit is affecting capital formation in the economy both by reducing private investment through increase in public sector's own investment and also through an increase in the rate of interest arising out of high fiscal deficit. The investment vacuum, if any, created by fiscal deficit would depend on the nature of relationship between private and public investment.

We specified a model for private investment focusing on fiscal policy and tried to derive an explicit relationship between public and private investment. In the process, we have tested two plausible hypotheses. First is the phenomenon of *real* crowding out, whether public sector investment utilizes the scarce physical and financial resources that would otherwise be available to the private sector for productive investment. Second is the McKinnon hypothesis - which challenged the Keynesian argument that investment is interest rate sensitive and low rate of interest would promote investment spending and economic development in developing countries. But, according to McKinnon, the principal constraints on investment in developing countries are the quantity, rather than cost of financial resources.

The autoregressive modeling of sequential causality detection (after the pre-tests of integration and cointegration) revealed that the rate of interest and the public investment cause private capital formation in Indian economy. The estimated error correction model also shows that public investment crowds in rather than crowds out private investment in India; and the magnitude is substantial (i.e. one per cent rise in public investment leads to 0.84 per cent rise in private investment). The results refuted the McKinnon hypothesis and found that it is the cost of credit that matters for private investment, and not the quantity of credit.

As public capital formation in India is heterogenous in nature, it is important to move one step further from the analysis of aggregate public investment and analyze the differential impacts of public infrastructure and non-infrastructure investment on private capital formation. Different types of public investment likely to have conflicting or mutually reinforcing effect on private capital formation. It is generally argued that infrastructure investment attracts private investment, while theory is ambiguous about the effect of public non-infrastructure investment on private capital formation. It is noted that both public infrastructure investment (i.e. investment in agriculture, electricity, water supply, oil, transport and communication) and public non-infrastructure investment (i.e. investment in manufacturing, mining, quarrying, trade, hotels and restaurant, finance and insurance etc) showed a declining trend since mid-eighties and the gap between the two series widened between mid-eighties and mid-nineties. The sequential autoregressive model in Hsiao's framework suggested that infrastructure investment causes private investment and the estimated correction model reinforces the result of *crowding in* effects; with magnitude of one per cent rise in public infrastructure investment results in 0.89 per cent increase in private investment. The model also refuted McKinnon hypothesis in Indian context. When public non-infrastructure investment is included in the model, the results did not show a strong evidence for *crowding out.*

One of the plausible reasons for the quantity of credit not becoming a significant determinant of private investment with a positive sign in the context of India could be the pattern of savings in the economy. The composition of savings have moved in favour of financial assets which, in turn have made financial resources available for investment. The share of financial savings in gross domestic savings has increased from 20.62 per cent in 1970-71 to 48.93 percent in 1993-94 and then increased to 49.78 per cent in 1998-99 immediately after a dip to 35.27 per cent in 1995-96. As mentioned, this compositional shift in the savings in India towards financial assets increased the availability of loanable funds in

the economy, and also possibly imparted less pressure on the rate of interest. Yet another plausible reason is the increase in the financial resources raised through capital markets especially since eighties, which give an indication that private corporate sector on the aggregate, did not face any shortage in the availability of investible resources. Empirical evidences on the financing pattern of private corporate investment revealed that corporate debentures and equity financing has increased over the years in India (Parker, 1995).

The interest rate sensitivity of private investment itself does not indicate *financial* crowding out. The evidence for *financial* crowding out can only be established after checking whether real rates of interest rise is induced by fiscal deficit. This is because adhoc configurations of demand for and supply of loanable funds in the market are affected by various factors and these factors may have their respective role in the determination of the rate of interest. But from the perspective of *financial* crowding out hypothesis, what is relevant is the extent to which the rate of interest rise is induced by the fiscal deficit. This analysis is carried out in Chapter 4.

Based on a theoretical model (Sargent, 1969), we have estimated the causal relationship between fiscal deficit and rate of interest in a multivariate framework. In sequential autoregressive model, we have found no evidence of *financial* crowding out for both administered and deregulated interest rate regime. No evidence of relationship between fiscal deficit and rate of interest was found in both the regime, which is quite contrary to the popular believe that increase in fiscal deficit induces the rate of interest. For the administered regime, the study examined the link between fiscal deficit and major rates of interest (in real and nominal terms), while in deregulated interest rate regime, treasury bill rate is selected as the reference rate and analysed the link between the two. The overwhelming conclusion drawn from the sequential multivariate vector autoregressive analysis is that rate of interest is affected by inflationary expectations, changes in money supply and fluctuations in the real effective exchange rate. As price expectations are found to be significant in determining rate of interest, the economic fundamentals need to prevail which can help in achieving price stability.

The sequential autoregressive modeling of Granger causality conducted between fiscal deficit and real rate of interest using high frequency data for the financially deregulated period revealed that direction of causality runs from real rate of interest to fiscal deficit and not the other way round. This result is in confirmation with the recent trend in Indian public finance

where the share of non-interest expenditure in total expenditure is on the decline because of the sharp rise in interest payment. The reason beneath this trend can be attributed to the interest rate deregulation, where high interest rate fuelled the accumulation of more debt through increase in interest payments and the consequent debt deficit spiral.

The impact of fiscal deficit on seigniorage and the conduct of monetary policy is analysed in Chapter 5. Though the prime channel through which fiscal deficit affects the conduct of monetary policy is seigniorage; it is to be noted that even if a positive functional relationship exits between seigniorage and fiscal deficit, it does not naturally ensure a link between deficit and money supply. In other words, there is no simple relationship between the growth of high-powered money and the growth of money supply. The behaviour of money multipliers can to a great extent determine the relationship between seigniorage and money supply. If money multipliers are stable, there may be a relationship between seigniorage and money supply and thereby money supply and fiscal deficit.

As a prelude to the analysis of interlinkages between fiscal deficit, seigniorage, money supply and inflation, we have estimated the revenue generated by the government through seigniorage and also inflation tax for the period between 1970-71 and 1999-2000. The estimates showed that seigniorage revenue as a percentage of GDP has increased over the decades from 1 per cent in the seventies to 3 per cent in the nineties, though late nineties showed a tremendous decline in the revenue generated from seigniorage. The econometric estimation showed that, one per cent rise in inflation tax generated 0.136 per cent of seigniorage revenue for the period between 1970-71 and 1999-2000. While explaining the link between seigniorage and fiscal deficit using Cagan's semi-logarithmic function for the demand for money, it was observed the existence of dual inflation equilibria. The dual inflation equilibria show that same amount of seigniorage revenue can be generated at high and low rate of inflation. This also shows the existence of a Seigniorage Laffer Curve. We have estimated *Seigniorage Laffer curve* for India over the period between 1970-71 and 1999-2000, and found that the squared inflation term which give rise to the inverted U-curve phenomenon is negative and significant, thereby reinforcing the existence of a non-linear relation between revenue from seigniorage (μ_t) and inflation rate (π_t).

The results from sequential autoregressive modeling revealed that fiscal deficit does cause seigniorage, but inflationary expectation is not a causal factor of seigniorage. This indicates the dominance of fiscal authority over monetary stance. The estimated error

correction model also revealed that fiscal deficit is a significant determinant of seigniorage along with output gap and real effective exchange rate. The positive sign of output gap in the estimated model depicts that the monetary policy is pro-cyclical in India. The significant real effective exchange rate indicates the active role that RBI plays in exchange rate management through sterilization policy, which in turn affects reserve money.

As mentioned above, the stability of money multipliers is the prerequisite condition for the interlinkages between seigniorage, money supply and fiscal deficit. The econometric evidence from the double-log regressions of narrow money (M1) and broad money (M3) on monetary base (corrected for first order autocorrelation using Cochrane-Orcutt procedure) revealed that money multipliers were not stable in India over the last three decades. The existence of unstable money multipliers provided a *prima facie* evidence of no relationship between money supply and fiscal deficit.

Instead of confining to the quantity theory based model (where money is a function of only price level and output), we have developed a comprehensive function for money supply taking into account the existence of multiplicity of interactive objectives of monetary policy. The causality detection in the sequential vector autoregressive framework deciphered that inflation rate and output gap causes money supply; while fiscal deficit does not cause money supply. The result thus confirms the Keynesian view of endogeneity of money in Indian context.

As we found no link between money supply and fiscal deficit, the potential question arises whether fiscal deficit itself is inflationary. It should be noted that apart from the generally agreed principle of increased money supply leading to higher rates of inflation, it is also argued that fiscal deficit contributes directly to inflationary pressures. The recent *fiscal theories of price determination* argued that the problems of price level indeterminacy can be solved if the Central Bank peg the nominal interest rate at a level consistent with the Central Bank's desired inflation rate, rather than by controlling the growth of (base) money supply. It is also to be noted that the fiscal policy has enormous influence on the price level because the Central Bank is forced to accommodate fiscal tendencies.

We developed the structure of inflation model from Lucas (1973) where he viewed that aggregate price level is determined by the interaction of aggregate supply and aggregate demand factors. His model is more relevant in Indian context than the monetarist models of

inflation because the inflationary process in India cannot be explained by money alone. The results from the sequential autoregressive causality detection showed that money does cause inflation in India. Apart from money, supply side factors found significant in the dynamics of price determination. Moreover, the results indicate that fiscal deficit itself causes inflationary pressures in the economy. The reverse causality tests showed that fiscal deficit is in turn caused by inflation. Thus a self-perpetuating process of inflation induced deficits and deficit induced inflation is found in the context of India over the last three decades.

The important question thus is whether inflationary consequences of fiscal deficit (as envisioned by *Unpleasant Monetarist Arithmetic)* can be considered as an insignificant issue or a switching over to *Unpleasant Fiscal Arithmetic*[1] through rules of constraint on the extent of fiscal deficit (for instance, Fiscal Responsibility Bill) as an appropriate policy step. It is also to be noted that inflationary nature of fiscal deficit, even if not via monetary root, may essentially be due to the nature of expenditure that are being financed by fiscal deficit. In situation where increasing proportion of fiscal deficit is diverted to finance the current consumption expenditure, there is a high possibility that such expenditure will have higher inflationary potential. But as the analysis revealed that there is a positive relationship between private investment and fiscal deficit, a cap on fiscal deficit may essentially reduce the volume of overall investment in the economy and thereby growth. Thus, efforts should be made to alter the expenditure pattern of the government in such a way that inflationary tendencies are controlled.

[1] Unpleasant Fiscal Arithmetic visualize to reverse the order of adjustment as assumed in Unpleasant Monetarist Arithmetic, that is to transfer the first mover advantage from fiscal agencies to the monetary authorities by introducing strict fiscal policy rules, through which fiscal agencies are obliged to adjust to the anti-inflationary policies of the independent Central Bank. Thus, Central Bank autonomy, is at the heart of Unpleasant Fiscal Arithmetic.

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