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INFLATION, INTEREST RATES AND INDEX-LINKED BONDS

Vikas Chitre
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Vikas Chitre

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INFLATION, INTEREST RATES AND INDEX-LINKED BONDS

EXECUTIVE SUMMARY

1. The recent financial sector development in India is characterised by two disquieting features, namely, rising interest burden on Central Government debt and a stagnating rate of gross domestic saving. Measures like market related borrowing through auctions, the historic step to phase out automatic monetisation of budget deficits and gradual removal of statutory restrictions on portfolios of captive investors in Government securities like banks, insurance corporations and provident funds combined with the build up of inflationary expectations portend further pressures on interest rates on Government borrowing. Furthermore, it has been well established that inflationary expectations unaccompanied by parallel increases in interest rates could trigger the demand for inflation hedges, diverting potential financial savings of households. It is in this context that the introduction of and the role that could be played by index-linked securities, especially those of the Government, are examined in its various facets in this study.

2. There has been a considerable discussion of index-linked bonds in the economic literature right from the time of Irving Fisher who went to the extent of organising a Stable Money League in 1921. Later, a number of economists like Keynes, Musgrave, Tobin, Friedman, Sarnat, Fischer and Blinder have advocated and analysed in depth the nature and positive consequences of index-linking of financial contracts, in particular of Government bonds: such bonds are perfect inflation hedges and therefore could enhance rates of financial and total saving, they are cost effective means of government borrowing, they enhance policy credibility towards containing inflation, they provide

valuable market information on the expected rate of inflation and the real rate of interest thus improving information efficiency of financial markets and helping effective conduct of monetary policy and above all they protect the real value of long-term savings. The literature has also brought out some limitations such as possible exacerbation of inflationary pressures due to large out-payments from government and the weakening of concern about inflation from the public as also the government.

3. The historical experience of countries shows that index-linked bonds could be viewed either as a part of a general programme of indexation of all financial contracts or as a segmented market operation like issuance of government bonds and savings certificates for the various beneficial impacts they bring forth. Index-linked securities were used at different times by a number of countries in Europe and Latin America as part of a general indexation programme, for the main purpose of sustaining capital market activities in the face of hyperinflation. But, widespread or general indexation has been viewed, based on an assessment of the experience of countries which practised them, as a necessary evil in the face of hyperinflation, but, something which should be generally avoided otherwise, because it would build inflation more or less permanently into the system. Countries like United Kingdom, Australia and Canada have introduced index-linked Government securities over the last fifteen years with the objectives of increasing the range of financial assets available in the system, providing an inflation hedge to investors, reducing interest costs enhancing creditibility of anti-inflationery policy and for picking up direct signals from the market on the expected rate of inflation and the real rate of interest. In the present Indian context, the experience of the latter group of countries provide valuable lessons and, therefore, is more relevant.

4. An analysis of the historical experience and general features of index-linked bonds in U.K., Australia and Canada suggests:

(i) The experience has been fairly satisfactory.

(ii) The volume, in terms of total issues, though not large (15% in U.K. and less than 5 per cent in Australia and Canada) satisfied the needs of long-term saving/ investing institutions like pension funds.

(iii) U.K. could successfully control inflation in early 1980's and could reduce the effective cost of Government borrowing through the issue of index-linked bonds.

(iv) The bonds compensated for inflation in respect of both the interest payments and the principal repayment, the latter on the maturity of the bonds.

(v) Retail Price Index/Consumer Price Index formed the basis for indexation of bonds.

(vi) Yields in index-linked securities provided useful information on the expected rate of inflation and the real rate of interest for the conduct of monetary policy.

5. While New Zealand has recently decided to introduce index-linked bonds with a view to enhancing the credibility of anti-inflationary policy of the Government, United States Treasury has yet to accept the proposal of index-linked bonds, despite considerable interest and debate in the last decade, on the grounds of doubtful saving in costs and uncertain demand. One type of index-linked bond proposed in the US involved periodic payment of inflation compensation on principal as well as interest.

6. An analysis for the Indian economy, based upon an econometric investigation of demand for financial assets, a financial programming exercise based upon Central Government budget constraint and an analysis of current policy environment in the context of financial sector has brought out the several beneficial impacts the issue of index-linked bonds could have on the system. The available evidence has, at the same time, adequately allayed the fears of any possible accentuation of inflationary pressures on account of the introduction of index-linked bonds in India.

7. A theoretical model extending Stanley Fischer's model of demand for index-linked bonds and other financial assets to include real money balances has been developed. In the absence of index-linked bonds in the Indian market, we have attempted to estimate (a) the demand for inflation hedges and (b) the inflation risk premium in a three-asset framework comprising equity, non-indexed bonds and money, using the data covering the 21-year period from 1972-73 to 1992-93. The demand for inflation hedges for the year 1992-93 estimated at Rs.1345 crore at current prices appeared rather small in relation to the outstanding debt, but, considering it as the initial flow demand, it would turn out to be nearly 2.8 per cent in terms of incremental government liabilities. The estimate of inflation risk premium, which averaged to around 1.06 per cent, also appeared not very high. However, these low values should be viewed in the context of the sample period characterised by restrictions on portfolio adjustments by institutional investors, including banks, and the administered nature of interest rates.

8. The financial programming exercise addressed the question whether inflation will feed on itself on account of a regular issuance of index-linked Government securities in the country, particularly because the out-payments of index-linked amounts of principal and interest might cause monetised deficit to rise and thereby accentuate

the inflation rate. An analysis of scenarios involving varying proportions of index-linked bonds of both UK type (with inflation compensation of principal only on maturity) and US (proposal) type and extreme budgetary situations and exogenous inflation shocks was made. The main conclusions of this analysis are:

(i) A comparison of alternative proposals for index-linking of Government bonds with the base-line scenario with no index-linked bonds shows that the index-linked bonds of UK type lead to significant savings to the Government and the 10 year bonds yield greater benefits than the 5 year bonds.

(ii) A comparison of alternative proportions of index-linked borrowing shows that the total interest payment, gross fiscal deficit, the rate of inflation and the interest rate on index-linked bonds all decline monotonically with a larger proportion of index-linking in the form of UK type index-linked bonds. On the other hand, the above variables increase monotonically with a larger proportion of index-linking in the form of the US (proposal) type bonds in the earlier years and decline with an increasing proportion of index-linked issues only in the later years. The index-linked bonds of the UK type compare favourably again with those of the US (proposal) type.

(iii) In extreme budgetary situations of larger primary deficits or when the interest rates on non-market borrowing are also linked to inflation the presence of index-linked bonds, far from destabilising the fiscal situation and the rate of inflation, seems to produce a stabilising influence on them.

(iv) In the face of exogenous inflation shocks continuing for about five consecutive years, index-linked bonds could worsen both the fiscal and inflationary situation. This must be regarded as a warning to avoid exposing the economy to continuous exogenous inflation shocks when a part of the fresh Government borrowing is planned through index-linked bonds

9. In the context of rising interest burden on Central Government debt, stagnating savings rate and the announced policy shift from direct to indirect tools of monetary control, Government could issue index-linked bonds with the objectives of increasing the rates of financial and total saving, reducing the cost of Government borrowing, enhancing credibility of anti-inflationary policy obtaining useful information on inflationary expectations and the real rate of interest and, above all, providing an essential instrument for protecting the real wealth of long-term savers.

10. After a careful analysis of the experiences of other countries and the findings of the empirical exercises, the study has analysed policy issues for issuance of index-linked bonds in India :

(i) The UK type bond with periodic compensation of interest payments and one-time compensation for principal at maturity is favoured

(ii) As against the econometric estimation of demand for inflation hedges at Rs.1,345 crore, an estimate of the likely demand for index-linked bonds essentially from investors like insurance companies and provident funds shows that considering both the demand and supply sides, an issue of Government bonds to the extent of around Rs.5000 crore per annum could be considered feasible. in addition to a possible issue of index-linked savings certificates to the extent of about Rs.1200 crore per annum.

(iii) Consistent with the recent policy of issuing bonds of less than 10-year maturity, maturity of 5 to 10 years may be initially considered

(iv) Point-to-point index-linking with a lag of eight months on the basis of the All India Wholesale Price Index is suggested.

(v) Taxation aspects of index-linked bonds need a careful consideration. Inflation compensation on principal repayment may not attract tax liability since long term capital gains are indexed for the purpose of taxation of capital gains.

(vi) Bonds could preferably be issued on tender/auction basis as it would enable pricing of bonds at market determined real rates of interest.

(vii) Bonds should not be open for non-resident investments as it is likely to accentuate inflation in a destabilising manner, nor should the bonds be linked to any foreign currency.

11. Sizeable savings in the cost of Government borrowing are predicted, provided the actual inflation rate is contained within reasonable limits. The lower the inflation rate actually achieved, the larger will be the savings from index-linked issues. An estimate based upon assumed inflation rates and income tax rates shows that achieving an inflation rate of less than about 6 per cent would bring in a net gain of around Rs.3900 crore to the Government from a borrowing programme of Rs.5000 crore per year over a ten year period, through index-linked bonds. Net cash gains can be sustained, however, only for inflation rates of less than about 8.4 per cent, when the expected rate of inflation is assumed to be 9 per cent.

12. It is necessary to give a serious trial to the issuance of index-linked bonds by the Government in the coming years, more in the spirit of a long- term financial reform and a socially and economically needed financial innovation and not merely as a short-term palliative. It must, however, be emphasised that while the introduction of index-linked bonds is desirable, it is not a substitute for price stability, in the context of a sizeable population in the country, with practically no savings, which cannot derive any protection from inflation even with the index-linked bonds.

INFLATION, INTEREST RATES AND INDEX-LINKED BONDS

Vikas Chitre, K. Kanagasabapathy
Partha Ray, Mridul Saggar*

1. INTRODUCTION

Two disquieting trends mark the recent financial sector development in India; first is the alarming rise in the burden of interest payments of the Central Government, particularly on domestic debt and other liabilities; second is the stagnating rate of gross domestic saving.

Rising Interest Burden

1.1 The interest payments by Central Government have increased from being 4.0 per cent of GDP in 1990-91 to being 4.9 per cent of GDP in 1994-95. Interest payments which amounted to 38.5 per cent of revenue receipts in 1990-91, rose to 49.5 per cent of revenue receipts in 1994-95 (RE). As percentage of revenue expenditure, interest payments which stood at 29.2 per cent in 1990-91, increased to 35.8 per cent in 1994-95.

Interest payments by the Government will be expected to increase further in the next few years because of a number of reasons. First, the high levels of gross fiscal deficits which averaged to over 8.2 per cent of GDP from 1985-86 to 1990-91, and to 6.4 per cent of GDP from 1991-92 to 1994-95, led to mounting

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outstanding liabilities of the Central Government standing at Rs.5,41,629 crore in 1994-95 (with Rs.4,91,001 crore of internal liabilities and Rs.50,628 crore of external liabilities, together accounting for about 60 per cent of GDP). Secondly, the policy decision and the consequent historic agreement between the Government of India and the Reserve Bank of India to phase out, by 1997-98, *ad hoc* Treasury Bills, because they resulted in automatic monetisation of budget deficits which was inflationary, has tended to increase Government's borrowing from more expensive non-RBI sources. Third, this fact coupled with the policy to reduce, over time, Government borrowing at low, administered interest rates and to increase Government borrowing at market-related rates, has tended to raise the rates of interest which the Government has had to pay on its borrowing. This policy shift is desirable in itself, but the implication of this change for the overall interest cost to Government should also be considered. Finally, interest rates have tended, in recent years, to adjust to the rate of inflation, at first due to the efforts of the Government to adjust the administered interest rate structure to changing inflation rates and, in very recent years, that is, since 1992-93 due to the variation in the market-related interest rates to reflect market's expectations about inflation rate.

The maximum coupon rate on Central Government securities .was raised from 6.5 per cent in 1977-78 to 11.5 per cent in 1985-86 and further to 12 per cent in 1991-92. With the introduction of the auction system in 1992- 93, the maximum rate touched a new high of 12.75

per cent. The rate increased further to 13.40 per cent in 1993-94 and to 14.00 per cent in 1995-96 after a fall to 12.71 per cent in 1994-95. The average interest rate on other internal liabilities of the Central Government, consisting of Small Savings, Provident Funds, etc., went up from an estimated 5.7 per cent to 11.4 per cent between 1980-81 and 1994-95. Similarly, the average interest rate on external liabilities increased from an estimated 2.1 per cent in 1980-81 to 8.7 per cent in 1994-95, reflecting the switch from concessional to commercial borrowing.

Stagnating Rate of Saving

1.2 While the high level of revenue deficits amounted to large dissaving by the Central Government, the gross saving rates of the household sector, private corporate sector and the public sector also show disappointing trends. According to the *Economic Survey,* 1994-95, The gross saving of the public sector as percentage of GDP, showed a declining trend from the mid-seventies and has come down to barely 0.2 per cent in 1993-94. The gross saving of the private corporate sector as percentage of GDP, though it has steadily increased over this period, has not at all been very high and was only 4 per cent in 1993-94. The gross saving of the household sector as percentage of GDP, increased from a low average level of 6.6 per cent in the period from 1950-51 to 1954-55 to an average level of 15.2 per cent in 1975-80, but maintained a very slow pace since then to reach 17.3 per cent in the recent four years from 1990-91 to 1993-94. On a year to year basis, it has actually declined from being 20 per cent in 1990-91 to 15.9 per cent in 1993-94. While part of this decline in household saving may be a statistical exaggeration stemming from the inherent limitation of estimating household saving in physical assets as a residual, the extent of decline does bring into focus the policy design for boosting household saving in the economy. The gross saving of the household sector as percentage of GDP can be considered as showing signs of stagnating, if not actually declining. The overall gross domestic saving of the economy which also seemed to be stagnating around a level of 23 per cent of GDP in 1990-91 - 1991-92, has in fact declined to 20.2 per cent in 1993-94.

If the gross saving rate in the economy does not increase, the real rates of interest in the economy will tend to increase, and it will be difficult to finance higher investment rates in a non-inflationary manner.

While the saving rate, particularly of the household sector, may or may not respond positively to nominal interest rates and negatively to the rate of inflation, statistical studies show that *financial* saving of the household sector deflated by prices or the ratio of financial saving to total saving of the household sector both respond quite strongly and positively to nominal interest rates and equally strongly but negatively to the rate of inflation. This result can be interpreted as showing that when the inflation rate increases or is expected to increase, unaccompanied by a corresponding increase in the interest rates on financial assets, households look for other inflation hedges as stores of value.

One solution to the problems of rising interest costs and the stagnating saving rate could be the introduction of index-linked securities in the market.

Index-linked Bonds as Perfect Inflation Hedges

1.3 Index-linked bonds are bonds which promise to repay both the principal and interest by moving the amounts of these upward or downward along with the movements in the value of the specified index of commodity prices. Not only Government bonds but also private bonds, loans or bank or post office deposits, national savings certificates can also be considered as prospective instruments for index-linking. An index-linked bond would work as follows: suppose the Government issues a 3 per cent index-linked bond of one year's maturity, linked say, to the Index of Wholesale Prices for all commodities. If the face value of the bond is Rs.100 and if the Index of Wholesale Prices increases by 10 per cent during the year, the Government will pay an amount of Rs.110 towards the repayment of principal and an amount of Rs.3 and 30 paise by way of interest at the rate of 3 per cent on Rs.110, that is, altogether an amount of Rs.113 and 30 paise. This will enable the lender to have purchasing power equivalent to what he could have bought with Rs.103 at the time, one year earlier, when the money was lent. Thus, he would have received a "real" coupon interest rate of 3 per cent and an amount the "real" value of which would be Rs.100 despite the 10 per cent increase in prices during the year. In this way, the lender does not suffer any loss of real value of the amount lent by him as well as the interest on it, even though there was inflation during the year. An investor is thus fully protected against inflation if he buys an index-linked bond and he does not have to look for any other inflation hedges such as shares, gold, real estate or durable goods. He may, of course, buy these for other reasons, but he would not have to buy these in order to protect himself against inflation, as he has to do now to hedge against inflation, in the absence of an index-linked security. Even though the above mentioned other stores of value may sometimes, even often, provide protection against inflation, they involve risk of variability of prices as in the case of shares or gold or heavy transaction costs and illiquidity as in the case of land, real estate or durable goods. During the 24-year period from 1970-71 to 1993-94, the average of annual percentage increase in the RBI Ordinary Share Price Index (in March) was 8.2 per cent, but its coefficient of variation was 242 per cent; the average of annual percentage increase in the price of gold was 19.6 per cent and its coefficient of variation was 106 per cent while the average of annual percentage increase in the Wholesale Price Index for all commodities was 9.1 per cent and its coefficient of variation was 90 per cent. Focusing attention only on the recent years, say from 1980-81 to 1994-95, would make shares a better inflation hedge than gold. But, the fact would still remain that these investments involve risk and are not perfect inflation hedges.

In the case of non index-linked Government bonds, if the interest rate is market-determined, it will adjust upward or downward as the market expects a higher or a lower inflation rate over the maturity period of the bond. However, even in this case, actual inflation may not always coincide with the inflation rate expected by the market. Therefore, such a bond also does not provide a perfect hedge against inflation. For an illustration, let us consider a non index-linked bond, namely, the Government of India 5.5 per cent Loan 1995, issued in 1965. If an amount of Rs.100 was invested in 1965 in this bond with a maturity of 30 year, its total maturity value in 1995, including reinvested coupons received periodically at prevailing current maximum coupon rates, would work out to Rs.599.2, yielding an effective return, *post-facto,* of 6.1 per cent. Between 1965 and 1995, on the other hand, the annual compound rate of inflation works out to 8.5 per cent, clearly showing the poor compensation for inflation provided by non indexed bonds over this period. The real return on non index-linked bonds is subject to fluctuation and risk because of the variability of the rate of inflation. For example, as pointed out earlier, the rate of inflation as measured by the Index of Wholesale Prices of all commodities showed a coefficient of variation of 90 per cent over the period from 1970-71 to 1993-94. Thus, in order to induce a risk-averse investor to hold a non index-linked bond, the yield on it must include a premium for inflation risk as well as a compensation for the expected inflation rate. An index-linked bond, on the other hand, will include full compensation for inflation and will not involve any risk due to the variability of the rate of inflation. It will be a perfect hedge against inflation and will assure a certain real return to an investor if he holds it until maturity. On the other hand, a non index-linked bond yields a certain *nominal* return to the investor if held up to maturity.

Advantages and Limitations of Index-linked Securities

1.4 Index-linked securities for Government borrowing have been advocated widely by many economists for a long time. The theoretical literature on index-linked securities has brought out several advantages of the index-linked bonds. They enhance the rates of financial and total saving by providing an instrument free of inflation risk. They are a cost effective means of Government borrowing. The movement in yields of index-linked bonds provide valuable measures of expected inflation rate and the expected real rate of interest which can improve information efficiency of the markets. Such information can also be used for effective conduct of monetary policy. They enhance the creditibility of the anti inflationary policy and thus can dampen inflationary expectations. Above all, they are essential to protect the real value of long- term savings.

The literature also has brought out certain limitations of index-linked bonds. The return on index-linked securities *vis-a-vis* nominal bonds would depend upon the relationship between the actual and expected rate of inflation. If the actual rate turned out to be higher than the expected rate, then the holders of index-linked securities will make a gain relative to investment in non index-linked securities, otherwise a loss relative to such investment. But, the opposite is true as far as the issuers are concerned. Fears have been expressed that index-linked bonds by themselves could exacerbate inflationary tendencies due to increase in money supply resulting from large out-payments of index-linked amounts of interest and principal and due to possible strengthening of inflationary expectations. Further, index-linked securities, providing a hedge against inflation, may accelerate inflation rather than dampening it, because people could as well live with inflation, thus weakening their concern about inflation, as the index-linked securities insulate them from the loss of real wealth on account of inflation. As a consequence, Government might also develop complacency in pursuing anti-inflationary policies.

Scope of the Study and Arrangement of Sections

1.5 With this background, we examine in this study the question of the issuance of index-linked Government bonds in India and the role which such bonds may be expected to play in the current Indian context.

The study is organised as follows. Section 2 is devoted to the survey of literature. Experience of a number of countries with regard to the issuance of index-linked bonds is taken up in Section 3. Extending Fischer's (1975) model of demand for index-linked bonds to include money as an additional asset in it, a continuous-time stochastic dynamic programming micro-theoretic model is developed in Section 4. In that model, economic agents are assumed to choose their optimum consumption plan and portfolio composition in a four asset world, comprising money, equity, and index-linked and non index-linked bonds, taking into account uncertainty about inflation. Section 5 takes up the empirical estimation of demand functions for financial assets in India in the light of the theoretical model developed in Section 4. The estimated demand function for the aggregate of financial assets is used to work out an estimate of the demand for inflation hedges and an estimate of inflation risk premium in the country during the period covered by the study, that is, from 1972-73 to 1992-93. Section 6 is devoted to examining, with the help of a financial programming exercise in the context of the monetary and fiscal situation currently prevalent in India, the question whether inflation would feed on itself on account of a significant presence of index-linked government borrowing. Section 7 is devoted to a discussion of policy issues in India.

2. SURVEY OF LITERATURE

There has been a long tradition and considerable discussion of index-linked bonds or purchasing power bonds in the literature. The practice of linking contractual payments to specific price has a long tradition extending back to Elizabethan times. However, the genesis of the concept of indexation can be traced to Bishop William Fleetword's pioneering 1707 study, *Chronicon Preciosum : An Account of English Money, The Price of Corn and Other Commodities for the Last Six Hundred Years.* Joseph Lowe and G. Poulett Scrope, two economists of the 19th Century British Classical School, were the first to argue that indexation might have a stabilizing impact on real economic variables. In particular Lowe, in his book *The Present State of England in Regard to Agriculture and Finance* (1822) contended that indexation of wage contracts would enhance downward flexibility of money wages. Scrope in his 1833 pamphlet, *An Examination of the Bank Charter Question,* and further in his book *Principles of Political Economy* (1833) referred to the table or list of commodity prices the weighted average of which formed the index-number for use in the index-linked contracts. The earliest neo-classical economist to revive the concept of indexation was Stanley Jevons, who devoted the entire chapter 25 of his *Money and Mechanism of Exchange* (1876) to the discussion of "A Tabular Standard of Value", a phrase coined by Scrope to designate indexation. Like Jevons, Alfred Marshall too was an enthusiastic advocate of the tabular standard. In his celebrated essay, "Remedies

[1] See Friedman (1974), Humphrey (1974) and Jud (1978), Ch.1, for a detailed bibliography on these earlier writings and a discussion on the concept of indexation in the history of economic thought.

for Fluctuations of General Prices", which appeared in the March 1887 issue of *Contemporary Review,* Marshall suggested the use of indexation so as to maintain the value of money. Nevertheless, it was Irving Fisher who was the first advocate of index-linked bonds in the twentieth century.

The Case for Index-linked Bonds - the Earlier Discussion

2.1 Irving Fisher organised a vigorous movement for stable money and even established (in 1921) an organisation called the Stable Money League. Fisher recognised the importance of framing contracts in terms of index numbers of prices. He was perhaps the first in the United States to introduce indexed wages for the purpose of offsetting the rising cost of living in the First World War in a commercial business of his, called the Index Visible. In 1925, the Rand Kardex Company of Buffalo, New York, in which Fisher held some interest, offered the public the first "Stabilised Bond" in history. It was a 30 year purchasing power bond with interest and principal linked to the wholesale price index [Jud(1978)]. However, the bond did not command a wide market and was within a short time retired in favour of gold-clause bonds because the latter, with which the market was familiar, had a better prospect of being demanded. One of the features of Fisher's bonds, which obviously must have made them unpopular, was a provision that a 10 per cent change in the price level was required before indexing provision became effective.

Fisher wanted a law to be passed to allow, though not require, the use of index number of prices as a standard of deferred payments. As the main source of economic fluctuations according to him was the sharp fluctuations in money supply due to credit cycle, which was itself, in turn, caused by nominal interest rates lagging behind inflation during the upswing as well as the downswing, he believed that indexation, particularly that of bonds, would reduce economic fluctuations [Fisher(1922); Jud (1978),p.6].

2.2 Keynes also pleaded for the issuance of index-linked bonds by the British Government [Keynes (1927)] on the ground that this would protect the investors against inflation and would generate saving in the interest cost as compared with the conventional non index-linked bonds as the interest rate on the latter must include a premium for inflation risk.

2.3 G.L. Bach and R.A. Musgrave (1941) also advocated issuance of index-linked government bonds arguing that this would limit inflation-induced speculative investment in durable goods and encourage household saving.

2.4 James Tobin in his classic essay on public debt management, published in 1963, also strongly recommended the introduction of purchasing power government bonds.

Tobin argued that introduction of a purchasing power bond will enable the monetary authorities to conduct open market operations in terms of a security which will be a closer substitute for equities than the conventional bonds because it would share the role of equities as a hedge against inflation. Therefore, the monetary authority will be able to influence the real return on capital and the supply price of capital through open market operations in the purchasing power bonds. This would make monetary policy more effective as open market operations in purchasing power bonds would directly influence the terms on which the public is willing to hold capital stock. This would provide a direct link between monetary policy and the real sector of the economy.

Tobin also argued that the issuance of purchasing power bonds by the government will also fill in a major gap in the asset menu currently available to investors, because, as we have seen earlier, it will provide for an asset which is a perfect hedge against inflation. In the absence of a purchasing power bond, individual investors and financial institutions with long-term liabilities, such as employees' provident funds, public provident funds, life insurance companies, etc., have no alternative but to place bulk of their investible funds in conventional government securities. Because of this, the interest rates on government securities would not adequately reflect the market's expectation about future inflation rate even when the interest rate on them were market-determined. Not only that, but in the absence of an asset which is linked to the general level of commodity prices, banks and other financial institutions would not be in a position to offer to their customers liabilities with guaranteed purchasing power (for example, index-linked bank deposits, insurance policies, retirement saving plans, etc.) even when their customers would prefer to hold such assets and would be willing to forgo a part of the return on these assets in return for the safety of the purchasing power of the principal and interest.

Tobin suggested that the government should offer non- marketable savings bonds with purchasing power escalation also in order to meet the preference of the small savers for a risk-free asset.

Tobin considered at length the objections to the introduction of purchasing power bonds: that it will further accentuate inflation by weakening the economic brakes on inflation which at present exist in the form of forced saving, that it may weaken the political will to control or prevent inflation, that servicing of such bonds will place an incalculable burden on the government, and finally that it may be taken as a signal that the government has given up the fight against inflation.

Since these questions about the purchasing power bonds are bound to arise in everyone's mind, it will be useful to briefly paraphrase Tobin's rebuttal of these objections to the introduction of the purchasing power bonds. The main purpose of purchasing power bonds is to eliminate the iniquitous re-distribution of wealth brought about by unanticipated inflation. And if this weakens a brake on the process of inflation that exists in the current situation in the form of forced saving, it is necessary to replace reliance on such iniquitous and arbitrary method of regulating aggregate demand as inflation tax by other forms of taxation and by the control of government expenditure. The presence of a purchasing power bond in the menu of assets in the economy may itself help stimulate greater voluntary saving and thus put a check on the inflation process. As regards the cost to the government, in an economy without the purchasing power bond, this cost can be kept low only to the extent that the public is deceived into believing that inflation will not be higher, whereas in an economy with the purchasing power bonds, the government can reduce its debt servicing cost by following anti-inflationary policy and by bringing down the rate of inflation to levels lower than those anticipated by the public. If, in the long-run, the public is assumed to more or less correctly anticipate the rate of inflation on the average, then the cost of debt servicing will be lower in the case of the purchasing power bonds to the extent that the interest rate on the conventional bonds must also include a premium to cover the inflation risk. Finally, in the case of conventional non index-linked government debt, the government has an incentive to reduce the real burden of its outstanding debt, through inflation. There would be no such incentive for the government to step up the rate of inflation when a sizeable part, if not the entire volume of its outstanding debt, is in the form of index-linked debt. Thus, even though index-linked debt might weaken to some extent the public's resolve to control inflation by offering protection against inflation to the segment of the population holding index-linked bonds and savings, at the same time, it reduces government's incentive to cause inflation. As regards the fear that issuance of purchasing power bonds would be taken as a signal that the government has given up the fight against inflation, Tobin writes:

> "Similarly unemployment insurance might be interpreted as a signal that the government had given up the battle to prevent unemployment" [Tobin (1963), p 210].

2.5 Milton Friedman in his essay on "Monetary Correction" (1974), proposed the introduction of purchasing power bonds as a part of a comprehensive programme of indexation of wages, tax brackets, exemption limits and standard deduction for personal income taxation, the base levels for calculating capital gains and depreciation on fixed capital assets for personal income taxation as well as corporate taxation and the book profit on inventories resulting from changes in prices. As regards purchasing power bonds, unlike Tobin who was arguing for making available to the investors both conventional as well as purchasing power bonds, Friedman proposed that except for short-term bills and notes, *all* government securities should be issued in the form of purchasing power bonds. The effect of these proposals would be to eliminate windfall tax yield on account of inflation, inflation tax revenue in the form of reduction in the real value of domestic, interest-bearing government debt and would reduce the revenue yield from inflation to the extent of additional creation of fiat money by the government or what is also called the 'seigniorage'. What is more important, because of the index-linking of money wages, the lag between inflation and the adjustment in the nominal wage rates would be removed. Consequently, monetary changes would not lead to any real effects, that is, effects on output and employment. Money supply changes would cause inflation. But purchasing power bonds would prevent the iniquitous distributional effects of inflation. If high inflation rates are to be brought down, wage-indexation would mean the necessary downward adjustment of money wages and therefore, wage-indexation would avoid the creation of unemployment, and in such a situation, index-linked bonds will bring down nominal interest rates and also prevent a heavy interest burden from being placed on borrowers, thus preventing a slackening of investment.

Inflation Uncertainty and the Demand for Index-linked Bonds

2.6 Sarnat (1973) was perhaps the first to highlight the role of index-linked bonds in reducing overall risk of all borrowers and lenders by introducing the possibility of issuing or holding an asset which involved zero inflation risk. In the presence of variable inflation, cash is not a riskless asset. Therefore, in the absence of a short-term (say, one year) index-linked bond, all assets are subject to one kind of risk or another, including inflation-risk, and there is no perfectly riskless asset available. The efficiency frontier of the investors, giving maximum expected real rate of return on the portfolio for each given level of the standard deviation of the real rate of return on the portfolio, will in this case completely lie in the positive quadrant of the expected real return standard deviation two dimensional plane, reflecting that all assets are risky assets and that it is impossible to reduce the overall risk (measured by the standard deviation of the real return) of the portfolio below some minimum positive level (See Figure 1). However, introducing the possibility of lending and borrowing through index-linked bonds (ILB) opens up the possibility of reducing the overall risk of the real return on the portfolio of every economic agent and so of permitting every economic agent to improve his utility or welfare level by choosing a preferred combination of the expected level and the risk of the real return on the portfolio by holding a portfolio consisting of the perfectly riskless asset (index-linked bond) and an efficient combination of all other (risky) assets.

EFFICIENCY FRONTIER WITH AND WITHOUT INDEX-LINKED BONDS (ILB)

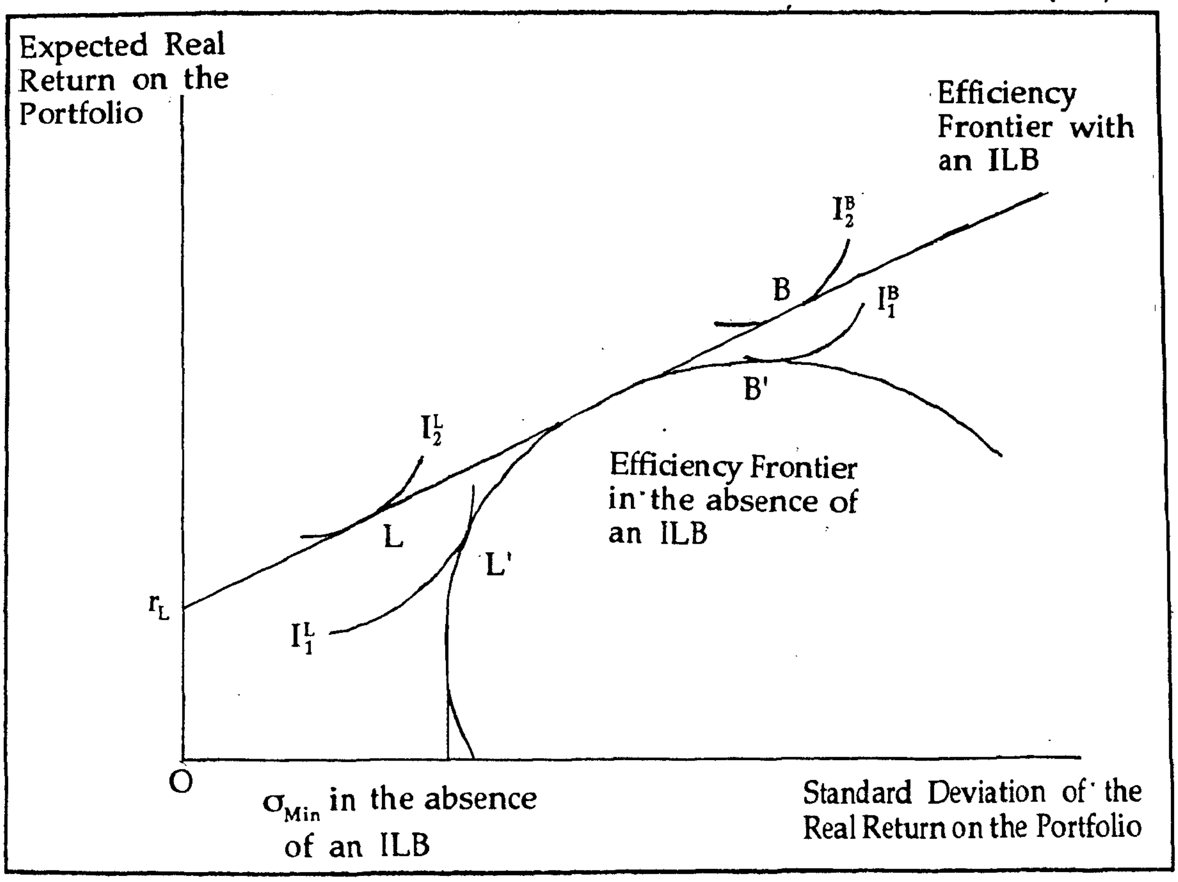

Figure 1

In Figure 1, L′ and B′ show the equilibrium positions of an index-linked lender and an anti index-linked borrower respectively. L and B show the equilibrium positions of the same economic agents in the absence of index-linked bonds.

2.7 The subject of the issuance of index-linked government bonds was investigated with great rigour and depth by Stanley Fischer (1975). Fischer derived the demand functions of an individual economic agent for index-linked bonds (the real return on which was assumed to be certain), nominal (non index-linked) bonds (the nominal return on which was assumed to be certain but the real return was stochastic since the rate of inflation was assumed to be stochastic) and equities (both the real and the nominal returns on which were assumed to be stochastic) in a continuous-time stochastic dynamic programming model in which the economic agent was viewed as simultaneously determining an optimum portfolio of the above-mentioned assets at each time-point so as to maximise the sum of the expected utility of consumption over his life time, financed out of the returns on the portfolio of the above-mentioned assets. The behaviour of the real returns on the above assets as well as the real wage income at each time point were postulated to be governed by stochastic processes in which, except for the real return on index-linked bonds, which was considered to be deterministic, the proportionate changes, per unit of time, in the real return on the other assets and in the real wage income of the individual were assumed to follow normal distributions with constant means and variances, per unit of time, and to be temporally not auto-correlated.

The economic agent's optimization problem is:

To maximise :

$$\int_{t_0}^{\infty} E_t U(C(t),t)dt \qquad (1)$$

subject to :

$$dV = \sum_{i=2}^{3} w_i(r_i - r_1)Vdt + r_1(V - C)dt + \sum_{i=2}^{3} w_i\sigma_i V dx_i + vYdt + bYdq \qquad (2)$$

and $V(t_0) = V_0$,
where U (C(t),t)) gives the utility of consumption C at time t, and is assumed to be strictly concave in C, V and Y are the individual's real wealth and real wage income, w_1,w_2 and w_3 (with $w_1 + w_2 + w_3 = 1$) are the proportions of real wealth held in the form of the three assets, namely, the index-linked bonds, the equities and the nominal bonds, respectively, and the real rates of return on these assets are denoted by r_1, r_2 and r_3, respectively, with the corresponding nominal rates of returns being given by R_1 ($=dQ_1/Q_1$), R_2($=dQ_2/Q_2$) and R_3 ($=dQ_3/Q_3$). The behaviour of the real rates of return on the three assets as well as that of the rate of inflation and the real wage income is postulated to be given by the following stochastic processes:

$$\frac{d\ (Q_1/P)}{(Q_1/P)} = r_1 dt \qquad (3a)$$

$$\frac{d\ (Q_2/P)}{(Q_2/P)} = r_2 dt + \sigma_2 dx_2 \qquad (3b)$$

$$\frac{d\,(Q_3/P)}{(Q_3/P)} = r_3 dt + \sigma_3 dx_3 \tag{3c}$$

$$\frac{dP}{P} = \pi\, dt + s_1 dz_1 \tag{3d}$$

$$\frac{dY}{Y} = vdt + bdq \tag{3e}$$

The term involving dt in each of the above characterization of the stochastic processes gives its deterministic part or the "drift" of the process per unit of time and also the expected proportionate change in the underlying variable (for example, Q_1/P, Q_2/P, etc.) per unit of time (over the time period dt here) and the second term, if any, gives the stochastic part of the process and is assumed to be temporally independently and normally distributed with mean zero and a finite variance per unit of time. Thus, taking the stochastic process for (dP/P), the rate of inflation, as an example, we can say that the rate of inflation in a small time interval (dt) is assumed to be normally distributed with mean (πdt) and variance $s_1^2\,dt$ [$= (s_1 dz_1)^2$] and is further assumed to be independently distributed of the rate of inflation in any other time-interval. Such stochastic processes are called Itô processes.

Fischer has uncovered some quite startling effects of uncertainty of the rate of inflation on the relationship between nominal and real interest rates, by making use of the stochastic processes postulated above. He has shown that in this case the real return on nominal bonds follows a normal distribution with mean equal to $(R_3 - \pi + s_1^2)$ dt and variance equal to s^2_1 dt over a small interval of time (dt).[2] That is, when the rate of inflation is uncertain, the mean or the expected real rate of return on nominal bonds is *not* given by $(R_3 - \pi)$ dt but by $(R_3 - \pi + s_1^2)$ dt. Hence, the higher the variance of the inflation rates per unit of time, the *larger* is the mean or expected real rate of return on nominal bonds per unit of time than $(R_3 - \pi)$ dt. Similarly, when the rate of inflation is uncertain, the mean or the expected real rate of return on equities per unit of time

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[2] For this purpose, he uses the so-called Itô's lemma on the differential of a function of stochastic processes. If $F(P_1, P_2, \ldots P_n, t)$ is a function of random variables $P_1, P_2, \ldots P_n$ whose stochastic behaviour is governed by Itô processes :

$$\frac{dP_i}{P_i} = \pi_i dt + s_i dz_i \,, \; i = 1,2, \ldots, n$$

then Itô's lemma states that if F is twice differentiable, the *stochastic* differential of F is given by :

$$dF = \sum_{i=1}^{n} F_i dP_i + F_{n+1} dt + ½ \sum_{i=1}^{n} \sum_{i=1}^{n} F_{ij} dP_i dP_j$$

with, $F_i = \delta F / \delta P_i$; $F_{ij} = \delta^2 F / \delta P_i \delta P_j$

where the products $dP_i \, dP_j$ are obtained using :

$dx_i dx_j = s_i s_j \rho_{ij} dt$ for all i, j, with $\rho_{ii} = 1$

and, $dx_i dt = 0$ for all i

where ρ_{ij} is the correlation coefficient between dx_i and dx_j.

Applying Itô's lemma to the real return on nominal bonds (Q_3/P), we have

$$\frac{d(Q_3/P)}{(Q_3/P)} = \frac{dQ_3}{Q_3} - \frac{dP}{P} - \frac{dP}{P}\frac{dQ_3}{Q_3} + \left(\frac{dP}{P}\right)^2$$

$$= R_3 dt - (\pi dt + s_1 dz_1) - (R_3 dt)(\pi dt + s_1 dz_1) + (\pi dt + s_1 dz_1)(\pi dt + s_1 dz_1)$$

$$= (R_3 - \pi + s_1^2)\, dt - s_1 dz_1$$

where terms in $(dt)^2$ are ignored but not those in $(dz_1)^2 = dt$.

is $(R_2-\pi+s_1^2-s_1s_2\rho_{12})dt$ and not $(R_2-\pi)dt$. [3] Here $s_2^2\,dt$ is the variance of the nominal rate of return on equities and ρ_{12} the correlation coefficient between the nominal rate of return on equities and the rate of inflation.

Fischer derives the individual economic agent's optimal holdings of the assets from the above-mentioned dynamic programming formulation. (See Appendix 1 of the present study and equations (A-10a)-(A-10c) derived there in particular). Assuming that all economic agents' expectations, as reflected through the parameters of the stochastic processes, are the same but the ratios of their real wage income to real wealth are different, the kth economic agent's asset demand functions, derived by Stanley Fischer, may be written as:

$$w_2^k = A(V^k,Y^k)\left[\frac{r_2-r_1}{\sigma_2^2(1-\rho_{23}^2)} - \frac{(r_3-r_1)\rho_{23}}{\sigma_2\sigma_3(1-\rho_{23}^2)}\right] - \left[1+\frac{C_Y(V^k,Y^k)}{C_V(V^k,Y^k)}\right]\cdot\frac{Y^k}{V^k}\cdot\left[\frac{b(\eta_2-\rho_{23}\eta_3)}{\sigma_2(1-\rho_{23}^2)}\right] \tag{4a}$$

$$w_3^k = A(V^k,Y^k)\left[\frac{(r_3-r_1)}{\sigma_3^2(1-\rho_{23}^2)} - \frac{(r_2-r_1)\rho_{23}}{\sigma_2\sigma_3(1-\rho_{23}^2)}\right] - \left[1+\frac{C_Y(V^k,Y^k)}{C_V(V^k,Y^k)}\right]\cdot\frac{Y^k}{V^k}\cdot\left[\frac{b(\eta_3-\rho_{23}\eta_2)}{\sigma_3(1-\rho_{23}^2)}\right] \tag{4b}$$

and,

$$w_1^k = 1 - w_2^k - w_3^k \tag{4c}$$

where ρ_{23} is the correlation coefficient between the real rates of

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[3] It can be checked by applying Itô's lemma to (Q_2/P),

$$\frac{d\,(Q_2/P)}{(Q_2/P)} = (R_2-\pi_1+s_1^2-s_1s_2\,\rho_{12})dt + s_2dz_2-s_1dz_1$$

return on equities and non index-linked bonds and η_2 and η_3 are the correlation coefficients between real wage income and real rates of return on equities and nominal bonds respectively.

Thus, asset demands of the individual economic agent depend upon differentials of the real interest rates on equities and nominal bonds over that on index-linked bonds and the ratio of his real wage income to his real wealth. The parameters of the individual's asset demand functions depend upon the degree of his relative risk aversion, his marginal propensity to consume out of real wage income and that out of real wealth and the parameters of the various stochastic processes involved.

Since, as explained in Appendix A, the term $A(V^k, Y^k)$ gives the reciprocal of the degree of relative risk aversion of the kth economic agent, it can be observed from the above asset demand equations that if the correlation coefficient between the real rates of return on non index-linked bonds and equities (ρ_{23}) is zero, the higher the relative risk aversion of the economic agent, the smaller his demand for non index-linked bonds and equities and the greater his demand for index-linked bonds, other things remaining the same. Also in this case, the demand for each asset is positively related to the own real rate and negatively related to the real rate on other assets. Furthermore, the above asset demand equations imply that even if the agent's expectations, as reflected through the parameters of the stochastic processes, are the same, the responsiveness of their demands for index-linked bonds (and other assets) will not necessarily be the same, unless the degree of relative risk aversion is constant at all levels of real wage income and real wealth. The above asset demand functions of individual economic agents can be aggregated to arrive at the market asset demand functions. Equating the market demand functions for equities and non index-linked bonds with exogenously given aggregate quantities of these assets supplied by the issuers, one can solve for the equilibrium values of $(r_2 - r_1)$ and $(r_3 - r_1)$. The differential of the real interest rate on non index-linked bonds over that on index-linked bonds is given by:

$$(r_3 - r_1) = \frac{\sigma_3}{A(V,Y)} \left[\sigma_3 a_3 + \rho_{23}\sigma_2 a_2 b + \eta_2 \left(1 + \frac{C_Y}{C_V}\right) \frac{Y}{V} \right] \qquad (5)$$

where, $A(V,Y) = \frac{1}{V} \sum_k A(V^k, Y^k) V^k$, and $\frac{C_Y}{C_V} = \sum_K \left(\frac{C_Y^k}{C_V^k}\right) \left(\frac{Y^k}{Y}\right)$

Here a_i gives the ratio of the real quantity of the i^{th} financial asset issued to the total national real wealth, and $A(V,Y)$ is the weighted average of the reciprocal of the degree of relative risk aversion of the economic agents, the weights being the proportions of the aggregate real wealth held by the economic agents, and C_Y / C_V gives the weighted average of the ratios of the marginal propensity out of real labour income to that out of real wealth, the weights here being the proportions of the aggregate real labour income received by the economic agents.

Consider the case where $a_1 = 0$, $a_2 = 0$, and $a_3 = 1$. This case would be something like the current situation in India and in many developing countries in which there are no index-linked bonds and equities form a very small share of the total wealth of individual. For this case, equation (5) becomes:

$$r_3 - r_1 = \frac{\sigma_3}{A(V,Y)} \left[\sigma_3 + b\eta_2 \left(1 + \frac{C_Y}{C_V}\right) \frac{Y}{V} \right] \qquad (6)$$

Therefore, in this case, if $\eta_3 > 0$, then $(r_3 - r_1) > 0$.

That is, if the real wage income and the real return on nominal bonds are *positively correlated* ($\eta_3>0$), then the *real* return on index-linked bonds would be less than that on nominal bonds. In other words, if the real wage income is negatively correlated with the rate of inflation, there would be a premium contained in the real return on nominal bonds compared with index-linked bonds. Thus, the smaller the extent of indexation of wage income, the larger also will be the demand for index-linked bonds and the real inflation risk premium.

2.8 Fischer's result, that if the correlation between the rate of inflation and the real wage income is negative then the greater in absolute value this correlation, that is, the smaller the degree of indexation of wage income, the greater will the demand for index-linked bonds be and the greater will be the premium contained in the real return on nominal bonds compared with index-linked bonds, is also reached by Blinder (1977). Blinder also presents the empirical evidence in this regard. The annual rate of change of average spendable weekly earnings in the total private non-agricultural sector (adjusted for the unemployment rate) deflated by the Consumer Price Index (CPI) (used as a proxy for the real return on human wealth) shows a correlation of (-) 0.62 with the annual rate of inflation (as measured by the CPI) for the U.S. over the period from 1948 to 1975 with one percentage point change in the annual rate of CPI inflation leading to a *decline* of 0.61 percentage points in the annual rate of change in the average weekly earnings in the private non-agricultural sector. The correlation between the annual rate of change in the real average weekly real earnings in the private non-agricultural sector and the annual series on unanticipated inflation in the U.S. from 1955 to 1972 (based on the time series of expected inflation obtained from de Menil (1974)) was - 0.40, and the former declined "point-for-point with unanticipated inflation".

Blinder's paper, in fact, makes another, illuminating point that with the existence of index-linked bonds in the economy, individual worker-consumers negotiating, with the firms employing them, an optimal wage contract linking wage income to the rate of inflation will demand full cost of living escalation whereas when only non index-linked bonds are available in the economy, then workers with positive net worth will demand *more-than-100-percent* wage escalation while those with negative net worth *may* demand less-than-100-percent wage escalation[4].

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[4]Blinder, in fact, has concluded that when only non indexed bonds are available in the economy, the workers with positive net worth will demand more-than-100-percent wage escalation while those with negative net worth *will* demand less-than-100-percent wage escalation. We have stated the conclusion somewhat differently, as in the text, because our derivation of Blinder's formula for optimal wage contract, given in equation (5) of his paper, includes an additional term in that formula, which is *positive* when the real rate of return on nominal bonds decreases with the rate of inflation, as assumed by Blinder.

Examining the optimal offers of indexed wage contracts by the firms, Blinder observes that if the firms are risk neutral, they will be indifferent between all inflation-indexed wage contracts having an equal expected value, and the choice, therefore, will rest with the workers and will, in turn, depend on how the non-wage real incomes of the workers, for example, real returns on their savings, fare during inflation, as discussed in the previous paragraphs. Holding of index-linked bonds would restrict their demand for wage escalation to require full cost of living indexation, but they would require more than full cost of living wage escalation to the extent that they have to hold their savings in the form of nominal bonds or other assets the real return on which is negatively correlated with the rate of inflation.

If the firms are risk averse, however, they would be more willing to index wages provided their net real income, exclusive of wage payments, increases with inflation. Therefore, if a major part of the firms' non-wage cost is due to debt servicing and if the real debt servicing cost is reduced with inflation, then the firms would be willing to index wages. Blinder believes that inflation would reduce real debt servicing cost if the firms issue non index-linked debt and increase it if they issue index-linked debt. Therefore, he concludes that if the firms issue non index-linked debt they may be more willing to index wage payments, whereas they would have less of an incentive to index wages if bulk of the debt issued by them is index-linked. In view of this, Blinder sees indexed bonds and indexed wages as substitutes from the point of view of the firms also as from the point of view of the workers.

Blinder also suggested that while worker-consumers would have demand for bonds linked to a general price index the firms would want to issue bonds linked to the price of their individual products, particularly if their profits are positively correlated with the price of their products. Blinder has reported mild empirical support for this condition from the annual and quarterly data on profits of manufacturing corporations and the break-up of the Wholesale Price Index at the two-digit Standard Industrial Classification for the period from 1947 to 1975 for the U.S. in that 11 out of 23 industries show unambiguous (though not necessarily statistically significant) positive correlations between industry profits and price index for the industry group over the period.

Information Content of Index-linked Bonds

2.9 Recent literature on index-linked bonds has focused attention on an important piece of information which these bonds provide to the monetary authorities and help conduct monetary policy in a more effective manner. Arak and Kreicher (1985), Woodward (1985), and Hetzel (1992) suggested that by comparing the market interest rates on non index-linked and index-linked government bonds, one could obtain a direct measure of market's average expectation of the future inflation rate over the maturity period of the bonds. This measure of expected inflation rate and the real interest rate as determined in the market for index-linked bonds could be used to suitably formulate an appropriate monetary policy.

Consider the one year index-linked bond promising to pay a real principal amount of Rs.100 and a real coupon interest of 3 per cent (at the end of one year) which we earlier mentioned as an example. Suppose such a bond is auctioned in the market today on the basis of the price offered for it today. Suppose the cut-off price for the total amount to be raised through this bond happens also to be Rs.100. Then the market real interest rate equals the coupon real interest rate of 3 percent. If the cut-off price turns out to be say Rs.99, then the market real interest rate would be (4/99) x 100 or somewhat higher than 4 percent. Alternatively, the auction may be arranged directly on the basis of bids of the real interest rate. Suppose, a non index-linked bond of one year maturity offers a market interest rate of 13 percent and an index-linked bond of one year maturity offers a market real interest rate of 3 per cent, then we can say (for the time being abstracting from the inflation risk premium contained in the market interest rate on the conventional or non index-linked bond) that the market is expecting, on the average, an inflation rate of 10 per cent per year during the coming year. If the monetary authority wants to aim at a lower inflation rate, it must tighten the monetary policy somewhat, perhaps by restricting the money growth to a somewhat larger extent than what it has been doing. Take another example. Suppose the interest rates on Government securities have been rising as is the case in recent months since early 1995. Is this because the market's expectation of inflation rate is for a higher rate or is this because the real interest rate has started to increase, reflecting the increase in the growth rate of industrial production or reflecting heavy demand for funds by the Government and the private sector taken together? If the former, we need a tight money policy. If the latter, we do not. If we had a sufficiently wide market for both an index-linked bond as well as a non index-linked bond, we could get direct measures of the market's expectation of inflation as well as the real interest rate. If the real interest rate alone shows an increase, the monetary authorities may not tighten the growth of the supply of money and credit.

Gabriel De Kock(1991) examined the experience relating to the issuance of index-linked bonds in the U.K., particularly from the point of view of the usefulness for the conduct of monetary policy of the information about market's expectation of inflation and real interest rates revealed through the comparison of the yields on non index-linked and index-linked bonds of identical maturity. De Kock derived the measures of market's expected real interest rate from the monthly market yields on the 2 per cent index-linked bond maturing in 1996 and the measures of the market's expectation of inflation by comparing with the above-mentioned yields the monthly yields on conventional bonds maturing in 1996. He constructed monthly series of expected inflation rates and expected real market rates spanning the period from March 1982 to March 1991.

De Kock's main conclusion was that these market measures are not of much use for the conduct of monetary policy because the expected rates of inflation derived as above were poor predictors of future inflation rates, and the expected real interest rates poor predictors of future real economic activity. Nor did these measures of expected rates of inflation and expected real interest rates correctly reflect the stance of monetary policy. He showed that the yield on the index-linked bonds did not help in better prediction of future real GNP growth whereas four lags of the three month interbank rate together with four lags of Retail Price Index inflation rate, that is, 'the backward looking measure of short and long term real interest rates' do. He further argued that the monetary tightness in the U.K. during 1988-90 was not reflected in higher expected real interest rates or lower expected inflation rates as observed from the yields on index-linked bonds and the yield gap between non index-linked and index-linked bonds.

2.10 Hetzel (1992), however, has convincingly rebutted the conclusions reached by De Kock. The yield gap during the period from 1982 to 1991 on bonds maturing in 1996 measures expected rates of inflation over a relatively longer time horizon and these should not be compared with actual inflation rates over the next one, two or three years. He argued that the monetary policy as seen in terms of rapid growth of monetary aggregates during 1988-90 was, in fact, expansionary and that the observed increase in the market interest rates could have been because of higher expected rates of inflation.

2.11 Considerable empirical work has been done for estimating market's expectation of the future inflation rate and the usefulness of these estimates, using the data on the yields on index-linked and non index-linked bonds for comparable maturity, for the U.K. economy in which the Treasury has been regularly issuing index-linked bonds alongside the conventional non index-linked bonds since 1981. There are a number of difficult technical questions which need to be taken into account before measures of market's expectation of the inflation rate can be provided. The questions include the differences in the tax treatment of the two bonds in practice, measurement of the inflation risk premium contained in the yield on the non index-linked bonds, etc. The work of Eric J. Levin and Laurence S. Copeland (1993) shows that this can be done through careful statistical work. In fact, as it turns out, market yields on index-linked bonds of differing maturities can be used to provide the required decomposition if the 8-months' lag in the indexation of the U.K. index-linked bonds is exploited for this statistical analysis.

To illustrate the method used by Levin and Copeland (1993), suppose (for simplicity of exposition) that the expected real interest rate r, the expected inflation rate π^e, the expected marginal tax rate t and the inflation risk premium q are assumed to remain constant over the future years covering the maturity period of all bonds. Suppose that we have the data on prices P^L_i and P^L_j, for two index-linked bonds of different "durations" (that is, having different coupon interest payments A_i and A_j, different maturity periods m or both). Taking into account the fact that the U.K. index-linked bonds involve an indexation lag of one period (exactly eight months, but taken to be one year here to simplify exposition), the prices of these index-linked bonds must satisfy the following equations:

$$P^L_i = \frac{A_i\,(1 - t)}{(1 + \pi^e)\,(1 + r)} + \ldots\ldots + \frac{A_i\,(1 - t) + 100}{(1 + \pi^e)\,(1 + r)^m} \qquad (7)$$

$$P^L_j = \frac{A_j\,(1 - t)}{(1 + \pi^e)\,(1 + r)} + \ldots\ldots + \frac{A_j\,(1 - t) + 100}{(1 + \pi^e)\,(1 + r)^m} \qquad (8)$$

From these two equations, we can obtain the solutions of π^e and r in terms of t. Substituting these values of π^e and r in price equations for two non index-linked bonds (or for one index-linked and one non index-linked bond), as given below :

$$P^N_i = \frac{C_i\,(1-t)}{(1+\pi^e)\,(1+r)\,(1+q)} + \ldots\ldots + \frac{C_i\,(1-t)+100}{(1+\pi^e)^m\,(1+r)^m\,(1+q)} \tag{9}$$

$$P^N_j = \frac{C_j\,(1-t)}{(1+\pi^e)\,(1+r)\,(1+q)} + \ldots\ldots + \frac{C_j\,(1-t)+100}{(1+\pi^e)^m\,(1+r)^m\,(1+q)^m} \tag{10}$$

where P^N_i and P^N_j are prices and C_i and C_j are the coupon interest payments for the two non index-linked bonds, we can obtain the values of q and t.

Briefly, these results indicate that the measures of the rates of inflation expected to prevail after 3 years are more closely correlated with the actual rate of inflation at the time when the expectations were formed rather than with the actual inflation rate which prevailed after 3 years. This suggests "that market sentiment with regard to medium-term inflation is dominated by the current situation." The real rates appear to have moved up (in the U.K.) from around 2 per cent in 1982 to over 4 percent in 1990 as the programme of index-linked borrowing was continued over a decade while expected inflation fluctuated around a mean of 6.5 per cent during this period.

A surprising empirical finding of Levin and Copeland is that the inflation risk premium on non index-linked bonds in the U.K. has almost always been *negative,* the average value of it being (-)0.16, lying between the minimum value of (-) 0.52 and the maximum value of (+)0.12, during the period of their analysis, namely, from March 1982 to November 1991. It is noteworthy that, theoretically, the inflation risk premium can be either positive or negative, depending on the covariance between the marginal utility of future consumption and the future value of money. It has been shown by Benninga and Protopapadakis (1983) and Levin and Copeland (1993) that the inflation risk premium is the negative of the sum of the inflation risk premium proper, which is proportional to the above-mentioned covariance, and a positive quantity, known as Jensen's inequality, given by $[E(1/P) - 1/E(P)]$, where P is the future price level, giving the excess of the expected value of money over reciprocal of the expected future price level[5]. If the covariance between the marginal utility of future consumption and the future value of money is negative and large enough to outweigh the positive Jensen factor, the inflation risk premium will be positive. On the other hand, if the above- mentioned covariance is positive, the inflation risk premium would be negative. The former may be the case when, for example, a decrease in the future value of money, which lowers the real value of monetary assets, reduces future consumption and, hence, raises the marginal utility of future consumption. The latter

[5] More precisely, Jensen's inequality states that for a strictly convex function, the (mathematical) expectation of a random variable will be greater than the function of the (mathematical) expectation of the variable. That is, $E[g(x)] > g[E(x)]$. If we consider that the individual decision-makers, investments in the current period in index-linked and non-index-linked bonds, B_L and B_N, are determined from the maximisation of the expected utility:

$$E[U(Y-B_N-B_L, (1+i)(B_N/P) + (1+r)B_L)],$$

where Y is the current real income, i and r are the nominal and real interest rates respectively and P is the future level of commodity prices and the current price level is assumed to be equal to unity, the necessary conditions for maximum will be given by:

$$E[\{(1+i)/P\}U_2] = E(U_1), \text{ and } E[(1+r)U_2] = E(U_1).$$

from which, making use of the identity, $E(XY) = E(X).E(Y) + Cov(X,Y)$, we get $[(1+i)/(1+r)][\{1/E(P)\} + E(1/P)-\{1/E(P)\} + \{Cov(U_2, 1/P)\}/E(U_2)]=1$. Using $(1+i) = (1+r)E(P)(1+q)$, where q is the inflation risk premium, we obtain:

$$q = -[(1+i)/(1+r)][\{E(1/P) - (1/E(P)\} + \{Cov(U_2, 1/P)\}/E(U_2)].$$

would be the case where a decrease in the future value of money (due to a higher future price level) lowers the real interest rate which, in turn, increases future consumption and lowers the marginal utility of future consumption. Levin and Copeland argue that the latter was the case in U.K. during the period covered by their analysis as inflation was negatively correlated with the real rate of interest. This is how Levin and Copeland justify negative inflation risk premium estimated by them.

Apart from the inflation risk premium and the Jensen's inequality, the yields on non index-linked and index-linked bonds would differ on account of the interest-rate risk or price-risk premium, represented by the compensation a bond holder would require for variability of the capital value or the price of the bond over time. As the nominal interest rates (that is, the yields on non index-linked bonds) are higher than real interest rates (that is, the yields on the index-linked bonds) when expected inflation is positive, and because the variability of the nominal interest rates is higher than that of the real interest rates, reflecting the high variability of the expected inflation rate, the interest-rate risk or price-risk premium would be higher for non index-linked bonds as compared with the index-linked bonds.

The yields on non index-linked and index-linked bonds would also differ on account of the relative liquidity of the two types of bonds. The price of non index-linked or conventional bonds may be relatively higher in comparison with index-linked bonds because of the wider market for the former. From this angle, it may be possible to view by the negative estimate of inflation risk premium, observed by Levin and Copeland as showing the lower liquidity of index-linked bonds in comparison with that of non index-linked bonds. As Deacon and Derry (1994) point out, the current methodology of the Bank of England "assumes that all liquidity effects are negligible, but this may be unrealistic".

Index-linked Bonds and the Saving in the Cost of Debt Servicing

2.12 Saving in the cost of servicing government debt through the issuance of index-linked debt also arises when the actual inflation rate turns out to be lower than that anticipated. If future inflation is under-predicted by the market, the government saves on debt servicing cost, through the issuance of non index-linked bonds while if the future inflation is over the predicted, the government would save through the issuance of index-linked debt. As Woodward (1985) has pointed out, historically, from World War II upto the end of 1970s, inflation was probably under-predicted. As a result, nominal interest rates were rarely high enough to compensate lenders for the loss of the real value of the principal, and the governments gained to that extent in terms of lower debt servicing costs. However, Woodward argues that the situation would be opposite when the Government intends to pursue a policy of disinflation because in that case, market's anticipations of inflation will probably be over-estimates, and the Government would save money by indexing part of its debt.

Index-linked Bonds and Budgetary Uncertainty

2.13 Wooodward has further argued that while an indexed bond is a means of decreasing the inflation risk that a lender is exposed to, it does not necessarily increase the risk absorbed by the government. Though the government's nominal outlays would become more unpredictable with indexed debt, its real outlays, would become less so. Since government revenues vary with inflation, indexing government debt would make government outlays and receipts both vary together with inflation, thus reducing to some extent "budgetary uncertainty" caused by inflation.

Index-linked Bonds and the 'Dynamic Inconsistency Inflation'

2.14 Arthur Burns (1978) had strongly criticised inflation indexation calling it "a counsel of despair" and saying that, "...if a nation with our traditions attempted to make it easy to live with inflation, rather than resist its corrosive influence, we would slowly but steadily lose the sense of discipline needed to pursue governmental policies with an eye to the permanent welfare of our people". Some of the recent theoretical work [by Fischer and Summers(1989), (1993) and Agell and Ysander (1993)] on inflation indexation in general and inflation indexing of government securities in particular has addressed to the crucial question, namely, whether such indexation would "eliminate important sources of political opposition to inflation" by reducing the costs of inflation and thereby induce the governments to choose more inflationary options while considering trade-offs between inflation and unemployment.

Fischer and Summers (1989) developed the argument in the context of a positive theory of inflation according to which the rate of growth of money stock and the rate of inflation are determined by the policy-maker so as to minimise a loss function incorporating the society's evaluation of the relative costs of inflation and unemployment rate, subject to the negative (Phillips curve) relationship between unanticipated inflation and the deviation of the unemployment rate from the natural rate of unemployment, taking into account how expectations are formed by the private agents. As the private agents themselves are assumed to be forming their expectations (about inflation) by "effectively solving the problem that the optimising policy-maker will face" [Barro and Gordon (1983)], this amounts to imposing the condition that expectations are, in fact, realised. The outcome, which determines the policy-maker's choice of the rate of inflation (or the rate of money growth) and the rate of unemployment, is called the "consistent policy" by Kydland and Prescott (1977) and the "rational expectations equilibrium" by Barro and Gordon (1983). The main characteristic of this outcome emphasised by Kydland and Prescott and Barro and Gordon is that while this policy will continue to be chosen in each successive period in future, (hence called a consistent policy or an equilibrium), it is a sub-optimal one. As Kydland and Prescott point out, the consistent policy involves a positive rate of inflation whereas if the policy makers were compelled to follow the rule of maintaining price stability and did not have discretionary powers, the resulting equilibrium would have no higher unemployment. Such an optimal policy, on the other hand, is not consistent since, given discretion, the optimising policy-maker will not choose it as the best option and hence will not continue it. The higher inflation rate associated with the consistent policy is referred to by Fischer and Summers (1989) as the "dynamic inconsistency inflation".

Fisher and Summers (1989) and Agell and Ysander (1993) examine the question of the impact of indexation on "dynamic inconsistency inflation" and through it on the total welfare of the society. Thus, minimising a quadratic loss function of both government and society, dependent on the unemployment rate (U) and the inflation rate π, given by

$$L = (U - kU_n)^2 + b\,\pi^2 \qquad (11)$$

subject to the Phillips Curve trade-off relation between unemployment, rate and inflation, given by

$$U = U_n - a\,(\pi-\pi^e) \qquad (12)$$

and, taking account of the condition that for the consistent policy or for equilibrium,

$$\pi = \pi^e \qquad (13)$$

Fischer and Summers obtain the dynamic inconsistency inflation rate to be:

$$\pi = (a/b)U_n\ (1 - k) \qquad (14)$$

and, therefore, the minimum value of the loss function to be:

$$L = (U_n^2)\ (1 - k)\ [1 + (a^2/b)] \qquad (15)$$

Here U_n is the natural rate of unemployment and π^e the expected rate of inflation. kU_n gives minimum unemployment rate which will be always tolerated. In other words, a proportion k of the natural rate of unemployment is accepted by the society as irreducible minimum of the unemployment rate. The parameter b in the loss function reflects the direct welfare cost associated with inflation.

It will be noticed from equations (13) and (14) that lowering of the direct welfare cost of inflation (b), say through inflation - indexing of bonds, would be to increase the dynamic inconsistency inflation rate and the value of the loss function. Thus, inflation - indexing of bonds (or other forms of inflation indexation) which lower the direct social costs of inflation may induce society and government to choose more inflationary policies and end up with a smaller social welfare because the social costs of the resulting extra inflation would outweigh the direct benefit of protection against inflation provided by indexing. Also, no additional advantage whatsoever is obtained in the process in terms of lowering of the rate of unemployment which remains unchanged at the natural rate.

Needless to say that this result depends on the form of the loss function, tied as it is to the way in which the social loss function depends on the rate of inflation. The net change in social welfare will depend upon whether the social loss due to extra (dynamic inconsistency) inflation resulting from the lower direct cost of inflation on account of protection from inflation does or does not outweigh the benefit of the lower direct cost of inflation. Fischer and Summers have shown that the above result of a lowering of social welfare on account of inflation mitigation obtains in the case of the quadratic loss function but may not obtain for loss functions with different functional forms. Also, the above analysis has assumed that the inflation rate is entirely and precisely determined by the government. When inflation results from exogenous supply shocks or cannot be precisely controlled by the government, it has been shown by Fischer and Summers that some degree of inflation mitigation would increase social welfare. In particular, since the public's expectations about inflation depend on the credibility of the government's commitment to a low-inflation policy, a government which can establish such credibility through its performance can further benefit from enhanced credibility by providing protection against chance inflation arising from exogenous shocks beyond its control.

In the above discussion, money wages are assumed to adjust fully to expected inflation and hence eventually to actual inflation. Therefore, the equilibrium unemployment rate is independent of institutional environment including indexing of wages or tax brackets or bonds. However, Agell and Ysander (1993) have argued that in a strategic game-theoretic framework in which the government is assumed to choose the general inflation rate and an all-encompassing monopoly labour union to set the rate of wage inflation, the conclusions of Fischer and Summers do not carry over to the case of the Stackelberg game in which either the government or the union acts as "leader" and maximises its utility exploiting the reaction function of the other. Agell and Ysander show that if the union is strong and the government accommodating, lowering the direct social costs of inflation through indexation would lower equilibrium unemployment rate as the union would moderate its wage demands if it recognised the efficiency costs of inflation and/or the erosion of after tax real wage income through inflation due to a bracket-creep in a non-indexed and progressive income tax system. On the other hand, if the government is strong and the labour union accommodating, the incentive to the government for generating extra inflation is removed if tax brackets are inflation-indexed.

In a more relevant extension of the above strategic game-theoretic framework, Agell and Ysander incorporate into it the redistributions of real wealth due to inflation from the retired generation, which holds nominally denominated government debt and obtains unindexed (or partially indexed) social security, to the government and to the younger generation (consisting of the beneficiaries of the wage inflation resulting from the union action). As they note, Fischer and Modigliani (1978), in their systematic account of the real effects of inflation, have observed that such "wealth redistributions arising from unanticipated inflation are large, of the order of 1 per cent of GNP per 1 per cent unanticipated increase in the price level". Considering the case of the strong labour union and an accommodating government, Agell and Ysander show that increasing the gains from unexpected inflation increases the equilibrium inflation rate.

Their conclusion is important in our present context:

> "The policy lesson is straight forward. For every loser from unanticipated inflation there is a gainer. If the gainers also happen to be key players in the inflationary process, the outcome is high

> inflation...........By eliminating the other main channel of wealth redistributions from unexpected inflation, widespread indexation of private and government loan contracts may reduce inflation substantially".

The above discussion about the theoretical issues relating to index-linked bonds needs to be judged in the light of the experience of various countries with index-linked bonds. To this, we now turn.

3. EXPERIENCE OF INDEX-LINKED BONDS IN OTHER COUNTRIES

Index-linked government bonds could be either viewed as a segmented market operation or as a part of a general indexation programme of all financial contracts.

3.1 Countries like United Kingdom, Australia and Canada have introduced index-linked government securities as a segmented internal debt management operation with a view to increasing the range of assets available in the system, providing an inflation hedge to investors, reducing interest costs and to pick up direct signals from the market on expected inflation and real rate of interest. On similar grounds and with a view to enhancing credibility of the policy of containing inflation and thereby to reduce interest rates on conventional as well as index-linked bonds, New Zealand Government had announced its intention to introduce an inflation-indexed bond in 1995.

3.2 Index-linked securities both in public and private sectors were also used with the main purpose of sustaining capital market activities in the face of hyperinflation in countries with endemic inflation like France, Brazil, Chile, Iceland and Israel. Facing virtual collapse of financial system, these countries found it necessary to extend indexation virtually to all financial contracts.

In France, for example, index-linked issues of public bonds accounted for between 30 per cent and 55 per cent of all bonds issued each year between 1952 and 1958 and the index-linked issues of private bonds accounted for 80 per cent of all private bonds issued in 1954. France banned most forms of indexation in 1958, when the New Franc was created under the stabilisation programme, after devaluation.

The most extensive use of index-linked bonds, in countries other than with hyperinflation, was in Finland from 1947, with index linked issues comprising some three quarters of all Government bonds and most of the outstanding bonds of financial institutions by the end of the 1960's. Finland discontinued indexation when the general indexation in the economy seemed likely to exacerbate inflationary pressures.

Brazil introduced indexation practically to several areas of financial contracts like bond principals, savings accounts, mortgage payment, rentals, the exchange rate, and fixed physical assets and wage rates. This was a part of 'monetary correction' undertaken to control inflation and stimulate growth. Commenting upon Brazilian experience, Albert Fishlow (1974) had several reservations about Brazilian indexing. First, far from relying on a correction involving an automatic adjustment to the movements in the general price level, it had been characterised by significant modifications designed to accommodate policy objectives. Monetary correction, as applied, not only did not correct inequities generated by price rises but, in fact, reinforced them. In 1983, the presence of large stock of index-linked dollar denominated assets in Brazil reduced the effectiveness of an unanticipated devaluation, since it prevented the devaluation from reducing real wealth of the holders which was necessary for reducing inflationary pressures. Furthermore, Government's overall borrowing requirements became relatively larger. In 1987, the Central Government's deficit was 17.2 per cent of GDP, of which inflation adjustment was 13.9 per cent of GDP. While assessing the Brazilian experience, Paul Beckerman (1992) observed: "To the extent the debt is index-linked, its holders are protected against inflation; but the opposite side of the coin is precisely that the Government loses the possibility of using a burst of inflation to reduce claims on itself. In this perspective, index-linked bonds encapsulate a fundamental dilemma of inflation; it is fair, even efficient, to protect people from inflation; but to the extent the economy is protected from inflation, inflation will tend to persist".

Argentina and Israel were the other countries which used index-linked securities as part of their stabilisation programmes and with the objective of prevention of a collapse of their long-term capital markets in the face of hyperinflation. Following its wartime experience of hyperinflation, the German authorities became adamantly opposed to any form of indexation. Widespread or general indexation was thus viewed as a necessary evil in the face of hyperinflation; but, something which should generally be avoided otherwise, because it would build inflation more or less permanently into the system.

3.3 Index-linking of bonds discussed in this study is based more on experiences of countries like United Kingdom, Canada and

Australia which introduced index-linked securities with other forms of nominal debt as a measure of reducing borrowing costs to Government, encouraging financial savings by providing a perfectly inflation-hedged instrument, particularly meeting the demand from institutions like insurance companies and provident and pension funds with inflation-linked liabilities.

General Features of Index-linked bonds in U.K., Australia and Canada

3.4 The index-linked bonds are broadly of two types: capital-indexed and interest-indexed. In interest-indexed securities (issued earlier in Australia), interest at a uniform rate is payable on the face value of bonds, but interest payments are adjusted for inflation rates. The face value of the bond, however, stays the same over the life of the investment. In capital-indexed bonds, at present being issued in Australia, inflationary adjustments are made in capital value of bonds and a fixed interest is paid on the adjusted value of capital. Index-linked bonds issued in U.K. correspond to capital-indexed bonds of Australia. In effect, while capital-indexed bonds compensate both capital and interest payments for inflation, interest-indexed bonds compensate only interest payments for inflation. If only interest is inflation-indexed, then this more or less corresponds to a floating-rate instrument. In the case of floating interest rate instruments, indexation is not with reference to inflation but with reference to a bench-mark short-term interest rate. If the short-term reference rate adjusts exactly to the inflation rate, it will be akin to interest-indexed bonds. Therefore, it is the capital indexation that essentially differentiates the indexed bonds from floating rate instruments. The real return offered is before tax. Depending upon the tax-laws, the attractiveness of index-linked bonds would further vary vis-a-vis nominal bonds.

A detailed account of index-linked bonds in these countries is provided in the following paragraphs.

U.K.

3.5 Though the possibility of issuing indexed instruments was raised in U.K. on a number of occasions after the second World War, notably during the periods of worsening inflation, the British Government did not introduce index-linked bonds until 1981 much because of the fears of 'contagion', that is, the fear that indexation of bonds might lead to demands for indexation of other contracts. However, the Government issued certain savings schemes on index-linked basis. The first of these was the introduction, in 1975, of index-linked 'National Savings Certificates' which could be purchased only by retired persons (men over 65 years or women over 60 years). These became popularly known as 'granny bonds'. The second was an indexed 'Save as You Earn' instrument. These instruments had ceilings on the amounts that could be invested. The total amount invested in such instruments were at times, sizeable; but only between the years 1979-80 and 1981-82, did these instruments really become a major source of Government finances.

Besides the case for providing an inflation-hedged financial asset for the old age pensioners, the inflationary pressure in 1974 led to a more general re-awakening of interest in indexation. The arguments for indexation in general and for encouraging indexed financial instruments by private or public sectors in particular were taken up and supported in the Press. The next bout of interest developed in 1976 when the possibility of issuing indexed public sector bonds assumed importance. The argument for indexation of bonds in 1976 was that they could be sold when the conventional debt could not be, thereby breaking the spiral arising out of worsening inflationary fears due to some other external shocks. A fear was also, however, expressed that indexed bond issues might adversely affect equity prices. If equities had proved to be a poor inflation hedge, the availability of a better hedge in the form of indexed bonds would make long-term saving institutions, life insurance companies and pension funds shift their portfolios in favour of indexed bonds. Apart from indexed bonds, two other instruments were also considered, namely, a variable interest bond and a convertible bond which allowed investors to opt for a short maturity if inflation or nominal interest rates rose or a long maturity if the reverse occurred. Both these instruments provided some partial protection to investors against unanticipated inflation. These instruments did not involve any radical implications or a fear of 'contagion' associated with the index-linked bonds. Therefore, the Government proceeded with the latter two instruments leaving the indexed bonds to be reconsidered only if inflationary pressures worsened. The inflationary fears, in fact, eased in 1977. Therefore, official discussion on indexed bonds did not occur again until 1980 when the nominal bond yields for all maturities reached very high levels. The year-on-year increase in the Retail Price Index (RPI) was accentuated in June 1979 by a sharp hike in the rates of the Value Added Tax by about 8 to 15 per cent. Combined with the 1979 oil shock and the collapse of the incomes policy restraint on public sector wages, the 10 year bond rates were running at 13.7 per cent and the RPI was 21 per cent higher on a point-to-point basis at the end of June 1980. The medium-term financial strategy (MTFS) announced in March 1980 intended to reduce inflation in a determined manner by a steady and gradual reduction in the growth of M_3. In this background, it was felt that the current levels of medium and long-term interest rates were out of line with the Government's firm intentions and it was felt that conventional borrowing at nominal interest rates would prove to be excessively expensive. Apart from the reduction in the borrowing cost, indexed bonds were supported as a sign of counter-inflationary policy and also as a method of reducing Public Sector Borrowing Requirements (PSBR) in the near future, though this was achieved at the expense of larger maturity values in the long term. Though index-linked bonds would result in larger maturity values, the cash flows during the tenure of the bonds would result in sizeable reduction in borrowing requirements. Since there were representations from the OPEC for indexing both oil prices and financial instruments, the index-linked bonds were issued in 1981 to a limited class of eligible holders, namely, UK pension funds and life insurance companies undertaking pension business. Since the market demand initially for two issues aggregating £ 2 billion was small, the base for eligibility was widened and the Government bonds in general including index-linked bonds, were exempted from capital gains tax in 1982.[6]

The total index-linked issues constituted 25.5 per cent of Public Sector Borrowing Requirement in 1981-82. From 1981 to end-March 1983, there were 15 index-linked stocks in issue with a nominal outstanding value of £ 17 billion or over 11 per cent of the total gilt market. By the end of March 1994, there were 13 issues of index-linked stocks with outstanding amount at 30 billion representing 15 per cent of the total outstanding Government securities of £ 175 billion. The index-linked bond market has become as big as the government bond market for maturities longer than 15 years. However, the monthly turnover relative to the outstanding stock remains much lower for index-linked Government bonds in comparison with that for non index-linked Government bonds. In March 1990, it averaged to just over 125 times the outstanding stock in comparison with over 800 times for non index-linked Government bonds. This reflects a less active secondary market and a lower degree of liquidity for index-linked bonds.

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[6] The historical account of U.K. experience in this Section draws considerably from Goodhart (1992).

Features of Index-linked Issues

The bonds are issued generally on a tender basis. However, tapping of existing issues by selling 200 to 300 million in blocks to the Bank of England dealing department is also followed. The Bank of England distributes these bonds on a tap basis through the Gilt-Edged Market Makers (GEMMs). There is no particular schedule of issue. The Bank of England comes to the market on an 'opportunistic' basis (Lalani and Parker, 1994), that is, whenever there is demand for such issues.

The interest payments and the amount due at maturity of index-linked bonds are adjusted to reflect changes in the Retail Price Index (RPI). If RPI is rising, the index-linked bonds provides a nominal capital gain from purchasing the stock at issue and holding it to maturity. If retail prices were to fall, the expected redemption value of index-linked bonds would also decline, but would, retain its value in real terms.

The value of both interest payments and the principal repayment is determined by comparing the RPI eight months before issue (the base RPI) with the RPI eight months before a payment is due. The consideration here is that eight months' period is the minimum which allows an interest payment to be calculated before the stock goes ex-dividend, trading at clean price exclusive of accrued coupon in respect of the immediately preceding interest payment and so allows accrued interest to be calculated accurately at all times (Please see box for an example of calculation of payment of interest and principal on index-linked bonds).

INDEX-LINKED STOCKS

EXAMPLE :

4 1/8 % Index-Linked Treasury Stock 2030 was issued on 12 June 1992. Interest is payable on 22 January and 22 July each year, beginning on 22 January 1993. The stock is to be redeemed on 22nd July 2030, at which time the final interest payment will also be made.

The base month for the RPI for the stock was October 1991, i.e. eight months before June 1992. The RPI in October 1991 was 135.1.

Each interest payment (except the first, which related to a period of over seven months) comprises £ 2.0625 (half of the £ 4 1/8 coupon), adjusted for the movement in the RPI, on each £100 nominal of stock.

For example, the first interest payment, made on 22nd January 1993, was

$$£\ 4.125 \times \frac{224}{365} \times \frac{239.3}{135.1} = £\ 2.6102 \text{ per } £\ 100 \text{ nominal of stock.}$$

(Coupon, multiplied by number of days since issue divided by 365, multiplied by ratio of RPI in May 1992, eight months before the payment, to RPI in October 1991).

The second interest payment, on 22 July 1993, will be:

$$£\ 2.0625 \times \frac{139.7}{135.1} = 2.1327 \text{ per } £\ 100 \text{ nominal of stock}$$

(half of the coupon multiplied by ratio of RPI in November 1992 to RPI in October 1991).

The principal repayment will depend on the RPI in November 2029, eight months before redemption. Suppose that between March 1993 and November 2029 the RPI were to rise at 3% per annum to a published RPI for the latter month of 411.8. Then the sum repaid to investors would be :

$$£100 \times \frac{411.8}{135.1} = £304.8112 \text{ per } £100 \text{ nominal of stock}$$

(Source : Bank of England (1993) : *British Government Securities)*

In the usual case of a twice-yearly interest payment, the ratio of RPI relating to the payment date to the base RPI is multiplied by half of the coupon on the stock; when the stock is redeemed, the ratio (that is, the ratio of the RPI value eight months before maturity date to that at eight months before the date of issue) is multiplied by the nominal (Face) value of the stock.

Prices of index-linked securities in the secondary market adjust to expectations about future inflation. The real rates of return to maturity on index-linked bonds are often reported on the basis of assumed future inflation rates of 3 per cent, 5 per cent or 10 per cent. As on 31st of March 1993, the real rate of return to maturity for each index-linked bond was in every case a little lower at an assumed future inflation rate of 5 per cent than in the case of 3 per cent inflation.

Stockholders are protected against changes in the coverage of the index or its calculation which would be materially detrimental to their interests. If the Bank of England were to judge that a fundamental change had been made and that it was materially detrimental to the interests of stock holders, holders would be offered the right to require the Treasury to redeem their stock, not later than seven months from the last month of the publication of the old index.

While interest income on index-linked bonds is subject to tax, the capital gain on all government securities, including index-linked bonds, is exempt from tax.

The British Government was able to realise considerable savings in the cost of servicing the index-linked bonds as the actual inflation turned out to be lower than that expected by the market particularly in the earlier part of the period. A comparison of yields on matured index-linked issues and non index-linked issues for comparable maturities shows that index-linked securities, *post facto,* were cost effective resulting in a total saving of £72.34 million on issues totalling £1700 million. The yields on index-linked bonds were less than those on non index-linked bonds, the differential ranging from 1.48 per cent to 7.51 per cent (Table 1).

Table 1 : Comparison of Yields on Select Index-linked and Non Index-linked Issues

Index-linked Bonds	Comparable Non Index-inked Bonds	Maturity Period (Years)		Nominal Yield to Maturity		Differential Yield	Effective Interest Saved per annum
ILB	NILB	ILB	NILB	ILB(%)	NILB(%)	(%)	(£million)
1) 2% Index linked Treasury, 1994	8.5% Treasury, 1994	6 (400)	6	8.5583	10.1562	1.5979	6.3916
2) 2% Index Linked Treasury, 1988	13.25% Exchequer, 1987	6 (750)	5	7.2302	14.7399	7.5097	56.32275
3) 2% Index Linked Treasury, 1990	10% Treasury Convertible, 1990	6	6 (300)	9.0075	10.9804	1.9729	5.9187
4) 2% Index Linked Treasury, 1992	10% Treasury Convertible, 1992	4	4 (250)	9.1889	10.6723	1.4934	3.7085
Total		1700					72.3416

Note : Figures in bracket are total value of issue in £ million.
ILB: Index-linked bonds, NILB : Non index-linked bonds.

In the late 'seventies and the early 'eighties, with market expectations of rising inflation, the Bank of England had to carry out open market *purchase* of conventional Government bonds to prevent interest rates on them from rising. In this situation, De Kock (1991) argues that the Bank of England could control the growth of money stock by resorting to a sale of index-linked bonds "which could be sold in times of market expectations of rising inflation". The Government correctly expected saving in the debt servicing cost through the issuance of index-linked bonds in 1981. In the U.K. in early 1981, "long term bond rates were close to 14 per cent and retail prices were still rising rapidly, but the Government expected its firm anti-inflation policies to pay off in the near future." As inflation reduces the real value of non index-linked debt, the announcement of anti-inflationary policies accompanied by issuance of non index-linked Government debt could not lend credibility to the policy announcements. Issuance of index-linked Government debt, on the other hand, enhanced the credibility of the Government's anti-inflationary policies. The Government's credibility was further enhanced due to the "cosmetic improvement in the Public Sector Borrowing Requirement" brought about immediately because inflation compensation for the principal amount was made payable on maturity in the case of the index-linked bonds issued in the U.K.

Australia

3.6 Australian Government has started issuing index-linked bonds since 1985 in an attempt to meet perceived market demand for an inflation proof security, that is, one that offered a nominal rate of return that varied *automatically* with the rate of inflation. However, the experience in Australia has been chequered since there were no issues between 1988 and 1993 reportedly because of failed auctions in 1987. In early 1993, the issues were resumed through a 'panel of brokers'. In August 1994, Government resumed the auction process on the basis of demand from investors.

As stated earlier, there are two types of Treasury Indexed Bonds issued, namely, capital-indexed bonds and interest-indexed bonds. Capital-indexed bonds link the capital value of the bond to movements in consumer price index (CPI). A fixed real rate of interest is paid on the adjusted capital value and, at maturity, investors receive the inflation-adjusted capital value of their investment. Interest-indexed bonds keep the capital value of the bond constant but adjust the nominal rate of interest for movements in the CPI.

Interest for both the types of bonds is paid quarterly, against semi-annual coupons on nominal bonds. Capital-indexed bonds have been issued at periodic tenders and were also available, following tenders, in small parcels at pre-determined rates. Interest-indexed bonds were available only in small parcels at pre-determined rates. Since 1993, Australian Government has been issuing only capital-indexed bonds.

The index used for linking is the "Weighted Average of Eight Capital Cities: All Groups Index" as maintained and published quarterly by the Australian Bureau of Statistics. If the Australian Bureau of Statistics were to cease publication of the CPI and were to publish another index which is stated by them to be in replacement of the CPI then that index shall be used for indexing. Indexing is based on the average percentage change in the CPI over the two quarters ending in the quarter which is *two quarters prior* to that in which the next interest payment falls. For example, if the next interest payment is in November, it is based cn the average movement in the CPI over two quarters (January-June) ended in the one quarter preceding, and will be given by :

$$\frac{100}{2}\left[\frac{CPI_t}{CPI_{t-2}}-1\right]$$

rounded to two decimal places where CPI_t is the Consumer Price Index for the second quarter of the relevant period, and CPI_{t-2} is the Consumer Price Index for the quarter immediately prior to the relevant two quarter period (January - June).

Interest payments for stock are calculated on the basis of the following formula :

$$g \times \frac{K_t}{100}$$

where g = the fixed quarterly interest payable (equal to the annual fixed interest rate divided by 4); K_t = nominal value of principal at the next interest payment date.

An official announcement is made in respect of each series of Treasury indexed bonds indicating the amounts offered, and date and amount of the first interest payment, the closing time and date for bids and settlement arrangements. A subsequent announcement is made announcing the results of the tender.

Transfers of Treasury indexed bonds are free of stamp duty imposed by the Commonwealth and the States. Assessable income from Treasury indexed bonds derived by way of interest or discount or through capital accruals throughout the life of the Treasury indexed bonds is liable to tax according to the provisions of the laws of the Commonwealth and the States.

Apart from business surveys, Reserve Bank of Australia seems to take into account the secondary market yields of indexed and non-indexed bonds to interpret the market's expected average inflation rate over the time to maturity. Between September 1986 and December 1990, this measure for a 10 year maturity averaged 8.1 per cent while actual inflation averaged 7.8 per cent over the same period. This measure has fallen significantly from a peak of 9.3 per cent in 1989 to 6 per cent in early 1990-91 as compared with the decline in the actual rate of inflation from a peak of about 8.5 percent in 1989-90 to 6.5 per cent in July 1990-91.

The total volume of interest-indexed bonds on issue as of 13th of October 1994 was A$ 2.437 million and the volume of capital-indexed bonds as on the same date amounted to A$ 2,880.7 million, totalling A$ 2,883.14 million. This represented 3.92 per cent of total Commonwealth Government securities on issue amounting to A$ 73,569.6 million.

Canada

3.7 Government of Canada commenced issuing index-linked bonds, named as 'Real Return Bonds (RRBs)', from November 1991. Till October 1994, the Government issued seven series of RRBs carrying a fixed coupon of 4.25 per cent per annum and due to mature in 2021. The maturity date is fixed and not varied from series to series. The remaining period to maturity at the time of new issues has therefore varied from 30 years when it was issued first in November 1991 to 27 years when the last series was issued in August 1994. The total issues till August 1994 amounted to C$3.625 billion. As at the end of March 1994, the total outstanding RRBs amounted to C$ 2.725 billion against the total outstanding marketable debt of Canadian Government of C$ 203.372 billion. Thus, as at the end of 1993-94, the total outstanding RRBs represented only 1.34 per cent of total debt. The 1993-94 programme of debt issues covered an aggregate value C$ 48.825 billion of which the RRB issues amounted to C$ 1.525 billion representing 3.3 per cent. This shows that the Government intends to develop this product more in the future.

According to the official statements, the RRBs represent a 'small cost effective diversification of the marketable bond programme and has value for institutional investors whose long-term liabilities are related to rate of inflation and for retail investors principally for their 'Registered Retirement Saving Plans' (RRPs).

The RRBs bear interest adjusted for the Consumer Price Index for Canada (the CPI). Interest on the bonds consists of both an inflation compensation component calculated based on principal adjusted for at maturity and a cash entitlement (coupon interest) calculated based upon principal and accrued inflation, and payable half yearly. This is akin to Australian capital-indexed bonds.

Coupon interest is calculated by multiplying one half of the specified annual coupon rate for a series of bonds by the sum of the principal and the inflation compensation accrued from the original issue date to the relevant coupon payment date for such series. The following formula illustrates the coupon interest calculation for a series of bonds with an annual coupon payment of 4.25% and a coupon payment date of December 1, 1994:

$$\text{Coupon interest (Date: December 1,1994)} = \frac{4.25}{2} \times \{\text{Principal} + \text{inflation compensation December 1, 1994}\}$$

At maturity, investors will receive, in addition to a coupon interest payment a final payment equal to a sum of the principal amount and the inflation compensation accrued from the original issue date to maturity. The inflation compensation could be negative if index had fallen over the tenure of the bond.

The RRBs are distributed through a syndicate of Canadian securities dealers in the primary market. However, two of the issues launched in 1993 for value aggregating C$ 200 million were set aside specifically for the retail sector. These bonds were stripped[7], and re-packaged into Zero Coupon bonds by a retail

[7] When a bond is stripped, the maturity value and series of coupon payments are separated and allowed to be traded separately in the market as individual bonds of different maturities. Each bond partakes the nature of a Zero Coupon Bond, resulting in risk diversification, that is, the single maturity bond is broken up into a number of bonds consisting of a series of maturities.

syndicate and sold primarily to Retirement Saving Plan Schemes.

The amount outstanding of these bonds is still small. The secondary market in these bonds is developing. The major participants in the market are Canadian securities dealers, insurance companies and pension funds. One interesting feature of index-linking in Canada is that the Government has committed to publish the CPI series at least until the index ratio relevant to maturity date for each series of bonds outstanding has been determined[8]. If the Government of Canada determines not to publish the CPI, it will publish a substitute index that is designed to reflect the pure price movement in the Canadian economy and is equivalent in all material respects to the CPI.

The indexing procedure involves calculation of an index ratio which is applied to calculate both coupon interest and inflation compensation. The index ratio for any date is defined as the ratio of the reference CPI applicable to that date divided by the reference CPI applicable to original date of issue for a particular series of bonds; that is,

$$\text{Index Ratio} = \frac{\text{Reference CPI}_{\text{Date}}}{\text{Reference CPI}_{\text{Base}}}$$

The lag for calculation of the index ratio is three calendar months. The reference CPI for the first day of any calendar month

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[8] At present, the maturities extend upto the year 2021.

is the CPI for the third preceding calendar month.

The RRBs are not tax exempt. The bond owner is required to include as assessable income for taxation in a tax- year coupon interest which has been received or accrued during that year. The bond owner is also required to include while computing income for a taxation year, *as interest,* the amount by which inflation compensation has increased for any inflation adjustment period ending that year. In case the accrued compensation has decreased for any adjustment period such a decrease shall be deductible in computing the income for that year.

The weighted average real yield of RRBs for the period from November 1991 to August 1994 worked out to 4.47 per cent and in individual series, the rate varied in the range of 3.42 per cent to 4.75 per cent at the primary issue stage. In the recent issues, the RRBs were oversubscribed though the earlier issues were syndicated with some difficulty. The official perception is that there is underlying demand for RRBs and a quarterly issuance of C$ 500 million or C$ 2 billion a year should be feasible. The Government considers that RRB programme has generally turned out to be successful.

RRBs are held by a narrow class of investors with ten accounts owning 50 per cent of outstanding stock. Typical investors are investment counsellors (who manage pension funds) and public and private pension funds. About 87 per cent ownership was institutional, the balance representing foreign and retail ownership.

The liquidity of RRBs is relatively low compared with the total volume. The illiquidity of the RRB market is attributable to the relatively small volume of the outstanding stock, the investor demand being concentrated among investors who have index-linked liabilities (who deal only to 'buy and hold' the bond), and the difficulty of hedging RRB exposures (presumably in the absence of interest rate futures based on RRBs). The average volume of trading per day (during January-June 1994) was C$20 million in RRBs against the total size of about C$3.6 billion, that is, 0.56 per cent. This compared poorly with the daily trading volume of C$10.6 billion against the total volume of all marketable bonds at C$203.37 billion or 5.21 per cent.

In the recent past, the Government of Canada has been taking steps to introduce changes in the distribution system so as to overcome the uneven track record of the earlier issues. The main revisions proposed are the restructuring of the syndication process, gradual introduction of Dutch auction or regular multiple bid auction and specifying in advance the intention to bring a new issue in a particular week of the quarter. The proposed changes in the syndication process are expected to broaden the base of the dealers who are truly active in these bonds. Though the experience of Canada is quite short compared to Australia, it should be considered as more successful than that of the latter, because of the consistency and volume achieved within this short period.

The Debate in the United States

3.8 Economists have been advocating for a long period that the US Government should issue some portion of its Treasury debt securities in indexed form to achieve the following objectives:

(i) It would tend to reduce the Treasury's borrowing costs over the long run;

(ii) It would provide an (inflation) risk-free investment vehicle for investors who wish to be protected against erosion of their savings through inflation; and

(iii) It would enable the Federal Reserve to improve its monetary policy management and better stabilise the economy.

The Committee of House of Representatives of the US Congress (1985 and 1992) discussed these issues at length and strongly recommended for its implementation. While the recommendation received overwhelming support from all quarters including the Federal Reserve, the U.S. Treasury (represented by Mr. Jerome Powell), while considering that indexed securities would provide "some additional information" which would bring "some incremental gain to monetary policy" (Report of the House of Representatives on 'Fighting Inflation and Reducing the Deficit: The Role of Inflation-indexed Treasury Bonds, 1992'), did not accept the recommendation on the following grounds :

(i) The market for indexed bonds would be a relatively narrow one. The Treasury would not want to issue securities targeted to a particular narrow segment. It would tend to balkanise the market.

(ii) The demand from the narrow segment would not be on a sufficient scale to assure an active trading market, which would make them largely useless for monetary policy purposes.

(iii) Treasury was not sure whether the indexed securities would be cost-effective for meeting the borrowing costs of the US government.

The Committee of the U.S. House of Representatives in its hearings on this question in October 1992, rebuked the U.S. Treasury for what the Committee called "a costly historical mistake". In its Findings and Recommendations, the first thing which the Committee noted was:

> "The Treasury's failure to issue indexed debt during the 1980's cost U.S. tax payers many billions of dollars, possibly as much as $ 100 billion. (This was the estimate worked out by well-known economist William Poole). The Committee regrets the Treasury's failure to see more clearly, at that time, the great potential for taxpayer savings that was available from the winding down of inflation". (Sentence in the parenthesis added.)

4. EXTENSION OF FISCHER'S MODEL WITH MONEY

If equations of the type derived by Fischer could be estimated for the aggregate holding of debt and equity instruments, it may be possible to deduce from them how the demand for these assets has been influenced by the expected rate of inflation and the variability of inflation.

These estimated equations can be used to derive estimates of the demand for inflation hedges and the likely demand for index-linked bonds by considering how much the demand for the aggregate debt instruments would have been higher had the public not expected any inflation or not encountered any variability of inflation. Similarly, by considering how much the equilibrium levels of interest rates on the debt instruments would have been lower in the absence of inflation uncertainty, we can also estimate from Fischer-type equations the likely magnitude of the inflation risk premium in the nominal rates of interest on the various debt instruments including index-linked bonds. The likely effect of floating index-linked bonds on the demand for equity assets and on the rates of return on equity assets can also be assessed by using Fischer - type equations if they are estimated.

However, Fischer's model of the demand for financial assets does not explicity include demand for money since holding of money, which yields no nominal return or a lower nominal return than non index-linked bonds but is subject to the same inflation risk as the non index-linked bonds, would, in that model, be dominated by non index-linked bonds as an asset.

In any empirical estimation of the demand for debt instruments, it would, however, be necessary to consider the demand for money as well.

Therefore, it is necessary to extend Fischer's model to incorporate demand for real balances into it. The holding of real balances yields utility to the individual by enabling him to suitably finance his current consumption expenditure. Thus, his real balances enter his instantaneous utility function along with his current real consumption expenditure.

The individual's optimization problem, in this case, can be seen to be:

To maximise :

$$\int_{t_0}^{\infty} E(U(C(t), m(t), t)dt \tag{1a}$$

subject to :

$$dV = \sum_{i=2}^{4} w_i(r_i - r_1)Vdt + r_1(V - C)dt + \sum_{i=2}^{4} w_i \sigma_i V dx_i + vYdt + bYdq \tag{2a}$$

where $w_4 = m/V$ is the ratio of real balances to real wealth of the individual, and the real rate of return on money is given by:

$$\begin{aligned} \frac{d\,(Q_4/P)}{(Q_4/P)} &= \frac{dQ_4}{Q_4} - \frac{dP}{P} + \left(\frac{dP}{P}\right)^2 - \frac{dQ_4}{Q_4}\frac{dP}{P} \\ &= -\,(\pi dt + s_1 dz_1) + (\pi dt + s_1 dz_1)\,(\pi dt + s_1 dz_1) \qquad (3f) \\ &= -\,(\pi - s_1^2)dt - s_1 dz_1 \\ &= r_4 dt + \sigma_4 dx_4 \end{aligned}$$

where $r_4 = -(\pi - s_1)^2$ and $\sigma_4 = -s_1$, assuming that dQ_4/Q_4, the nominal rate of return on money, is zero.

If money includes interest-bearing (time) deposits, dQ_4/Q_4 may be taken to be equal to R_{TD}, the nominal rate of interest on time deposits.

In this case, in a manner analogous to that explained in Appendix A in the context of Fischer's model, our problem reduces to maximising:

$$\phi(C,w_4V,w_1,w_2,w_3;V,Y,t)=U(C(t),w_4V(t),t)+J_T+J_V\gamma V+J_YvY+\tfrac{1}{2}J_{VV}V^2\varepsilon^2$$
$$+\tfrac{1}{2}J_{YY}b^2Y^2+J_{VY}[w_2\sigma_2b\eta_2+w_3\sigma_3b\eta_3+w_4\sigma_4b\eta_4+b^2(Y/V)]VY \quad (16a)$$

where

$$\gamma = \sum_{i=2}^{4} w_i(r_i - r_1) + (r_1 \frac{C}{V}) + v \frac{Y}{V} \quad (16b)$$

and

$$\varepsilon^2 = w_2^2\sigma_2^2 + w_3^2\sigma_3^2 + w_4^2\sigma_4^2 + 2w_2w_3\sigma_2\sigma_3\rho_{23} + 2w_3w_4\sigma_3\sigma_4\rho_{34}$$
$$+ 2w_2w_4\sigma_2\sigma_4\rho_{24} + b^2 (\frac{Y}{V})^2 \quad (16c)$$
$$+ 2(w_2\sigma_2b\eta_2 + w_3\sigma_3b\eta_3 + w_4\sigma_4b\eta_4)\frac{Y}{V}$$

Therefore, the necessary conditions for maximising ϕ with respect to C and w_1, w_2, w_3 and w_4 are:

$$U_C - J_VV = 0 \quad (17a)$$

$$U_M + (r_4-r_1) J_V+J_{VV}V[\sigma_4^2w_4 + \sigma_3\sigma_4\rho_{34}w_3 + \sigma_2\sigma_4\rho_{24}w_2] \quad (17b)$$
$$= - [J_{VV}+J_{VY}]\sigma_4\eta_4bY$$

$$(r_3-r_1) J_V+J_{VV}V[\sigma_3\sigma_4\rho_{34}w_4 + \sigma_3^2w_3 + \sigma_2\sigma_3\rho_{23}w_2] \quad (17c)$$
$$= - [J_{VV}+J_{VY}]\sigma_3\eta_3bY$$

$$(r_2-r_1) J_V+J_{VV}V[\sigma_2\sigma_4\rho_{24}w_4 + \sigma_2\sigma_3\rho_{23}w_3 + \sigma_2^2w_2] \quad (17d)$$
$$= - [J_{VV}+J_{VY}]\sigma_2\eta_2bY$$

$$w_1 = 1 - w_2 - w_3 - w_4 \quad (17e)$$

It is easy to see that $\rho_{34}=1$, $\rho_{24} = \rho_{23}$ (= ρ, say). In other words, since the real rates of return on nominal bonds and money are influenced in an identical manner by the rate of inflation, the correlation coefficient between the real rates of return on nominal bonds and money must be equal to unity and the correlation coefficients between the real rate of return on equities and those on nominal bonds and money must be equal.

It can be very easily seen, in this case, that the variance covariance matrix of real rates of return on all assets, including money, will be singular and money is dominated by nominal bonds as long as the nominal return on money is zero (or smaller than that on nominal bonds). Hence, the key factor determining the demand for money would be U_m, the marginal utility of money (or, the capital value risk on nominal bonds which we have kept aside in the present analysis in order to focus attention on inflation risk). We shall presently advance the analysis further by specifying the economic agent's utility function.

However, before doing that, we make two observations based on the equilibrium condition (17c). From this condition, we have

$$\sigma_3\sigma_4\rho_{34}w_4 + \sigma^2{}_3w_3 + \sigma_2\sigma_3\rho_{23}w_2$$

$$= -\frac{J_V}{J_{VV}V}(r_3-r_1) - \sigma_3\eta_3\left(1+\frac{J_{VY}}{J_{VV}}\right)\frac{Y}{V} \qquad (18)$$

Since the terms $(-J_V/J_{VV}V)$ and $(1+J_{VY}/J_{VV})$ are positive for all economic agents, and since $\rho_{34} = 1$, and w_4 may be either positive or zero, but cannot be negative, for any economic agent (other than government, which is not being considered here), assuming $\eta_3>0$, and $\rho_{23} > 0$, $r_3 \leq r_1$ is inconsistent with the existence of households which do not issue either non index-linked bonds or equities. Therefore, if the real wage income and the real return on nominal bonds are positively correlated ($\eta_3 > 0$) and the real return on equities and nominal bonds are positively correlated ($\rho_{23} > 0$), we can conclude that $r_3 > r_1$. This is the point made by Liviatan and Levhari (1977) and Levhari (1983), emerging in our extension of the Fischer (1975) model to incorporate demand for money in it. Of course, the Liviatan - Levhari model does not include either the equities or the real wage income, and therefore, their conclusion that the real return on non index-linked bonds would have to include an inflation risk premium as compared with the real return on index-linked bonds does not depend upon the sign of the two above-mentioned correlations. These correlations become relevant, as noted in our discussion of the Fischer model earlier, when equites and real wage income are taken into account.

Now considering $r_3 > r_1$ and $\eta_3 > 0$, and $w_2 = 0$ for simplicity, it further emerges from equation (18) that either all economic agents in the private sector must be lenders in the non index-linked bond market or, if they are borrowers in that market, their (individual) borrowing through the issue of non index-linked bonds would be constrained by their holding of money or expected receipt of wage income in monetary form, as given by:

$$- w_3 \leq \frac{\sigma_4 w_4 + b\eta_3 \left(1 + \frac{J_{VY}}{J_{VV}}\right) \frac{Y}{V}}{\sigma_3} \tag{19}$$

Thus, the smaller the money holdings and expected receipts of money wage incomes of the economic agents, the smaller the incentive for them to issue non index-linked liabilities which involve a higher real interest rate as compared with index-linked liabilities. Also, obversely, the greater the size of money holdings and the expected money wage incomes, the greater the incentive for economic agents to hedge the possibility of lowering the real value of their monetary assets through unanticipated inflation by issuing non index-linked or monetary liabilities, the real value of which would also decline with unanticipated inflation. This is another important point made by Liviatan and Levhari (1977) and Levhari (1983).

We now advance our analysis further by specifying the economic agent's utility function at each time point to be given by the following quadratic function of his consumption and his holding of the real balance at time t :

$$U(C,m) = \alpha_0 C - \alpha C^2 + \beta_0 m - \beta m^2 + \gamma Cm \quad (20)$$

where we assume that

$$U_C = \alpha_0 - 2\alpha C + \gamma m > 0 \quad (20a)$$

$$U_m = \beta_0 - 2\beta m + \gamma C > 0 \quad (20b)$$

$$U_{CC} = -2\alpha < 0 \quad (20c)$$

$$U_{mm} = -2\beta < 0 \quad (20d)$$

$$U_{CM} = \gamma > 0 \quad (20e)$$

$$U_{CC}\, U_{mm} - (U_{Cm})^2 = 4\alpha\beta - \gamma^2 > 0 \quad (20f)$$

These are, of course, the usual assumptions about the concavity of the utility function in its arguments. The assumption $\gamma > 0$ means that we treat the economic agent's consumption and his holding of real balance at time t as complements of each other.

Substituting for U_c and U_m from equations (20a) and (20b) into the equilibrium conditions (17a) and (17b), we see that the kth individual's asset demand functions are given by:

$$\begin{bmatrix} \sigma_4^2(1+\delta_k) & \sigma_3\sigma_4 & \sigma_2\sigma_4\rho \\ \sigma_3\sigma_4 & \sigma_3^2 & \sigma_2\sigma_3\rho \\ \sigma_2\sigma_4\rho & \sigma_2\sigma_3\rho & \sigma_2^2 \end{bmatrix} \begin{bmatrix} w_4^k \\ w_3^k \\ w_2^k \end{bmatrix} = A_k \begin{bmatrix} q_4 \\ q_3 \\ q_2 \end{bmatrix} - \begin{bmatrix} \sigma_4\eta_4 \\ \sigma_3\eta_3 \\ \sigma_2\eta_2 \end{bmatrix} b\left[1+\frac{J_{VY}^k}{J_{VV}^k}\right]\frac{Y}{V} + \begin{bmatrix} Q_k \\ 0 \\ 0 \end{bmatrix} \qquad (21)$$

where

$$\delta_k = -\frac{2\beta_k}{J_{VV}^k\sigma_4^2} + \frac{\gamma_k^2}{2\alpha_k J_{VV}^k \sigma_4^2} = -\frac{(4\alpha_k\beta_k - \gamma_k^2)}{2\alpha_k J_{VV}^k \sigma_4^2} > 0 \qquad (21a)$$

$$A_k = -\frac{J_V^k}{J_{VV}^k V_k} > 0 \qquad (21b)$$

the reciprocal of the individual's degree of relative risk aversion,

$$q_i = r_i - r_1 \qquad (21c)$$

the risk premium in the real return on asset i relative to the index-linked bonds, and

$$Q_k = A_k\left[\frac{\alpha_{ok}\gamma_k + 2\alpha_k\beta_k}{2\alpha_k J_V^k} - \frac{\gamma_k V_k}{2\alpha_k}\right] \qquad (21d)$$

$$= A_k\left[\frac{\gamma_k}{2\alpha_k}\,\frac{(\alpha_{ok} - J_V^k V_k)}{J_V^k} + \frac{\beta_k}{J_V^k}\right] \geq 0$$

since we must have $(\alpha_{0k} - J_V^k V_k)/2\alpha_k \geq 0$, otherwise, assuming $\gamma_k > 0$, we shall have from the equilibrium condition (17a) and equation (20a), C=0 for some m > 0, which we can rule out since the individual would hold a positive real balance at time t only to finance a positive level of consumption expenditure as long as the nominal return on money is less than that on nominal bonds, in the absence of transactions costs, as in our present model.

Inverting the coefficient matrix in equation (21), we write the asset demand functions of the individual to be:

$$\begin{bmatrix} w_4^k \\ w_3^k \\ w_2^k \end{bmatrix} = \begin{bmatrix} \frac{1}{\delta_k \sigma_4^2} & -\frac{1}{\delta_k \sigma_3 \sigma_4} & 0 \\ -\frac{1}{\delta_k \sigma_3 \sigma_4} & \frac{1}{\delta_k \sigma_3^2} + \frac{1}{(1-\rho^2)\sigma_3^2} & -\frac{\rho}{(1-\rho^2)\sigma_2\, \sigma_3} \\ 0 & \frac{-\rho}{(1-\rho^2)\, \sigma_2 \sigma_3} & \frac{1}{(1-\rho^2)\, \sigma_2^2} \end{bmatrix} \begin{bmatrix} A_k\, q_4 - \sigma_4 \eta_4 b(1 + J_{VY}^k / J_{VV}^k)\frac{Y}{V} + Q_k \\ A_k\, q_3 - \sigma_3 \eta_3 b\ (1 + J_{VY}^k / J_{VV}^k)\frac{Y}{V} \\ A_k\, q_2 - \sigma_2 \eta_2 b\ (1 + J_{VY}^k / J_{VV}^k)\frac{Y}{V}\,) \end{bmatrix} \tag{22}$$

Aggregating the demand functions for each asset over all economic agents and writing the market equilibrium conditions:

$$\begin{bmatrix} a_4 \\ a_3 \\ a_2 \end{bmatrix} = \begin{bmatrix} \frac{B}{\sigma_4^2} & -\frac{B}{\sigma_3 \sigma_4} & 0 \\ -\frac{B}{\sigma_3 \sigma_4} & \frac{B}{\sigma_3^2} + \frac{A}{\sigma_3^2 (1-\rho^2)} & \frac{-A\rho}{\sigma_2 \sigma_3 (1-\rho^2)} \\ 0 & \frac{-A\rho}{\sigma_2 \sigma_3 (1-\rho^2)} & \frac{A}{\sigma_2^2 (1-\rho^2)} \end{bmatrix} \begin{bmatrix} q_4 \\ q_3 \\ q_2 \end{bmatrix} - \begin{bmatrix} \frac{\eta_4 - \eta_3}{\sigma_4}\ bD \\ \frac{(\eta_3 - \rho\eta_2) bF}{\sigma_3\, (1-\rho^2)} - \frac{(\eta_4 - \eta_3)}{\sigma_3} bD \\ \frac{\eta_2 - \rho\eta_3}{\sigma_2\, (1-\rho^2)}\ bF \end{bmatrix} \frac{Y}{V} + \begin{bmatrix} \frac{G}{\sigma_4^2} \\ -\frac{G}{\sigma_3 \sigma_4} \\ 0 \end{bmatrix} \tag{23}$$

where,

$$A = \sum_k \frac{A_k V_k}{V} > 0 \tag{23a}$$

$$B = \sum_k \frac{A_k}{\delta_k} \frac{V_k}{V} > 0 \tag{23b}$$

$$F = \sum_k \left[1+\frac{J^k_{VY}}{J^k_{VV}}\right]\frac{Y_k}{Y} \geq 0 \tag{23c}$$

$$D = \sum_k \frac{1}{\delta_k}\left[1+\frac{J^k_{VY}}{J^k_{VV}}\right]\frac{Y_k}{Y} \geq 0 \tag{23d}$$

$$G = \sum_k \frac{Q_k}{\delta_k}\frac{V_k}{V} \geq 0 \tag{23e}$$

Equations (23) can be estimated by using data on a_i' s, q_i' s and Y/V, as discussed in the following section.

Again, inverting the coefficient matrix in the market equilibrium conditions (23), we solve for the inflation risk premia q_i in the real rates of return on the these asssets compared with the real rate of return on the index-linked bonds as:

$$\begin{bmatrix} q_4 \\ q_3 \\ q_2 \end{bmatrix} = \frac{1}{A}\begin{bmatrix} \sigma_4^2\left(1+\frac{A}{B}\right) & \sigma_4\sigma_3 & \rho\sigma_4\sigma_2 \\ \sigma_4\sigma_3 & \sigma_3^2 & \rho\sigma_3\sigma_2 \\ \rho\sigma_4\sigma_2 & \rho\sigma_3\sigma_2 & \sigma_2^2 \end{bmatrix}\begin{bmatrix} a_4 + \frac{\eta_4-\eta_3}{\sigma_4} bD\frac{Y}{V} + \frac{G}{\sigma_4^2} \\ a_3 + \left[\frac{(\eta_3-\rho\eta_2)}{\sigma_3(1-\rho^2)}bF - \frac{(\eta_4-\eta_3)}{\sigma_3} bD\right]\frac{Y}{V} - \frac{G}{\sigma_3\sigma_4} \\ a_2 + \left(\frac{\eta_2-\rho\eta_3}{\sigma_2(1-\rho^2)}\right) bF \end{bmatrix} \tag{24}$$

Therefore, taking the matrix product in equation (24), we write the inflation risk premia in money, nominal bonds and equities as:

$$q_4 = \frac{1}{A}[\sigma_4^2 a_4 + \sigma_4\sigma_3 a_3 + \rho\sigma_4\sigma_2 a_2 + \sigma_4\eta_3 bF\frac{Y}{V}] \qquad (25a)$$
$$+ \frac{1}{B}[\sigma_4^4 a_4 + \sigma_4 (\eta_4 - \eta_3) bD \frac{Y}{V} - G]$$

$$q_3 = \frac{1}{A}[\sigma_4\sigma_3 a_4 + \sigma_3^2 a_3 + \rho\sigma_3\sigma_2 a_2 + \sigma_3\eta_3 bF\frac{Y}{V}] \qquad (25b)$$

and,

$$q_2 = \frac{1}{A}[\rho\sigma_4\sigma_2 a_4 + \rho\sigma_3\sigma_2 a_2 + \sigma_2^2 a_2 + \rho\sigma_2 \eta_3 bF \frac{Y}{V}] \qquad (25c)$$

The equations of the above form may be estimated for India, to which we now turn.

5. DEMAND FOR FINANCIAL ASSETS UNDER INFLATION UNCERTAINTY : AN ECONOMETRIC ANALYSIS

5.1 This section is devoted to an empirical analysis for the Indian economy based on estimation of the model, developed in section 4, extending Fischer's model to include real money balances. The theoretical model developed in that section adopts a four asset classification, namely, index-linked bonds (asset 1 or BL), equities (asset 2 or E), non index-linked bonds or debt (asset 3 or D) and money (asset 4 or M_3)[9]. However, in the absence of index-linked bonds in the Indian financial markets it was not possible to empirically estimate the demand for them directly. Therefore, we estimated demand for financial assets in a three asset framework with equity, non index-linked bonds and money. Since any possible demand for index-linked bonds or for inflation hedges in our model will be reflected through a decrease in the holding of the existing debt (and possibly also the equity) instruments as the public expects a higher rate of inflation or perceives a greater variability of the rate of inflation, we proceed to develop the demand for existing debt and equity instruments and make an estimate for the potential demand for inflation hedges from these estimated equations. Needless to say that such an approach has its limitation as it does not include a number of alternative assets which could possibly be serving as inflation hedges, like gold or real estate[10].

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[9] Thus, as a convention, subscript 2 refers to equity, subscript 3 refers to debt and subscript 4 refers to money.

[10] While we could not include the return on real estate due to non-availability of data, an attempt was made to capture the impact of gold price appreciation. However, its impact on the demand for financial assets was found to be insignificant.

Choice of Variables

5.2 Apart from the stock of financial assets (FA) comprising of E, D and M_3, we considered net capital stock (K) in our exercise. Adding these two types of assets, we arrive at the total stock of assets in the economy, namely, V = FA + K, which we use as a proxy for total nominal wealth. In accordance with the equation set (23) of section 4, we define the following ratios: $a_2 = E/V$, $a_3 = D/V$, and $a_4 = M_3/V$.

We have two sets of independent variables[11]. The first is the ratio of labour income to total assets (w = Y/V), which appears in all the asset demand functions. The second is a set of 'real returns adjusted for inflation variability', denoted by r_2, r_3, r_4 respectively, and defined as follows:

$$r_4 = R_4 - \pi^e + s_1^2$$

$$r_3 = R_3 - \pi^e + s_1^2$$

$$r_2 = R_2 - \pi^e + s_1^2 - s_1 s_2 \rho_{12}$$

where,

(i) R_i (i = 4,3,2) are nominal returns on various assets and are measured by the 3 - year term deposit rate, the redemption yield on 10 year Government securities, and yield on equity (comprising both dividend and capital appreciation), respectively;

(ii) π^e is expected inflation rate, generated by an AR(2) process. Since π^e is a crucial variable in our estimated equation, we

[11] The details regarding the variables and data sources are given in Appendix B.

tried with a number of alternative variants. Three methods were tried in particular, namely,

(a) an adaptive expectation scheme of the form $\pi^e_t = a\pi^e_{t-1} + b\pi_{t-1}$;

(b) following Chitre and Paranjpe (1987), generation of changes in the rate of inflation predicted from the rate of growth of money, the deviation of agricultural income from its trend value, the phase of the industrial cycle and the rate of change of import prices and adding it to the actual inflation rate for 1971-72;

(c) an AR (2) scheme of the form, $\pi^e_t = a + b\,\pi_{t-1} + c\pi_{t-2}$

Of the three, the AR(2) process gave the best estimate, in terms of the lowest forecast errors. The equation was estimated through maximum likelihood method using Newton-Raphson sub-routine;

(iii) s_1^2 is a proxy for variability of inflation and is measured by 3 - year variance of actual inflation rate from its expected (or anticipated) value, that is,

$$(s_1^2)_t = \frac{1}{3}\sum_{i=0}^{2} (\pi_{t-i} - \pi^e_{t-i})^2$$

The variance of actual inflation rate was computed around its anticipated rather than mean value because if the economic agents' anticipations of inflation are always fulfilled, they would be able to fully adapt their decisions, including their borrowing and lending and portfolio decisions, to the changing inflation rate and would not be exposed to any inflation risk even though the inflation rate showed considerable dispersion around the mean.

(iv) $s_1 s_2 \rho_{12}$ is a proxy for the association between inflation variability and variability in equity yield (around its mean), that is,

$$(s_1 s_2 \rho_{12})_t = \frac{1}{3} \sum_{i=0}^{2} (\pi_{t-i} - \pi^e_{t-i}) \, (R_{2,\,t-i} - \bar{R}_{2,\,t-i}),$$

$$\text{with } \bar{R}_{2,\,t} = \frac{1}{3} \sum_{i=0}^{2} R_{2,\,t-i}$$

Asset Demand Functions in Ratio Form

5.3 To estimate the asset demand functions, we start by estimating the following three equations for the period from 1972-73 to 1992-93,

Money : $a_4 = \alpha_{40} + \alpha_{44} \, r_4 + \alpha_{43} r_3 + \alpha_{45} w$

Bonds : $a_3 = \alpha_{30} + \alpha_{34} \, r_4 + \alpha_{33} r_3 + \alpha_{32} r_2 + \alpha_{35} w$

Equities : $a_2 = \alpha_{20} + \alpha_{24} \, r_4 + \alpha_{23} r_3 + \alpha_{22} r_2 + \alpha_{25} w$

The relevant regression results for OLS estimates, using Cochrane-Orcutt transformations, are reported in Table 2. It is apparent from Table 2 that the coefficients of r_4 and r_3 appear almost with equal magnitude but opposite signs. This is indicative of high degree of multicollinearity between r_4 and r_3. The equations also show high standard errors for the coefficients of r_4 and r_3.

Table 2 : Asset Demand Functions in Ratio Form : 1972-73 to 1992-93

Equation Number	(i)	(ii)	(iii)	(iv)
Dependent Variables	a_4	a_3	a_2	a_4+a_3
Constant	0.1330 (13.55)*	0.2593 (7.86)*	0.0259 (4.32)*	0.3919 (14.48)*
r_4	- 0.0019 (1.85)#	- 0.0042 (1.41)	- 0.0008 (2.33)@	- 0.0056 (2.22)@
r_3	0.0018 (1.72)#	0.0041 (1.37)	0.0008 (2.31)@	0.0054 (2.11)@
r_2		- 0.0005 (0.80)	- 0.0001 (0.48)	- 0.0001 (0.87)
w	- 0.2001 (3.12)*	0.3433 (1.56)	- 0.0048 (0.14)	0.1381 (0.79)
$\bar{R}^2$	0.8472	0.3025	0.8831	0.7752
DW	2.12	2.05	2.34	1.86
SER	0.0043	0.0092	0.0011	0.0080
F (d.f)	27.34* (4,15)	2.30# (6,12)	23.66* (6,12)	11.35* (6,12)

Note: (1) While equation (i) has been estimated by Cochrane - Orcutt method with first order autoregressive transformation, equations (ii) to (iv) have been estimated by the same method with second-order autoregressive transformation.

(2) Figures in parentheses are values of the respective t-statistic; *, @ and # signify significance at 1 per cent, 5 per cent and 10 per cent respectively.

This problem of multicollinearity is due to our definition of 'real returns adjusted for inflation variability', where a rather large number s_i^2 is added to the usual notion of real returns, namely, $R_i - \pi^e$ (for i = 3,4) and consequently, r_3 and r_4 turn out to be very similar. Apart from this, coefficients of r_2 are both small and insignificant in all the equations. Therefore, in order to generate meaningful estimates, we abandoned this line of inquiry and instead preferred to work on asset demands as functions of nominal interest rates, expected inflation, inflation variability and the ratio of labour income to total assets independently.

Preferred Asset Demand Function

5.4 Incorporation of all the nominal rates of return (R_i's) separately as arguments of the asset demand functions did not result in any marked improvement in the results as only R_3 appeared to be significant in all the asset demand functions. The insensitivity of money demand to R_4 is, however, consistent with the literature in this area where money demand is normally not found to be responsive to deposit rates. The insignificance of R_2 in the equity demand may be indicative of a rather subdued equity demand throughout the reference period, that is, 1972-73 through 1992-93, besides imperfections and poor efficiency of the capital markets. Moreover, as debt is derived as a residual and constitutes the bulk of the financial assets, the significance of its nominal return is expected. In all these cases, the absolute numbers (in logarithms) capturing asset demands seem to have performed distinctly better than the proportions, as reported in Table 3. Thus, our preferred regression equations are of the form :

$$Ln\ (x/p) = \alpha_1 + \alpha_2 R_3 + \alpha_3 \pi^e + \alpha_4 s_1^2 + \alpha_5 Ln\ (w)$$

Where, $x = M_3, D, E, M_3+D, FA$

The relevant regression equations are reported in Table 3. The equations show a good fit. For the purpose of finding out the demand for inflation hedges, we employed the debt (that is, D/P) and real financial assets, that is, $(M_3 + D + E)/P = FA/P$, equations.

Table 3 : Asset Demand Functions : 1972-73 to 1992-93

Equation Number	(v)	(vi)	(vii)	(viii)	(ix)
Dependent Variable	$\ln(M_3/P)$	$\ln(D/P)$	$\ln(E/P)$	$\ln[(M_3+D)/P]$	$\ln(FA/P)$
Constant	7.7764 (16.51)*	9.6703 (35.?8)*	6.9146 (8.53)*	5.1059 (17.52)*	5.2357 (18.43)*
R_3	0.1020 (6.88)*	0.1073 (12.10)*	0.1628 (6.69)*	0.1040 (10.32)*	0.1085 (11.21)*
π^e	- 0.0072 (1.93)*	- 0.0064 (2.14)@	- 0.0067 ((2.04)#	- 0.0058 (2.07)@	- 0.0059 (2.12)@
s_1^2	- 0.0037 (4.48)*	- 0.0022 (3.61)*	- 0.0024 (2.72)@	- 0.0025 (4.16)*	- 0.0025 (4.17)*
ln (w)	- 0.9679 (3.29)*	- 0.5186 (2.98)*	- 0.3040 (0.78)	- 0.6632 (3.55)*	- 0.5997 (3.30)*
$\bar{R}^2$	0.9850	0.9860	0.9817	0.9880	0.9884
DW	1.8624	2.0484	1.9070	2.1001	2.0745
SER	0.0630	0.0483	0.0612	0.0468	0.0460
F (d.f)	243.85 (5,14)	264.60 (5,14)	204.29 (5,14)	314.75 (5,14)	325.36 (5,14)

Notes: (1) All the equations have been estimated by Cochrane -Orcutt method with first order autoregressive transformation.

(2) Figures in parentheses are values of the respective t -statistic; *, @ and # signify significance at 1 per cent, 5 per cent and 10 per cent respectively.

However, in doing so, we faced three difficulties. First, there could be the problem of simultaneity bias due to two-way causality between R_3 and D/P. To overcome this, we estimated D/P from the following system through two-stage least square (2SLS):

$$\hat{R}_3 = \beta_1 + \beta_2 \pi^e + \beta_3 s_1^2 + \ln w$$
$$\text{Ln (D/P)} = \gamma_1 + \gamma_2 \hat{R}_3 + \gamma_3\pi^e + \gamma_3 s_1^2 + \gamma_5 \ln w$$

Where $\hat{R}_3$ is the estimated R_3 value from $\hat{R}_3$ equation.
The Ln(D/P) equation is estimated as:

$$\text{Ln(D/P)} = \underset{(40.03)}{9.4167} + \underset{(13.53)}{0.1101}\, \hat{R}_3 - \underset{(1.78)}{0.0052}\pi^e - \underset{(3.74)}{0.0021}s_1^2 - \underset{(4.29)}{0.6393}\text{Ln(w)} \quad \text{(vi a)}$$

with, $\bar{R}^2 = 0.9855$, DW = 1.63, SER = 0.0489, $F(4,15) = 323.46$

Considering the fact that coefficients in equation (vi a) are not remarkably different from those in (vi), and that the various test statistics of (vi) are better than those of (vi a), we chose to work with equation (vi).

Secondly, as stated earlier, the equation for ln(D/P) was seen to perform distinctly better than that for (D/P) suggesting the possibility of non-linearity in the underlying relationship. Therefore, we considered the possibility of higher order terms as independent variables; as a result, we included quadratic terms involving various arguments of equation (vi) and did not transform financial assets and the ratio of labour income to total assets into logarithms. We tried various combinations and found the most preferred D/P equation in quadratic form, estimated through second order Cochrane-Orcutt method, as follows:

$$(D/P) = -\ 141900.8 + 1686.6R_3^2 + 747.3R_3 - 584.4\pi^e + 20.2(\pi^e)^2$$
$$(0.86) \quad (0.22) \quad (2.21) \quad (0.49) \quad (0.32)$$

$$+\ 749s_1^2 - 8.5s_1^4 + 1753296w - 4624306w^2 \qquad \textbf{(vi b)}$$
$$(1.81) \quad (2.23) \quad (1.27) \quad (1.35)$$

with, $\bar{R}^2 = 0.9879$, $DW = 2.78$, $SER = 4291.4$, $F(10,8) = 147.5$

Apart from noting the insignificance of a number of terms of (vi b), in order to compare its performance *vis-a-vis* (vi) we performed out of sample forecasts by alternatively using equations (vi) and (vi b). To do so, we re-estimated both (vi) and (vi b) for a truncated sample period from 1972-73 to 1987-88, and used the equations to generate forecasts for the remaining period, which were then compared with the actuals. The performance of (vi) turned out to be distinctly better than (vi b) from this standpoint, as the Root Mean Square Error (RMSE) from (vi) was much lower than that from (vi b). Similar results also held for (FA/P) equation.

Finally, we have already mentioned that since our asset structure does not include gold or real estate, the derived demand for inflation hedges could be considered as imperfect. To judge the extent of imperfection, we included the following three variables related to gold price (P_g) :

(i) the rate of inflation of gold price (π_g);

(ii) variability of gold price (s_g^2), measured by its three-year variance around mean, that is,

$$(s_g^2)_t = \frac{1}{3}\sum_{i=0}^{2} (\pi_{g,\,t-i} - \bar{\pi}_{g,\,t-i})^2, \text{ where } \bar{\pi}_{g,\,t} = \frac{1}{3}\sum_{i=0}^{2} \pi_{g,\,t-i};$$

and,

(iii) $s_1 s_2 \rho_{1g}$ to capture the association between inflation variability and variability in gold price inflation, that is,

$$(s_1 s_2 \rho_{1g})_t = \frac{1}{3} \sum_{i=0}^{2} (\pi_{t-i} - \pi^e_{t-i}) (\pi_{g,\, t-i} - \bar{\pi}_{g,\, t-i}) .$$

We re-estimated equation (ix) with these three additional independent variables (and also alrenatively the real returns on gold[12]). All these variables have turned out to be insignificant.

Demand for Inflation - hedges

5.5 To find out the demand for inflation hedges and related notions of inflation risk premium we use equations (vi) and (ix). For estimating the potential demand for inflation hedges at current prices, we look at equation (ix) (see figure 2) in its parametricised form as follows :

$$\text{Ln } (FA/p)|_{(\pi^e = 0, s_1^2 = 0)} = 5.2357 + 0.1085 \ R_3 - 0.5997 \text{ Ln } W$$

From the above equation, we arrived at an estimate of Rs.1345.4 crore as the demand for inflation hedges for the year 1992-93 at the prices in that year. The demand estimate, so arrived at, can be considered as small in relation to outstanding debt[13]. However, considering this as the initial flow demand, this turns out to be roughly 2.8 per cent in terms of the incremental government liabilities for the year 1992-93.

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[12] Note that, real return on gold after adjusting for its inflation variability is given by, $r_g = \pi_g - \pi^e + s_1^2 - s_1 \ s_g \ \rho_{1g}$

[13] The estimate for demand for inflation hedges from the quadratic equation turned out to be much larger; however, because of other considerations, as discussed above, we chose to neglect this.

To find out the extent of inflation risk premium, we invert equation (vi) in terms of R_3, and arrive at

$$(R_3)_t = 9.3197 Ln(D/p)_t - 90.1240 + 0.0596\pi_t^e + 0.0205(s_1^2)_t + 4.8332 \ln(w)_t$$

From the above equation, we arrive at the following two definitions, namely :

(i) **Inflation risk premium** (IRP) : This is defined as the increase in the rate of interest R_3 which is due only to the variability of inflation, that is,

$$IRP = 0.0205\ (s_1^2)_t$$

(ii) **Inflation risk premium adjusted for positive expected rate of inflation** (IRPA) :This is the increase in the rate of interest R_3 which is due to a positive expected inflation rate and its variability, that is,

$$IRPA = 0.0597\ \pi_t^e + 0.0205\ (s_1^2)_t$$

The average inflation risk premium (IRPA) and average inflation risk premium adjusted for positive expected rate of inflation (IRPA) for the years covered by the study come to 0.52 per cent and 1.06 per cent respectively. The nominal rate of interest (R_3) for the year 1992-93 was 13.23 per cent. Subtracting from it the expected rate of inflation of 9.60 per cent and the inflation risk premium (adjusted for positive expected rate of inflation) of 0.66 per cent for that year, the estimate of the real interest rate for the year 1992-93 is seen to be 2.97 per cent. Similar computations for all years in the sample period from 1972-73 to 1992-93 show that the real interest rate was negative for most of the years, with an average value over the period equal to (-) 1.84 per cent. However, the real rate has continuously increased and remained positive over the last three years of this period.

Calculation of Inflation Risk Premium

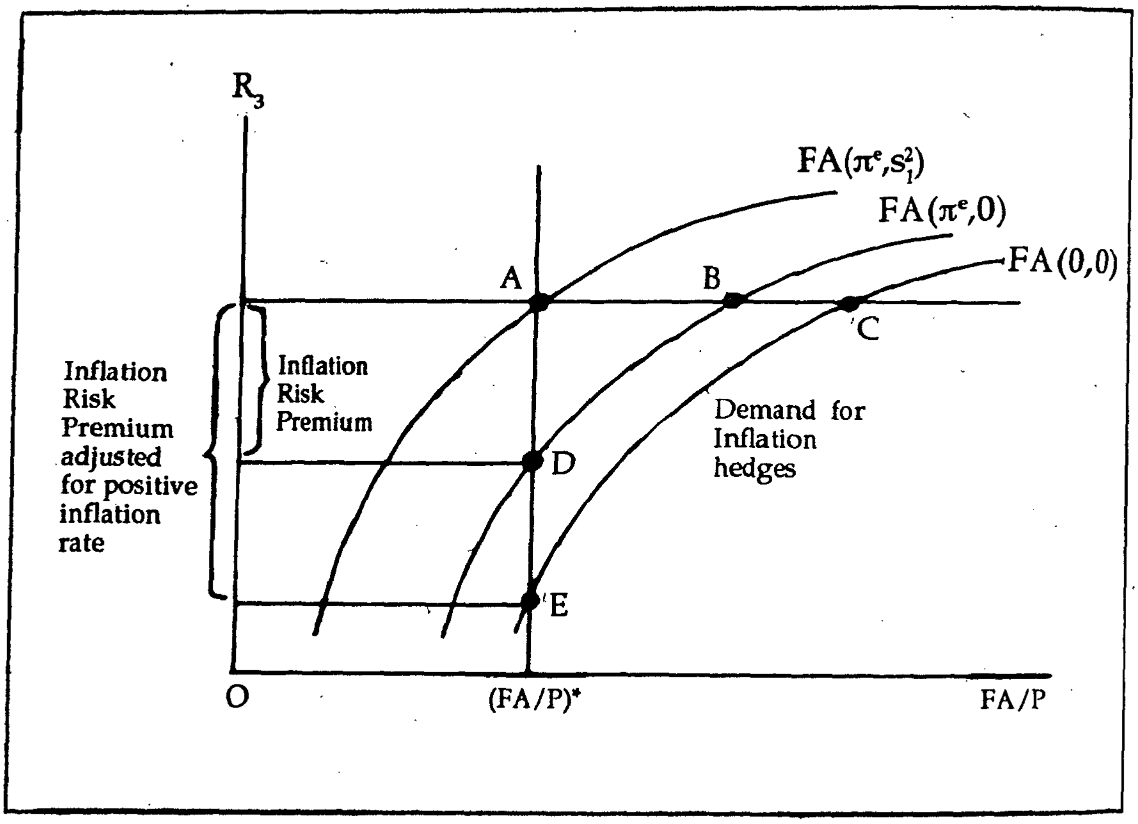

Figure 2

6. WILL INFLATION FEED ON ITSELF ON ACCOUNT OF INDEX-LINKED BONDS? - A FINANCIAL PROGRAMMING EXERCISE

6.1 A critical question, which will need to be examined before coming to a conclusion about whether to introduce index-linked government securities in India or not, is whether inflation will feed on itself on account of a regular issuance of index-linked government securities in the country. As stated in the sections on Introduction and the Survey of Literature, this may be expected to happen through three possible channels. First, the out-payments of index-linked amounts of principal and interest may lead to an accentuation of the growth of reserve money and that of money supply causing inflation rate to rise further. Second, complacency about inflation on the part of the government and the public, induced by indexation in general and by index-linking of government bonds in particular, may weaken fiscal discipline on the part of the government. Third, in turn, this may further lead to a strengthening of inflationary expectations. It is, therefore, necessary to examine whether a significant presence of index-linked bonds in the economy can accentuate the inflation rate in the country continuously in a destabilising manner. It is also necessary to examine whether exogenous inflationary shocks would tend to get built into the system if a significant proportion of government debt in the country is index-linked. We study these questions in the present section with the help of a simple financial programming exercise in the context of the fiscal and monetary situation which obtained in the country in 1994-95.

Equations used in the Financial Programming Exercise : Analytical Framework

6.2 The equations used in the financial programming exercise along with a note explaining the data and the notations used for this purpose are given respectively in Appendices C and D. Here, we explain briefly the logic behind the equations and the various scenarios examined and highlight the conclusions which emerge from a study of these scenarios.

The crucial building blocks of our financial programming exercise are the following two identities reflecting the Government budget constraint:

$$GFD_t = GPD_t + IP_t \tag{26}$$

where, GFD_t is the gross fiscal deficit, GPD_t the gross primary deficit and IP_t the total interest payments during the year t, and

$$dMD_t = GFD_t - \Sigma_j \, dB_{jt} + dGCB_t - (Adj)_t \tag{27}$$

where dMD_t gives the monetised deficit (or the net RBI credit to or the *change* in total monetary debt) of the Central Government, dB_{jt} the fresh net borrowing or the *change* (or variation) in Central Government net debt of the jth type or category during the t^{th} year, $dGCB_t$ the *change* in the Central Government cash balance during the t^{th} year and $(Adj)_t$ the adjustment factor reflecting the statistical discrepancy in the data for the base year, namely, the financial year

1994-95, between the change in the total outstanding debt of the Central Government during the fiscal year 1994-95 as reported in the *Receipts Budget* of the Government of India and the corresponding flow figures obtained from the *Budget at a Glance, 1995-96* the sum of the latter of which exactly matches with the gross fiscal deficit.

The main categories of Central Government debt (B_i) and borrowing (dB_i) considered here are (i) long-term or market borrowing (dBM) (further divided, for the purposes of the present financial programming exercise between index-linked(dBL) and non index-linked (dBN) borrowing in the proportion Θ and ($1-\Theta$) respectively, of the total market borrowing), (ii) short-term borrowing (dBS) (excluding net RBI credit to the government), (iii) non-market borrowing (dBNM), (iv) external borrowing (dBE), and (v) other borrowing (dBO). (See Appendices C and D for further details on data sources and the data for the base year). All figures for outstanding debt are at the beginning of each financial year, and all fresh borrowing during the year is assumed, for the sake of analytical convenience, to have been contracted also at the *beginning* of each financial year.

For the purposes of the financial programming exercise, annual borrowing of each category (except dMD) is assumed to maintain the same proportion of GFD as in the base year, that is, 1994-95.

Since the base year fiscal balance sheet is taken to be the starting point of analysis, the data classification and adjustments pertaining to that year would get repeated for all subsequent years during the period of analysis. Thus, the change in government cash balance, which was *negative* in the base year, that is a *decrease* in the government cash balance (to the extent of Rs.2350 crore or 3.85 per cent of the GFD), is assumed to remain the same, as percentage of the GFD, in the following years as in the base year.

The total interest payments IP have been divided between interest payments on long-term market borrowing and those on other categories of debt. The interest rates for the other categories of debt have been worked out by expressing the interest payments for each category of debt during 1994-95 as percentage of the amount of debt of that category outstanding as of March 31, 1994 (see Statement 2 of Appendix D), and have been assumed to remain constant through the following years at their respective levels in the above year (except for the interest rate on non-market borrowing for one of the scenarios). Interest payments during any year on these categories of debt are computed by applying these interest rates to the amounts of debts of the corresponding categories, outstanding as at the beginning of the year, and the payments are assumed to be made during the year. In other words:

$$IP_t = IPM_t + 0.0556\ BS_t + 0.0556\ MD_t + 0.1135\ BNM_t + 0.0868\ BE_t + 0.0938\ BO_t \quad (28)$$

The interest payments (IPM) on long-term market borrowing have been computed as follows. For the purposes of the financial programming exercise, the market debt/borrowing was viewed as consisting of non index-linked debt/borrowing and index-linked debt/borrowing.

Interest payment on non index-linked debt would itself consist of three components, namely, (a) interest payment ($IBNO_t$) on *non-matured* part (BNO_t) of the debt which was outstanding at the end of March 1994 (BNO_0) and which was contracted at an average interest rate of 10.74 per cent in years prior to the base year and would, therefore, continue to be serviced at that average rate, (b) interest payment ($IBNR_t$) by way of additional conversion cost on the part of the debt outstanding as at the end of March 1994, which would mature year by year (BNR_t) and would be replaced by fresh debt contracted at the interest rates which would prevail as and when these debts mature, and (c) interest payment (IPN_t), on fresh non index-linked debts which would be raised after 1994-95 (dBN_t) also at the interest rates which would prevail when these debts are raised.

In terms of the notations indicated in the preceding paragraph, the total interest payment for marketable long-term debt, IPM, has been computed as follows:

$$BNO_t = (0.94)\ BNO_{t-1}\ , \quad \text{with } BNO_0 = BN_0 \tag{29}$$

$$BNR_t = BNO_{t-1} - BNO_t \tag{30}$$

$$IBNO_t = (0.1074)\ BNO_t \tag{31}$$

$$IBNR_t = \begin{cases} IBNR_{t-1} + i_{Nt-1} \, BNR_t \text{ for } t = 1,2,......,5 \\ IBNR_{t-1} + i_{Nt-1} \, BNR_t + BNR_{t-5} \, (i_{Nt-1} - i_{Nt-6}) \end{cases} \quad (32a)$$

$$IPN_t = \begin{cases} IPN_{t-1} + i_{Nt-1} \, (dBN)_{t-1} \text{ for } t = 1,2,......,5 \\ IPN_{t-1} + i_{Nt-1} \, (dBN)_{t-1} + (dBN)_{t-6} \, (i_{Nt-1} - i_{Nt-6}) \end{cases} \quad (32b)$$

$$IPM_t = IBNO_t + IBNR_t + IPN_t + IPL_t \quad (32c)$$

where (IPL_t) is the interest payment on index-linked debt.

While writing the above equations, it has been assumed that of the marketable long-term Central Government securities outstanding at the end of March 1994, a proportion equal to 6 per cent matures every year. This assumption reflects the fact that the average maturity of such securities in March 1994 was about 16 years. It is also assumed, while writing the above equations and in the computations reported in this section, that the average maturity of all fresh debts, including the debts which replace the maturing ones, is five years. This compares favourably with the average maturity of about six years of all new market borrowings from April to September 1995. It also makes the interest payments on new non index-linked debts comparable with those on index-linked debts to be incorporated in the present financial programming exercise, the maturity of which also has been taken to be five years for the purposes of the financial programming exercise.

The interest payment on index-linked debt is computed as follows. As stated above, in all exercises, we assume for simplicity that only five year index-linked bonds are issued. (Only in one exercise, we consider an index-linked bond of 10 year maturity with appropriate changes in the computation of the payment of interest and inflation compensation). The interest payment on index-linked bonds (IPL) includes payment of interest proper (INTL), including the inflation compensation in respect of it, and the inflation compensation in respect of the principal (InfCPL). That is, we have:

$$IPL_t = INTL_t + InflCPL_t \tag{33}$$

As explained in section 3, the inflation compensation in respect of interest payment is paid every year for the UK type index-linked bonds while that in respect of the principal is paid altogether on maturity. In the case of a proposal for index-linked bonds which emerged in the discussions of index-linking of bonds in the U.S., inflation compensation in respect of the principal as well as the interest is required to be paid every year. Therefore, the interest payment proper including the inflation compensation in respect of it, and the inflation compensation in respect of the principal for the UK type and the US (proposal) type five year index-linked bonds of face value of Re 1/-, issued in year 1, will be as shown in Table 4 below:

Table 4 (a): UK Type Index-linked Bond

Year	INTL	InflCPL
0	-	-
1	-	-
2	$r(1+\pi_1)$	0
3	$r(1+\pi_1)(1+\pi_2)$	0
4	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)$	0
5	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)(1+\pi_4)$	0
6	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)(1+\pi_4)(1+\pi_5)$	$[(1+\pi_1)(1+\pi_2)(1+\pi_3)(1+\pi_4)(1+\pi_5) -1]$

Table - 4 (b): US (Proposal) Type Index-linked Bond

Year	INTL	InflCPL
0	-	-
1	-	-
2	$r(1+\pi_1)$	π_1
3	$r(1+\pi_1)(1+\pi_2)$	π_2
4	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)$	π_3
5	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)(1+\pi_4)$	π_4
6	$r(1+\pi_1)(1+\pi_2)(1+\pi_3)(1+\pi_4)(1+\pi_5)$	π_5

In Table 4, r is the real coupon rate, which we shall assume to remain constant at 3 per cent (or $r = 0.03$), and π_t is the actual inflation rate in year t.

It now remains to outline how the interest rate (i_N) on non index-linked bonds and the inflation rate (π) are assumed to evolve in the financial programming exercise.

Given dMD from equation (2), we deduce dRM, the change in the stock of reserve money, by assuming that the ratio of the sources of reserve money, other than the net RBI credit to the Government, taken together, would maintain the same ratio to GDP as they did in the base year, that is, in 1994-95. Since this ratio in the base year was, (28477/910970) = 0.03126, we write:

$$dRM_t = dMD_t + 0.03126\ Y_t \qquad (34)$$

where dRM_t is the change in the stock of reserve money and Y_t the GDP at current prices in year t.

The annual inflation rate π_t is generated in the financial programming exercise through the following simple relationship:

$$\pi_t = \frac{dRM_t}{RM_t} - (1.6)\ (g_y) \qquad (35)$$

where RM_t is the stock of reserve money at the beginning of the year g_y is the annual growth rate of real GDP.

The real GDP is assumed to grow at a constant annual rate of 5.5 per cent, the income elasticity of demand for money in taken to be 1.6 based on past trend and the reserve money multiplier is assumed to remain constant for comparing the alternative scenarios generated in the financial programming exercises.

The nominal interest rate on non index-linked bonds is assumed to fully adjust to the expected inflation rate π^e over and above the postulated real rate of interest of 3 per cent and the inflation risk premium of 1 per cent. As our empirical work on the demand for financial assets yielded an estimate of the average inflation risk premium of about 1.06 per cent for a sample period characterised by regulations on the portfolio adjustments by the banks and other financial institutions, the assumption of 1 per cent inflation risk premium for a period with market determined interest rates may be considered conservative.

With these assumptions, the interest rate on non index-linked bonds is given by:

$$i_{Nt} = r + q + \pi^e_t = 0.04 + \pi^e_t \quad (36)$$

where r is the real interest rate and q the inflation risk premium on non index-linked bonds.

Expected rate of inflation π^e_t is assumed to be given by the following autoregressive scheme, selected in our previous section on the estimation of the asset demand functions:

$$\pi^e_t = (6.3730 + 1.0329 \ \pi_{t-1} - 0.7655 \ \pi_{t-2})/100 \quad (37)$$

Outcomes under Different Scenarios

6.3 Before examining the working of the financial programming model in response to exogenous shocks in the form of higher or lower rates of gross primary deficits or in the form of high increase in the inflation rates for one year or for a longer duration, first let us compare the outcomes of the model under different schemes of index-linking of government securities or with different proportions (Θ) of the total fresh issue of marketable long-term government securities to be issued in the form of index-linked securities.

Tables 5-9 present the values of the key variables such as the interest payment, including inflation compensation in respect of the principal, on index-linked bonds (IPL), interest payment on index-linked and non index-linked bonds taken together (IPM), total interest payment (IP), monetised deficit (dMD), gross fiscal deficit (GFD), the inflation rate (π), the interest rate on non index-linked bonds (i_N), gross fiscal deficit as a percentage of gross domestic product at current market prices (GFD/Y) and total outstanding debt as a percentage of gross domestic product at current market prices (Debt/Y) for selected years upto 2015-16 for alternative schemes or scenarios.

Outcomes under Alternative Proposals for Index-Linked Bonds

6.4 Table 5 gives the outcomes for the existing pattern of borrowing and for three alternative proposals for index-linked government bonds, namely, conducting 15 per cent of the fresh market borrowing in the form of index-linked bonds of (a) US (proposal) type with a 5 year maturity, (b) UK type with a 5 year maturity, and (c) UK type with a 10 year maturity. Column (3) gives values of the above-mentioned key variables for the case when no index-linked bonds are issued. This may be treated as a base-line scenario with the monetary and fiscal situation as it obtained in 1994-95 and the then existing ratio of gross primary deficit to GDP and the borrowing pattern of the Government, given the other assumptions common to all financial programming exercises worked out here, as explained earlier in the present section. It is not to be interpreted as a forecast of the likely development in the coming years, but is to be used for comparison with outcomes emerging under specific changed assumptions in different exercises reported here.

The main points emerging from the comparison of the outcomes under the alternative proposals presented in Table 5 are that the issuance of either the 5 year or 10 year index-linked bonds of the UK type will lead to significant savings to the government over the time horizon of 20 years compared with either the baseline scenario of no index-linked bonds or the issuance of US (proposal) type index-linked bonds. The saving in the total interest payment from the issuance of 5 year index-linked bonds of the UK type in comparison with the base-line scenario is Rs.411 crore for 1996-97 and Rs.444 crore for 2000-01, but rises substantially in later years to Rs.3461 for 2005-06 and Rs.36179 crore for 2015-16. The saving in the interest payment amounts to about 1.5 per cent in 2005-06 and 4 per cent in 2015-16. While the savings are significant, particularly for the later years when the inflation rate comes down substantially, they are, of course, not sufficiently large in comparison with the growth of reserve money a large part of which comes from RBI credit to non-Government sectors. Hence, the inflation rate does not change significantly in comparison with the base-line scenario. But, the situation never worsens throughout the time horizon studied in the financial programming exercise, in respect either of the inflation rate, the interest rate on non index-linked bonds or in terms of the gross fiscal deficit or the total outstanding debt as percentages of GDP on account of the issuance of index-linked bonds. The steep increase in GFD and total outstanding debt as percentage of GDP at current market prices in later years is due to the rapid fall in the inflation rate in all scenarios, including the base-line scenario. This fall in inflation rate is partly due to a constant ratio of gross primary deficit to GDP, underlining the importance of fiscal adjustment, and to a small extent due to some moderation in interest payments which comes from savings through index-linked bonds as well as through lower interest rates on non index-linked bonds in the successive years; both of which contribute to keep the deficit and money growth low. Between the 5 year and the 10 year index-linked bonds of the UK type, the saving in the cash-flow resulting from the postponement of the inflation compensation of the principal is achieved for a longer time-span for the latter bonds and amounts to Rs.3058 crore or about 2.75 per cent of the total interest cost in the base-line scenario by the year 2000-01 and Rs.4013 crore or 1.75 per cent of the total interest cost by 2005-06 and Rs.34726 crore or over 3.75 per cent of the total interest cost by 2015-16. The 10 year index-linked bond will result in a lowering of the gross fiscal deficit by Rs.3098 crore or about 2 per cent of itself by the year 2000-01 compared with Rs.474 crore or 0.3 per cent in respect of the issuance of 5 year index-linked bonds of the UK type. While this is mainly due to postponement of the payment of inflation compensation for which it will be prudent to set aside a sinking fund (in which case only the net RBI credit to the Government will be lower though not the GFD) rather than using these savings in cash outflow for any other purpose, it is noteworthy that even with the issuance of 10 year index-linked bonds no bunching of interest and inflation compensation payments develops in comparison with the base-line scenario. On the whole, 10 year index-linked bonds are likely to be more advantageous compared with the 5 year ones. However, the choice of the mix of maturities may have to depend also on the expected demand for the bonds of different maturities.

Outcomes for Alternative Θ-Values

6.5 Tables 6 and 7 enable us to examine the outcomes of issuing different proportions of the fresh market borrowing of the government in the form of index-linked bonds of the UK type and the US (proposal) type respectively. While the proportion of fresh market borrowing to be issued in the form of index-linked bonds will have to depend upon the demand for such bonds, these Tables enable us to understand the consequences of increasing the extent of index-linked government borrowing for total interest payment, gross fiscal deficit, inflation rate etc.

It emerges from these two Tables that the total interest payment, gross fiscal deficit, the inflation rate, the interest rate on index-linked bonds, and the gross fiscal deficit and the total outstanding debt as percentage of GDP at current market prices all decline as a larger proportion of fresh market borrowing of the government is issued in the form of index-linked bonds of the UK type, though, as pointed out earlier, the last four variables show declines which are only marginal. For the UK type index-linked bonds, the total interest payment and the gross fiscal deficit decline by Rs.2737 crore (4.6 per cent) and Rs.2749 crore (3.3 per cent) respectively for the year 1996-97 and by Rs.2,22,033 crore (24.1 per cent) and Rs.2,27,988 crore (19.5 per cent) respectively for the year 2015-16 as we increase the percentage of index-linked bonds from zero to 100 per cent in the fresh market borrowing by the Government.

The only difference between the outcomes when alternative proportions of fresh market borrowing by the Government are index-linked in the form of US (proposal) type index-linked bonds is that in this case, the total interest payment and the gross fiscal deficit *increase* monotonically during the *earlier*[14] years after the introduction of index-linked bonds, and decline monotonically with increasing proportion of index-linked bonds in fresh borrowing only during the later years. On the other hand, as pointed out earlier, these magnitudes decline monotonically in all years for the UK type bonds. Thus, with the US (proposal) type bonds, only a government which is not myopic would go in for the issuance of index-linked bonds in its fresh market borrowing, even if there was

[14] A comparison of detailed year-wise values of IP and GFD for the US (proposal) type bond (not reported here) shows that both variables increase with the value of Θ (for the tabulated values of Θ) up to the year 2006-07 but decrease with the value of Θ for years after 2006-07.

demand for such bonds.

In the case of the UK type index-linked bonds, the Government gets the advantage of the postponement of inflation compensation in the earlier years and the advantage of the falling inflation rate in the later years, thus the total interest payment and the gross fiscal deficit always decline when a larger proportion of fresh market borrowing by the Government is carried out in terms of index-linked bonds of the UK type.

Outcomes under Alternative Extreme Budgetary Situations

6.6 Table 8 compares the outcomes of alternative extreme budgetary situations (a) in the absence of any index-linked borrowing and (b) with 15 per cent of fresh market borrowing of the Government carried out through 5 year index-linked bonds of the UK type. Apart from the outcomes for the 1994-95 situation with gross primary deficit (GPD) being 1.87 per cent of GDP, which are reproduced from Table 5 to facilitate comparison, the outcomes for four other budgetary situations are presented. We assume alternatively that throughout the period of the financial programming exercise:

(i) GPD equals 3 per cent of GDP (the highest post 1991 reform level of GPD reached in 1993-94),

(ii) GPD equals 4.32 per cent of GDP reached in 1990-91, being the highest level of GPD reached in the past five years),

(iii) GPD equals 0.5 per cent of GDP (around the value targeted in the Union Budget for 1995-96, reflecting a favourable situation), and

(iv) GPD equals 1.87 per cent of the GDP but the interest rate on all non-market Government borrowing is also linked to the rate of inflation.

Table 8 shows that the situation with regard to total interest payments, gross fiscal deficit, the rate of inflation and the rate of interest on non index-linked bonds greatly deteriorates even with the base-line scenario when we consider high ratios of GPD to GDP. But, the situation always remains better in respect of the key variables considered here with the presence of index-linked bonds than in the absence of them. Far from destabilising the fiscal situation and the rate of inflation, the presence of index-linked bonds is seen to provide a stabilising influence on them. On the other hand, in the favourable fiscal situation of a low level of gross primary deficit, the total interest payments and gross fiscal deficits are lower and the rate of inflation and the interest rate on non index-linked bonds are no higher when compared with the base -line scenario.

Similarly, when the interest rate on non-market borrowing of the Government is linked to the rate of inflation, this leads to an increase in the total interest payments and in the gross fiscal deficit and a worsening of the inflation situation whether index-linked bonds are present or not. But, the increases in the interest payments and in the gross fiscal deficit are smaller and the deterioration in the inflation situation is margin

presence of index-linked bonds than in the abs

Outcomes under Exogenous Inflation Shocks

6.7 Finally, we consider the consequence of exogenous inflation shocks, that is, of autonomous increase in the rate of inflation when index-linked bonds are present. Two types of shocks are considered: (a) a once only increase in the rate of inflation by 7 percentage points, this being one of the highest increase in the rate of inflation which the Indian economy experienced during the recent years, and (b) a step-up in the rate of inflation by 7 percentage points for five consecutive years beginning with 1995-96.

The outcomes in respect of the key variables, mentioned earlier, produced by the financial programming exercise for the above-mentioned two cases have been shown in Table 9 for Government borrowing programme alternatively including and not including index-linked bonds of 5 year maturity amounting to 15 per cent of the total fresh market borrowing of the Government.

It is noteworthy that even a once only shock of a large magnitude in the rate of inflation gets built into the system even when no index-linked bonds are present and the rate of inflation remains higher by over one percentage point till as late as 2015-16. This is the effect of the close interaction among the actual and the expected rates of inflation and the interest rate on non index-linked bonds incorporated in our financial programming model. However, as far as the effect of the presence of the index-linked bonds is concerned, as may be expected from the outcomes reported in Table 8 earlier, the outcomes with a once only step-up are more favourable when index-linked bonds are present than when they are not.

The situation, however, is reversed when we consider a continuous step-up in the rate of inflation for five consecutive years. Here, the total interest payments and the gross fiscal deficits remain larger and the rate of inflation and the interest rate on non index-linked bonds are marginally higher when index-linked bonds are present than when they are not. Thus, when the inflation shock is of a continuous nature, it does appear to get built into the system to a somewhat greater extent when index-linked bonds are present than when they are absent. This must be regarded as a warning to avoid exposing the economy to continuous exogenous inflation shocks when a part of fresh market borrowing of the government is carried out in the form of index-linked bonds. Even in the case where index-linked bonds are present and a very large and continuous inflation shock is applied to the economy in the context of a financial programming model which incorporates a tendency for even a once only inflation shock to get built into the system, the inflation rate comes down from its initial high level of 24-25 per cent to around 9.4 per cent over the years and inflation does not seem to feed on itself in the sense of generating higher and higher rates in a destabilising manner.

Even when we consider the very extreme case in which the *entire* fresh market borrowing of the government is done by issuing index-linked bonds, a continuous step-up of 7 percentage points in the rate of inflation for five consecutive years, the rate of inflation eventually (that is, by the year 2015-16) returns to a lower (though still a fairly high) level of 9.42 percent for the UK type index-linked bonds and 9.65 per cent for the US type index-linked bonds. (See Table 9, Columns (9) and (10)). The situation is, thus, technically stable in the extreme cases also. Total interest payments and GFD mount greatly in these scenarios. Even here, total interest payments and GFD increase to a much greater extent for the system involving the US (proposal) type index-linked bonds.

An implication of the above results is that the underlying financial programming model incorporating

(a) the simple inflation process based on reserve money growth and income elasticity of money demand equal to 1.6,

(b) the auto-regressive inflationary expectations function selected as being the best predictor of the rate of inflation during the period from 1972-73 to 1992-93,

(c) the interest rate on non index-linked bonds assumed to fully adjust to the expected rate of inflation,

(d) the gross primary deficit as percentage of GDP and the pattern of Government borrowing assumed to remain the same as they obtained in the base year, namely, 1994-95,

is stable no matter what the proportion of fresh market borrowing of the Government which is done by issuing index-linked bonds, whether of the UK type or of the US (proposal) type.

While this implication is analytically of some significance and while we can draw the conclusion that the introduction of index-linked Government bonds is not likely to lead to an explosive inflationary situation in our present context, since the total interest payments, the gross fiscal deficit, the rate of inflation and the interest rate on non index-linked bonds all remain at substantially high levels for a considerable length of time following a step-up in the rate of inflation for a number of consecutive years, caution needs to be exercised in avoiding such developments. We shall point out in the next section one such possible development, which will need to be avoided, particularly when index-linked bonds are introduced.

Table 5 : Comparison of Outcomes under Alternative Proposals for Index-Linked Bonds

(Amounts in Rs. Crore)

Variable	Year\ Proposal	No Index Linked Bonds	15 Per Cent of Fresh Market Borrowing in the form of Index-Linked Bonds of		
			US (Proposal) Type with 5-Year Maturity	UK Type with 5 Year Maturity	UK Type with 10 Year Maturity
(1)	(2)	(3)	(4)	(5)	(6)
IPL	1994-95	0	0	0	0
	1995-96	0	0	0	0
	1996-97	0	578	122	122
	2000-01	0	3,696	3,632	1,018
	2005-06	0	9,947	7,800	9,453
	2015-16	0	32,925	25,392	29,060
IPM	1994-95	11,880	11,880	11,880	11,880
	1995-96	14,103	14,103	14,103	14,103
	1996-97	17,903	17,949	17,492	17,492
	2000-01	38,840	39,063	38,772	36,158
	2005-06	81,671	81,792	79,101	79,993
	2015-16	3,19,244	3,05,405	2,93,955	2,96,911
IP	1994-95	44,004	44,004	44,004	44,004
	1995-96	50,656	50,656	50,656	50,656
	1996-97	59,600	59,645	59,189	59,189
	2000-01	1,11,803	1,12,056	1,11,359	1,08,745
	2005-06	2,31,797	2,32,099	2,28,336	2,27,784
	2015-16	9,20,398	9,04,002	8,84,219	8,85,672
dMD	1994-95	2,130	2,130	2,130	2,130
	1995-96	2,471	2,471	2,471	2,471
	1996-97	2,911	2,913	2,897	2,897
	2000-01	5,449	5,458	5,432	5,341
	2005-06	11,117	11,129	10,993	10,970
	2015-16	40,663	40,087	39,369	39,409
GFD	1994-95	61,040	61,040	61,040	61,040
	1995-96	70,902	70,902	70,902	70,902
	1996-97	83,540	83,586	83,128	83,128
	2000-01	1,56,360	1,56,617	1,55,886	1,53,262
	2005-06	3,19,017	3,19,336	3,15,451	3,14,790
	2015-16	11,66,817	11,50,292	11,29,695	11,30,840

Table 5 : Comparison of Outcomes under Alternative Proposals for Index-Linked Bonds (Continued)

(Amounts in Rs. Crore)

Variable	Year\ Proposal	No Index Linked Bonds	15 Per Cent of Fresh Market Borrowing in the form of Index-Linked Bonds of		
.			US (Proposal) Type with 5-Year Maturity	UK Type with 5 year Maturity	UK Type with 10 Year Maturity
(1)	(2)	(3)	(4)	(5)	(6)
π (Rate, per unit)	1994-95	0.1040	0.1040	0.1040	0.1040
	1995-96	0.1265	0.1265	0.1265	0.1265
	1996-97	0.1208	0.1208	0.1207	0.1207
	2000-01	0.0992	0.0992	0.0991	0.0989
	2005-06	0.0746	0.0746	0.0745	0.0744
	2015-16	0.0346	0.0344	0.0342	0.0342
i_N (Per unit)	1994-95	0.1074	0.1074	0.1074	0.1074
	1995-96	0.1476	0.1476	0.1476	0.1476
	1996-97	0.1548	0.1548	0.1548	0.1548
	2000-01	0.1275	0.1275	0.1274	0.1274
	2005-06	0.1213	0.1213	0.1212	0.1211
	2015-16	0.1111	0.1111	0.1110	0.1110
GFD/Y (Percentage)	1994-95	6.7	6.7	6.7	6.7
	1995-96	6.5	6.5	6.5	6.5
	1996-97	6.5	6.5	6.5	6.5
	2000-01	6.6	6.6	6.5	6.4
	2005-06	6.8	6.8	6.8	6.8
	2015-16	8.9	8.7	8.7	8.6
Debt/Y (Percentage)	1994-95	60.8	60.8	60.8	60.8
	1995-96	59.6	59.6	59.6	59.6
	1996-97	57.0	57.0	57.0	57.0
	2000-01	52.3	52.3	52.0	52.0
	2005-06	52.5	53.5	53.2	52.8
	2015-16	72.7	72.4	71.6	71.6

Concluded.

Table 6 : Comparison of Outcomes for Alternative Θ Values for UK type Index-Linked Bonds (Continued)

(Amounts in Rs. Crore)

Variable Year	Year	UK Type Bonds							
		Θ = 0.00	Θ = 0.15	Θ = 0.25	Θ = 0.40	Θ = 0.50	Θ = 0.60	Θ = 0.75	Θ = 1.00
IPL	1994-95	0	0	0	0	0	0	0	0
	1995-96	0	0	0	0	0	0	0	0
	1996-97	0	122	203	325	406	488	610	813
	2000-01	0	3,632	6,038	9,623	11,998	14,361	17,882	23,694
	2005-06	0	7,800	12,949	20,599	25,652	30.669	38,131	50,408
	2015-16	0	25,392	41,715	65,324	80,498	95,233	1,16,537	1,50,010
IPM	1994-95	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880
	1995-96	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103
	1996-97	17,903	17,492	17,219	16,808	16,534	16,261	15,850	15,166
	2000-01	38,840	38,772	38,752	38,761	38,792	38,843	38,956	39,241
	2005-06	81,671	79,101	77,426	74,971	73,376	71,814	69,537	65,924
	2015-16	3,19,244	2,93,955	2,77,553	2,53,622	2,38,106	2,22,933	2,00,804	1,65,556
IP	1994-95	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,044
	1995-96	50,656	50,656	50,656	50,656	50,656	50,656	50,656	50,656
	1996-97	59,600	59,189	58,915	58,505	58,231	57,958	57,547	56,863
	2000-01	1,11,803	1,11,359	1,11,092	1,10,732	1,10,520	1,10,329	1,10,083	1,09,777
	2005-06	2,31,797	2,28,336	2,26,069	2,22,731	2,20,549	2,18,403	2,15,253	2,10,194
	2015-16	9,20,398	8,84,219	8,60,687	8,26,251	8,03,856	7,81,904	7,49,787	6,98,365
dMD	1994-95	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130
	1995-96	2,471	2,471	2,471	2,471	2,471	2,471	2,471	2,471
	1996-97	2,911	2,897	2,887	2,873	2,863	2,854	2,839	2,816
	2000-01	5,449	5,432	5,422	5,409	5,401	5,393	5,384	5,372
	2005-06	11,117	10,993	10,912	10,792	10,713	10,636	10,523	10,341
	2015-16	40,663	39,369	38,527	37,295	36,494	35,708	34,559	32,717
GFD	1994-95	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040
	1995-96	70,902	70,902	70,902	70,902	70,902	70,902	70,902	70,902
	1996-97	83,540	83,128	82,853	82,440	82,166	81,891	81,478	80,791
	2000-01	1,56,360	1,55,886	1,55,598	1,55.208	1,54,976	1,54,765	1,54,490	1,54,136
	2005-06	3,19,017	3,15,451	3,13,115	3,09,674	3,07,424	3,05,210	3,01,959	2,96,736
	2015-16	11,66,817	11,29,695	11,05,544	10,70,194	10,47,201	10,24,657	9,91,668	9,38,829

Note : Θ is the proportion of fresh market borrowing in the from of index-linked bonds.

Continued.

Table 6 : Comparison of Outcomes for Alternative Θ Values for UK Type Index-Linked Government Bonds

(Amounts in Rs. Crore)

Variable	Year	UK Type Bonds							
		Θ = 0.00	Θ = 0.15	Θ = 0.25	Θ = 0.40	Θ = 0.50	Θ = 0.60	Θ = 0.75	Θ = 1.00
π (Rate, per unit)	1994-95	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040
	1995-96	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265
	1996-97	0.1208	0.1207	0.1207	0.1206	0.1205	0.1205	0.1204	0.1203
	2000-01	0.0992	0.0991	0.0991	0.0991	0.0990	0.0919	0.0990	0.0989
	2005-06	0.0746	0.0745	0.0744	0.0742	0.0741	0.0740	0.0739	0.0737
	2015-16	0.0346	0.0342	0.0339	0.0336	0.0333	0.0331	0.0327	0.0322
i_N (Per Unit)	1994-95	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074
	1995-96	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476
	1996-97	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548
	2000-01	0.1275	0.1274	0.1273	0.1272	0.1272	0.1271	0.1270	0.1268
	2005-06	0.1213	0.1212	0.1212	0.1211	0.1211	0.1211	0.1210	0.1209
	2015-16	0.1111	0.1110	0.1110	0.1108	0.1108	0.1107	0.1106	0.1104
GFD/Y (Percentage)	1994-95	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	1995-96	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	1996-97	6.5	6.5	6.5	6.4	6.4	6.4	6.4	6.3
	2000-01	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	2005-06	6.8	6.8	6.7	6.7	6.6	6.6	6.5	6.4
	2015-16	8.9	8.6	8.4	8.2	8.0	7.9	7.7	7.3
$Debt/Y_{t-1}$ (Percentage)	1994-95	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8
	1995-96	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
	1996-97	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
	2000-01	52.3	52.0	51.9	51.6	51.5	51.3	51.1	50.7
	2005-06	53.5	53.2	53.0	52.8	52.6	52.4	52.2	51.7
	2015-16	72.7	71.6	70.9	69.9	69.2	68.5	67.5	65.9

Note : Θ is the proportion of fresh market borrowing in the from of index-linked bonds.

Concluded.

Table 7 : Comparison of Outcomes for Alternative Θ Values for US (Proposal) Type Index-Linked Bonds

(Amounts in Rs. Crore)

Variable	Year	UK Type Bonds							
		Θ = 0.00	Θ = 0.15	Θ = 0.25	Θ = 0.40	Θ = 0.50	Θ = 0.60	Θ = 0.75	Θ = 1.00
IPL	1994-95	0	0	0	0	0	0	0	0
	1995-96	0	0	0	0	0	0	0	0
	1996-97	0	578	964	1,542	1,927	2,313	2,891	3,855
	2000-01	0	3,696	6,164	9,873	12,349	14,828	18,554	24,779
	2005-06	0	9,947	16,598	26,604	33,294	40.000	50,090	66,988
	2015-16	0	32,925	54,666	86,964	1,08,289	1,29,450	1,60,883	2,12,460
IPM	1994-95	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880
	1995-96	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103
	1996-97	17,903	17,949	17,979	18,025	18,056	18,086	18,132	18,209
	2000-01	38,840	39,063	39,213	39,439	39,590	39,742	39,971	40,356
	2005-06	81,671	81,792	81,874	82,000	82,086	82,172	82,305	82,531
	2015-16	3,19,244	3,05,405	2,96,210	2,82,462	2,73,328	2,64,219	2,50,604	2,28,045
IP	1994-95	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,044
	1995-96	50,656	50,656	50,656	50,656	50,656	50,656	50,656	50,656
	1996-97	59,600	59,645	59,676	59,722	59,753	59,783	59,829	59,905
	2000-01	1,11,803	1,12,056	1,12,226	1,12,482	1,12,653	1,12,825	1,13,085	1,13,521
	2005-06	2,31,797	2,32,099	2,32,303	2,32,612	2,32,820	2,33,030	2,33,348	2,33,887
	2015-16	9,20,398	9,04,002	8,93,104	8,76,805	8,65,972	8,55,166	8,39,008	8,12,220
dMD	1994-95	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130
	1995-96	2,471	2,471	2,471	2,471	2,471	2,471	2,471	2,471
	1996-97	2,911	2,913	2,914	2,916	2,917	2,918	2,919	2,922
	2000-01	5,449	5,458	5,464	5,473	5,479	5,485	5,494	5,510
	2005-06	11,117	11,129	11,136	11,147	11,155	11,163	11,174	11,194
	2015-16	40,663	40,087	39,704	39,131	38,751	38,371	37,804	36,868
GFD	1994-95	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040
	1995-96	70,902	70,902	70,902	70,902	70,902	70,902	70,902	70,902
	1996-97	83,540	83,586	83,617	83,663	83,693	83,724	83,770	83,847
	2000-01	1,56,360	1,56,617	1,56,789	1,57,048	1,57,222	1,57,396	11,57,654	1,58,101
	2005-06	3,19,017	3,19,336	3,19,551	3,19,877	3,20,097	3,20,318	3,20,653	3,21,222
	2015-16	11,66,817	11,50,292	11,39,307	11,22,879	11,11,960	11,01,068	10,84,783	10,57,783

Note : Θ is the proportion of fresh market borrowing in the from of index-linked bonds.

continued.

Table 7 : Comparison of Outcomes for Alternative Θ Values for US (Proposal) Type Index-Linked Bonds

(Amounts in Rs. Crore)

Variable	Year	UK Type Bonds							
		Θ = 0.00	Θ = 0.15	Θ = 0.25	Θ = 0.40	Θ = 0.50	Θ = 0.60	Θ = 0.75	Θ = 1.00
π (Rate per unit)	1994-95	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040
	1995-96	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265	0.1265
	1996-97	0.1208	0.1208	0.1208	0.1208	0.1208	0.1209	0.1209	0.1209
	2000-01	0.0992	0.0992	0.0992	0.0992	0.0992	0.0993	0.0993	0.0993
	2005-06	0.0746	0.0746	0.0746	0.0747	0.0747	0.0747	0.0747	0.0747
	2015-16	0.0346	0.0344	0.0343	0.0341	0.0340	0.0339	0.0337	0.0334
i_N (Per Unit)	1994-95	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074
	1995-96	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476
	1996-97	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548
	2000-01	0.1275	0.1275	0.1275	0.1275	0.1275	0.1275	0.1275	0.1276
	2005-06	0.1213	0.1213	0.1213	0.1213	0.1213	0.1213	0.1213	0.1213
	2015-16	0.1111	0.1111	0.1110	0.1110	0.1109	0.1109	0.1109	0.1108
GFD/Y (Percentage)	1994-95	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	1995-96	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	1996-97	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	2000-01	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	2005-06	6.8	6.8	6.8	6.9	6.9	6.9	6.9	6.9
	2015-16	8.9	8.7	8.7	8.5	8.5	8.4	8.3	8.1
$Debt/Y_{t-1}$ (Percentage)	1994-95	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8
	1995-96	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
	1996-97	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
	2000-01	52.3	52.3	52.3	52.3	52.3	52.3	52.3	52.4
	2005-06	53.5	53.5	53.6	53.6	53.6	53.7	53.7	53.8
	2015-16	72.7	72.4	72.2	72.0	71.8	71.6	71.3	70.8

Note : Θ is the proportion of fresh market borrowing in the from of index-linked bonds.

Concluded.

Table 8 : Index-linked Bonds with Alternative Budget Scenarios - Comparison with Similar Scenarios without Index-linked Bonds

(Amounts in Rs. crore)

Vari -able	Year	GPD 1.87 percent of GDP (1994-95 situation)		GPD 3 per cent of GDP (1993-94 situation)		GPD 4.32 per cent of GDP (1990-91 situation)		GPD 0.5 per cent of GDP		Interest rate on non-market loans linked to the rate of inflation	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IPL	1994-95	0	0	0	0	0	0	0	0	0	0
	1995-96	0	0	0	0	0	0	0	0	0	0
	1996-97	0	122	0	143	0	169	0	96	0	126
	2000-01	0	3,632	0	4,431	0	5,425	0	2,724	0	3,784
	2005-06	0	7,800	0	10,249	0	13,425	0	5,143	0	8,273
	2015-16	0	25,392	0	36,791	0	52,731	0	14,004	0	27,258
IPM	1994-95	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880
	1995-96	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103
	1996-97	17,903	17,492	18,520	18,038	19,244	18,680	17,159	16,835	18,016	17,593
	2000-01	38,840	38,772	44,233	44,115	50,788	50,630	32,562	32,572	39,959	39,865
	2005-06	81,671	79,101	1,00,768	97,685	1,24,500	1,20,919	59,943	58,092	85,389	82,702
	2015-16	3,19,244	2,93,955	4,37,556	4,04,349	5,91,905	5,49,612	1,91,325	1,75,667	3,39,220	3,12,384
IP	1994-95	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,004
	1995-96	50,656	50,656	50,656	50,656	50,656	50,656	50,656	50,656	52,911	52,911
	1996-97	59,600	59,189	61,110	60,629	62,886	62,321	57,779	57,454	63,165	62,741
	2000-01	1,11,803	1,11,359	1,25,171	1,24,597	1,41,247	1,40,534	96,068	95,796	1,20,020	1,19,484
	2005-06	2,31,797	2,28,336	2,82,194	2,78,014	3,44,139	3,39,224	1,73,789	1,71,298	2,50,947	2,47,226
	2015-16	9,20,398	8,84,219	12,50,594	12,03,423	16,76,218	16,16,432	5,58,627	5,35,819	9,95,668	9,56,548
dMD	1994-95	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130
	1995-96	2,471	2,471	2,900	2,900	3,405	3,405	1,953	1,953	2,550	2,550
	1996-97	2,911	2,897	3,476	3,459	4,143	4,123	2,235	2,224	3,037	3,022
	2000-01	5,449	5,432	6,902	6,880	8,664	8,635	3,753	3,744	5,742	5,722
	2005-06	11,117	10,993	14,905	14,752	19,637	19,453	6,832	6,744	11,809	11,675
	2015-16	40,663	39,369	58,568	56,856	82,208	80,002	21,540	20,739	43,421	42,022
GFD	1994-95	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040
	1995-96	70,902	70,902	83,225	83,225	97,706	97,706	56,052	56,052	73,168	73,168
	1996-97	83,540	83,128	99,736	99,251	1,18,879	1,18,309	64,136	63,811	87,133	86,707
	2000-01	1,56,360	1,55,886	1,98,050	1,97,416	2,48,602	2,47,782	1,07,707	1,07,428	1,64,758	1,64,189
	2005-06	3,19,017	3,15,451	4,27,699	4,23,312	5,63,476	5,58,197	1,96,032	1,93,521	3,38,855	3,35,022
	2015-16	11,66,817	11,29,695	16,80,608	16,31,497	23,58,965	22,95,664	6,18,085	5,95,109	12,45,970	12,05,833

Continued.

Note:- (a) with no index-linked bonds
(b) with 15 per cent of fresh market borrowing in the form of index-linked bonds of UK type with 5 year maturity.

Table 8 : **Index-linked Bonds with Alternative Budget Scenarios - Comparison with Similar Scenarios without Index-linked Bonds**

(Amounts in Rs. crore)

Vari -able	Year	GPD 1.87 percent of GDP (1994-95 situation)		GPD 3 per cent of GDP (1993-94 situation)		GPD 4.32 per cent of GDP (1990-91 situation)		GPD 0.5 per cent of GDP		Interest rate on non-market loans linked to the rate of inflation	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
π (Rate per unit)	1994-95	0.1040	0.104	0.1040	0.104	0.1040	0.104	0.1040	0.104	0.1040	0.104
	1995-96	0.1265	0.1265	0.1296	0.1296	0.1332	0.1332	0.1228	0.1228	0.1271	0.1271
	1996-97	0.1208	0.1207	0.1241	0.1240	0.1280	0.1279	0.1168	0.1168	0.1216	0.1215
	2000-01	0.0992	0.0991	0.1032	0.1031	0.1079	0.1078	0.0943	0.0943	0.1000	0.0999
	2005-06	0.0746	0.0745	0.0791	0.0789	0.0843	0.0841	0.0692	0.0691	0.0755	0.0753
	2015-16	0.0346	0.0342	0.0395	0.0391	0.0452	0.0447	0.0285	0.0282	0.0354	0.0350
i_N	1994-95	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074
	1995-96	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476
	1996-97	0.1548	0.1548	0.1580	0.1580	0.1617	0.1617	0.1510	0.1510	0.1554	0.1554
	2000-01	0.1275	0.1274	0.1286	0.1285	0.1300	0.1298	0.1261	0.1260	0.1277	0.1276
	2005-06	0.1213	0.1212	0.1225	0.1224	0.1239	0.1239	0.1198	0.1197	0.1215	0.1214
	2015-16	0.1111	0.1110	0.1125	0.1123	0.1140	0.1139	0.1095	0.1094	0.1114	0.1112
GFD/Y (Per-centage)	1994-95	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	1995-96	6.5	6.5	7.7	7.7	9.0	9.0	5.2	5.2	6.8	6.8
	1996-97	6.5	6.5	7.7	7.7	9.2	9.1	5.0	5.0	6.8	6.8
	2000-01	6.6	6.5	8.2	8.1	10.0	10.0	4.6	4.6	6.9	6.9
	2005-06	6.8	6.8	8.8	8.7	11.1	11.0	4.4	4.4	7.2	7.1
	2015-16	8.9	8.6	11.7	11.4	14.9	14.6	5.2	5.0	9.3	9.0
Debt/Y_{t-1} (Per-centage)	1994-95	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8
	1995-96	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
	1996-97	57.0	57.0	58.1	58.1	59.3	59.3	55.8	55.8	57.2	57.2
	2000-01	52.3	52.0	57.0	56.7	62.5	62.2	46.4	46.2	53.3	53.0
	2005-06	53.5	53.2	62.3	62.0	72.4	72.1	42.3	42.1	55.2	55.0
	2015-16	72.7	71.6	90.8	89.6	110.4	109.2	49.0	48.1	75.9	74.8

Concluded

Table 9 : Index-linked Bonds in Extreme Scenarios

(Amount in Rs Crore)

Variable	Year/ Scenario	No index-linked bonds-Baseline Scenario	Once-only step-up in the rate of inflation		Continuous Step-up for five years in the rate of inflation				
			with no index-linked bonds	with UK type bonds	with no index-linked bonds	with UK type bonds	with US type bonds	with entire fresh borrowing in the form of 5year UK type bonds	with 5year US (Proposal) type bonds
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IPL	1994-95	0	0	0	0	0	0	0	0
	1995-96	0	0	0	0	0	0	0	0
	1996-97	0	0	134	0	670	915	893	6,102
	2000-01	0	0	4,645	0	5,206	9,286	55,351	65,287
	2005-06	0	0	9,461	0	19,521	24,758	1,39,367	1,84,196
	2015-16	0	0	32,991	0	1,35,533	1,39,162	7,11,376	11,05,713
IPM	1994-95	11,880	11,880	11,880	11,880	11,880	11,880	11,880	11,880
	1995-96	14,103	14,103	14,103	14,103	14,103	14,103	14,103	14,103
	1996-97	17,903	17,980	17,570	17,980	15,930	18,351	15,247	20,455
	2000-01	38,840	41,488	42,063	53,877	68,188	58,077	73,441	83,444
	2005-06	81,671	88,764	86,900	1,20,946	1,47,222	1,31,901	1,57,050	2,01,933
	2015-16	3,19,244	3,68,657	3,44,056	7,12,340	7,25,313	7,64,469	7,29,565	11,23,980
IP	1994-95	44,004	44,004	44,004	44,004	44,004	44,004	44,004	44,004
	1995-96	50,656	50,656	50,656	50,656	50,656	50,656	50,656	50,656
	1996-97	59,600	59,788	59,378	59,788	57,738	60,159	57,055	62,264
	2000-01	1,11,803	1,16,269	1,16,406	1,32,450	1,44,157	1,37,014	1,48,582	1,64,503
	2005-06	2,31,797	2,47,323	2,44,711	3,14,911	3,44,390	3,28,707	3,54,933	4,16,170
	2015-16	9,20,398	10,46,537	10,12,217	18,83,660	19,34,205	19,67,870	19,50,529	25,38,046
dMD	1994-95	2,130	2,130	2,130	2,130	2,130	2,130	2,130	2,130
	1995-96	2,471	2,524	2,475	2,524	2,524	2,524	2,524	2,524
	1996-97	2,911	2,993	2,911	3,062	2,991	3,075	2,967	3,149
	2000-01	5,449	5,836	5,657	7,382	7,781	7,543	7,933	8,515
	2005-06	11,117	12,327	11,821	18,609	19,642	19,107	20,010	22,262
	2015-16	40,663	48,079	46,344	1,05,263	1,07,240	1,08,424	1,07,876	1,29,742
GFD	1994-95	61,040	61,040	61,040	61,040	61,040	61,040	61,040	61,040
	1995-96	70,902	72,438	72,438	72,438	72,438	72,438	72,438	72,438
	1996-97	83,540	85,893	85,481	87,875	85,816	88,248	85,129	90,362
	2000-01	1,56,360	1,67,470	1,67,570	2,11,814	2,23,290	2,16,445	2,27,645	2,44,328
	2005-06	3,19,017	3,53,736	3,51,013	5,33,988	5,63,625	5,48,285	5,74,198	6,38,816
	2015-16	11,66,817	13,79,638	13,44,307	30,20,541	30,77,273	31,11,233	30,95,513	37,22,966

Continued

Table 9 : Index-linked Bonds in Extreme Scenarios

(Amount in Rs Crore)

Variable	Year/ Scenario	No index-linked bonds-Baseline Scenario	Once-only step-up in the rate of inflation		Continuous Step-up for five years in the rate of inflation				
			with no index-linked bonds	with UK type bonds	with no index-linked bonds	with UK type bonds	with US type bonds	with entire fresh borrowing in the form of 5 year UK type bonds	with 5 year US (Proposal) type bonds
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
π (Rate, per unit)	1994-95	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040	0.1040
	1995-96	0.1265	0.2120	0.2120	0.2120	0.2120	0.2120	0.2120	0.2120
	1996-97	0.1208	0.1360	0.1359	0.2222	0.2218	0.2223	0.2216	0.2217
	2000-01	0.0992	0.1132	0.1132	0.1810	0.1820	0.1814	0.1824	0.1837
	2005-06	0.0746	0.0871	0.0870	0.1487	0.1495	0.1491	0.1498	0.1515
	2015-16	0.0346	0.0441	0.0438	0.0938	0.0941	0.0942	0.0942	0.0965
i_N (Per unit)	1994-95	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074	0.1074
	1995-96	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476	0.1476
	1996-97	0.1548	0.2431	0.2431	0.2431	0.2431	0.2431	0.2431	0.2431
	2000-01	0.1275	0.1311	0.1310	0.1820	0.1813	0.1821	0.1811	0.1830
	2005-06	0.1213	0.1244	0.1244	0.1403	0.1404	0.1404	0.1404	0.1411
	2015-16	0.1111	0.1135	0.1135	0.1262	0.1263	0.1263	0.1263	0.1269
GFD/Y (Percentage)	1994-95	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	1995-96	6.5	6.2	6.2	6.2	6.2	6.2	6.2	6.2
	1996-97	6.5	6.2	6.1	5.9	5.7	5.9	5.7	6.0
	2000-01	6.6	6.1	6.1	5.0	5.3	5.1	5.4	5.7
	2005-06	6.8	6.2	6.2	4.6	4.8	4.7	4.9	5.4
	2015-16	8.9	7.7	7.6	5.0	5.0	5.1	5.1	5.9
Debt/Y (Percentage)	1994-95	60.8	60.8	60.8	60.8	60.8	60.8	60.8	60.8
	1995-96	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
	1996-97	57.0	53.2	53.2	53.2	53.2	53.2	53.2	53.2
	2000-01	52.3	47.2	47.0	33.9	32.9	34.1	32.6	34.9
	2005-06	53.5	46.8	46.6	29.4	29.9	29.7	30.0	32.0
	2015-16	72.7	61.2	60.5	32.5	33.3	33.2	33.6	37.7

Concluded

7. POLICY ISSUES FOR INDIA

7.1 In India, while the overall Government borrowing has grown enormously, the servicing cost of Government debt till middle of 1992 was kept low because of the administered system of interest rates, statutory portfolio prescriptions for banks and investing institutions like insurance corporations and provident funds and the automatic monetisation of budgetary deficit by the Reserve Bank of India at a low cost. With the onset of economic reform programmes, Government has not only started to borrow at market related rates but also has committed to do away with the practice of automatic monetisation of deficits as it used to be inflationary. As a result, even while the target of Gross Fiscal Deficit has been kept at lower levels, the marginal cost of Government borrowing has increased since 1992, putting further pressures on the revenue deficit. Though the Government and the Reserve Bank of India have been committed to bringing down the inflation rate to less than 6 to 7 per cent, the inflationary expectations in the market continue to rule very high and put pressures on nominal rates. The maximum coupon rate on Central Government securities thus went up from 12.71 per cent in 1994-95 to 14.00 per cent in early 1995-96. There is generally a lag between the actual reduction in inflation rate and the lowering of inflationary expectations in the market as expectations tend to adjust adaptively. The Reserve Bank of India has also shifted its focus of monetary control from direct measures like administered interest rates to indirect tools like open market operations and bank rate policies.

Moreover, the restrictions on asset portfolios of the banks and other institutional investors are also being relaxed. The effective implementation of such policies would require better indicators of liquidity, inflationary expectations and the real return expected by investors. In this environment, introduction of the index-linked securities for Government borrowing could serve the following main objectives:

(i) It would enhance the rates of financial and total saving by providing an inflation risk-free hedge.

(ii) It would reduce the cost of Government borrowing.

(iii) It would serve as a measure of inflationary expectations and expected real return on capital, enabling information - efficient monetary management.

(iv) It would enhance credibility of the Government's anti-inflationary Policy.

(v) Above all, it is a measure needed to protect the real value of long-term savings.

7.2 While any specific proposal for issuing index-linked bonds by the Government of India (GOI) has to take into account the implications of the different features of index-linked bonds as discerned through the experiences of other countries like U.K., Canada and Australia, the following paragraphs examine aspects such as the type of bonds, volume of issues, maturity pattern, method of indexing including the choice of an appropriate index, the lag period, tax status and other related features of bonds.

Type of Bond

7.3 From the discussion under Section 3 on the experience of other countries, it is discerned that inflation compensation could be provided by three types of bonds, namely,

(i) Capital indexed bonds (of Australia, U.K. and Canada) in which both principal and interest are adjusted for inflation, but the compensation for principal is made at maturity;

(ii) Interest indexed bonds (of Australia) in which compensation is only in respect of interest payments;

(iii) Capital indexed bonds (as proposed in the United States), wherein inflation compensation is made periodically in respect of both principal and interest;

(iv) One variant of type (iii) could be to fix the interest payment in such a way that it is linked to the inflation rate directly with a spread set equivalent to 'real rate'

For illustrating the distinguishing features, let us consider the cash-flow of these four types of bonds as presented in Table 10.

Table 10 : Cash Flows of Payments under Different Types of Bonds

Assumptions:
[Inflation Rate : 9 per cent, Coupon on Index-linked bond : 3 per cent,
Inflation Risk Premium : 1 per cent, Real rate (including inflation risk premium): 4 per cent]

Type of bond	Year 1	Year 2	Year 3	Year 4	Year 5
(i) Capital Indexed bonds					
(a) Principal	—	—	—	—	153.86
(b) Interest	3.27	3.56	3.89	4.23	4.62
	3.27	3.56	3.89	4.23	158.48
(ii) Interest Indexed bonds					
(a) Principal	—	—	—	—	100.0
(b) Interest	3.27	3.56	3.89	4.23	4.62
	3.27	3.56	3.89	4.23	104.62
(iii) Capital Indexed (US Proposal)					
(a) Principal	9.00	9.00	9.00	9.00	109.00
(b) Interest	3.27	3.56	3.89	4.23	4.62
	12.27	12.56	12.89	13.23	113.62
(iv) Variant of type (iii)					
(a) Principal	—	—	—	—	100.00
(b) Interest	12.00	12.00	12.00	12.00	12.00
	12.00	12.00	12.00	12.00	112.00

The type (ii) bond introduced in Australia turned out to be unpopular as it is a poor compensator for inflation; it is because the principal amount remains totally delinked from inflation. This may not therefore be a right choice.

The distinguishing features of the other three types of bonds could be summarised as below:

(a) Type (i) is a complete inflation-hedge; but, the cash flow is bunched at the terminal date of the bond. In this respect, it looks more akin to a zero coupon bond. Therefore, it has less reinvestment risk while being completely free from inflation risk. In markets, where zero coupon bond is popular with investors, such bonds could be expected to become popular.

(b) As between types (iii) and (iv), cash flows in type (iv) appear slightly less attractive. But, type (iv) has the advantage of simplicity to be easily understood by the investing public apart from being easier to administer. But, like nominal bonds with bullet repayment, they carry larger reinvestment risks.

(c) The advantage of saving in cash-flow in the initial years to the issuer (Government) lies only in type (i) bond. When compared with nominal non-indexed bonds, Government cannot reap significantly larger cash benefits during the tenure of the bonds in bond types of both (iii) and (iv).

Our financial programming exercise in the previous section also showed bonds of type (i) to be preferable to those of type (iii).

On the above basis, it may be summed up that type (i) would be the best choice. The second best choice would be (iv), if the objective is to provide more an inflation-hedged instrument rather than reaping savings in cash out-flows to the Government.

Volume

7.4 The volume of issues will be governed by two factors, namely, the total size of Government borrowing in the coming years and the expected demand from the prospective investor groups. The Government of India is committed to bringing down the gross fiscal deficit to GDP ratio to less than 5 per cent. This implies that the growth in volume of Government borrowing is likely to decelerate in the near future. During the year 1994-95, the Government of India mobilised an amount of Rs.7,700 crore by way of medium and long-term borrowing, excluding the funding of Treasury Bills (Rs.20,700 crore including funding). Assuming a moderate growth in borrowings we may reasonably estimate that, on an average, the size of term borrowing in the next five years could be of the order of Rs.10,000 crore per annum. On the demand side, the prospective demand at least in the initial stages of issue is likely to come largely from provident funds, insurance corporations, trusts and educational institutions. A part of small savings could be expected to get invested, if index-linked savings certificates are introduced along with Government bonds. Professionally managed private pension funds as a culture have yet to be developed in India. While the institution of pension funds might develop over the medium term, for practical purposes, the limit of demand could be set in terms of prospective investments from provident funds and insurance corporations. The increase in investment of insurance corporations in Government securities in 1993-94 was of the order of Rs.5,830 crore of which the share of Central Government securities was Rs.5,046 crore. In the case of provident funds, their investments till 1994-95 were essentially in State Government and Government guaranteed securities. In 1995-96, provident funds are required to invest 25 per cent of their investible funds (amounting approximately to Rs.16,000 crore) in Central Government securities. This is expected to bring in a potential investment of about Rs.4,000 crore in Central Government securities by provident funds. The small savings schemes of Government have mobilised an amount of Rs.11,790 crore in 1994-95. This provides a potential for introducing index-linked savings certificates; such certificates could mop up about Rs.1200 crore in a year, if at least 10 per cent of such savings is invested in index-linked certificates.

It may be added that as of now, the investment pattern of provident funds and insurance corporations is governed by the directions issued by the Government. The portfolio restrictions on institutional investment including insurance corporations and provident funds are being gradually relaxed. Therefore, in future, the demand from these institutional groups for Government securities, whether index-linked or otherwise, may be expected to come only on a voluntary basis. The demand for index-linked bonds may not be lower than about Rs.5,000 crore in a year if at least 50 per cent of incremental investment from insurance corporations and provident funds in Central Government Securities is assumed to be made in index-linked issues and ten percent of demand to come from other investors. Even in U.K., Canada and Australia, the ownership of index-linked securities is reported to be concentrated among pension funds and insurance companies besides retirement savings plan schemes. To illustrate, a volume of about Rs.5,000 crore per annum of issue of index-linked bonds in the next five years in addition to issue of about Rs. 1200 crore of index-linked savings certificates could be considered feasible, as summarised in Table 11. This would give an idea of the magnitude of the likely demand for index-linked bonds computed on the basis of certain plausible assumptions.

Table - 11 : An Estimate of likely Demand for Index-linked Bonds

Investing agencies/institutions	Total incremental investment in Central government securities (Rs crore)
1. Life Insurance Corporation	4,960 (1993-94)@
2. General Insurance Corporation	85 (1993-94)@
3. Non-Government Provident Funds	4,000 (1995-96)*
(A) Total 1+2+3	9,045
Estimated demand @ 50% of (A) 4,522	4,500
Demand from other sources (10 per cent of total demand)	500
Total (B)	5,000

Source: @ Balance Sheets of LIC,GIC
* Potential estimated based on Central Government budget receipts.

Conceivably, banks could introduce index-linked deposits, in which case there would be demand from them as well for index-linked Government securities. Individual households may be expected to contribute to index-linked savings certificates. The Government could, however, also expect some competition, on the supply side, from the mutual funds, in the near future or medium term. The above estimate appears to be somewhat optimistic in comparison with the estimate of demand for inflation hedges at Rs.1345 crore arrived at for the year 1991-92 in our econometric analysis reported in Section 5. However, since the sample period for that analysis was characterised by restrictions on portfolio adjustments by banks, provident funds and insurance corporations, the response to expected inflation and variability of inflation in their portfolios was low as reflected in the low values of the coefficients of those variables, leading to a low estimate of the demand for inflation hedges.

Maturity

7.5 The maturity of index-linked bonds has to be decided taking account of the preference of investors. Generally, the insurance corporations and provident funds prefer long-term maturities of more than 10 years. However, if a real return is offered on securities, the maturity of the bond is not such a significant factor since even medium-term bonds could be rolled over. To ensure consistent demand, it would, however, be necessary to give an assurance that inflation-indexed bonds would continually be issued to meet the demand from potential investors. In recent years, the Government's policy has been to issue maturities of not more than ten years, since the existing pattern of maturities was highly skewed towards the long end of more than 15 years. In UK and Canada, index-linked bonds have carried maturities of 27 years and more than 15 years respectively; in Australia these bonds were issued for 10 year maturities. In India, consistent with the recent policy of issuing bonds of less than 10 year maturity, initially, it would be desirable to experiment with 5 to 10 year maturities. Between index-linked bonds with a maturity of 5 years or 10 years, our financial programming exercise of the previous section showed the latter to be preferable. As longer maturities of index-linked bonds are likely to be preferred by prospective investors, particularly insurance corporations and provident funds, maturities of 15 to 20 years could also be considered.

Form of Indexing

7.6 In other countries, the bonds are invariably linked to the consumer price index (CPI). There are three CPI series available in India, namely, for industrial workers, urban non-manual employees and agricultural workers. The consumer price index for industrial workers is the most popular one and is extensively used for wage compensations. In India, prominence has, however, been given to the rate of inflation as measured by the wholesale price index, through a regular and more frequent publication of the rate of inflation based on the wholesale price index for all commodities.

The coverage of CPI is restricted to specified groups based on industrial workers' consumption basket in select centres and therefore may not be considered as universally representative as the retail price index system in vogue in other countries. This limitation is applicable also to the other CPI series in India. GDP deflator could be another useful measure of inflation, but, data on GDP deflators would be available only annually and that too after a lag of about two years and therefore will not serve the practical purpose. Similarly, the average hourly earnings of workers could reflect the inflationary impact; but our data base is weak to produce this series on a regular and comprehensive basis. It is the All India wholesale price index which is extensively used for measuring inflation and therefore a suitable index for linking bonds in India. As the index-linked bonds essentially aim at inflation compensation, the choice of index has to be preferably the All India wholesale price index till such time as a suitable retail price index series becomes available on a regular basis.

Indexation Lag

The lag period for indexation is eight months in U.K. whereas it is three and six months, respectively, in Canada and Australia. The lag period is actually related to the periodicity of interest payments. The reason for eight months' lag in U.K. is that after providing for the publication lag, it enables a calculation, with certainty, of interest payment even for the broken periods between two interest payment dates. A certainty regarding interest calculation for the broken period seems necessary for fair secondary market trading in index-linked bonds. Considering the publication lag of about six weeks and the normal practice of half-yearly coupon payments, the U.K. pattern of a lag of eight months will need to be followed in India.

Nature of Indexation

Another related issue is whether the bonds should be capital-indexed or interest-indexed. As argued earlier, interest-indexed bonds (without inflation compensation for capital) would not be much different from the floating rate bonds and the inflation compensation would be only partial. It will be ideal to index both capital and interest. As discussed earlier, after weighing the different distinguishing features of three types of bonds which index both capital and interest, the U.K. type bond with periodical inflation compensation for interest and terminal compensation for principal would be the ideal choice for the Government.

A question may arise whether there would be demand for such issues with postponement of payment of inflation compensation. In the light of the overwhelming response to the zero coupon bond issues, with similar characteristics, this may not be a serious cause for concern.

Another closely related question is whether the compensation should be on the basis of point to point variation in the price index or on the basis of variation in some measure of average index. It might be recalled that the Canadian Real Return Bonds compensate the investors based on the average change in the index, after allowing for the lag period. This would avoid very high or very low compensations which could possibly occur on account of seasonalities in the movements of the price the index within the year. Such a procedure would smoothen the compensation payment over the period. This may also allay any fears in the minds of investors of possible manipulations in price indices for any particular month or week. However, it would, on the other hand, considerably reduce the coverage of inflation risk provided by the index-linked instruments and, therefore, indexation based on point to point variation in the price-index appears to be preferable.

Protection of Face Value

In Australia, index-linked securities protect the investor so as to ensure his getting a maturity value of at least 100 per cent of the face value. In other words, if deflation is to occur between the issue and maturity dates, the investor would not suffer a capital loss. On the other hand, if inflation occurs, he would get a higher real return. It may be argued that a similar feature may be incorporated in the index-linked bonds issued in India too to infuse investor confidence. However, this may give a signal that the Government does not expect any deflation ever over the maturity of bond. If over the next 20 years or so, our inflation rates come down to near zero as in the case of the US and Japan now, such a clause would become an obstacle in inducing further savings to the Government by lowering inflation rates below zero, besides affecting the credibility of the Government's anti-inflation stance. In the light of this, protection of the face value may not be a desirable feature.

Taxation Aspects

7.8 Taxation is one of the important elements that will decide the relative attractiveness of index-linked bonds. In U.K., while the interest earnings are taxable, the capital gains of Government securities, whether indexed or non-indexed, are not treated as income for the purpose of taxation. Correspondingly, the capital losses are also not allowable for the purpose of arriving at tax liabilities. In both Australia and Canada, assessable income from capital-indexed bonds derived by way of interest or discount or through capital accruals over the life of the bond is liable to tax. Therefore, in U.K., there is a preferred advantage shown to index-linked bonds vis-a-vis nominal bonds. In Australia and Canada, there is no allowance for inflation content of capital gains when deals take place in index-linked bonds before maturity or at redemption at the time of maturity of the bonds. In Canada, the inflation compensation is required to be specifically included as interest in every assessment year on an accrual basis, though the actual compensation is payable only at the time of maturity.

The relative tax advantage in U.K. could be one of the reasons for the relatively greater popularity of these bonds in U.K. when compared with Australia and Canada. The discussions at the Committees of the U.S. Congress in 1985 and 1992 also show that the tax provisions in the United States are similar to those of Australia and Canada. In the United States, even on zero coupon bonds, the gain in principal value over time is treated as accrued income for corresponding tax periods and is assessed for tax.

In India, interest income from Government securities is taxable and the rates applicable vary depending upon the category of investors. While certain institutions like provident funds, the Unit Trust of India and other mutual funds are tax exempt, insurance corporations pay taxes at a very low concessional rate. Capital gains are taxable, but, long-term capital gains are adjusted for inflation before tax. Therefore, capital gains only in real terms become taxable even in the case of non-indexed bonds. This position makes the Indian situation more or less comparable with that of U.K. If an index-linked bond is introduced in India and an investor holds such a bond till maturity, the enhanced principal value on account of inflation over the tenure of the bond would be treated as purely an inflationary gain and would therefore be, in effect, exempt from tax. However, if the nominal capital gain exceeds at any point of time the inflationary gains upto that period reflecting a decline in the market real interest rate, the excess of nominal capital gain over the inflationary gain that is, the real capital gain would become taxable. It is pertinent to add that the Government of India, Central Board of Direct Taxes, has chosen to treat the gain in principal value of zero coupon bonds as 'interest income' and not as capital gains. If this principle is applied in the case of index-linked bonds, (as would be the position in the United States and Canada) then, there is a possibility of inflation compensations of an index-linked bond being taxed in India. Tax treatment of index-linked bonds on par with zero coupon bonds would make the index-linked securities unattractive to taxable investors, like banks and companies.

Method of Issue

7.9 Government of India has moved over to issuing securities through an auction system. Index-linked bonds in other countries are being issued through auction. An auction system will ensure that the pricing of bonds generates market determined real rate of interest in primary issues. The other alternative is to price the bond at par in primary issues and fix the coupon rate in such a way that it offers the real interest rate required by the market. If such issues fail to be accepted by the market, it will devolve on Reserve Bank of India or Primary Dealers (when authorised). If primary issues are not through auctions, the market's expectation of real rate of interest will have to emerge purely from secondary market trading.

The bids in auctions could be either in terms of 'price' or 'real yield/ return'. In the case of nominal bonds, the present practice is to receive bids in terms of 'yield to maturity', except in the case of discount securities like zero coupon bonds. It will be desirable to let the market know the weighted average of the yield/price emerged through auctions as this will give information about the real rate of interest on Government securities.

Considering the advantage of price/yield discovery through auctions, auction issues of index-linked securities may be desirable.

Investment by Non-Residents

7.10 At present, non-resident Indians (NRIs) are allowed freely to invest in Indian Government securities on a repatriation basis. Foreign Institutional Investors (FIIs) and individual foreigners are, however, prohibited from investing in Government rupee securities. There have been suggestions to open up the Government securities market to foreign investors. Even if the Government decides to allow foreign investment in Government securities, we need to exercise caution before allowing such investments in index-linked securities. As the investments in index-linked bonds by the foreign investors are protected against any inflation, which such inflows may themselves cause, they are likely to continuously accentuate inflation in a destabilising manner. It may be recalled that our financial programming exercise in the previous section showed that a continuous inflation shock for consecutive five years or so could get built into the system to a somewhat greater extent when index-linked bonds are present than when they are absent. Hence, there is a need for exercising caution in this regard.

While dwelling on this question, it may be worth referring to the Mexican financial crisis of late 1994 - early 1995. The Annual Report for the year 1994-95 of the Bank for International Settlements, while surveying the Mexican financial crisis, does not make any reference to index-linked bonds, but points out that the Mexican Government, which was reluctant to raise domestic interest rates further, decided in March 1994 to replace maturing peso denominated government debt with short term *dollar-linked* securities (called tesobonos), a predominant proportion of which came to be held by non-residents. By the end of the year 1994, tesobonos held outside the banking system increased from less than $ 2 billion to about $ 21 billion, of which non-resident holdings were put at over $ 17 billion. At the same time, the commercial banks had increased significantly shor-term dollar-denominated debt as well as being exposed to many customers in the same position.

The run on the currency in late 1994 coming on top of the heavy accumulation of short-term dollar debt and depleted reserves triggered the capital flight and led to the plummeting exchange rate and stock market in the early months of 1995. Thus, the Mexican experience brings out the dangers of issuance of Government securities and other debt linked to foreign currency on a significant scale.

Cost Implications to Government

7.11 To get an idea about the possible savings (only from the interest cost, ignoring the other benefits such as those stemming from a more effective monetary management) in the Indian context, let us consider the following calculation :

Suppose the entire medium and long-term market borrowing of the Central Government (excluding funding of Treasury Bills) of around Rs.10,000 crore is done by issuing non index-linked bonds, the market interest rate on it may be around 13 per cent per year. If this 13 per cent consists of an expected inflation rate of 9 per cent, a real rate of interest of 3.0 per cent and an inflation risk premium of 1.0 per cent, the saving in the interest cost on account of the issuance of a 5 year index-linked bond instead, due to the absence of the inflation risk premium on it, would be Rs.2500 crore over the nine years period or Rs.277.78 crore, on average, per year, as shown in Table 12.

Table 12 : Savings in Interest Cost due to Absence of Inflation Risk Premium

1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	(Amount of Savings, in Rs. Crore)
100	100	100	100	100					Sum over 9 Years =
	100	100	100	100	100				Rs. 2,500 Crore / 9
		100	100	100	100	100			
			100	100	100	100	100		= Rs. 277.8
				100	100	100	100	100	Crore per year

If inflation rate is brought down by 1 percentage point, this will lead to an additional saving of similar amounts, that is, another Rs.2500 crore over the nine year period or Rs.277.78 crore per year.

In general, the amount of (undiscounted) saving on account of absence of inflation risk premium q, for an index-linked bond of m years of maturity with an n-year programme of annual index-linked borrowing of Rs. B_L is given by :

$$S = m.n.q.\ B_L$$

and the average saving per year is given by :

$$s = \frac{S}{n+m-1} = \frac{m.n.q.B_L}{(n+m-1)}$$

Thus, if the inflation risk premium q equals 0.01 (one per cent), a

10 year programme of annual index-linked borrowing of Rs.1000 crore by issuing bonds of 5 year maturity will lead to a total (undiscounted) saving of Rs.500 crore (=5x10x.01x1000) or an average annual saving in debt servicing cost of Rs.35.7 crore over the next 14 years. A 5 year programme of borrowing by issuing index-linked bonds of 10 year maturity will produce an identical amount of saving.

Similar additional savings can be achieved, as compared with non index-linked borrowing, by reducing the inflation rate by one percentage point, given the inflation risk premium and the nominal interest rate on non-index linked bonds and given an index-linked borrowing programme.

The total saving to the government on account of index-linking will also depend upon how the actual inflation rate turns out to be vis-a-vis the expected inflation rate. If the actual inflation rate turns out to be much higher than the expected inflation rate, then the Government might actually stand to lose due to index-linking. Secondly, there is a potential loss of tax revenue to the Government on account of indexed issues. Assuming that interest income on Government securities is taxable at rate 't' in respect of all investors, the net saving on account of index-linked issues is given by:

$$S = m.n. \{q(1-t) + [\ \pi^e(1-t) - \pi\ ]\}\ B_L$$

where π^e and π represent respectively the expected and actual rates of inflation.

As some of the major institutional holders of Government securities like provident funds and mutual funds are exempt from tax in any case, the net saving for the Government, when a proportion of investment will remain tax-exempt, can be given by :

$$S=m.n.B_L\,[(1-\varepsilon)\ (q(1-t)\ +\ (\pi^e\,(1-t)\ -\ \pi))\ +\ \varepsilon\ (q+\pi^e\ -\ \pi)]$$

where ε represents the proportion of tax-exempt investments in Government securities.

On the assumption of a 13 per cent nominal rate of interest, of which 3 per cent constitutes the real rate, 9 per cent the expected inflation and 1.0 per cent the inflation risk premium, the maximum rate of actual inflation below which Government would be able to make a positive net saving is given by :

$$\pi \leq (q\ +\ \pi^e\ )\ (1-t)$$

when all investments are taxable; if all investments are taxable at 24.725 %,

$$\pi \leq (0.01\ +\ 0.09)\ (1-0.24725)$$

$$=\ 0.075275 \text{ or } \underline{7.50 \text{ per cent}}$$

As only about one third of investments are taxable, taking into account the proportion of non-taxable investment, the maximum rate of actual inflation which would give a positive cash benefit to Government is given by :

$$\pi \leq [(q\ +\ \pi^e)\ (1-t)]\ (1-\varepsilon)\ +\ (q\ +\ \pi^e)\ \varepsilon$$

$$=\ 0.075 \times 0.66\ +\ 0.10 \times 0.34$$

$$=\ 0.0835 \text{ or } \underline{8.35 \text{ per cent}}$$

For an annual issue of Rs.5000 crore of index-linked issues, the saving for the Government has been worked out for different assumed rates of actual inflation ranging from 6.0 per cent to 13.0 per cent, and has been presented in Table 13.

Table 13 : Estimate of Annual Savings to Government from Issue of Index-Linked Bonds at Different Inflation rates

Assumptions

Issue per annum	:	Rs. 5,000 Crore
Maturity	:	5 Years
Number of Years of Programme	:	10 Years
Expected Inflation Rate	:	9 per cent
Real Rate of Interest (inclusive of the inflation risk premium)	:	4 per cent
Inflation Risk Premium	:	1 per cent
Coupon Rate on Index-linked Bond	:	3 per cent

	Assumed Actual Inflation Rates							
	6%	7%	8%	9%	10%	11%	12%	13%
				Annual Savings (Rs.Crore)				
1. Without taking into account tax loss to the Government	714.29	535.71	357.14	178.57	0.009	-178.57	-357.14	535.71
2. Assuming that all investors are tax payers	272.77	94.20	-84.38	-262.95	-441.52	-620.09	-798.66	977.23
3. Assuming that 66% of investors are tax payers and 34% of investors are tax exempt	422.88	244.31	65.74	-112.83	-291.40	-469.97	-648.54	827.12

Saving in Cash Flow

7.12 We should mention one special feature of index-linked bonds, particularly of medium and long-term index-linked bonds of the type issued in the U.K., in comparison with non index-linked bonds of similar maturity. The inflation compensation for the principal and the interest, to the extent that it is implicitly provided in the case of the conventional bonds, are front-loaded in the case of both the interest as well as the principal. In the case of the index-linked bonds, as they have been issued in the U.K., as also in Australia and Canada, the inflation compensation for the interest is paid every year when the interest on the bond is paid. But, the inflation compensation on the principal amount, though it is cumulated over the maturity period, is paid only at the end of the maturity period. On both these cash flows, the internal rate of return or the implied annual compound interest rate is the same. It is as if the index-linked bond yields its return mainly in the form of capital appreciation on maturity or sale, as one might get an implicit return on the holding of gold or a house at the time of the sale. Thus, since the demand for an index-linked bond would be primarily as an inflation hedge, individuals would hold an index-linked savings certificate just as they might hold gold or a gold price linked bond as an inflation hedge (demand for gold for being used and displayed as jewellery is separate) and financial institutions would not be able to hold gold but would be able to hold index-linked bonds for capital appreciation rather than for annual interest return on them. This capital appreciation would fully and exactly compensate them for the actual inflation during the intervening period and under the present provision of indexation of the base for the capital gains for the purposes of Income Tax Act, would be exempt from income taxation.

The lower cash outflow on account of interest payments during the intervening period can be used to lighten the interest burden of the Government for the immediate intervening years. These years can be used to stabilise the fiscal situation, reduce the inflation rate and to promote a higher growth rate.

In the absence of index-linked bonds, let us suppose that the Government issues every year for a period of five years Rs.10,000 crore of non index-linked bonds with maturity of 5 years at an average coupon rate of 13 per cent per annum.

Alternatively, let us assume that the Government issues 50 per cent of index-linked bonds at 3.0 per cent coupon rate or real return[15], with eight months' lag on the basis of monthly wholesale price index (WPI). Let us also assume that future inflation rate could be 9 per cent at the higher and 6 per cent at the lower end. The cash-flow implications for the Government for a period of 10 years have been worked out under these assumptions and presented in Table 14 (Details of the calculations are given in Appendix E).

The cash flow duly takes into account the loss of tax-revenue to the Government on account of lower tax base in respect of index-linked bonds. The important conclusions are:

(i) If the inflation rate is 9 per cent, then there are positive gains in the initial period of 5 years though there is a net loss to Government of Rs.776 crore in absolute terms over the entire 10 year period; but in terms of present value at the beginning of the period, there is a net gain of Rs.936 crore.

(ii) If the inflation rate turns out to be 6 per cent per annum, then there is a net gain in absolute terms for government of Rs.3884 crore, and there are positive cash flows upto 7 years, outweighing negative flows in the later three years; but, in terms of present value at the beginning of the period, the gain is Rs.2,742 crore.

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[15] This is based on the assumption that the real rate of interest expected on non index-linked bonds is 4 per cent of which 1.0 per cent represents the inflation risk premium. The econometric estimate of inflation risk premium works out to an average of about 1.06 per cent for the estimation period. Considering the fact that the estimation period was characterised by restrictions on portfolio adjustment by financial institutions, 1.0 per cent risk premium in a market oriented environment is conservative.

Table 14 : Cash-flow Implications for the Government

(Amounts in Rs. Crore)

Year	1	2	3	4	5	6	7	8	9	10
Scenario I :		100% Non Index-Linked Bonds (Rs.10,000 crore)								
Net Cash outflow :	391	1,370	2,349	3,327	4,306	14,501	13,523	12,544	11,566	10,587
Scenario II :		50% Non Index-Linked Bonds & 50% Index-Linked Bonds (9% Inflation Rate) (Rs.5,000 crore each)								
Net Cash outflow :	243	857	1,482	2,119	2,769	14,844	14,231	13,503	12,902	12,292
Scenario III :		50% Non Index-Linked Bonds & 50% Index-Linked Bonds (6% Inflation Rate) (Rs.5,000 crore each)								
Net Cash outflow :	242	852	1,469	2,094	2,727	13,894	13,284	12,611	12,020	11,386
Difference in Net Cash Outflow										
A. I - II										
(9% Inflation Rate)	149	513	867	1,208	1,536	-343	-708	-958	-1,337	-1,705
B. I - III										
(6% Inflation Rate)	149	518	879	1,233	1,578	607	239	-67	-455	-799
Present Value (A) : @ 13% discount	132	402	601	741	834	-165	-301	-360	-445	-502
Present Value (B) : @ 13% discount	132	406	609	756	857	292	101	-25	-151	-235

(Total Net flows : 9% Inflation Rate -776, 6% Inflation Rate 3,884

Net Present Value: (@ 13% discount) (A) 9% Inflation Rate : 936, (B) 6% Inflation Rate : 2742

Assumptions:
Coupon Rate on Index -Linked Bonds: 3 per cent
Coupon Rate on Non Index-Linked Bonds : 13 per cent
Maturity of Bonds: 5 years
Programme of Issue: 5 year period

Of course, it will be prudent to set aside a sinking fund to make the higher inflation compensation for the principal amount on maturity rather than raising Government expenditure to this extent during the intervening period. This would, however, mean that while fiscal deficit would not be reduced, the creation of reserve money would be reduced and the inflation rate would come down to that extent.

A Comparison with Gold Price Linked Bonds and Floating Rate Bonds

7.13 Before we conclude this section, it may be useful here to compare an index-linked bond with a gold price linked bond. Though the Government should not encourage gold holding habit among the public, there should be no objection to a gold price linked bond as such. However, to the extent that the individuals hold gold as a hedge against inflation, this function will be better performed by an index-linked bond since the gold price also fluctuates relative to the price level of all commodities and the gold price linked bond does not have the advantage of providing valuable information about the market's evaluation of the real interest rate and a measure of the future prospects of inflation and of linking Government savings in the debt servicing cost to its performance on the inflation front.

7.14 Similarly, we may also usefully compare the index-linked bond with a floating interest rate bond, which have been earlier introduced by a few private companies and public corporations in India and has recently been introduced by the Government of India. In the case of such bonds, the coupon interest rate is not kept fixed over the maturity period of the bond, but is changed during every interest payment period in accordance with the movement of a reference rate which is usually the interest rate on short-term debt. In the U.S., the Federal Reserve discount rate on the Treasury Bills has been used as a reference rate for the floating interest rate notes. In India, the yield rate on 364 day Treasury Bill has been used for this purpose. The advantage of a floating interest rate bond is that, unlike the conventional long-term bond, the issuers and the investors are not saddled with an interest rate, determined by the current market conditions, for a long-term debt. Such a flexible coupon interest rate on a long-term bond, would be an advantage to the investors when the market interest rates are rising and an advantage to the issuers when the market interest rates are falling. A floating interest rate bond in effect provides an instrument which offers to the investors and the issuers the possibility of rolling-over a short-term debt over a longer maturity period of the bond, without incurring any additional transaction costs for such a rolling-over operation and without having to accept any capital risk and lack of assurance of continuous availability of finance, in the case of issuers, or of an investment opportunity, in the case of an investor. However, as an inflation hedge, it can provide protection against inflation only to the extent that the market interest rates on conventional short-term bills or bonds adjust to the rate of inflation which, in turn, depends on the market's ability to anticipate inflation, albeit over the period of the short-term debt. Thus, it is also not free from inflation risk and is not a perfect hedge against inflation as an index-linked bond is.

Concluding Observation

7.15 It is necessary to give a serious trial to the issuance of index-linked bonds by the Government in the coming years, more in the spirit of a long-term financial reform and a socially and economically needed financial innovation and not only as a short-term palliative. It must, however, be emphasised at the same time that while the introduction of index-linked bonds is desirable, since a sizeable proportion of our population, which does not have the capacity to save because of low incomes, cannot derive any protection from inflation even with the introduction of index-linked bonds, this measure is not a substitute for a policy of price stability.

APPENDIX A

FISCHER'S DERIVATION OF ASSET DEMAND FUNCTIONS

We show here the solution to the economic agent's optimisation problem, formulated by Fischer. Let us define,

$$J\ (V,Y,t) = \max_{c,w_i} \int_t^{\infty} E_{\tau}U(C(\tau))d\tau \qquad \textbf{(A.1)}$$

Then, by Bellman's Optimality Principle, we can write the following recursive equation :

$$J\ (V,Y,t) = \max_{c,w_i} (U(C^*(t),\ t) + \lim_{dt\to 0} E_t\ [J(V+dY,Y+dY,t+dt)]) \qquad \textbf{(A.2)}$$

or,

$$0=\max_{c,w_i}\ [U(C^*(t),\ t)+\lim_{dt\to 0}\ E_tJ\ (V+dV,Y+dY,t+dt)-J(V,Y,t)] \qquad \textbf{(A.3)}$$

Therefore, if we define

$$\phi\ (C,w_i;V,Y,t)=U(C(t),t)+\lim_{dt\to 0}\ E_tJ\ (V+dV,Y+dY,t+dt)-J\ (V,Y,t) \qquad \textbf{(A.4)}$$

Our problem is to maximise ϕ with respect to C and w_i.

Using the quadratic approximation of the second term of (A.4) by Taylor's expansion, (A.4) can be rewritten as

$$\phi=U\ (C\ (t),t)+J_VdV+J_YdY+J_tdt+\tfrac{1}{2}J_{VV}\,(dV)^2+\tfrac{1}{2}J_{YY}\,(dY)^2+J_{VY}\,dVdY \qquad \textbf{(A.5)}$$

where J_V, J_Y, J_T, J_{VV}, J_{YY}, J_{VY} are the first and second order partial derivatives of J.

From equations (1) and (2), in the text, we have

$$\frac{dV}{V} = \gamma\, dt + \varepsilon\, dz \tag{A.6a}$$

$$\text{where, } \gamma = \sum_{i=2}^{3} w_i(r_i - r_1) + (r_1 - \frac{C}{V}) + v\frac{Y}{V} \tag{A.6b}$$

and,

$$\varepsilon^2 = (w_2^2\ \sigma_2^2 + w_3^2\ \sigma_3^2 + 2w_2\ w_3\ \sigma_2\ \sigma_3\ \rho_{23}) + b^2\ (\frac{Y}{V})^2 + 2(w_2\ \sigma_2\ b\eta_2 + w_3\ \sigma_3\ b\eta_3) \tag{A.6c}$$

where ρ_{23} is the correlation coefficient between the real rates of return on equities and nominal bonds and η_2 and η_3 are the coefficients of correlation between dq and dz_2 and dz_3, that is, between real wage income and real rates of return on equities and nominal bonds, respectively.

Substituting equations (2a) (in the text) and (A.6a) in equation (A.5) and applying Itô's lemma to expand it, our problem reduces to one of maximising,

$$\phi\ (C,w_i;V,Y,t) = U(C(t),t) + J_t + J_V\gamma V + J_Y VY + 1/2\ J_{VV}\ V^2\varepsilon^2 + J_{YY}\ b^2 Y + J_{YV}\ \rho_{YV}\ \varepsilon bVY \tag{A.7}$$

Where γ and ε are as given in equations (A.6b and A.6c) and ρ_{YV} is the correlation coefficient between real wage income and real wealth. It can be seen that,

$$\rho_{YV} = \frac{w_2\sigma_2 b\ \eta_2 + w_3\ \sigma_3\ b\ \eta_3 + b^2\ (\frac{Y}{V})^2}{\varepsilon b} \tag{A.8}$$

Taking account of equations (A.6b), (A.6c), (A.7) and (A.8), the necessary conditions for maximisation of ϕ with respect to C and w_i are :

$$U_C - J_V V = 0 \qquad \textbf{(A.9a)}$$

$$(r_2-r_1)\, J_V + J_{VV}\; V[w_2\sigma_2^2 + w_3\sigma_2\sigma_3\rho_{23} + \sigma_2 b\eta_2 \frac{Y}{V}] + J_{VY} Y\sigma_2 b\eta_2 = 0 \qquad \textbf{(A.9b)}$$

$$(r_3-r_1)\, J_V + J_{VV}\; V[w_3\sigma_3^2 + w_2\sigma_2\sigma_3\rho_{23} + \sigma_3 b\eta_3 \frac{Y}{V}] + J_{VY} Y\sigma_3 b\eta_3 = 0 \qquad \textbf{(A.9c)}$$

The solutions for optimal holdings of the assets, as proportion of real wealth, are given by

$$w_2 = -\frac{J_V}{J_{VV}V}\left[\frac{r_2-r_1}{\sigma_2^2(1-\rho_{23}^2)} - \frac{(r_3-r_1)\rho_{23}}{\sigma_2\sigma_3\;(1-\rho_{23}^2)}\right] - \left(1+\frac{J_{VY}}{J_{VV}}\right)\frac{Y}{V}\,\frac{b(\eta_2-\rho_{23}\eta_3)}{\sigma_2\;(1-\rho_{23}^2)} \qquad \textbf{(A.10a)}$$

$$w_3 = -\frac{J_V}{J_{VV}V}\left[\frac{r_3-r_1}{\sigma_3^2(1-\rho_{23}^2)} - \frac{(r_2-r_1)\rho_{23}}{\sigma_2\sigma_3\;(1-\rho_{23}^2)}\right] - \left(1+\frac{J_{VY}}{J_{VV}}\right)\frac{Y}{V}\,\frac{b(\eta_3-\rho_{23}\eta_2)}{\sigma_3\;(1-\rho_{23}^2)} \qquad \textbf{(A.10b)}$$

and $w_1 = 1 - w_2 - w_3$

$$= 1 + \frac{J_V}{J_{VV}V}\left[\frac{(r_2-r_1)\;(\sigma_3-\rho_{23}\sigma_2)}{\sigma_2^2\sigma_3(1-\rho_{23}^2)} - \frac{(r_3-r_1)\;(\sigma_2-\rho_{23}\sigma_3)}{\sigma_2\sigma_3^2\;(1-\rho_{23}^2)}\right]$$

$$+ \left(1+\frac{J_{VY}}{J_{VV}}\right)\;\frac{Y}{V}\;\frac{b[\sigma_3(\eta_2-\rho_{23}\eta_3) + \sigma_2(\eta_3-\rho_{23}\eta_2)]}{\sigma_2\sigma_3\;(1-\rho_{23}^2)} \qquad \textbf{(A.10c)}$$

Recognising that, since J gives the expected utility at the point of optimum consumption and asset holdings, the term $(-J_V/J_{VV}V)$ gives the reciprocal of the degree of relative risk aversion of the economic agent, Fischer denotes it by A(V,Y). Fischer also notes that in view of equation (A.9a) giving a necessary condition for maximum, the term J_{VY}/J_{VV} is equal to the ratio of marginal propensity to consume out of real wage income to that out of real wealth. Hence, this term may be taken as positive[1].

In the light of the remarks made in the preceding paragraph, and assuming that all economic agents' expectations are the same but the ratios of their real wage income to real wealth are different, the kth economic agent's asset demand functions derived by Stanley Fischer, may be rewritten as:

$$w_2^k = A(V^k,Y^k)\left[\frac{(r_2-r_1)}{\sigma_2^2(1-\rho_{23}^2)} - \frac{(r_3-r_1)\,\rho_{23}}{\sigma_2\sigma_3\,(1-\rho_{23}^2)}\right] - \left[1+\frac{C_Y(V^k,Y^k)}{C_V(V^k,Y^k)}\right]\frac{Y^k}{V^k}\left[\frac{b(\eta_2-\rho_{23}\eta_3)}{\sigma_2\,(1-\rho_{23}^2)}\right] \quad \text{(A.11a)}$$

$$w_3^k = A(V^k,Y^k)\left[\frac{(r_3-r_1)}{\sigma_2^2(1-\rho_{23}^2)} - \frac{(r_2-r_1)\,\rho_{23}}{\sigma_2\sigma_3\,(1-\rho_{23}^2)}\right] - \left[1+\frac{C_Y(V^k,Y^k)}{C_V(V^k,Y^k)}\right]\frac{Y^k}{V^k}\left[\frac{b(\eta_3-\rho_{23}\eta_2)}{\sigma_3\,(1-\rho_{23}^2)}\right] \quad \text{(A.11b)}$$

and, $w_1^k = 1 - w_2^k - w_3^k$ (A.11c)

Or, writing in terms of general notation :

$$w_2^k = \alpha_{20}^k + \alpha_{21}^k\,(r_2 - r_1) + \alpha_{22}^k\,(r_3 - r_1) + \alpha_{23}^k\,\frac{Y^k}{V^k} \quad \text{(A.12a)}$$

$$w_3^k = \alpha_{30}^k + \alpha_{31}^k\,(r_2 - r_1) + \alpha_{32}^k\,(r_3 - r_1) + \alpha_{33}^k\,\frac{Y^k}{V^k} \quad \text{(A.12b)}$$

and,

$$w_1^k = \alpha_{10}^k + \alpha_{11}^k\,(r_2 - r_1) + \alpha_{12}^k\,(r_3 - r_1) + \alpha_{13}^k\,\frac{Y^k}{V^k} \quad \text{(A.12c)}$$

[1] There is a slight difference in the term involving Y/V in each of the three asset demand functions given in our equations (A.10a) - (A.10c) and equations (36,37 and 38) in Fischer's original paper, which the readers may notice. Our detailed derivation based on Fischer's formulation has led to the equations as given in (A.10a) - (A.10c). However, this discrepancy does not change the main implications drawn by him from the asset demand funtions derived by him.

where, $\alpha_{10}{}^{k} = 1,\ \alpha_{20}{}^{k} = \alpha_{30}{}^{k} = 0,$

and , $\sum_{j=1}^{3} \alpha_{ji}{}^{k} = 0,\ i = 1, 2, 3$

The market equilibrium conditions will be given by,

$$S_2 = \sum w_2^k V^k = \sum \alpha_{20}^k V^k + (r_2 - r_1)\sum \alpha_{21}^k V^k + (r_3 - r_1)\sum \alpha_{22}^k + \sum \alpha_{23}^k Y^k \qquad \text{(A.13a)}$$

$$S_3 = \sum w_3^k V^k = \sum \alpha_{30}^k V^k + (r_2 - r_1)\sum \alpha_{31}^k V^k + (r_3 - r_1)\sum \alpha_{32}^k + \sum \alpha_{33}^k V^k \qquad \text{(A.13b)}$$

$$S_1 = \sum w_1^k V^k = \sum \alpha_{10}^k V^k + (r_2 - r_1)\sum \alpha_{11}^k V^k + (r_3 - r_1)\sum \alpha_{12}^k + \sum \alpha_{13}^k V^k \qquad \text{(A.13b)}$$

where, S_i's are the real quantities issued of the three types of bonds.

Or, letting a_1, a_2, a_3 stand for the ratios of S_1, S_2 and S_3 to total national real wealth, we have

$$a_2 = \alpha_{20} + \alpha_{21}(r_2 - r_1) + \alpha_{22}(r_3 - r_1) + \alpha_{23} Y/V \qquad \text{(A.14a)}$$

$$a_3 = \alpha_{30} + \alpha_{31}(r_2 - r_1) + \alpha_{32}(r_3 - r_1) + \alpha_{33} Y/V \qquad \text{(A.14b)}$$

$$a_1 = \alpha_{10} + \alpha_{11}(r_2 - r_1) + \alpha_{12}(r_3 - r_1) + \alpha_{13} Y/V \qquad \text{(A.14c)}$$

where, $\alpha_{10} = 1,\ \alpha_{20} = \alpha_{30} = 0,\ \sum_{j=1}^{3} \alpha_{ji} = 0,\ i = 1, 2, 3;$

$\alpha_{ji} = (1/V)\sum_k \alpha_{ji}^k V^k,\ i = 1, 2;\ \alpha_{ji} = (1/Y)\sum_k \alpha_{ji}{}^{k} Y^k,\ i = 3.$

Solving for equilibrium values of $r_2 - r_1$ and $r_3 - r_1$ from the market equilibrium conditions for equities and non index-linked bonds and substituting the values for the coefficients in the asset demand functions (A.11a) and (A.11b), we obtain equation (5) of the text:

$$(r_3 - r_1) = \frac{\sigma_3}{A(V, Y)} \left[\sigma_3 a_3 + \rho_{23} \sigma_2 a_2 + b\eta_3 \left(1 + \frac{C_Y}{C_V}\right) \frac{Y}{V} \right] \quad ; \qquad (A.15)$$

where, $A(V,Y) = \frac{1}{V} \sum_k A(V^k, Y^k) V^k$ and, $\frac{C_Y}{C_V} = \sum_k \left[\frac{C_Y^k Y^k}{C_V^k Y} \right]$

APPENDIX B

DATA USED IN THE ECONOMETRIC ESTIMATION OF ASSET DEMAND FUNCTIONS - AN EXPLANATORY NOTE

The data used in the estimation of the asset demand functions pertain to the following variables : (i) financial stock, (ii) capital stock, (iii) inflation rate, its expectation and its variance, (iv) interest rates on various financial assets, and (v)labour income. Data for these variables were drawn for the period from 1970-71 to 1991-92 (22 observations) using different sources, as explained below. However, the exercise for asset demand functions was based on 20 observations as the first two observations were lost in taking three years' moving average for working out variance of inflation.

(i) Financial Stock:

Data on financial stock was derived using the figures for the stocks of financial assets from the national balance sheet compiled in Venkatachalam and Sarma (1976) for the year 1970-71. The stocks for the subsequent years were estimated using the Reserve Bank data on flow of funds of the Indian economy as published in various issues of the *RBI Bulletin*. The flow of funds accounts are organised along two dimensions - by economic sectors and by type of financial instruments. For estimating the asset demand functions, the financial instruments in the flow of funds matrices were disaggregated and supplemented by the monetary data to obtain the following three components of financial stocks-broad money stock, government debt stock and the equity stock. The money stock was obtained as broad money (M3) outstanding as on March 31 each year and consisted of currency with public, demand and time deposits and 'other deposits' as its components. Annual data on equity stocks were derived from the flow of funds data as additions to corporate securities and other financial institutions (OFI) securities. OFI securities as per flow of funds classification include units of UTI and other mutual funds. As the flow of funds data does not provide a break-up of securities in shares and debentures, the term 'equity' denotes a composite flow of these two instruments in our analysis. This is consistent with the stock of 'private securities' as obtained from Venkatachalam and Sarma (1976) which comprises of shares as well as debentures. Notwithstanding the diverse risk-return perception for shares on the one hand and debentures on the others, the composite stock of 'equities' as defined above would have higher risk and higher returns attached to it than other financial assets. As such, equities are expected to serve as a better hedge against inflation for investors and so serve as a closer substitute for index-linked bonds. Government debt stock was derived as a residual by deducting the money stock and the equity stock from the total financial stock. As such, the government debt stock includes Central and State Government Securities, small savings, life fund, provident fund, compulsory deposits and foreign claims. All estimates of financial stocks are derived from the sources side of the flow of funds and constitute stocks at current market prices. It may be mentioned that while estimates of tangible wealth usually suffer from valuation problems due to scanty data on prices, estimates of financial wealth are reasonably firm. Estimation errors, however, do exist and are reflected in the discrepancies (sources - uses) in the flow of funds statements. Sectorally, the household sector claims are derived as residuals by eliminating the reported holdings by other sectors from the respective instrument aggregates. As such, errors do get concentrated in this sector. However, as instrument-wise data at aggregate level is used in our analysis, the financial stock data could be considered firmer and useful for portfolio analysis.

(ii) Capital Stock :

Capital stock data taken in this study are estimates of net capital stock at current prices. They capture that part of national wealth which is tangible and reproducible. Estimates of tangible wealth (including land) is available in Venkatachalam and Sarma (1976). However, it has not been possible to use these estimates due to valuation problems. The benchmark estimates in that study pertains to 1949-50 and the stock of reproducible tangible assets is built up for succeeding years from the benchmark estimate by adding the figures of capital formation. However, valuation difficulties arise because the entire stock of capital gets revalued each year at the current prices. As such, net capital stock in period t cannot be derived as a sum of net capital stock in period t-1 and the net capital formation in period t-1. Net capital stock series making similar adjustment for revaluation of entire stock at current prices is available from Mohanty (1993) and Central Statistical Organisation (C.S.O.) (various issues of National Accounts Statistics) for different time periods. In this study, the capital stock data for the period from 1970-71 to 1979-80 are the estimates as reported in Mohanty (1993). Estimates for this period are not available from C.S.O. For subsequent years, the C.S.O. data is used. It may be added, that apart from the valuation problem posed by poor availability of price data, the capital stock data are also affected by the errors which may creep in the estimation of Consumption of Fixed Capital (CFC), which measures depreciation. The CFC data in the capital stock series used by us has been prepared using the Perpetual Inventory Method (PIM) which is based upon the construction of life-table of assets and differs from any similar series of depreciation according to book value. Intuitively, the PIM is economically more meaningful but is not without estimation errors. As such, data on capital stock may be rightly considered as less reliable than financial stock. However, as this is generally true in case of all the countries, we proceed to define aggregate value of total assets (V) as a sum of financial assets stock (FA) and net capital stock (K) which we use as a proxy for total wealth. Gold is not included in the capital stock data in line with the treatment accorded to gold in the System of National Accounts (SNA). Gold is treated as a consumption item in national accounts, even though it has charecteristics akin to assets and serves as an important inflation hedge in the Indian conditions.

(iii) Inflation :

Inflation (π) is based on the Wholesale Price Index (WPI) compiled by the Ministry of Industry. For obtaining the series on WPI for the period of the study, the All-Commodities price indices of base 1981-82 were converted to base 1970-71. Expected inflation (π^e) was generated as an AR(2) process and estimated by using the maximum likelihood method. Newton-Raphson method was applied to generate the parameter estimates given below:

$$\pi^e_t = 6.373 + 1.0329\pi_{t-1} - 0.76562\ \pi_{t-2}$$

Alternative methods for capturing expected inflation were also tried (e.g. adaptive expectations or structural formulations) but the results favoured generating expected inflation as an AR(2) process. Variance of inflation $(s_1^2)_t$ was generated as a three-year moving average around expected inflation:

$$(s^2_1)_t = \frac{1}{3} \sum_{i=0}^{2} (\pi_{t-i} - \pi^e_{t-i})^2$$

(iv) Interest Rate :

Asset demand sensitivity with alternative interest rates - nominal and real-was analysed. Asset demand for money was considered to be dependent on own rate of interest measured by 3 year term deposit rate in nominal (R_4) or real terms r_4, or simply its opportunity cost measured in terms of the inflation rate.

Government debt was taken to be dependent on redemption yield on Government of India securities. Yield on equity was obtained by adding the capital appreciation component proxied by the percentage change in RBI's Ordinary Share Price Index to the weighted dividend represented by the yield on industrial sercurities (Ordinary shares) published by the Reserve Bank. For arriving at the yields on Government debt and on equity, the new series on yields on Government securities and industrial securities with base 1980-81 was employed by splicing it with comparable series with 1970-71 as the base year. The RBI series with the old base was known as the series of Index Numbers of security prices. The yields on Government securities are based on quotations for 16 loans of the Central Government on the Bombay Stock Exchange and 40 loans of the States as quoted in three premier stock exchanges, namely, Bombay, Calcutta and Madras. The series for the yield on Industrial securities covers 441 scrips with quotations from five premier stock exchanges, namely, Bombay, Calcutta, Madras, Ahmedabad and Delhi. The yield denotes the dividend on the scrip expressed as a percentage of its average price quotation during the year, adjusted for bonus/rights issues, wherever necessary. The yield series of the RBI does not account for capital appreciation due to secondary market transactions which could be sizeable in relation to dividend yields. As such, to capture the returns to investors, it was considered essential to add the annual percentage variation in the ordinary share price index (average for the months).

Apart from the above, we have computed the covariance between the return on ordinary shares (around its mean ($\bar{r}_{2t}$) for the last three years and π_1. Thus,

$$Cov\ (r_2, r_4) = \frac{1}{3} \sum_{i=0}^{2} (r_{2,\ t-i} - \bar{r}_{2,\ t-i})\ (\pi_{t-i} - \pi^e_{t-i})$$

(v) Labour Income :

Labour income was obtained from the factor income series of the National Accounts. Official estimates of factor incomes at current prices, giving distribution of Net Domestic Product, are available from the C.S.O. in two series. The old series consistent with the base 1970-71 is available upto 1984-85. Factor income is disaggregated into compensation to employees, mixed income, interest, rent, profits and dividends in this series. The new series, consistent with base 1980-81 of the National Accounts is available since its base year and disaggregates factor income into compensation of employees, mixed income and operating surplus. Disaggregation of property income into rent, interest and imputed banking charges is also separately available. With the available data base, obtaining labour income directly from the factor shares becomes difficult because of predominant existence of unincorporated enterprises and household industries, which are, wholly or to a large extent, managed by self employed workers and for whom accounts are often not available. As such, factor incomes generated cannot always be separated between income from labour and income from entrepreneurship and are, therefore, shown as 'mixed income of the self employed'. Mixed income, as above, covers compensation of employees of own account workers as well as profit and loss generated by unincorporated enterprises. However, as the imputed labour component of the mixed income is not available, mixed income in its entirety is added to compensation of employees for arriving at labour income in our exercise. In order to generate a consistent series of labour income at current prices for the period of the study, the old series was converted to the new series by splicing using the 1980-81 estimates of the two series.

All the data are given in Statement 1.

Statement 1 : Basic Data used for Econometric Analysis

(Rs. Crore)

YEAR	BROAD MONEY	GOVERNMENT DEBT STOCK	EQUITY STOCK	TOTAL FINANCIAL ASSETS	CAPITAL STOCK	TOTAL ASSETS	LABOUR INCOME
	(M3)	(D)	(E)	(FA)	(K)	(V)	(Y)
1972-73	15,013	67,094	6,613	88,720	105,595	194,315	40,027
1973-74	17,624	72,429	6,786	96,839	127,317	224,156	52,175
1974-75	19,549	80,981	6,912	107,442	168,538	275,980	60,605
1975-76	22,480	92,304	7,070	121,854	183,253	305,107	61,537
1976-77	27,781	103,506	7,528	138,815	198,754	337,569	64,482
1977-78	32,906	121,431	8,080	162,417	212,359	374,776	72,985
1978-79	40,112	131,556	8,908	180,576	237,116	417,692	77,163
1979-80	47,226	151,052	9,901	208,179	284,799	492,978	82,951
1980-81	55,774	176,059	11,112	242,945	338,104	581,049	101,816
1981-82	62,752	202,562	12,717	278,031	409,103	687,134	116,627
1982-83	73,184	245,472	15,059	333,715	484,088	817,803	128,019
1983-84	86,525	276,175	17,648	380,348	555,039	935,387	150,661
1984-85	102,933	320,759	21,123	444,815	636,659	1,081,474	167,951
1985-86	119,394	369,325	24,896	513,615	743,267	1,256,882	186,167
1986-87	141,632	430,589	29,628	601,849	843,466	1,445,315	205,998
1987-88	184,275	474,724	34,219	693,218	948,379	1,641,597	235,644
1988-89	193,493	582,055	42,764	818,312	1,085,556	1,903,868	280,914
1989-90	230,950	687,598	52,095	970,643	1,242,040	2,212,683	321,374
1990-91	265,828	840,236	62,472	1,168,536	1,416,756	2,585,292	368,329
1991-92	317,049	968,367	85,604	1,371,020	1,662,881	3,033,901	424,964
1992-93	366,825	1,103,278	107,387	1,577,490	1,878,976	3,456,466	483,136

Continued.

Statement 1 : Basic Data used for Econometric Analysis

	3-YEAR DEPOSIT RATE (%)	10-YEAR REDEMPTION YIELD ON GOI SECURITIES (%)	YIELD ON ORDINARY SHARES (%)	3-YEAR VARIANCE OF π AROUND π^e	COVARIANCE BETWEEN π AND R_2	INFLATION RATE	EXPECTED INFLATION RATE	RATE OF INFLATION IN GOLD PRICES	3-YEAR VARIANCE OF GOLD PRICE INFLATION	COVARIANCE BETWEEN GOLD PRICE INFLATION AND π
	(R_4)	(R_3)	(R_2)	(s_1^2)	$(s_1 s_2 \rho_{12})$	(π)	(π^e)	(π_g)	(s_g^2)	$(s_1 s_g \rho_g)$
1972-73	6.5	4.98	3.68	0.67	-2.30	10.12	8.7	20.97	n.a	n.a
1973-74	7.0	5.18	11.08	16.40	8.05	20.17	13.3	52.49	226.25	60.86
1974-75	9.0	5.67	4.42	77.15	-0.83	25.20	11.7	40.59	228.46	72.45
1975-76	9.0	5.79	-8.92	100.00	31.07	-1.10	7.3	4.99	470.67	146.99
1976-77	9.0	5.73	12.96	90.61	36.99	2.06	-2.3	0.90	328.95	67.93
1977-78	8.0	5.82	9.79	30.72	43.09	5.19	6.8	16.01	352.02	51.68
1978-79	7.5	5.84	27.17	11.67	-0.89	0.04	3.7	24.03	132.20	-38.55
1979-80	8.5	5.87	15.08	19.24	-20.51	19.96	13.5	46.45	164.73	20.6
1980-81	8.5	6.36	17.94	18.48	-18.12	18.35	17.8	31.39	141.66	24.8
1981-82	10.0	6.76	25.46	14.64	-2.54	9.37	8	12.92	205.83	29.56
1982-83	10.0	7.34	0.23	9.95	27.43	2.64	7.9	0.20	173.76	17.28
1983-84	10.0	7.72	14.82	22.79	30.55	9.43	3.2	7.89	171.82	19.6
1984-85	10.0	8.50	11.64	22.19	27.57	7.12	7.4	6.75	72.78	27.34
1985-86	10.0	9.03	69.55	14.35	-23.06	5.76	7.8	7.16	1.35	1.75
1986-87	10.0	9.84	7.99	15.58	21.46	5.28	11.8	9.31	1.91	-3.51
1987-88	10.0	10.19	-6.00	16.42	37.73	7.59	9.2	32.62	88.88	-12.07
1988-89	11.0	10.90	23.76	20.29	43.18	7.03	11	3.02	136.59	3.7
1989-90	13.0	11.96	47.94	11.16	-37.83	7.41	11.3	1.70	174.24	21.04
1990-91	13.0	12.30	41.85	10.43	-54.69	10.27	10.9	6.91	89.26	29.13
1991-92	12.0	13.36	57.30	9.35	-24.84	13.74	10.2	24.51	102.02	29.19
1992-93	11.0	13.23	48.66	4.38	8.83	10.06	9.6	-4.51	124.11	13.19

Concluded.

APPENDIX C

EQUATIONS USED IN THE FINANCIAL PROGRAMMING EXERCISE

$$GFD_t = GPD_t + IP_t \tag{C.1}$$

$$GPD_t = (0.0187)\ Y_t \tag{C.2}$$

$$IP_t = IPM_t + IS_t + IDM_t + INM_t + IE_t + IO_t \tag{C.3}$$

$$IPM_t = (IBNO_t + IBNR_t + IPN_t) + IPL_t \tag{C.4}$$

$$IBNO_t = (0.1074)\ BNO_t \tag{C.5}$$

$$BNO_t = (0.94)\ BNO_{t-1} \text{ with } BNO_0 = BN_0 \tag{C.6}$$

$$BNR_t = BNO_{t-1} - BNO_t \tag{C.7}$$

$$IBNR_t = \begin{cases} IBNR_{t-1} + i_{Nt-1} \,.\, BNR_t \text{ for } t=1, 2,....5 \\ IBNR_{t-1} + i_{Nt-1} \,.\, BNR_t + BNR_{t-5}\ (i_{Nt-1} - i_{Nt-6}) \text{ for } t>5 \end{cases} \tag{C.8}$$

$$IPN_t = \begin{cases} IPN_{t-1} + i_{Nt-1} \,.\, dBN_{t-1} \text{ for } t=1, 2,....5 \\ IPN_{t-1} + i_{Nt-1} \,.\, dBN_{t-1} + dBN_{t-6}\ (i_{Nt-1} - i_{Nt-6}) \end{cases} \tag{C.9}$$

$$IPL_t = INTL_t + InfCPL_t \tag{C.10}$$

$$INTL_t = (0.03) * BLINF_t \tag{C.11}$$

$$BN_t = BN_{t-1} + dBN_{t-1} \quad \text{with } BN_0 = BN \text{ for 1994-95} \tag{C.12}$$

$$BL_t = BL_{t-1} + dBL_{t-1} \tag{C.13}$$

$$BLINF_t = (BLINF_{t-1} + dBL_{t-1}) * (1 + \pi_{t-1}) \text{ with } BLINF_0 = 0 \tag{C.14}$$

$$InfCPL\text{-}US = \pi_{t-1} BL_t \text{ (for the US proposal for index-linking)} \quad (C.15a)$$

$$InfCPL - UK = \begin{cases} 0 \text{ for } t = 0, 1, 2.....,5 \\ dBL_{t-5} [(1 + \pi_{t-5}) (1 + \pi_{t-4}) ...... (1 + \pi_{t-1}) - 1] \end{cases} \quad (C.15b)$$

(for the UK type index-linked bonds having a maturity of five years)

$$IS_t = (0.0556) * BS_t \quad (C.16)$$

$$IDM_t = (0.0556) * MD_t \quad (C.17)$$

$$INM_t = (0.1135) * BNM_t \quad (C.18)$$

$$IE_t = (0.0868) * BE_t \quad (C.19)$$

$$IOt = (0.0938) * BOt \quad (C.20)$$

$$BM_t = BN_t + BL_t \quad (C.21)$$

$$dBM_t = (\frac{dBM}{GFD})_0 * GFDt \quad (C.22)$$

$$dBN_t = (1-\Theta) dBM_t \quad (C.23)$$

$$dBL_t = \Theta dBM_t \quad (C.24)$$

$$BS_t = BS_{t-1} + dBS_{t-1} \quad (C.25)$$

$$dBS_t = (\frac{dBS}{GFD})_0 \quad GFD_t \quad (C.26)$$

$$BNM_t = BNM_{t-1} + dBNM_{t-1} \quad (C.27)$$

$$dBNM_t = (\frac{dBNM}{GFD})_0 \quad GFD_t \quad (C.28)$$

$$BE_t = BE_{t-1} + dBE_{t-1} \quad (C.29)$$

$$dBE_t = \left(\frac{dBE}{GFD}\right)_0 GFD_t \quad (C.30)$$

$$BO_t = BO_{t-1} + dBO_{t-1} \quad (C.31)$$

$$dB0_t = \left(\frac{dB0}{GFD}\right)_0 GFD \quad (C.32)$$

$$dGCB_t = 0 \text{ for } t > 0 \quad (C.33)$$

$$(Adj)_t = GFD_t * \Big[1 - \left(\frac{dBM}{GFD}\right)_0 - \left(\frac{dBS}{GFD}\right)_0 - \left(\frac{dBNM}{GFD}\right)_0$$
$$- \left(\frac{dBE}{GFD}\right)_0 - \left(\frac{dBO}{GFD}\right)_0 - \left(\frac{dMD}{GFD}\right)_0 + \left(\frac{dGCB}{GFD}\right)\Big] \quad (C.34)$$

$$dMD_t = GFD_t - dBM_t - dBS_t - dBNM_t$$
$$- dBE_t - dBO_t + dGCB_t - (Adj)_t \quad (C.35)$$

$$RM_t = RM_{t-1} + dRM_{t-1} \quad (C.36)$$

$$dRM_t = dMD_t + Y_t * \left(\frac{dRBICCS + dRBINFA - dRBINML}{Y}\right)_0 \quad (C.37)$$

$$\pi_t = \frac{dRM_t}{RM_t} - (1.6)\ (g_y) \quad (C.38)$$

$$g_y = 0.055 \quad (C.39)$$

$$i_{Nt} = r + q + \pi^e_t = 0.04 + \ + \pi^e_t \quad (C.40)$$

$$\pi^e_t = (6.3730 + 1.0329\ \pi_{t-1} - 0.7655\ \pi_{t-2}) / 100 \quad (C.41)$$

$$dB_t = dBM_t + dBS_t + dMD_t + dBNM_t$$
$$+ dBE_t + dBO_t - dGCB_t + (Adj)_t \quad (C.42)$$

$$D_t = BM_t + BS_t + BNM_t + BE_t + BO_t + MD_t \quad \text{(C.43)}$$

where

Adj	=	adjustment term to account for discrepancy between the two sides of the Government budget constraint identity.
B	=	total borrowings of the Central Government.
BE	=	external debt outstanding.
BLINF	=	inflation adjusted outstandings of index-linked bonds.
BM	=	long-term market borrowings outstanding, index-linked and non index-linked, taken together.
BN	=	long-term non index-linked market borrowings outstanding.
BNM	=	non-market borrowings outstanding.
BNO	=	non-matured part of the long-term market debt outstanding at the end of March 1994.
BNR	=	maturing part of the long-term market debt, outstanding at the end of March 1994, which is replaced during the year.
BO	=	other debt outstanding.
BS	=	short-term market borrowings outstanding.
D	=	total debt of Central Government.
dGCB	=	change in the cash balances of the Central Government with RBI.
GFD	=	gross fiscal deficit
GPD	=	gross primary deficit
g_y	=	growth rate of in real GDP at factor cost.
IBNO	=	interest payment on (BNO) non-matured long-term market debt.
IBNR	=	interest payment on (BNR) replaced long-term market debt.
IDM	=	interest payment on monetary debt.
IE	=	interest payment on external debt.

i_N = interest rate on long-term market borrowing.

InfCPL = inflation compensation in respect of the principal amount.

INM = interest payment on non-market debt.

IO = interest payment on other debt.

IP = total interest payment.

IPL = interest payment on new debt in the form of index-linked bonds.

IPM = interest payment on long-term market debt.

IPN = interest payment on new long-term non index-linked market debt.

IS = interest payment on short-term market debt.

MD = monetary debt or net RBI credit to the Central Government (RBICG) outstanding.

q = inflation risk premium

r = real interest rate

RBICCS = RBI credit to commercial sector.

RBINFA = net foreign exchange assets of RBI.

RBINML = net non-monetary liabilities of RBI.

RM = reserve money.

Y = gross domestic product (GDP) at current market prices.

π = actual inflation rate measured by Wholesale Price Index for all-commodities.

π_t^e = expected inflation rate.

Θ = proportion of index-linked debt issued during the year, to total long-term market borrowing (index-linked and non index-linked) during the year.

Note : (1) Variable notation preceded by the difference operator (d) indicates annual flow; for example, dB_t is the Central Government's borrowing (addition to liabilities) during the year.

(2) Subscript t denotes time period t in terms of the fiscal year. Subscript t-1 denotes one year lag. Subscript o denotes fiscal year 1994-95, with subscript (-1) denoting one year lag, that is, fiscal year 1993-94.

APPENDIX D

DATA USED IN THE FINANCIAL PROGRAMMING EXERCISE - AN EXPLANATORY NOTE

The financial programming exercise undertaken *inter-alia* to assess the inflationary potential of the index-linked bonds is primarily based on the information contained in the budgetary data for the Union government as presented in the Union Budget, 1995-96. The data used in this exercise are presented in Statement 2.

The base-line scenario for the financial programming exercise was generated by presenting the government budget constraint as an identity for the year 1994-95 by equating the Gross Fiscal Deficit (GFD), comprising primary deficit and interest payments on various kinds of borrowings, with the sum of the changes in stocks of corresponding debt components. As a supplement to budgetary information, data on monetised debt (MD) or the Net RBI Credit to the Central Government (RBICG) were obtained from RBI sources (March 31, basis). In practice, RBICG comprises both short-term and long-term borrowing of the Central Government. However, it is not possible to obtain disaggregated data in this form, either from the published monetary data or from the published records of the budget. The Union budget does provide information on total short-term and long-term borrowing of the Central Government, but such borrowing is funded through both RBI and non-RBI sources. Information also exists on the budget deficit of the Central Government which comprises the part of short-term borrowing that is through 91 day Treasury Bills and the change in Government's cash balances maintained with RBI. However, as the short-term borrowing through 91 day Treasury bills is financed partly by the Reserve Bank and partly by non-RBI sources, the break-up for which is not available, it is not possible to obtain the short-term component of RBICG. In the recent years, RBI accommodation to the Centre has been primarily in the form of short-term borrowing and not in the form of long-term borrowing. In the absence of alternative information, it has been assumed that the entire RBICG consists of short-term debt.

Based on the above information from budgetary and monetary data, the Central Government's outstanding liabilities were divided into the following components: (1) long-term market borrowing (BM), (2) short-term market borrowing (BS), (3) Monetary Debt (MD) or the Net-RBI Credit to Central Government (RBICG), (4) Non-market borrowing (BNM), (5) External debt (BE) and (6) other debt (BO). Data on these are provided in Statement 2. Short-term market borrowing consists of 91 day and 364 day Treasury bills held by non-RBI sources, while similar holding of dated securities constitutes the long-term borrowing. Non-market borrowings include small savings, pension and provident funds. External debt is debt incurred from non-resident sources. Other debt consists of deposits bearing interest, other accounts, and other miscellaneous debt heads. The variations in these debt components have been adjusted to the extent that change in monetary debt (dMD) has been excluded from Government's short-term borrowing to arrive at the adjusted figure of Government's short-term market borrowing (dBS).

Average interest payments on these debt components have been computed by dividing the revised estimates of interest payments for 1994-95 by the outstanding liabilities as on March 31, 1994.

Since in practice, the Gross Fiscal Deficit (GFD), comprising primary deficit and interest payments, does not match the right hand side of the budget constraint identity comprising the flows of debt stock components on account of minor discrepancies arising out of Securities issued to International Financial Institutions, as also due to some accounting entries inadequately capturing certain debt transactions, an adjustment term $[(Adj)_t]$ has been introduced in the identity to correct for the discrepancy. The adjustment term has been explained by equation (C.34) in Appendix C and is defined to make the identity hold empirically.

Statement 2: Base Year Data Used for Financial Programming Exercise

(Rs. crore)

Sr.No. & Item	Central Government Liabilities outstanding as on 31st March as per *Receipts Budget*		Change in Liabilities	Capital Receipts as per *Budget at a Glance*	Interest Payment 1994-95 (as per *Expenditure Budget*)	Average Interest Payment
	1994	1995	(3 - 2)	(5)		(6 / 2)
1)	(2)	(3)	(4)	20,700	(6)	(7)
1. Market Borrowing Long-term (BN)	1,10,611	1,31,311	20,700 (dBN)	3,340(b)	11,878 (IPM)	0.1074 (i_N,t)
2. Market Borrowing Short-term (a) (BS)	38,318	44,344	6,026 (dBS)		2,130 (IS)	0.0556 (is,t)
3. RBI Credit to the Central Government (MD)	96,783	98,913	2,130 (dMD)	24,800[c]	5,383 (IMD)	0.0556 (iMD)
4. Non-market Borrowing (BNM)	1,60,355	1,90,147	29,792 (dBNM)	3,947[d]	18,196	0.1135 (iNMT)
5. External Debt (BE)	47,345	50,628	3,283 (dBE)	2,248	4,110	0.0868 (ie,t)
6. Other Debt (BO)	24,556	26,285	1,729 (dBO) (-896)[e]	55,035	2,303	0.0938 (io,t)
7. Total	4,77,968	5,41,628	63,660	6,000	44,000	
8. Budget Deficit (of which the decrease in cash balance)			61,035	(2,350) 61,035		
9. Fiscal Deficit			61,035			

Notes : (a) total outstanding short-term debt as per *Receipts Budget* is the summation of items (2) and (3),

(b) these include only 364 day Treasury Bills; 91 day Treasury Bills are part of item 8 that is budget deficit,

(c) excludes receipts from 'other items' as shown in *Receipts Budget,*

(d) includes receipts under revolving fund,

(e) represents the adjusted change in liabilities to make the total consistent with fiscal deficit. This adjustment pertains to cash balances and the net effect of discrepancies observed under heads which are lumped in item (6), that is, other debt.

APPENDIX E

STATEMENTS OF CASH-FLOWS OF INDEX-LINKED AND NON INDEX-LINKED BONDS

Statement 3 : Cash Flow of Index-linked Bonds (6 per cent Inflation)

(Rs. Crore)

Year	1	2	3	4	5	6	7	8	9	10
Issue	5000.0	5000.0	5000.0	5000.0	5000.0					
Interest @ 3 %	61.7	160.3	170.0	180.2	191.0	119.9				
		61.7	160.3	170.0	180.2	191.0	119.9			
			61.7	160.3	170.0	180.2	191.0	89.9		
				61.7	160.3	170.0	180.2	191.0	89.9	
					61.7	160.3	170.0	135.1	191.0	89.9
	61.7	222.0	392.0	572.2	763.2	821.4	661.1	416.0	280.9	89.9
Redemption						6025.2	6025.2	6025.2	6025.2	6025.2
Total Cash Outflow	61.7	222.0	392.0	572.2	763.2	6846.6	6686.3	6441.2	6306.1	6115.1
Inflow on account of Tax Receipts (i) Income Tax	15.2	54.9	96.9	141.5	188.7	203.1	163.4	102.9	69.42	22.2
Net Cash Outflow (6% Inflation)	46.5	167.1	295.1	430.7	574.5	6643.5	6522.9	6338.3	6236.7	6092.9

Statement 4 : Cash-Flow of Index-linked Bonds (9 per cent Inflation)

(Rs. Crore)

Year	1	2	3	4	5	6	7	8	9	10
Issue	5000.0	5000.0	5000.0	5000.0	5000.0					
Interest @ 3 %	62.4	165.4	180.3	196.5	214.2	137.4				
		62.4	165.4	180.3	196.5	214.2	137.4			
			62.4	165.4	180.3	196.5	214.2	103.1		
				62.4	165.4	180.3	196.5	160.6	103.1	
					62.4	165.4	180.3	147.3	160.6	103.1
	62.4	227.8	408.1	604.6	818.8	893.8	728.4	411.1	263.7	103.1
Redemption						6920.9	6920.9	6920.9	6920.8	6920.8
Total Cash Outflow	62.4	227.8	408.1	604.6	818.8	7814.7	7649.3	7332.0	7184.5	7023.9
Inflow on account of Tax Receipts (i) Income Tax	15.4	56.3	100.9	149.5	202.4	221.0	180.1	101.6	65.2	25.5
Net Cash Outflow	47.0	171.5	307.2	455.1	616.4	7593.7	7469.2	7230.4	7119.3	6998.4

Statement 5 : Cash-Flow of Non Index-linked Bonds

(Rs. Crore)

Year	1	2	3	4	5	6	7	8	9	10
Issue	5000.0	5000.0	5000.0	5000.0	5000.0					
Interest @ 13%	260.0	650.0	650.0	650.0	650.0	390.0				
		260.0	650.0	650.0	650.0	650.0	390.0			
			260.0	650.0	650.0	650.0	650.0	390.0		
				260.0	650.0	650.0	650.0	650.0	390.0	
					260.0	650.0	650.0	650.0	650.0	390.0
	260.0	910.0	1560.0	2210.0	2860.0	2990.0	2340.0	1690.0	1040.0	390.0
Redemption						5000.0	5000.0	5000.0	5000.0	5000.0
Total Cash Outflow	260.0	910.0	1560.0	2210.0	2860.0	7990.0	7340.0	6690.0	6040.0	5390.0
Inflow on account of Tax Receipts (i) Income Tax	64.3	224.0	385.7	546.4	707.1	739.3	578.6	417.9	257.1	96.4
Net Cash Outflow	195.7	685.0	1174.3	1663.6	2152.9	7250.7	6761.4	6272.1	5782.9	5293.6

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