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Effects of Public Investment in Infrastructure on Growth and Poverty in India

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Abstract

Counter factual policy simulations of sustained increase in public investment in infrastructure, financed through borrowing from commercial banks, shows substantial increase in private investment and thereby output in this sector. Further, due to increase in absorption, real private investment and thereby output in all the other three sectors also seems to increase, which sets-in motion several other macro economic changes. A 20% sustained increase in public investment in infrastructure, which is 0.5% of GDP and 2.7% of total govt. revenue in 2000-03, can accelerate the real macro economic growth by 1.8% in the medium to long-run (6-10 years after the policy change). This will be accompanied by a 1.4% fall in wholesale price index and 0.2% decline in the rate of inflation. Sectoral prices, except that of agriculture, also decline to varying extent, the steepest decline being for infrastructure price. Further, this increase in income will lead to 0.7% reduction in poverty in rural India. This shows the potential for achieving the much-debated 10% aggregate real GDP growth in the Indian economy.

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I. Introduction

There has been a lot of public debate in recent months, particularly after the presentation of annual central budget for 2006-07 by the Union Finance Minister, Mr. P. Chidambaram, about (a) the need for achieving 10% GDP growth and its feasibility, (b) the role and potential of infrastructure sector in achieving the desired GDP growth and (c) the ways and means of raising resources for public investment in infrastructure sector and particularly the use of accumulated foreign capital inflows for this purpose. This paper attempts to address these issues and seek quantitative answers in a macro economic theoretical framework. The tool of counter factual policy simulation is used for this purpose. The answers to the above questions seem affirmative as detailed below[2].

A macro econometric model is as a system of simultaneous equations, seeking to explain the behavior of key economic variables at the aggregate level, based on the received theories of macroeconomics. Macro econometric modeling, in general, pursues two objectives: forecasting and policy analysis. The latter objective is the focus of this study. Fiscal and monetary policies are the foremost policies that are virtually analyzed in macro econometric models from their inception.

This paper attempts to utilize the tool of an aggregative, structural, macro econometric model to analyze the macroeconomic effects of changes in selected exogenous variables for India. Before we give the details of the selected model, its estimation etc., it would be useful to briefly look at the literature on this topic pertaining to India. A detailed review of macro econometric models built for Indian economy is beyond the scope of this paper[3]. Since this study proposes to analyze the economy from a monetary framework, it

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[2] While browsing through the literature on infrastructure sector in India, we came across the most comprehensive study by the 'Expert Group on the Commercialization of Infrastructure Projects' with Dr. Rakesh Mohan as Chairman. Their report, submitted in 1996, has examined in detail all aspects of this most crucial sector and made policy recommendations relating to its commercialization, role of capital markets, the necessary regulatory framework, fiscal reform, and sub-sector specific issues for the post-reform period. We are thankful to Dr. Dinesh Singh for bringing this reference to our notice.
[3] A comprehensive review of macro econometric models and policy modeling for India can be found in Krishnamurty (2001), Pandit and Krishnamurty (2004) and Bhattacharya and Kar (2005).

would be worthwhile to look into how the monetary sector was modeled in the Indian context[4]. This will be useful for identifying the research issues pertinent to this study.

Modeling monetary sector and its links with fiscal and external sectors became a challenging task in India after 1970s. Modeling money and monetary policy for the determination of real output and price level has increased considerably in India (e.g. Rangarajan and Mohanty, 1997 and Rangarajan, 2000). In these models, stock of money varies endogenously through feedback from reserve money, which changes to accommodate fiscal deficit and changes in foreign exchange reserves. The output supply is determined by real money balances and net capital stock, both with lags; while the price level depends on the money supply and production. Some models attempt to link the real, monetary and fiscal sectors [e.g. Krishnamurty and Pandit (1985) and Murty and Soumya (2006a)].

Public investment adds to real capital stock, which in turn increases the real output. Analysis of the effect of public investment on private investment indicates crowding-in (e.g. Krishnamurty and Pandit, 1985). More recent assessment suggests the weakening of this phenomenon in the last decade possibly due to resource constraint and the negative price effect of public investment financed by fiscal deficit (e.g. Krishnamurty, 2001; IEG-DSE, 1999; Rangarajan and Mohanty, 1997).

Modeling the external sector was not a major concern in the earlier models, because of restrictions on trade. But, in the recent years, several models emerged with detailed emphasis on the external sector and it's interlinks with the monetary and fiscal sectors. Krishnamurty and Pandit (1996) modeled the merchandise trade flows in supply-demand framework and included disaggregated output, prices and investment behavior.

Macroeconomic impact of fiscal deficit on balance of payments in India is an emerging issue in recent years since the inception of stabilization program. Rangarajan and Mohanty (1997) postulated that fiscal deficit increases the absorption in the economy relative to output and the output effect of deficit follows with a lag.

In a recent paper, Sastry et. al. (2003), have analyzed the sectoral linkages between agriculture, industry and services in the Indian economy. The study emphasized the role of agriculture through its demand linkages with other sectors in determining the over-all growth of the economy. The next section outlines the methodology and the proposed model of this study.

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[4] A good review of monetary sector models was provided by Jadhav (1990).

II. Methodology and Proposed Model

This paper tries to extend the work by the authors (Murty and Soumya, 2006a), wherein they attempted to build a small macro econometric model for India using the absorption approach of Polak. Both these efforts extensively utilize the work of Rangarajan and Mohanty (1997). Some important changes to expand that model and to address the theme of this paper have been made. The basic model is monetarist in focus. The model emphasizes the inter-relationships between internal and external balances and also the relation between money, output, prices and balance of payments.

The model strives for a balance between the two polarized approaches of the classicals and the Keynesians. While classicals contend that changes in money supply, ultimately results in changes in the price level, the Keynesians on the other hand postulate that the changes in money supply eventually leads to changes in output, under conditions of less than full employment. Viewing reality lying somewhere in between these two extremes, one can postulate that changes in money supply affect both the output and the price level. Thus, the model tries to capture the effects of changes in money supply on both output and price level.

The model mainly focuses on the determination of money supply and its links with fiscal operations and the impact of money stock on output. It is postulated that real money balances or credit affects output besides the real capital stock. An increase in real credit results in monetary expansion, which in turn has an effect on aggregate output and price level. A rise in output through increase in credit neutralizes the rise in price level caused by monetary expansion. Further, RBI credit to finance the fiscal deficit, the latter defined as govt. total expenditure less govt. total receipts, causes money supply to increase endogenously with the rise in reserve money. This monetary expansion again affects the price level and output to a lesser extent, and the cycle continues.

In the proposed model, private investment is assumed to be explained by (a) public investment in that specific sector, (b) real interest rate, (c) public sector resource gap and (d) sectoral output price. The public sector resource gap variable, defined as the difference between gross public sector savings and investment, is common to all the four sub-sectors and expected to have a negative correlation with private investment. Based on the net effect of the above four explanatory variables of private investment, we classify whether there exists 'crowding-in' or 'crowding-out' between public and private investments. If the net effect is positive (negative), we say that there exists crowding-in (crowding-out) respectively.

The proposed model also incorporates the savings-investment identity through current account balance. It also has an interest rate equation, in a reduced form. The interest rate determinants are changes in bank credit to commercial sector, current account balance, rate of inflation and equilibrium level of gross domestic savings.

External sector is modeled through demand (and supply) for exports, demand for imports and BOP identity. Assuming equilibrium in the exports market, the export supply function is specified as a price equation for unit value of exports. It incorporates world real income, relative price and the export price of the rest of the world. The export demand depends on relative export price and the real domestic income. The import demand function depends on the domestic absorption and the relative import price. The nominal exchange rate is a function of domestic price level, current account balance and the change in foreign assets of RBI.

In order to link the economic growth with poverty reduction, the model postulates a simple relationship between head count ratio and the per capita real income, separately in rural and urban areas.

Proposed Model

Based on the methodology outlined above, we propose the following model[5], which consists of 4 blocks- real, fiscal, monetary and external sectors. These 4 blocks are regrouped into 3 separate modules for econometric estimation. Module-I consists of all macro economic equations covering fiscal, monetary and external sectors. Module-II covers all real sector equations, which include production[6], investment, and prices. Module-III has only two equations representing rural and urban poverty ratios. **The description of variables is given in the Appendix-II.**

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[5] The explanatory variables given in each equation are those actually found to be empirically suitable after careful search process during estimation. It is therefore more appropriate to call the given model as 'selected model' instead of 'proposed model'.
[6] The underlying equations are some what modified production functions in the sense that some other related variables viz. infrastructure output appears as 'intermediate input' in the production of agriculture, while the aggregate demand variable included in manufacturing sector.

Module-I: Fiscal, monetary and external sectors

Fiscal Sector:

    (1) DT $= f$ (YNAR, PGDP)

    (2) DIT $= f$ (Y)

    (3) NTX $= f$ (YM)

    (4) CONS $= f$ (YM/P)

    (5) PC $= f$ (PYDR)

    (6) FD $= f$ (GXP, TR, $(P-P_{-1})/P_{-1}$)

Monetary Sector:

    (7) P $= f$ (YR, M_3, IB)

    (8) M3 $= f$ (RM)

    (9) IB $= f$ ((Δ BCP + CAPB), $(P-P_{-1})/P_{-1}$, SAV)

External Sector:

    (10) EXPT $=$ f (UVIX/EXR/WPEXP, WYR)

    (11) UVIX $=$ f (P/EXR, WYR, WPEXP, $EXPT_{-1}$)

    (12) IMPT $=$ f (UVII*EXR/P, AD)

    (13) EXR $=$ f (P, CAB, ΔRBFA)

Link equation

    (14) PGDP $= f$ (P)

Module-II: Real Sector

Production functions

    (15) YAR $= f$ (RAIN, AREA, $KAGR_{-1}$, $YINFR_{-1}$)

    (16) YMNR $=$ f (ADD, KMNR)

    (17) YINFR $=$ f ($KINFR_{-1}$, $M_{3\,-1}/P_{-1}$)

    (18) YSRR $=$ f ($KSRR_{-1}$, M_3/P)

Investment functions

    (19) PIAG $= f$ (YAR_{-1}, $PCFAG_{-1}$, $PIINF_{-1}$, Real IB, $PSRG_{-1}$, PRAG)

        where PSRG: Public Sector Resource Gap = PCFSAV/PGKE–PCFTOT

    (20) PIMN $=$ f (PCFMN, PIINF, Real IB, PRMN)

    (21) PIINF $=$ f ($PCFINF_{-1}$, PRINF)

    (22) PISR $=$ f (PCFSR, $PIINF_{-1}$, Real IB, PRSR)

    (23) DEPAG $= f$ ($KAGR_{-1}$)

    (24) DEPMN $= f$ ($KMNR_{-1}$)

(25) DEPINF = f (KINFR$_{-1}$)

(26) DEPSR = f (KSRR$_{-1}$)

<u>Output Prices</u>

(27) PRAG = f (YAR, PYDR, P)

(28) PRMN = f (P)

(29) PRINF = f (YINFR, PYDR, P)

<u>Module-III:</u> Poverty Ratios

(30) HCRRUR = f (PYDR/NTOT)

(31) HCRURB = f (PYDR/NTOT)

Identities:

1. PYD   =   YM – TR + TRP + PYDIFF
2. PYDR   =   PYD / P
3. Y   =   YR * PGDP
4. YR   =   YAR + YNAR
5. YNAR   =   YMNR + YINFR + YSRR
6. YM   =   Y+DIT+YMDIFF
7. KAGR   =   KAGR$_{-1}$ + PIAG + PCFAG – DEPAG
8. KMNR   =   KMNR$_{-1}$ + PIMN + PCFMN - DEPMN
9. KINFR   =   KINFR$_{-1}$ + PIINF + PCFINF - DEPINF
10. KSRR   =   KSRR$_{-1}$ + PISR + PCFSR - DEPSR
11. PCFTOT =   PCFAG + PCFMN + PCFINF + PCFSR
12. PITOT   =   PIAG + PIMN + PIINF + PISR
13. ABSP   =   PC + PITOT
14. ADD   =   ABSP + CONS + PCFTOT + EXPT – IMPT
15. AD   =   ADD + IMPT
16. GCFADJ =   GCFDIFF + (PCFTOT + PITOT) * PGKE
17. SAV   =   GCFADJ - CAPTR + CAB
18. GXP   =   CONS * P + TRP + PCFTOT * PGKE
19. TR   =   DT + DIT + NTX
20. ΔRCG   =   FD - ΔBCG - DNB - EB – MISCR
21. RM   =   RCG + RBCS + RBFA + GCL - RNML + MISL
22. BCP   =   M3 - RCG - BCG - RBFA - GCL + RES
23. TB   =   UVIX * EXPT - UVII * IMPT
24. CAB   =   TB + INVISB
25. BOP   =   CAB + CAPB

III. Trends and patterns in Indian macro economy

It is important to understand the trends and patterns in the observed data, before estimating the proposed model and using it for counter factual simulations. This provides a backdrop for interpreting the empirical results to be obtained. The data were taken from the

National Accounts Statistics (NAS), published by CSO, and the Handbook of Statistics on Indian Economy, published by the RBI. The poverty estimates are based on the National Sample Survey (NSS) data.

The study period is 1978-79 to 2002-03. Although data are now available for two more recent years for GDP and few other variables, there are gaps for many other variables and therefore we confined our analysis to the above period. For any macro econometric model, the choice of sectoral break-up is very important and it determines the over-all size of the model. Here, we chose a 4 sector disaggregation for the investment and outputs of the real sector from the NAS. These four sub-sectors are (a) agriculture including forestry & fishing (Industry group 1), (b) manufacturing including mining (Industry groups 2 and 3), (c) infrastructure, which includes electricity, gas, water supply; construction; and transport, storage & communication (Industry groups 4, 5 and 7) and (d) services sector, covering all other activities (Industry groups 6, 8 and 9). For simplicity of reference these four sub-sectors are called (i) agriculture, (ii) manufacturing, (iii) infrastructure and (iv) services respectively, in the rest of the document.

Most of the variables for the real and external sectors used in the econometric analysis are in real form (constant 1993-94 prices) to avoid inflationary effects. The monetary and fiscal variables are in current prices. All price variables are indices with 1993-94 as unity. To study the macro economic trends, decade-wise annual average compound growth rates for all the variables are computed using semi-logarithmic regressions[7] and are given in Appendix-I, Table-1. To analyze the structural changes/patterns, average levels and percentage shares of important variables are also given in Appendix-I, Table-2. A few variables are also plotted to understand visually the trends and fluctuations in them (Chart-I).

Output and Prices

Real gross domestic product at factor cost, an indicator of total economic activity or proxy for real income, grew by a moderate 5.7% p.a. during the entire study period 1980-81 to 2002-03. The relatively good performance of the Indian economy during post-'80s, compared to earlier period, is attributable to the better utilization of industrial capacity and favorable demand conditions. The real output growth has accelerated from 5.4% during '80s to 6.2% during '90s. Between 1993-03, the post-liberalization decade, which is also our data period for policy simulation analysis, the real output has grown at 6% p.a., which implies a

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[7] Due to volatility in the data for certain variables, the compound growth rates for the sub periods do not match well with that of the entire period. To avoid this, some analysts recommend smoothing of the series using moving average method before computing growth rates. This has not been done here.

significant slowing down in the economy during 2000-03. Real per capita output (income) also shows similar trends.

The above aggregate growth was made possible through differential sectoral growth: Agricultural output grew by 3%, manufacturing by 6.6%, infrastructure by 6.5% and services sector by 7.2% during 1980-03. From the decade-wise trends, it is clear that the manufacturing sector has slowed-down secularly, while infrastructure and services have accelerated. Agriculture has shown acceleration during '90s, but decelerated later. Some analysts attribute this slowing down of the Indian economy during 2000-03 period, to supply related 'infrastructural bottlenecks', which perhaps is due to deceleration of investment in this crucial sector (See also Shetty, 2001 for similar findings)[8].

The growth rate in the wholesale price index fluctuated between 6.6-7.8%, which declined to 5.5% during 1993-03. The rate of inflation declined at differential rates, the most rapid decline (12.7%) being during '90s. The decline became slower during 1993-03. The national income deflator, shows similar trends but at 0.5-1% higher level. Sector specific GDP deflators (proxies for sectoral output prices) also show varying rates of changes, the slowest growth (7.2%) being for manufacturing output price and the most rapid (9.4%) for infrastructure output price. The agricultural output price grew at 9.0% p.a. during the entire study period, 1980-2003. The recent decade shows deceleration in these prices as well.

The real GDP share in agriculture fell from 36.4% in '80s to 29.1% in '90s and it stood at 26.5% during the recent decade (1993-03), a sizable decline of 10 percentage points. The non-agriculture exhibits the opposite pattern. Within the non-agriculture, share of the services sector is the largest, accounting for more than one-third of the GDP. The share has gone-up from 32.3% in '80s to 37% in '90s and more recently to 38.8% of the GDP. The GDP share of infrastructure remained stagnant around 14-15%, although the GDP level has roughly little over doubled. The GDP share of manufacturing sector improved marginally from 17.6% in '80s to 19.4% in '90s and even subsequently. Thus, there is a structural shift in production from agriculture to infrastructure and services in the Indian economy.

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[8] Perhaps anticipating this, the 'expert group' has made projections of yearly investment requirements during 1996-2006 in order to achieve the desired 8.5% GDP growth in India by 2005-06. The required total investment in infrastructure over the 10 year period 1996-2006 is estimated at Rs. 750,000 crores, with a break-up of 85% from domestic and 15% external sources. The share of infrastructure investment in GDP is projected to increase from 5.5% in 1994-95 to 7% in 2000-01 and 8% in 2005-06. However, in retrospect, we notice that the share of infrastructure investment (out of GDP) declined to merely 3.5% in 2002-03. The desired GDP growth seems to have been achieved despite this decline.

Investment and savings

During 1980-03, real public investment in agriculture and manufacturing sectors has declined by 2.1% and 0.1% respectively, whereas real public investment in infrastructure and services sectors grew by 3.9% and 3.7% respectively. These investment trends are consistent with the production trends discussed above. The public investment in all sectors put together grew by 2.5% in the study period. In fact, the public investment growth has decelerated from 4.5% during '80s to 2.2% during '90s. In the post-liberalization period, the growth is only 1.1%. This is the result of massive disinvestment of public sector units in the country during post-90s.

To a certain extent, private investment has substituted for public investment. Private investment in agriculture, manufacturing, infrastructure and services sectors grew by 4.2%, 6.9%, 5.9% and 6.3% respectively in the entire study period. Private total investment in all sectors grew by 6.3% in the study period. Between '80s and '90s, private investment accelerated in agriculture and manufacturing (substantially), but nearly stagnant or decelerated in the other two sectors. In the post-'93 period, except in agriculture, private investment slowed down in all the three other sectors. The graphs depicting investment shares also confirm this.

Nominal gross domestic savings in the economy has been growing at an average rate of 16.2% during 1980-'03, which is 0.6% faster than the growth in nominal gross investment (15.6%). However, both gross domestic savings and investment seem to have decelerated by about 4% p.a. during the recent decade[9]. These trends indicate that there has been some disillusionment in the investment climate during post-'93 period in India. The reasons could be fall in demand and recessionary conditions in the Indian economy.

Fiscal and monetary variables

In developing countries, the finances of the government play an important role in the growth of the economy. Govt. total expenditure consists of current and capital expenditures. The nominal total govt. expenditure has decelerated from 16.2% in '80s to 14.1% in '90s. The govt. consumption expenditure, however, accelerated from 15.4% to 16.3%. Therefore, the deceleration in govt. expenditure can solely be attributed to the deceleration in investment. These trends continued into 1993-03 period as well. Although the nominal govt. direct tax collection has accelerated, the total revenue seems to have

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[9] Not with standing this deceleration in domestic savings (and investment), there are serious criticisms about the over estimation of the rate of domestic savings during recent years by the CSO (e.g. Shetty, 2005, 2006). Dr. Shetty puts the extent of over estimation in the savings rate around 3-4% during 2000-03.

decelerated. Some fiscal prudence has led to deceleration in the fiscal deficit over the years. In fact, fiscal deficit decelerated from 18.7% in '80s to 15.8% in '90s. However, the govt. seems to have lost control over fiscal deficit again during 1993-03. Money supply grew more or less steadily at about 17% during the study period. Nominal interest rate grew marginally during '80s by 0.8% p.a., but dropped significantly since then and the trend continued.

External sector

Real export growth from the country has accelerated rapidly from 5.1% in '80s to 10.8% in '90s, with an overall growth of 9.5% p.a. Exports seems to have picked-up again (10.6%) during 1993-03. The unit value of exports, proxy for export price, has increased slower than export quantity during most of the period except during '80s and much slower in the recent decade. The export competitiveness was facilitated by significant depreciation of Indian rupee (9.4%) against the US$, in addition to rise in unit value of exports. Despite rupee depreciation, growth in real imports has accelerated very rapidly from 7.3% in '80s to 14.7% in '90s, mainly due to higher demand. A substantial part of these imports could be POL imports, which have become essential both as inputs and final consumption goods. The import growth however seems to have slowed down to 7.8% during 1993-03. The nominal trade balance, as expected, has been negative and highly volatile, particularly during the '90s and thereafter. The opening-up of the economy must have been largely responsible for this.

Poverty ratios

The data on the head count (poverty) ratios, separately for rural and urban India, are taken from Radhakrishna et. al. (2004) and Panda (2006). The poverty estimates in these studies are obtained using data from the NSS, which are on calendar-year basis for some years and crop-year (July-June) for others. There are also gaps in the data for some years due to non-existence of NSS rounds. In order to match NSS rounds with NAS time series, simple average of two adjacent years is used wherever necessary. For the purpose of estimating regressions, the data are interpolated for missing years. We know that this is not a very satisfactory way, but there is no other alternative. The poverty ratios shows declining trend, though with some fluctuations, in both rural and urban areas. The rate of decline also seems to have been slowed down in recent years. The fluctuations are more in the rural poverty estimates. The head count ratio declined by about 3-5% during the study period.

In summary, the above trend analysis shows that the macro economy has been under severe stress with high volatility and slowing down of investment and economic growth

12

during the mid '90s and thereafter. However, the infrastructure and services sectors seem to hold some hope. This paper therefore tries to look at the potential of increasing public investment in the infrastructure sector as a vehicle for accelerating economic growth and reaching the much debated 10% GDP growth in India.

IV. Estimated Model

The proposed macro econometric model consists of 4 blocks- real, fiscal, monetary and external sectors. It has 56 endogenous variables (31 equations and 25 identities) and 35 exogenous variables. For convenience of estimation and future improvements, the model is estimated in three separate modules (I, II and III) using 3SLS method for each module. The module-I contains all the macro economic relationships except the real sector equations, which are put into module-II. Module-III has only 2 equations representing rural and urban head count (poverty) ratios. Due to lags and use of rate of change in some variables, the actual estimation uses data for 1981-82 to 2002-03.

While estimating the model, a TREND variable is included in some equations to capture the autonomous time related changes in the endogenous variables. Dummy variables are included in the model to separate the pre- and post-liberalization (1991-92 onwards) effects (Dummy2) and also to capture the abnormal fluctuations in the data for certain variables (Dummy1, Dummy3, Dummy4, Dummy5 and Dummy6). The choice of the equations was guided by expected sign as well as statistical significance for the coefficients and high goodness-of-fit, including absence of serial correlation for residuals. It may be mentioned that the choice of lag length for various determinants was also guided by expected sign and significance. It involved careful search process. The finally selected model is given in the Appendix-II.

A perusal at the estimated model indicates that the model is estimated quite well. Almost all the regression coefficients, except few (4 to be precise out of 124 coefficients), are significant at 5% or less. The signs of the coefficients also look appropriate, a priori. However, despite our best efforts, some of the equations still seem to suffer from the problem of serial correlation. In order to understand the direction and relative magnitude of response of each determinant on the dependent variable, the estimated mean partial elasticities are also given in each equation. It is important to note however that the direction and size of response implied by these mean partial elasticities is only indicative and the net impacts measured through policy simulations are likely to be different from these mean partial elasticities. For this reason, the interpretation of the individual coefficients may be of less importance except

making few observations on the implied incremental capital-output ratios (ICOR) for different sectors and the direction of association between some important variables in the model.

From the coefficient of the net capital stock variable in the agricultural production function, the implied ICOR in agriculture is low at 1.5. Thus, there exists significant (nearly unitary) output response in Indian agriculture with respect to capital stock. It is interesting to note that there is a significant complementarity between outputs of agriculture and infrastructure, the latter acting as an essential input to the former. The other two sectors, manufacturing and services, do not exhibit this feature. In the manufacturing sector, which includes mining and quarrying, the implied ICOR is very high at 13.8, indicative of low productivity of capital or high capital intensity[10]. For the infrastructure sector, the implied ICOR of 7.6 is some what high and reflect the relatively high capital intensity of this sector. The implied ICOR of the services sector is low at 2.2. The real balances (credit) variable seems to play an important and positive role in the production of both infrastructure and services sectors. This confirms our main proposition that changes in money supply affects both output and prices, which in turn causes several macro economic effects.

In all the four sectors, public investment variable has a positive coefficient in the respective private investment equations and sets the stage for crowding-in effect between public and private investments. The resource-gap variable also seems to contribute to this phenomenon in the agriculture sector alone. With the exception of infrastructure sector, rather surprisingly, the real interest rate (current or lagged) seems to be significant despite it being regulated by the central bank until recently. It is interesting to notice significant cross complementarity between private investments in infrastructure and all the other three sectors as well. This is contrary to the belief that private sector is less enthusiastic in investing in infrastructure and expects the govt. to invest first.

From the estimated general price equation, with increase in money stock (and also interest rate), the whole sale price index will go up by a negligible percentage. An increase in real aggregate output, ceteris paribus, will decrease the whole sale price index by a small magnitude. Assuming demand-supply equilibrium (market clearance)[11] for three sectoral

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[10] The estimated coefficient (and hence the ICOR) of the net capital stock variable in the production of manufacturing sector seems some what sensitive to the inclusion of time trend variable in the regression. For manufacturing sector, the ICOR is inflated due to inclusion of time trend variable. In general, the time trend variable in a production function is expected to account for all omitted variables including changes in technology.

[11] It may be mentioned that the output equations are 'production', but not 'supply' functions and therefore it is not conventional 'market equilibrium'. Further, the output price of services sector is assumed exogenous to the model keeping in mind the increasing share of IT, banking, insurance and other services after globalization. There exists large heterogeneity in the constituents of this sector and endogenous determination of its price in a simple demand-supply framework may be difficult to justify.

outputs namely agriculture, manufacturing and infrastructure, we use inverse demand functions to estimate their output prices. Based on these, sectoral outputs of both agriculture and infrastructure seem to exert a larger pressure on their respective output prices (deflators). A surprising exception is the manufacturing sector, where output has no significant effect on the sectoral price. Perhaps, mark-up pricing, rather than demand-supply, may be appropriate for this sector. For all the above three sectoral prices, wholesale price index exhibits (positive) near unitary elasticity; while real personal disposable income has elastic positive response for only agriculture and infrastructure sectors. Manufacturing price seems independent of real personal disposable income, again puzzling a bit.

Government nominal revenue from direct taxes and indirect taxes as well as non-tax revenue seem to increase with income. Government consumption expenditure also increases with income. The export, import demand functions and nominal bilateral exchange rate equations have expected signs for their determinants.

As expected, the head count (poverty) ratio is inversely related to per capita real income in both rural and urban areas. This seems to be the broad linkage between economic growth and poverty reduction. It underlies the familiar 'trickle down' hypothesis, with all its limitations. In reality, the nature and extent of (absolute) poverty depends on several socio-economic factors, real income being only one of them.

V. Simulation methodology

To assess the empirical adequacy of the full model in describing the historical data, EViews package was employed to solve the 56 relations together iteratively for each year with deterministic simulation and dynamic solving options for the entire sample period, 1981-82 to 2002-03. The simulated values for the above period are also called the 'base simulation' values. Assessment of the full model was done by (a) comparing the time series plots of actual and base simulation values and (b) computing the summary measures, mean absolute percentage error (MAPE) and root mean square percentage error (RMPE). Based on all these three criteria, the base simulation was found to trace the historical data quite well. Due to limitation of space, these details are omitted here.

The allocative and dynamic effects due to the above exogenous/policy change are quantified as percentage changes, also known as multipliers, with reference to base simulation values. They are reported only at four points of time, namely response in the same

year of exogenous change (immediate or instantaneous or impact), response after one year (short-term), response between 3-5 years (medium term) and response between 6-10 years (long-term). Since the responses change each year rather slowly, the medium-term and the long-term responses are simple averages of the respective time periods. In the case of head count ratio, rate of inflation, rate of interest and trade balance, the impacts are changes in level, not rates of change. It may be mentioned that these percentage responses are contemporaneous in nature (policy simulation vs. base simulation) and should not be treated as usual percentage rate of change over time. These responses therefore are likely to be different from the direct responses (both partial and net) implied by the estimated equations. The results of counterfactual simulations are discussed in the next section.

Counterfactual Policy Simulations

The main purpose of this paper is to analyze the impacts of hypothetical sustained[12] change(s) in public sector real investment in the infrastructure sector financed through borrowing from commercial banks. These changes are envisaged to be implemented from the year 1993-94. The policy simulation can be done for any sample period or even post-sample period. Here, the period 1993-'94 to 2002-'03 is chosen because it covers the first decade after the implementation of economic reforms and their taking roots into the economy. The scenario results are presented in Table-1. The simulation impacts for a few important variables are also plotted (Charts-II& III).

Sustained 20% increase in public sector real investment in infrastructure sector financed through borrowing from commercial banks:

It is hypothesized that the govt. will raise the necessary investment resources through borrowing from commercial banks. In this simulation therefore, both the exogenous variables, real public investment in infrastructure (PCFINF) and commercial bank credit to govt. (BCG) are increased by 20% of PCFINF each. Since BCG is in nominal terms, the amount of bank credit to govt. is expressed in current prices using gross investment deflator (PGKE). Assuming competing needs for money, in other words 'liquidity crunch', the bank credit that was available to commercial sector earlier (in base simulation) will be lesser in the policy simulation by the amount borrowed by the govt. for investment in the infrastructure sector. Such a policy will reduce the reserve bank credit to the govt. and thereby reserve

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[12] Some analysts prefer to hypothesize one-period or shock-type exogenous change. If the underlying estimated model is dynamically stable, the impacts of any one-period exogenous change should decay over time and all the endogenous variables return to base simulation levels. In other words, shock-type simulations are inappropriate for studying long-term policy effects. The present model confirmed this property.

money and money supply. Changes in money supply will trigger several other changes in the economy. A sustained 20% increase in public real investment in infrastructure[13], envisaged as above, has both short- and long-run effects on all the sectors of the Indian economy. The impacts and the dynamic multipliers are given in Table-1 and graphs comparing baseline and policy simulated values are given in Charts-II& III.

Impacts:

From the estimated model, it can be seen that public investment in infrastructure can affect private investment in that sector **only with a one-year lag**. This probably is due to gestation lags and delays. However, there is another important channel namely the monetary (or interest rate) channel, which can bring about crowding-in or crowding-out depending on the sign and magnitude of the coefficient[14]. Yet another channel is the output price channel, which is highly significant here. The 20% increase in public investment in infrastructure in 1993-94 increased gross investment (3.5%) thereby savings (3.4%) and hence the nominal interest rate fell (0.2%). Although, this has no direct effect on private investment in infrastructure in 1993-94 due to lagged response, the fall in interest rate has a net negative effect on price of infrastructure goods through the monetary (price) channel and hence on private investment in infrastructure, implying a very small (0.1%) net crowding-out effect on private investment in that year.

Similar is the case with private investment in all the three other sectors, wherein the interest rate channel is also present and reinforcing the monetary channel. But, the impacts are smaller is the case of agriculture and services sectors. The aggregate private investment has therefore decreased negligibly (0.1%).

Further, there are other macro economic effects. Due to increased public investment, govt. expenditure (3.0%) and fiscal deficit (7.9%) will rise. Since the govt. is envisaged to borrow the required funds from the commercial banks, the govt. may not require any support from the central bank (RBI). In fact, the RBI credit to govt. has fallen (1.3%). This results in decline in reserve money (1.0%), money supply (0.1%) and prices (0.2%).

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[13] This constitutes Rs. 6927 crores in 1993-94 and Rs. 7494 crores in 2002-03 at 1993-94 prices. These expenditures, in nominal terms, are 4.5% and 2.7% of govt. total revenue; 0.9% and 0.5% of GDP in respective years. From the past experience, during 1993-03, both public and private investments in infrastructure have grown at 2% p.a. The average investment growth was higher at 3.9% and 5.9% during 1980-03 in the public and private sectors. The investment projections in infrastructure made by the 'Expert Group' for public and private sectors are much higher than what we are postulating. However, some analysts (e.g. Sastry et. al., 2003) believe that sustained public investment may not be possible under the present circumstances of resource crunch in the economy.

[14] But, rather surprisingly, the real interest rate channel is inoperative only for this infrastructure sector as the variable dropped out of the private investment equation due to statistical insignificance though it had correct (negative) sign.

Due to one-period lag for the net capital stock variable in the production function for the infrastructure sector, the output will increase only with a lag. Due to increase in investment, aggregate demand (absorption) in the economy will increase, thereby increasing total output negligibly (0.04%), mainly due to small output growth in manufacturing (0.2%) and services (0.02%) sectors. There will be a small decrease in GDP deflator (0.2%), leaving a decrease of 0.1% in nominal income. Nominal gross investment seems to increase by 3.5%, exceeding marginally the growth in nominal domestic savings (3.4%), necessitating adjustment with current account balance from the external sector.

On the fiscal side, the impacts in 1993-94 are small, except for govt. expenditure and fiscal deficit. Higher public investment will increase govt. expenditure (3.0%). Due to decline in nominal income, there will be a small fall in revenue from indirect taxes (0.1%) and non-tax revenue (0.1%) of the govt., leaving a large uncovered fiscal deficit (7.9%). Demand (supply) for Indian exports will rise (0.0%), due to negligible rise in relative export price (0.03%). Also, real imports into the country will rise (0.5%) due to cheaper import prices and higher absorption. The Indian rupee depreciates marginally (0.03%) against the US$. As expected, nominal trade balance and balance of payments will worsen (0.4%).

Since the head count ratio is inversely related to per capita real income, the former declines negligibly (0.0%) due to similar increase in the latter in both rural and urban areas in 1993-94, the year of 20% increase in public investment in infrastructure. Thus, growth in income leads to decline in poverty instantaneously, though very small in magnitude.

Short-run effects:

The impacts get strengthened by 1994-95 and subsequent years. Due to crowding-in effect, 20% increase in public sector investment in infrastructure in 1993-94 encourages private real investment in infrastructure by 10.4% in 1994-95, a significant positive (lagged) response of private sector. This implies a net (total) elasticity of 0.52 for private investment w.r.t. public investment in this sector. This value, incidentally, is very close to the partial elasticity (0.48) given in Appendix-II, Equation-21. Due to increase in real gross (and net) capital stock in infrastructure in 1993-94, there will be increase in infrastructure output (0.8%) this year. It is very interesting to note that private investment responds positively in all the other three sectors of the Indian economy, with lead role from the manufacturing sector (2.2%) followed by agriculture (0.7%) and services (0.0%) in that order.

The aggregate real private investment is expected to rise by 2.5% and output (real income) by 0.2% in 1994-95. The nominal income will however declines (0.1%) due a

steeper fall in the GDP deflator (0.3%).   This sets-in other macro economic effects. Prominent among these are increases in govt. expenditure (2.7%), revenue (0.2%), fiscal deficit (7.9%), money supply (0.2%) and imports (0.6%). Important variables which fell are GDP deflator and price level (0.3%), real exports (0.0%) and trade balance (0.7%). Growth in gross domestic savings (4.1%) continues to lag behind gross investment (4.3%), the gap bridged by current account balance.

By 1994-95, the decline in poverty gained momentum in both rural and urban areas. Due to larger increase in per capita real income, the head count (poverty) ratio declined by nearly 0.1% in both the areas. This implies that the percentage decline in poverty is roughly half the percentage increase in aggregate real income (GDP).

Long-run effects:

As expected, all these effects get strengthened further over time (since the policy is a sustained change) and lead to significant and wide spread real benefits to the economy. For example, after ten years (long-term), real gross capital stock in agricultural sector and thereby real agricultural income is expected to increase by a sizeable 1.2%, real aggregate income by 1.8%, with a moderate increase in money supply (0.9%). Therefore, general price level is expected to fall by 1.4% and rate of inflation by 0.2%.

Real exports will continue to decline (0.3%) and imports will increase (0.7%), resulting in a moderate deterioration in nominal trade balance (2.4%) and balance of payments. The current account balance is also expected to fall by the same extent. The Indian Rupee will appreciate by 0.4% against the US $. However, due to significant fall in prices (and GDP deflator), the nominal income increases by only 0.4%.

Two other alternative simulations are also attempted aimed at raising the necessary resources for public investment through utilizing (a) the foreign exchange assets (reserves) of the RBI and (b) the accumulated foreign capital inflows (capital account balance of BOP). The long-run effects of these two scenarios (Tables-2&3) are also found to be quite similar, the second alternative indicating a slightly higher GDP growth (2.0%) and money supply (1.2%). Since the required legal apparatus for the utilization of RBI foreign assets and more so for foreign capital inflows by the govt. appears not in place yet, probably, it may be easier for the govt. to borrow the required funds from the commercial banks by selling the conventional govt. security bonds. Thus, sustained public investment in infrastructure can provide the necessary push to the higher growth path of the Indian economy.

The approach paper by the Planning Commission for the 11th Five Year Plan documented that the Indian economy had registered an average 7% real GDP growth during the first 4 years of the current 10th Five Year Plan (2002-03 to 2005-06) and indicated the potential for achieving 9% real GDP growth. This study confirms such scenario provided the necessary infrastructural investments are made. If the more recent estimate of 8% or even higher GDP growth was true and sustainable, then our scenario projection will make it nearly 10% p.a. Further, it is interesting to note that in the long-run, the head count (poverty) ratio declined by 0.7% in rural and 0.6% in urban areas of India. This is a very significant result and offers credence to policy initiatives aimed at reducing poverty through economic growth[15].

VI. Summary and Conclusions

This study has analyzed the likely macro economic effects of changes in public investment in infrastructure in India. The quantified effects include the allocative and dynamic responses of the chosen policy change on important macro economic variables relating to four broad sectors- real, fiscal, monetary and external sectors of the Indian economy. The real sector further decomposed into four sub-sectors, agriculture, manufacturing, infrastructure and services. The sign and magnitude of the effects vary over time- immediate to long- run.

Briefly, the estimated model indicated significant crowding-in effect between private and public sector investment in all the four sub-sectors of the real economy. This has important consequences for investment/disinvestment policies of the govt. in each of these sectors. Sustained increase in public investment in infrastructure was found to stimulate sizable increase in private investment in all the sectors. Such a policy is expected to result in wide spread changes in the fiscal and monetary sectors of the economy. Thus, public sector investment in infrastructure has the potential to provide the much-needed push and accelerate the growth process of the Indian economy.

A 20% sustained increase in public sector investment in infrastructure (about Rs. 6900-7500 crores p.a. at 1993-94 prices) will enable the Indian economy to grow at an additional 1.8% and achieve the much debated 10% aggregate real GDP growth per annum in

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[15] Some recent studies (e.g. Himanshu 2006) aimed at decomposing the rate of decline in poverty into growth, inequality and population components indicate that the economic growth is the largest contributor to decline in poverty in urban India. However, some other analysts (e.g. Panda 2006) argue that growth may only be a necessary but not sufficient condition for poverty reduction.

the medium- to long-run[16]. Further, such growth is non-inflationary and welfare improving through higher govt. revenue and 0.7% reduction in poverty in rural and 0.6% in urban areas. The additional expenditure is about 0.5% of the GDP and 2.7% of the govt. total revenue in 2002-03. We believe that such investment is quite feasible and cost effective. An alternative simulation wherein the govt. utilizes accumulated capital inflows instead of borrowing from commercial banks, gave similar results, with few changes in external and monetary sectors. It must be mentioned that the major limitation of the study is its aggregative nature- both sectoral and spatial (all India). A more disaggregated model may give better insights into the process of the working of the Indian economy.

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[16] Shetty, 2001 suggests that the banking system can provide additional resources to the extent of Rs. 15000-16000 crores p.a. for infrastructure development in specific projects without causing inflation.

Table-1: Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by commercial bank credit.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Real Sector					
Nominal Income	816.87	-0.12	-0.08	0.27	0.41
GDP Deflator	1.02	-0.17	-0.31	-0.82	-1.41
Agriculture	1.07	-0.14	-0.09	-0.02	0.01
Manufacturing	1.00	-0.15	-0.27	-0.74	-1.22
Infrastructure	1.02	-0.14	-0.78	-2.62	-3.89
Real Income	800.91	0.04	0.23	1.10	1.84
Agriculture	241.80	0.00	0.00	0.58	1.23
Manufacturing	150.98	0.19	0.36	0.75	1.03
Infrastructure	114.83	0.00	0.77	3.16	4.51
Services	293.31	0.02	0.14	0.84	1.50
Real Private Investment	108.31	-0.07	2.50	3.60	3.51
Agriculture	11.20	-0.04	0.70	1.62	1.82
Manufacturing	46.10	-0.11	2.16	2.73	3.00
Infrastructure	15.93	-0.07	10.40	8.29	7.31
Services	35.08	-0.02	0.01	4.18	3.28
Real Private Consumption	581.48	0.01	0.12	0.70	1.27
Real Personal Disposable Income	727.48	0.01	0.16	0.92	1.58
Gross Domestic Savings (N)	191.71	3.36	4.06	4.42	3.59
Gross Investment (N)	196.42	3.49	4.33	4.68	3.99
Head Count Ratio-Rural (%)	38.90	0.00	-0.05	-0.33	-0.67
Head Count Ratio-Urban (%)	33.92	0.00	-0.04	-0.29	-0.58
Fiscal Sector					
Govt. Consumption (N)	94.30	0.04	0.26	1.71	3.34
Govt. Total Expenditure(N)	230.52	2.95	2.68	2.66	2.69
Govt. Revenue (N)	164.48	-0.03	0.18	0.96	1.35
Direct Taxes (N)	30.96	0.35	1.23	3.80	5.00
Indirect Taxes (N)	100.78	-0.11	-0.07	0.25	0.39
Non-tax Revenue (N)	32.74	-0.12	-0.08	0.28	0.41
Fiscal Deficit (N)	70.95	7.93	7.93	5.61	4.16

Table-1 contd..

Table-1 (contd.): Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by commercial bank credit.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Monetary Sector					
Money Supply	441.58	-0.09	0.22	0.72	0.92
Price Level	1.01	-0.16	-0.29	-0.79	-1.36
Rate of Inflation (%)#	8.51	-0.17	-0.15	-0.18	-0.17
Rate of Interest (%)#	11.78	-0.16	-0.17	-0.22	-0.29
External Sector					
Real Exports Demand	77.92	0.00	-0.03	-0.22	-0.30
Real Imports Demand	89.48	0.49	0.65	0.78	0.74
Unit Value of Exports	0.99	0.03	0.05	0.11	0.17
Exchange Rate (N)	30.45	0.03	0.02	-0.17	-0.45
Trade Balance (N)#	-12.64	-0.41	-0.70	-1.52	-2.35

*: Rs. '000 crores, except for GDP deflators, price level, rate of inflation, rate of interest, unit value of exports and exchange rate.
N: Nominal, i.e. current prices.
#: Changes in level.

Table-2: Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by RBI foreign assets.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Real Sector					
Nominal Income	816.87	-0.01	0.02	0.34	0.46
GDP Deflator	1.02	-0.02	-0.19	-0.73	-1.33
Agriculture	1.07	-0.01	0.02	0.06	0.07
Manufacturing	1.00	-0.02	-0.17	-0.67	-1.15
Infrastructure	1.02	-0.01	-0.61	-2.51	-3.79
Real Income	800.91	0.01	0.21	1.08	1.82
Agriculture	241.80	0.00	0.00	0.57	1.23
Manufacturing	150.98	0.10	0.36	0.76	1.03
Infrastructure	114.83	0.00	0.70	3.11	4.47
Services	293.31	-0.02	0.11	0.81	1.47
Real Private Investment	108.31	-0.01	2.56	3.62	3.54
Agriculture	11.20	-0.01	0.72	1.63	1.83
Manufacturing	46.10	-0.01	2.25	2.75	3.03
Infrastructure	15.93	-0.01	10.48	8.35	7.36
Services	35.08	-0.01	-0.02	4.17	3.27
Real Private Consumption	581.48	0.01	0.12	0.70	1.26
Real Personal Disposable Income	727.48	0.01	0.16	0.92	1.57
Gross Domestic Savings (N)	191.71	1.65	4.05	4.37	3.54
Gross Investment (N)	196.42	3.52	4.36	4.69	4.00
Head Count Ratio-Rural (%)	38.90	0.00	-0.05	-0.33	-0.67
Head Count Ratio-Urban (%)	33.92	0.00	-0.04	-0.28	-0.58
Fiscal Sector					
Govt. Consumption (N)	94.30	0.01	0.23	1.69	3.31
Govt. Total Expenditure(N)	230.52	3.00	2.71	2.69	2.71
Govt. Revenue (N)	164.48	0.01	0.22	0.98	1.37
Direct Taxes (N)	30.96	0.08	1.03	3.68	4.91
Indirect Taxes (N)	100.78	-0.01	0.02	0.32	0.44
Non-tax Revenue (N)	32.74	-0.01	0.02	0.35	0.47
Fiscal Deficit (N)	70.95	7.95	7.98	5.63	4.16

Table-2 contd..

Table-2 (contd.): Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by RBI foreign assets.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Monetary Sector					
Money Supply	441.58	-0.09	0.22	0.72	0.93
Price Level	1.01	-0.02	-0.18	-0.70	-1.29
Rate of Inflation (%)#	8.51	-0.02	-0.17	-0.19	-0.17
Rate of Interest (%)#	11.78	-0.01	-0.16	-0.21	-0.27
External Sector					
Real Exports Demand	77.92	-2.34	-0.33	-0.26	-0.34
Real Imports Demand	89.48	1.91	0.72	0.86	0.82
Unit Value of Exports	0.99	-0.32	0.32	0.10	0.16
Exchange Rate (N)	30.45	-1.91	-0.02	-0.25	-0.54
Trade Balance (N)#	-12.64	-3.74	-0.81	-1.75	-2.66

*: Rs. '000 crores, except for GDP deflators, price level, rate of inflation, rate of interest, unit value of exports and exchange rate.
N: Nominal, i.e. current prices.
#: Changes in level.

Table-3: Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by borrowing from BOP capital a/c balance.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Real Sector					
Nominal Income	816.87	-0.14	-0.14	0.08	0.11
GDP Deflator	1.02	-0.23	-0.46	-1.15	-1.88
Agriculture	1.07	-0.16	-0.16	-0.26	-0.29
Manufacturing	1.00	-0.20	-0.41	-1.04	-1.63
Infrastructure	1.02	-0.17	-1.10	-3.15	-4.59
Real Income	800.91	0.09	0.33	1.24	2.02
Agriculture	241.80	0.00	0.00	0.64	1.32
Manufacturing	150.98	0.19	0.37	0.75	1.02
Infrastructure	114.83	0.00	1.06	3.50	4.93
Services	293.31	0.15	0.28	1.02	1.73
Real Private Investment	108.31	-0.08	2.46	3.52	3.39
Agriculture	11.20	-0.03	0.70	1.61	1.81
Manufacturing	46.10	-0.15	2.08	2.61	2.80
Infrastructure	15.93	-0.08	10.26	8.01	6.92
Services	35.08	0.00	0.06	4.23	3.35
Real Private Consumption	581.48	0.03	0.16	0.77	1.37
Real Personal Disposable Income	727.48	0.04	0.22	1.00	1.71
Gross Domestic Savings (N)	191.71	3.34	4.01	4.33	3.51
Gross Investment (N)	196.42	3.48	4.30	4.63	3.93
Head Count Ratio-Rural (%)	38.90	-0.01	-0.07	-0.36	-0.72
Head Count Ratio-Urban (%)	33.92	-0.01	-0.06	-0.31	-0.63
Fiscal Sector					
Govt. Consumption (N)	94.30	0.09	0.38	1.93	3.64
Govt. Total Expenditure(N)	230.52	2.95	2.67	2.62	2.63
Govt. Revenue (N)	164.48	0.02	0.24	0.93	1.27
Direct Taxes (N)	30.96	0.64	1.76	4.45	5.71
Indirect Taxes (N)	100.78	-0.12	-0.12	0.07	0.10
Non-tax Revenue (N)	32.74	-0.14	-0.14	0.08	0.11
Fiscal Deficit (N)	70.95	7.85	7.80	5.54	4.14

Table-3 (contd.): Impacts and dynamic multipliers of 20% sustained increase in real public investment in infrastructure financed by borrowing from BOP capital a/c balance.

Variable	Base Simulation Level* (1993-94)	Multiplier (%)			
		Impact (1993-94)	Short-term (1994-95)	Medium-term (1995-98)	Long-term (1998-2003)
Monetary Sector					
Money Supply	441.58	0.38	0.62	1.02	1.15
Price Level	1.01	-0.22	-0.44	-1.10	-1.81
Rate of Inflation (%)#	8.51	-0.24	-0.24	-0.23	-0.21
Rate of Interest (%)#	11.78	-0.24	-0.29	-0.37	-0.48
External Sector					
Real Exports Demand	77.92	-0.05	-0.13	-0.41	-0.47
Real Imports Demand	89.48	0.48	0.63	0.74	0.69
Unit Value of Exports	0.99	0.04	0.07	0.15	0.22
Exchange Rate (N)	30.45	0.00	-0.07	-0.38	-0.76
Trade Balance (N)#	-12.64	-0.44	-0.77	-1.64	-2.45

*: Rs. '000 crores, except for GDP deflators, price level, rate of inflation, rate of interest, unit value of exports and exchange rate.
N: Nominal, i.e. current prices.
#: Changes in level.

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Table-1: Annual Average Compound Growth Rates (%) of important variables used in the model.

Variable	Annual Compound Growth Rate (%) during			
	(1980-89)	(1990-99)	(1980-03)	(1993-03)
Real Sector				
Nominal Income	13.9	15.2	14.5	12.4
GDP Deflator	8.1	8.5	8.4	6.1
Agriculture	8.1	9.4	9.0	6.5
Manufacturing	6.8	7.1	7.2	5.0
Infrastructure	10.9	9.3	9.4	5.7
Services	7.7	8.1	8.0	6.4
Real Income	5.4	6.2	5.7	6.0
Agriculture	3.0	3.2	3.0	2.2
Manufacturing	7.3	6.9	6.6	5.9
Infrastructure	5.4	6.8	6.5	8.0
Services	7.1	7.9	7.2	7.9
Real Income Per Capita	3.1	4.1	3.6	4.0
Real Private Consumption	4.1	5.0	4.5	5.2
Real Personal Disposable Income	6.6	7.0	6.5	7.1
Head count ratio- rural (%)	-4.3	-2.7	-2.7	-5.1
Head count ratio- urban (%)	-3.1	-4.3	-3.2	-4.7
Gross Domestic Savings (N)	16.2	15.4	16.2	12.7
Gross Investment (N)	16.8	16.1	15.6	11.7
Fiscal Sector				
Govt. Consumption (N)	7.7	6.4	5.9	7.0
Govt. Total Expenditure(N)	16.2	14.1	14.3	13.8
Govt. Revenue (N)	15.9	13.6	14.1	12.1
Direct Taxes (N)	14.5	18.9	17.2	15.2
Indirect Taxes (N)	16.5	12.1	13.4	11.1
Non-tax Revenue (N)	14.7	14.2	13.8	12.2
Fiscal Deficit (N)	18.7	15.8	15.4	17.2
Govt. Non-market Borrowings (N)	19.1	15.0	14.9	19.3
Monetary Sector				
Money Supply	17.3	17.4	17.2	16.6
Price Level	6.6	7.8	7.7	5.5
Rate of Inflation (%)	-4.9	-12.7	-3.0	-10.3
Rate of Interest (%)	0.8	-1.7	-0.8	-7.5

Table-1 (contd.): Annual Average Compound Growth Rates (%) of important variables used in the model.

Variable	Annual Compound Growth Rate (%) during			
	(1980-89)	**(1990-99)**	**(1980-03)**	**(1993-03)**
External Sector				
Real Exports Demand	5.1	10.8	9.5	10.6
Real Imports Demand	7.3	14.7	9.3	7.8
Unit Value of Exports	9.7	7.5	9.2	3.6
Exchange Rate (N, Rs./$)	7.6	9.1	9.4	5.7
Trade Balance (N) #	9.0	26.9	13.2	13.1
Real Total Investment	4.9	6.0	4.8	1.8
Public Investment	4.5	2.2	2.5	1.1
Agriculture	-3.9	-0.1	-2.1	-0.8
Manufacturing	7.3	0.1	-0.1	-4.7
Infrastructure	6.4	1.8	3.9	1.9
Services	3.3	5.1	3.7	3.6
Private Investment	5.3	8.2	6.3	2.3
Agriculture	2.6	3.5	4.2	4.8
Manufacturing	6.0	11.7	7.0	0.8
Infrastructure	5.3	5.2	5.9	2.0
Services	5.6	4.8	6.2	4.0

Note: The annual average compound growth rate is computed using semi-logarithmic regression over time for each variable.
N: Nominal, i.e. current prices.
#: In absolute value.

Table-2: Annual average for important variables.

Variable	Annual Average*			
	(1980-89)	**(1990-99)**	**(1980-03)**	**(1993-03)**
Real Sector				
Nominal Income	253.3	1053.9	839.6	1500.5
GDP Deflator (1993-94=1.00)	0.48	1.14	0.92	1.39
Agriculture	0.46	1.17	0.93	1.43
Manufacturing	0.52	1.11	0.91	1.32
Infrastructure	0.44	1.15	0.90	1.39
Services	0.50	1.14	0.94	1.40
Real Income	510.7	886.9	772.2	1052.2
Agriculture	184.2	254.2	228.6	274.1
Manufacturing	90.4	172.9	146.4	206.4
Infrastructure	70.0	128.9	113.3	159.9
Services	166.1	330.9	283.9	411.8
Real Income Per Capita (Rs.)	6787.6	9593.1	8708.4	10749.8
Real Private Consumption	412.9	632.5	566.1	729.2
Real Personal Disposable Income	438.8	812.5	701.6	983.2
Gross Domestic Savings (N)	55.8	269.5	213.8	392.1
Gross Investment (N)	61.6	282.0	219.9	399.6
Fiscal Sector				
Real Govt. Consumption	65.1	110.8	97.5	132.1
Govt. Total Expenditure(N)	82.7	310.2	256.7	452.5
Govt. Revenue (N)	54.4	208.4	167.9	294.1
Direct Taxes (N)	7.2	38.6	31.4	59.6
Indirect Taxes (N)	36.0	128.9	102.7	175.4
Non-tax Revenue (N)	11.2	40.9	33.7	59.1
Fiscal Deficit (N)	23.5	91.2	78.6	142.1
Govt. Non-market Borrowings (N)	15.6	56.1	49.4	88.0
Monetary Sector				
Money Supply	123.1	612.7	516.9	971.0
Price Level	0.5	1.1	0.9	1.4
Rate of Inflation (%)	8.0	8.1	7.6	6.1
Rate of Interest (%)	9.9	11.0	10.0	9.8
External Sector				
Real Exports Demand	35.5	89.1	76.8	123.9
Real Imports Demand	45.5	115.2	93.5	150.8
Unit Value of Exports	0.4	1.0	0.8	1.2
Exchange Rate (N, Rs./$)	11.6	31.7	24.9	39.2
Trade Balance (N)	-8.7	-36.3	-26.7	-48.6

Table-2 contd..

Table-2 (contd.): Annual average for important variables.

Variable	Annual Average*			
	(1980-89)	**(1990-99)**	**(1980-03)**	**(1993-03)**
Real Total Investment	129.5	222.4	185.7	246.0
Real Public Investment	57.5	74.3	67.7	77.8
Agriculture	6.4	4.8	5.5	4.9
Manufacturing	15.1	16.5	15.1	14.6
Infrastructure	22.0	32.8	28.9	35.5
Services	14.1	20.1	18.2	22.8
Real Private Investment	71.9	148.1	118.0	168.2
Agriculture	7.8	12.3	10.8	13.6
Manufacturing	35.0	79.6	60.2	89.0
Infrastructure	9.2	17.8	14.6	20.2
Services	19.9	38.4	32.3	45.3
Real GDP Share (%)				
Agriculture	5.2	2.2	3.5	2.0
Manufacturing	11.6	7.6	8.9	5.9
Infrastructure	17.0	15.2	16.0	14.6
Services	11.0	9.2	10.1	9.3
Real Pub. Investment Share (%)				
Agriculture	6.2	5.6	5.9	5.6
Manufacturing	26.6	34.8	30.8	35.9
Infrastructure	7.1	8.0	7.7	8.2
Services	15.4	17.3	17.0	18.4
Real Pvt. Investment Share (%)				
Agriculture	36.4	29.1	31.5	26.5
Manufacturing	17.6	19.4	18.6	19.6
Infrastructure	13.7	14.5	14.4	15.1
Services	32.3	37.0	35.5	38.8

*: Rs. '000 crores, except GDP deflators, Price level, Rate of inflation, Rate of interest, Unit value of exports, which are indices and Exchange rate (Rs./$).
N: Nominal, i.e. current prices.

Appendix-II

Description of variables used in the analysis:

Endogenous variables (Rs. '000 Crores):

1. ABSP: Real Private Absorption
2. AD: Real Aggregate Absorption
3. ADD: Real Aggregate Demand for domestically produced goods
4. BCP: Bank Credit to Commercial Sector (Nominal)
5. BOP: Balance of payments (Nominal)
6. CAB: Current account balance (Nominal)
7. CONS: Real Government Consumption Expenditure
8. DEPAG: Real Depreciation in Agriculture
9. DEPINF: Real Depreciation in Infrastructure
10. DEPMN: Real Depreciation in Manufacturing
11. DEPSR: Real Depreciation in Services
12. DIT: Indirect taxes of both central and state govts. (Nominal)
13. DT: Direct taxes of both central and state govts. (Nominal)
14. EXPT: Real Exports
15. EXR: Exchange Rate against US $ (Nominal, Rs. /$)
16. FD: Gross Fiscal Deficit of both central and state govts. (Nominal)
17. GCFADJ: Gross domestic capital formation, adjusted series (Nominal)
18. GXP: Total Expenditure of both central and state govts. (Nominal)
19. HCRRUR: Head count ratio in rural areas (%)
20. HCRURB: Head count ratio in urban areas (%)
21. IB: Nominal Interest Rate (%) on 3-Year bank deposits
22. IMPT: Real Imports
23. KAGR: Real Net Capital Stock in Agriculture
24. KMNR: Real Net Capital Stock in Manufacturing
25. KINFR: Real Net Capital Stock in Infrastructure
26. KSRR: Real Net Capital Stock in Services
27. M_3:   Money Supply (Nominal)
28. NTX: Non-tax revenue of both central and state govts. (Nominal)
29. P: Wholesale Price Index (1993-94=1.0)
30. PC: Real Private Consumption
31. PCFTOT: Real Aggregate Public Investment
32. PITOT: Real Aggregate Private Investment
33. PGDP: GDP deflator (1993-94=1.0)
34. PIAG: Real Gross Private Investment in Agriculture
35. PIINF: Real Gross Private Investment in Infrastructure
36. PIMN: Real Gross Private Investment in Manufacturing
37. PISR: Real Gross Private Investment in Services
38. PRAG: Price Deflator for Agriculture, forestry & fishing (Industry
              group 1 of NAS)
39. PRINF: Price Deflator for Infrastructure incl. electricity, gas, water
              supply; construction; transport, storage & communication (Industry
              groups 4, 5 and 7 of NAS)
40. PRMN: Price Deflator for Manufacturing incl. mining & quarrying (Industry
              groups 2 and 3 of NAS)
41. PYDR: Real Personal Disposable Income
42. PYD: Personal Disposable Income (Nominal)

43. RCG: Reserve bank credit to the govt. (Nominal)
44. RM: Reserve money (Nominal)
45. SAV: Gross domestic savings (Nominal)
46. TB: Trade balance (Nominal)
47. TR: Current Revenue of both central and state govts. (Nominal)
48. UVIX: Unit Value of Exports (1993-94=1.0)
49. Y: Output at factor cost (Nominal)
50. YAR: Real Output in Agriculture, forestry & fishing (Industry group 1 of NAS)
51. YINFR: Real Output in Infrastructure incl. electricity, gas, water supply; construction; transport, storage & communication (Industry groups 4, 5 and 7 of NAS)
52. YM: Gross Domestic Product at Market Prices (Nominal)
53. YMNR: Real Output in Manufacturing incl. mining & quarrying (Industry groups 2 and 3 of NAS)
54. YNAR: Real Output in Non-Agriculture Sector (=YMNR+YINFR+YSRR)
55. YSRR: Real Output in Services incl. all others (Industry groups 6, 8 and 9 of NAS)
56. YR: Real Output at factor cost

Exogenous Variables (Rs. '000 Crores):

1. AREA: Index of Gross Cropped Area (1993-94=1.0)
2. BCG: Commercial Bank Credit to Government (Nominal)
3. DNB: Non-Market Borrowings of both central and state govts. (Nominal)
4. CAPB: Net capital account in the balance of payments incl. errors & omissions (Nominal)
5. CAPTR: Capital transfers to govt. (Nominal)
6. DUMMY1: Dummy for sharp increase in output of Infrastructure (1993-98)
7. DUMMY2: Dummy for post reform period (1991-92 onwards)
8. DUMMY3: Dummy for sharp decline in Inflation (post '90s)
9. DUMMY4: Dummy for sharp increase in exports (1999 onwards)
10. DUMMY5: Dummy for sharp increases in private investment in manufacturing sector
11. DUMMY6: Dummy for sharp increases in gross fiscal deficit (1998 onwards)
12. EB: External borrowings by the govt. (Nominal)
13. INVISB: Invisibles in Current Account Balance (Nominal)
14. GCL: Government current liabilities to the public (Nominal)
15. MISCR: Other components of RBI credit to govt. (Nominal)
16. MISL: Miscellaneous components of Reserve Money (Nominal)
17. PCFAG: Real Gross Public Investment in Agriculture
18. PCFINF: Real Gross Public Investment in Infrastructure
19. PCFMN: Real Gross Public Investment in Manufacturing
20. PCFSR: Real Gross Public Investment in Services
21. PCFSAV: Gross Public Sector Savings (Nominal)
22. PGKE: Gross investment deflator (1993-94=1.0)
23. PRSR: Price Deflator for Services incl. all others (Industry groups 6, 8 and 9 of NAS)
24. PYDIFF: Difference between income at market prices and factor cost (Nominal)
25. RAIN: Annual Rainfall (mm)
26. RBCS: RBI credit to the commercial sector (Nominal)

27. RBFA: Net Foreign Exchange Assets of RBI (Nominal)
28. RES: Residual components of Bank credit to commercial sector
29. RNML: RBI's net non-monetary liabilities (Nominal)
30. TRP: Transfer payments (Nominal)
31. UVII: Unit Value of Imports (1993-94=1.0)
32. WPEXP: World Price Index (1993-94=1.0)
33. WYR: Real World Income
34. NTOT: Aggregate population (millions)
35. TREND: Time trend variable with its value as unity for 1978-79.

Estimated Model: **Period: 1981-82 to 2002-03**   **Method: 3SLS**

Module-I:

Fiscal Sector:

1. $DT = -36.518 + 0.177\ YNAR - 31.083\ P$
    (-15.96)   (8.85, 2.31)   (-2.78, -0.71)
                    $\bar{R}^2 = 0.98$ $DW = 0.49$

2. $DIT = 11.358 + 0.109\ Y + 0.400\ AR\ (1)$
    (4.71)   (52.85, 0.94)   (3.15)
                    $\bar{R}^2 = 0.99$ $DW = 1.78$

3. $NTX = 0.036\ YM + 0.357\ AR\ (1)$
        (55.26, 1.01)   (2.52)
                    $\bar{R}^2 = 0.99$ $DW = 1.96$

4. $CONS = 0.119\ (YM/P) + 0.407\ CONS_{-1} + 1.075\ AR\ (1)$
        (6.80, 1.06)   (4.58)   (55.78)
                    $\bar{R}^2 = 0.99$ $DW = 2.06$

5. $PC = 164.923 + 0.573\ PYDR + 0.594\ AR\ (1)$
        (22.68)   (65.11, 0.77)   (4.92)
                    $\bar{R}^2 = 0.99$ $DW = 1.71$

6. $FD = 0.817\ GXP - 0.786\ TR - 16.904\ ((P-P_{-1})/P_{-1})$
        (39.30, 2.60) (25.10, -1.62) (-2.13, -0.01)
                                + 8.537 DUMMY6 − 0.610 AR(2)
                                (5.41)   (-5.10)
                    $\bar{R}^2 = 0.99$ $DW = 1.88$

Monetary Sector:

7. $P = -0.0002\ YR + 0.000098\ M_3 + 0.009\ IB + 0.017\ TREND + 0.823\ P_{-1}$
    (-3.00, -0.18)   (2.53, 0.07)   (3.43, 0.07)   (4.81)   (12.04)
                                + 0.348 AR (1)
                                (3.04)
                    $\bar{R}^2 = 0.99$ $DW = 2.33$

8. $M_3 = -67.265 + 0.297\ RM - 17.321\ TREND + 1.122\ AR\ (1)$
        (-2.02)   (2.04, 0.08)   (-3.19)   (123.24)
                    $\bar{R}^2 = 0.99$ $DW = 2.56$

9. $IB = 7.901 + 0.018\ (\Delta(BCP) + CAPB) - 6.410\ ((P-P_{-1})/P_{-1}) - 0.010\ SAV$
        (16.55) (2.82, 0.19)   (-2.31, -0.04)   (-4.52, -0.40)
                                + 2.559 DUMMY2 + 2.861 DUMMY4
                                (9.34)   (9.12)
                    $\bar{R}^2 = 0.86$ $DW = 1.40$

External Sector:

10. EXPT = 190.908 − 3453.455 (UVIX/EXR/WPEXP) + 0.0004 WYR
$\quad$(9.21)$\quad\quad$(-7.50, -0.67)$\quad\quad\quad\quad\quad\quad\quad\quad$(3.84, 0.30)
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$- 33.227 DUMMY4
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$(-5.85)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.93$$\quad\quad\quad\quad\quad$DW = 1.04

11. UVIX = − 4.867 (P/EXR) + 9.14E-06 WYR + 0.560 WPEXP − 0.002 EXPT$_{-1}$
$\quad\quad\quad\quad$(-8.16, -0.14)$\quad\quad$(22.77, 0.69)$\quad\quad$(17.07, 0.60)$\quad\quad$(-5.09)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.96

12. IMPT = 0.082 AD − 2.270 (UVII*EXR/P) + 0.316 (TREND*TREND)
$\quad\quad\quad$(3.98, 0.58)$\quad\quad$(-5.03, -0.55)$\quad\quad\quad\quad$(5.75)
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$+ 0.821 AR (1)
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$(7.77)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.20

13. EXR = 21.700 P − 0.107 CAB + 0.141Δ RBFA + 4.006 DUMMY2
$\quad\quad\quad$(30.14, 0.75)$\quad$(-3.31, 0.02)$\quad\quad$(6.23, 0.12)$\quad\quad$(7.61)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.73

Link equation:

14. PGDP = -0.058 + 1.063 P + 0.616 AR (1)
$\quad\quad\quad\quad$(-2.80)$\quad$(57.48, 1.04)$\quad\quad$(5.98)
$\quad\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.50

Module-II:

Real Sector:

15. YAR = -261.002 + 0.035 RAIN + 222.162 AREA +0.664 KAGR$_{-1}$ +0.360 YINFR$_{-1}$
$\quad\quad\quad$(-1646)$\quad\quad$(5.73, 0.11)$\quad$(10.54, 0.81)$\quad\quad\quad$(21.08, 0.84)$\quad\quad$(12.61, 0.19)
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$- 0.501 AR (1)
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$(-5.18)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 2.06

16. YMNR = 0.045 ADD + 0.072 KMNR + 4.202 TREND + 0.622 AR (1)
$\quad\quad\quad\quad$(2.59, 0.27)$\quad$(3.12, 0.32)$\quad\quad$(3.92)$\quad\quad\quad\quad$(5.38)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.45

17. YINFR = 0.132 KIFNR$_{-1}$ + 0.153 (M$_{3-1}$/P$_{-1}$) + 0.812 AR(1)
$\quad\quad\quad\quad$(12.85, 0.41)$\quad\quad\quad$(21.17, 0.59)$\quad\quad$(13.37)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 2.09

18. YSRR = -156.810 + 0.462 KSRR$_{-1}$ + 0.171 (M$_3$/P) + 0.559 AR(1)
$\quad\quad\quad\quad$(-5.69)$\quad\quad$(8.13, 1.09)$\quad\quad$(4.21, 0.28)$\quad\quad$(4.72)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.99$$\quad\quad\quad\quad\quad$DW = 1.91

19. PIAG = 0.029YAR$_{-1}$+0.136 PCFAG$_{-1}$+ 0.060 PIINF$_{-1}$ −0.054(IB-((P-P$_{-1}$)*100/P$_{-1}$))
$\quad\quad\quad$(6.66, 0.57)$\quad$(1.60, 0.05)$\quad\quad$(2.28, 0.09)$\quad\quad\quad$(-1.89, -0.01)

$\quad\quad\quad\quad\quad\quad\quad\quad$- 0.012 (PCFSAV$_{-1}$/PGKE$_{-1}$ − PCFTOT$_{-1}$) + 2.26 PRAG
$\quad\quad\quad\quad\quad\quad\quad\quad$(-2.63, 07)$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$(3.63, 0.24)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.95$$\quad\quad\quad\quad\quad$DW = 2.95

20. PIMN = - 46.941 + 3.075 PCFMN + 0.979 PIINF − 1.275 (IB-((P-P$_{-1}$)*100/P$_{-1}$))
$\quad\quad\quad\quad$(-9.33)$\quad\quad$(11.76, 0.50)$\quad\quad$(2.65, 0.22)$\quad\quad$(-4.40, -0.05)
$\quad\quad\quad\quad$+ 27.333 PRMN − 10.398 DUMMY5 + 0.513 PIMN$_{-1}$ − 0.718 AR (1)
$\quad\quad\quad\quad$(4.51, 0.40)$\quad\quad\quad$(-7.19)$\quad\quad\quad\quad\quad$(8.20)$\quad\quad\quad\quad\quad$(-7.16)
$\quad\quad\quad\quad\quad\quad$$\bar{R}^2 = 0.90$$\quad\quad\quad\quad\quad$DW = 2.12

21. $PIINF = 0.279\ PCFINF_{-1} + 7.445\ PRINF$
    (3.68, 0.48)   (3.46, 0.51)
                $\bar{R}^2 = 0.74$ DW = 1.74
22. $PISR = 0.711\ PCFSR + 0.994\ PIINF_{-1} - 0.716\ (IB-((P-P_{-1})*100/P_{-1})) + 7.739\ PRSR$
    (5.18, 0.36)   (3.79, 0.44)   (-2.84, -0.06)   (1.69, 0.24)
                $\bar{R}^2 = 0.90$ DW = 1.50

23. $DEPAG = -7.128 + 0.057\ KAGR_{-1}$
            (-2.66)   (6.56, 1.57)
                $\bar{R}^2 = 0.61$ DW = 1.59

24. $DEPMN = 15.516 + 0.037\ KMNR_{-1} + 0.175\ AR\ (1)$
            (4.75)   (7.64, 0.68)   (5.01)
                $\bar{R}^2 = 0.74$ DW = 2.06
25. $DEPINF = -4.362 + 0.079\ KINFR_{-1} - 0.146\ AR\ (1)$
            (-3.89)   (28.02, 1.12)   (-2.18)
                $\bar{R}^2 = 0.95$ DW = 1.89
26. $DEPSR = -5.960 + 0.034\ KSRR_{-1}$
            (-3.62)   (16.69, 1.24)
                $\bar{R}^2 = 0.90$ DW = 1.23
27. $PRAG = -0.003\ YAR + 0.002\ PYDR + 1.033\ P + 1.094\ AR\ (1)$
            (-6.93, -0.57)   (6.64, 1.22)   (6.54, 0.98) (78.82)
                $\bar{R}^2 = 0.99$ DW = 1.84
28. $PRMN = 0.070\ + 0.916\ P\ + 0.502\ AR\ (1)$
            (6.69)   (97.83, 0.95)   (4.90)
                $\bar{R}^2 = 0.99$ DW = 1.76
29. $PRINF = -0.170 - 0.008\ YINFR + 0.001\ PYDR + 0.988\ P$
            (-15.57) (-14.30, -0.89)   (14.93, 1.04)   (27.76, 0.97)
                $\bar{R}^2 = 0.99$ DW = 2.08

Module-III:
Poverty ratios:
30. $HCRRUR = 64.760 - 36.774\ (PYDR/NTOT) + 4.132\ DUMMY2 + 0.425\ AR\ (1)$
            (19.27)   (-8.06, -1.13)   (2.48)   (2.40)
                $\bar{R}^2 = 0.89$ DW = 2.32
31. $HCRURB = 59.998 - 31.975\ (PYDR/NTOT)$
            (51.46)   (-22.74, -1.14)
                $\bar{R}^2 = 0.96$ DW = 1.64

Note: The t-ratios are given in parenthesis. For important variables, the short-run mean partial elasticity is also given adjacent to the t-ratio.

Chart-I

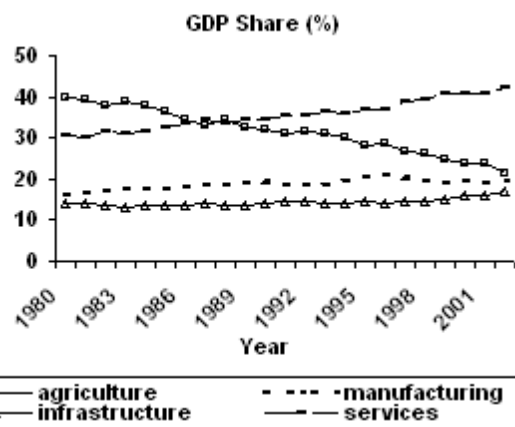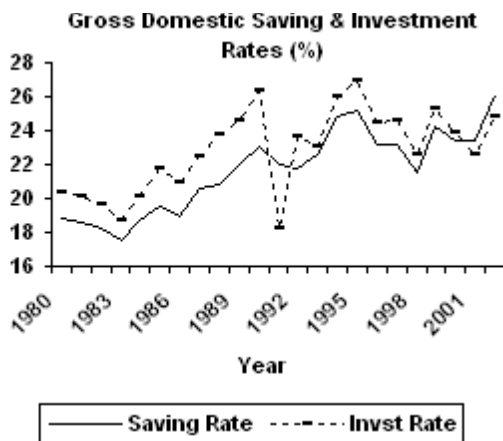**Real private and public sector investments (Rs. '000 Crores).**

Agriculture

Manufacturing

Infrastructure

Services

Private — — — — Public

Pub. Investment (%)

Pvt. Investment (%)

Gross Domestic Saving & Investment Rates (%)

Saving Rate ------ Invst Rate

GDP Share (%)

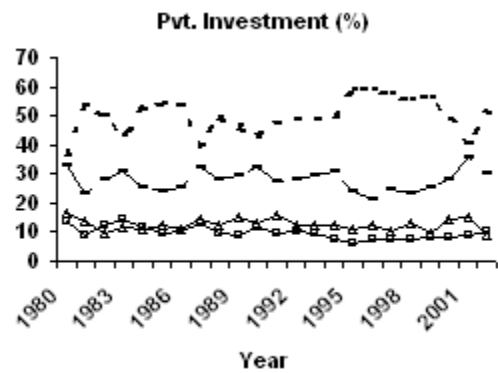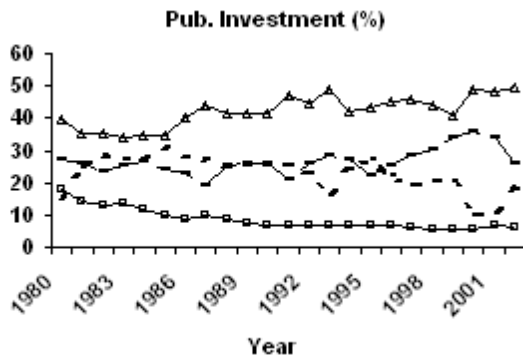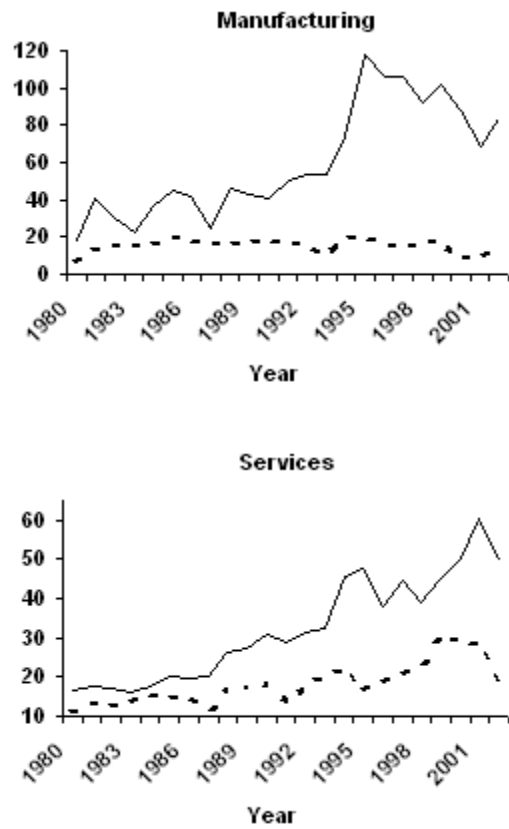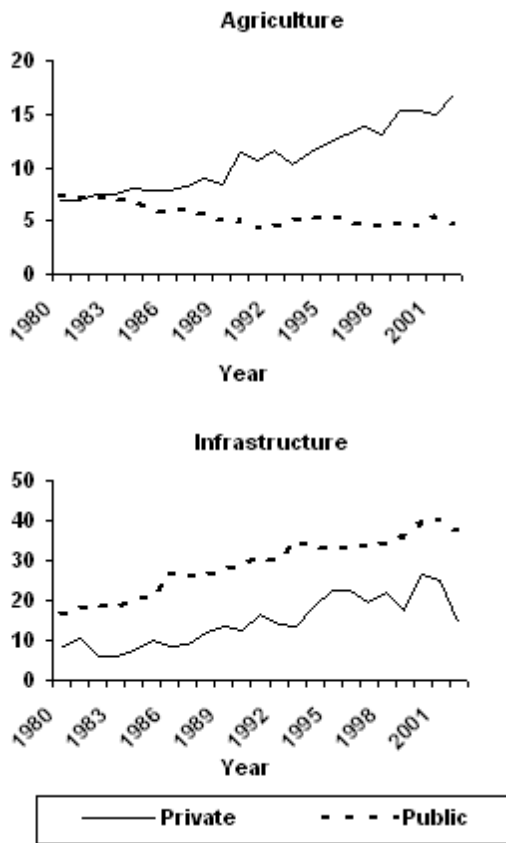agriculture — — — — manufacturing
infrastructure — — services

Chart-II

Impact of 20% sustained increase in public investment in infrastructure on selected macro variables (Rs. '000 Crores).

Real private investment in agriculture

Real private investment in manufacturing

Real private investment in infrastructure

Real private investment in services

Real Output in Agriculture

Real GDP

Real Output in Infrastructure

Gross Domestic Investment

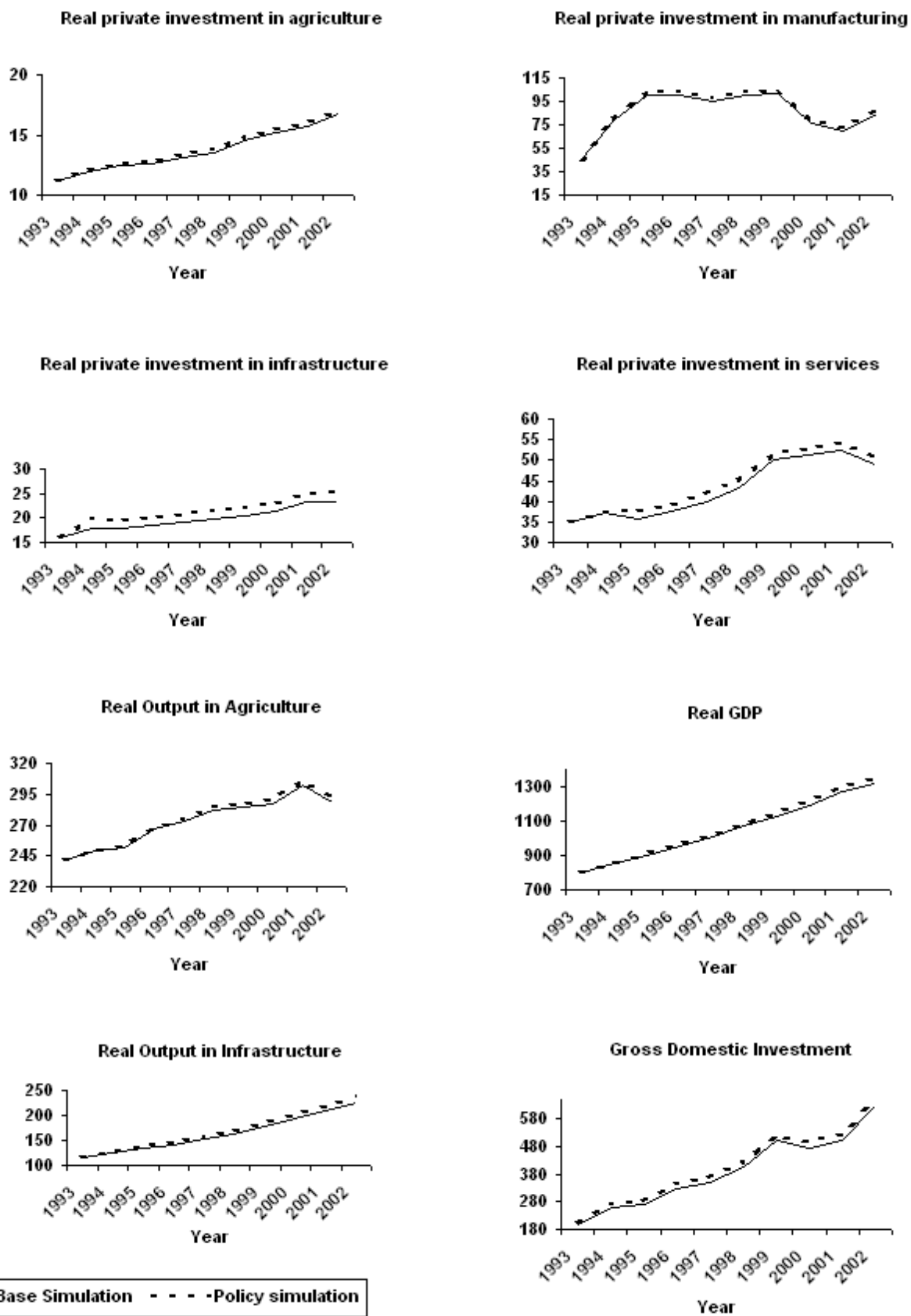—— Base Simulation　- - - Policy simulation

Chart-III

Impact of 20% sustained increase in public investment in infrastructure on selected macro variables.

Nominal Fiscal Deficit (%)

Inflation (%)

Nominal Interest Rate (%)

Imports (%)

Exports (%)

Money Supply (%)

Rural poverty ratio (%)

Urban poverty ratio (%)

—— Base Simulation   - - - -Policy simulation