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DYNAMICS OF MACROECONOMIC ADJUSTMENT WITH GROWTH: SOME SIMULATION RESULTS*

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This paper examines the impact of several macroeconomic policies, both demand and supply management policies, on economic activity within a small macroeconomic simulation model. The model is based on a standard analytical framework that underlies adjustment policies in developing economies (DEs). The standard approach has been to use aggregate government expenditure as an instrument of fiscal policy to shock economic activity in a DE, with a negative dynamic response typically observed. In the context of such a small macroeconomic simulation model we decompose government expenditure into consumption and investment expenditure. Simulation exercises with and without model-consistent expectations throw up some contrasting results in the sense that fiscal policy can influence output positively through the effects of public sector investment on private investment in a DE such as India. [F43, E62]

1. INTRODUCTION

Macroeconomic management in DEs has typically been demand-oriented with little emphasis on supply-side policies, since the aim has been to achieve short run stabilisation. This ignores medium term growth, given the implicit assumption that productive capacity is exogenous. Such neglect of medium run growth in the adjustment process came under vehement criticism in recent years as persisting external and internal imbalances led to a slackening in growth, balance of payments (BOP) difficulties, and high inflation. The cause of the short run disequilibria has frequently been traced to a situation of government fiscal deficits that end in excessive monetary expansion and feed domestic demand. Stabilisation programs (whether sponsored by the IMF or otherwise) are typically put into effect to reduce these demand pressures. A financial (or stabilisation)

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program is a package of policies designed to eliminate disequilibrium between aggregate demand and supply in the economy, which typically focuses on correcting short term imbalances by aiming at a desired BOP outcome, and a desired rate of inflation.

It has frequently been argued that these adjustment programs fail to encourage economic growth. For modelling stabilisation and growth, this paper simulates a small macroeconomic model of DEs, which explicitly covers the basic interrelationships between money and the real economy. Attempts at integrating short run stabilisation and long run growth in the context of developing world have not been able to adequately address the complex dynamic interactions involved in the relationship between stabilisation and growth. However, Khan and Knight (1985) [henceforth KK] attempted to show that the adjustment programs of the IMF type can achieve a viable BOP within the context of improved long-term growth performance and price stability.[1] While KK's structural model can be understood to be based on standard financial programming model of the Fund[2] and gap model of the World Bank,[3] the Fund and the Bank models, on the contrary, rely heavily on accounting identities and thus leave out a substantial amount of economic structure and behaviour. With the help of the model some simulation experiments are carried out in order to analyse and compare the effects of different monetary, fiscal and exchange rate policy measures on certain macroeconomic variables and also on the economy as a whole.

The model presented in this paper is in essence a variant of the simulation model reported in KK. KK in their simulations show that adjustment programs often supported by the resources of the Fund do not impose significant economic costs. They indicate how alternative combinations of demand-side and supply-side measures can be expected to influence the rate of growth of output in the short run. Here we show that the composition of government expenditure is a neglected factor in explaining the long-term growth of the economy. Instead of considering aggregate government expenditure as in KK's simulations, a de-composition into consumption and investment expenditure allows public investment expenditure to become a major stimulant to long-term growth. This is important when government expenditure is treated either as an individual policy

[1]Examples of the burgeoning literature on the subject of growth-oriented adjustment can be found in Khan, Montiel and Haque (1990), Blejer and Chu (1989), Bacha and Edwards (1988), and Corbo, Goldstein, and Khan (1987).

[2]The Fund doctrine has been expounded at length in Polak (1957) which considers only one policy instrument, that is, domestic credit ceilings. After 1973 with the breakdown of the Brettonwoods convention of fixed exchange rates, the exchange rate has been the second major instrument for stabilisation through demand management (IMF, 1977; 1987).

[3]For an overview of the gap models, see Chenery and Strout (1966), Bacha (1990), and Taylor (1994b). The two-gap conception, including the resource gap and the trade gap, is a simple open economy extension of the Harrod-Domar model of long-term growth based on the simple Keynesian system.

measure or as part of a complete policy package. A policy package is meaningful because most of the adjustment programs contain a set of policies to be implemented synchronously. Though KK's model is treated as a medium term model with the specification of the determinants of productive capacity, it is still deficient in terms of its treatment of investment as exogenous.[4] Hence, a behavioural private investment equation, influenced by public expenditure and real interest rate, can be introduced as an additional channel through which economic activity could be stimulated. The formation of expectations in KK was modelled in an adaptive fashion, and we consider the sensitivity of the results to this assumption by also implementing a forward-looking treatment. The second section of this paper presents the model. The third section provides empirical estimates of an investment model. We analyse the effects of policy changes on economic growth in the fourth section. The fifth section sums up.

2. THE ANALYTICAL MODEL

Although no single model can generally cover the whole range of policy measures contained in a typical adjustment program, one such model that does include the whole gamut of policies involving the control of aggregate demand and supply is the one by Khan and Knight (1985). This is a variant of the econometric model developed by Khan and Knight (1981, 1982). Khan (1990) provides a summary of studies evaluating the effects of Fund-supported adjustment programs on the leading macroeconomic objectives in the short-run. Overall, these studies yield three conclusions. First, there is frequently an improvement in the BOP and the current account, although a number of studies show no effects of such programs. Secondly, inflation is generally not affected by programs. Finally, the effects on the growth rate are uncertain, with the studies showing an improvement or no change being balanced by those indicating deterioration in the first year of a program. The theoretical core of the KK model can be summarised in what follows.

Structure of the Model

KK's model, a highly aggregated structural dynamic model, which has been found to provide a framework in the sense of being able to handle several policies synchronously, can be taken as a starting point for analysing the dynamic effects of macroeconomic policies. This simulation model was preferred from numerous in the literature on development macroeconomic models for the following reasons:

[4]The stylised Fund-Bank model treats investment as determined by the available saving, while the three-gap model (Bacha, 1990) derives it residually from saving, foreign exchange availability, or the government budget, depending on which is the binding constraint.

(1) It is an aggregated model with a simple open DE structure;
(2) It integrates monetary and real sectors of the economy;
(3) The model simultaneously determines output growth, inflation, BOP, and money supply;
(4) It explicitly considers the composition of the BOP and more importantly allows capacity output growth to be endogenously determined.

The model consists of six behavioural equations and five identities, as follows:

The first equation is a standard demand for money equation relating the desired stock of real money balances (m^d) to real income (y), the rate of interest on deposits (r), and the expected rate of inflation (p^e), which is assumed to follow an adaptive process:

$$\log m_t^d = a_1 \log y_t - a_2 \log r_t - a_3 p_t^e . \tag{2.1}$$

The next two equations describe the behaviour of imports (IM) and exports (X). The desired demand for real imports depends on real income and relative prices:

$$\log\left(\frac{IM}{Pm.e}\right)_t^d = a_4 \log y_t - a_5 \log\left(\frac{Pm.e}{P}\right)_t \tag{2.2a}$$

where Pm: price of imports, P: domestic price level, and ε: nominal exchange rate expressed as the index of units of domestic currency per unit of foreign currency. The actual quantity of imports is assumed to adjust proportionally to the difference between the demand for imports and actual imports in the previous period. This partial adjustment model is specified as

$$\Delta \log\left(\frac{IM}{Pm.e}\right)_t = b\left[\log\left(\frac{IM}{Pm.e}\right)_t^d - \log\left(\frac{IM}{Pm.e}\right)_{t-1}\right] \tag{2.2b}$$

where b is the coefficient of adjustment, *0 £ b £ 1*. As is well known, this type of adjustment model introduces a distributed lag process (with geometrically declining weights) into the behaviour of real imports. Substituting equation (2.2a) into (2.2b) and solving for the level of nominal imports yields

$$\log IM_t = \log(Pm.e)_t + b\left[a_4 \log y_t - a_5 \log(Pm.e\ /\ P)_t\right] + (1 - b)\left[\log IM_{t-1} - \log(Pm.e)_{t-1}\right]. \tag{2.2}$$

The volume of exports will increase with the productive capacity of the economy (represented by y^*) and with the profitability of producing and selling exports (captured by the ratio of export prices (*Px*) to domestic prices - *Px.e/P*):

$$\log X_t = \log(Px.e)_t + a_6 \log y_t^* + a_7 \log(Px.e\ /\ P)_t + a_8 \log(Px.e\ /\ P)_{t-1} + a_9 \log(Px.e\ /\ P)_{t-2}. \tag{2.3}$$

The domestic rate of inflation ($\Delta \log P$) is assumed to be positively related to the excess supply of real money balances and the rate of foreign inflation, which is measured by the rate of growth of import prices ($\Delta \log Pm$) adjusted by the percentage change in the exchange rate ($\Delta \log e$):

$$\Delta \log P_t = a_{10}\left[\log(M\ /\ P)_{t-1} - \log m_t^d\right] + a_{11}(\Delta \log Pm_t + \Delta \log e_t) + (1 - a_{11})(\Delta \log Pm_{t-1} + \Delta \log e_{t-1}). \tag{2.4}$$

This formulation ensures that domestic inflation is determined by foreign inflation in the long run and the dynamic coefficients associated with foreign inflation add up to one.

The rate of growth of output ($\Delta \log y$) is specified to respond to both monetary and fiscal variables, the deviations of output from capacity output (the output gap), and the rate of growth of real exports:

$$\Delta \log y_t = a_{12}(\Delta \log DCP_t - \Delta \log P_t) + a_{13}(\Delta \log DCP_{t-1} - \Delta \log P_{t-1}) - a_{14} \log(y_{t-1}\ /\ y_t^*) + a_{15}\ (\Delta \log G_t - \Delta \log P_t) + a_{16}\left[\Delta \log X_t - \Delta \log(Px.e)_t\right]. \tag{2.5}$$

The rate of growth of capacity output ($\Delta \log y^*$) is central to analysing supply-side policies, and a simple growth model that starts with an aggregate production function (f) relating output (y) to the capital stock (K) and the labour force (L) has been used:

$$y = f(K, L). \tag{2.6a}$$

Converting this equation into rates of growth yields

$$\frac{dy}{y} = f_K \cdot \frac{dK}{y} + \left(f_L \cdot \frac{L}{y} \right) \cdot \frac{dL}{L} \tag{2.6b}$$

where the variable dK is defined as equal to the rate of gross real investment (IR), treated as exogenous. A log-linear counterpart to equation (2.6b) would render the capacity output growth equation, that is,

$$\Delta \log y_t^* = a_{17} (IR / y)_t + a_{18} \Delta \log L_t \tag{2.6}$$

where $a_{17} = f_K$ and $a_{18} = f_L.L/y$.

The remaining equations in the model are identities. The supply of money (M) comes from the banking system's balance sheet in the form of domestic credit (DC) and international reserves (R) as

$$\Delta M_t = \Delta DC_t + \Delta R_t. \tag{2.7}$$

The external sector's budget constraint defines the BOP, which is equal to the trade balance (X-IM), the net services account (S) and the change in foreign financing to the private sector (ΔFIP) and the public sector (ΔFIG):

$$\Delta R_t = X_t - IM_t + S_t + \Delta FIP_t + \Delta FIG_t. \tag{2.8}$$

Changes in domestic credit (ΔDC) can result from changes in commercial banks' clai ms on the private sector (ΔDCP) and central bank financing of the government budget deficit (ΔDCG):

$$\Delta DC_t = \Delta DCP_t + \Delta DCG_t . \tag{2.9}$$

Now the fiscal and monetary accounts are linked by assuming that any government deficit (G-T) can be financed only by borrowing from the banking system (ΔDCG) or borrowing abroad (ΔFIG), that is,

$$G_t - T_t = \Delta DCG_t + \Delta FIG_t \tag{2.10a}$$

where G and T are government expenditures and revenues respectively. Rearranging yields:

$$\Delta DCG_t = G_t - T_t - \Delta FIG_t \tag{2.10}$$

Finally, the expectations of inflation were assumed to be generated by an adaptive process in which these expectations are revised proportionally to the difference between the actual rate of inflation in the previous period ($\Delta \log P_{t-1}$) and the rate that was expected to prevail (p^e_{t-1}):

$$\Delta p^e = g(\Delta \log P_{t-1} - p^e_{t-1}) \tag{2.11}$$

where g is the coefficient of expectations, $0 £ g £ 1$. In this formulation a value of g equal to unity would mean expected rate of inflation is equal to the actual rate of inflation in the previous period: $p^e_t = \Delta \log P_{t-1}$.

The framework outlined above contains 11 equations, the structure of which has been summarised in Table 1.1 (I1). KK calibrate it by imposing the values of the parameters, the specific choice of which were broadly consistent with the estimates obtained by empirical studies on various aspects of stabilisation policies in DEs. They have used it to compare alternative policy packages for the BOP, inflation and real output growth. These comprise a package of demand-management policies (that is, a once-for-all reduction in the rates of growth of nominal domestic credit and nominal government expenditures, plus a devaluation), and a combined package of demand-management and structural policies (that is, the above-mentioned demand management policies, plus a set of structural policies that would gradually raise the rate of growth of capacity output). They find that the combined package of demand-management and supply-side policies succeeds in putting the economy on a higher secular growth path. However, the demand-oriented policy package includes a reduction in government expenditure, and the model makes no distinction between government consumption expenditure and government investment expenditure. In a country like India, a cut in government expenditure in practice falls more on the reduction of capital expenditure, which contributes to long-term growth, relative to consumption expenditure. Hence the composition of the government expenditure is important in gauging their effect on long-term growth.

Table 1.1. Structure of the Model

Endogenous variables	Purely Exogenous Variables		Endogenous Variables	Policy Variables
	I1: Original Version (KK specification)			
$\Delta \log y$	S	IR	M	e
$\Delta \log P$	T	Px	DC	DCP
$\Delta \log y^*$	FIG	Pm	DCG	G
m^d	FIP		ΔR	
IM	L		p^e	
X	R			
	I2: Revised Version (Extended specification)			
IRP			G	IRG
IR			RIR	GC

In itself, KK model is inadequate in achieving the objective of growth-oriented adjustment despite their claims of doing so in the absence of a growth-inducing mechanism in the model that primarily comes through investment which KK treat as exogenous. Hence an alternative way of examining the effect of fiscal policy on output growth should be made through public investment. The IMF literature holds the view that government fiscal deficits adversely affect real output due to the crowding-out effect. Here we argue that it will no longer be valid if the deficit is created in generating physical or social infrastructure in the economy that would induce private investment and thereby growth. Further an increase in public investment can result through the receipt of foreign financing, since most governments in DEs are fiscally constrained and financing through domestic credit expedites inflation. However, the reduction in fiscal deficit through cuts in government expenditure does not take the relationship between public and private investment. Since the public sector provides the necessary infrastructure and reductions in public investments on basic infrastructure can have adverse effects on private investment and growth, we extend the supply side in the basic KK model by incorporating a detailed investment mechanism.

It has invariably been argued by Indian economists that the public investment on infrastructure must not be cut in the transition process of the economy, for it has adverse long-term consequences. In other words, the private sector relies on public investment in most of the infrastructure because this is either a natural or a legal public monopoly. Hence there are potential supply side relations between public and private investment, and public infrastructure and private investment should be complementary, in that infrastructure deficiencies will hold back both private production and private investment (Joshi and Little, 1994). Thus the real private investment (*IRP*) equation has been introduced to depend on real public investment (*IRG*) and real interest rate (*RIR*):[5]

$$\log IRP_t = a_{19} \log IRG_t + a_{20}\ RIR_t. \tag{2.12}$$

The real interest rate is defined as nominal deposit rate (r) minus the expected inflation rate: $RIR_t = r_t - p_t^e$. Total real investment is equal to real public investment and real private investment:

$$IR_t = IRG_t + IRP_t. \tag{2.13}$$

From the fiscal account, total government expenditure can be disaggregated into government consumption expenditure (*GC*) and government investment expenditure (*IRG*):

$$G_t = CG_t + IRG_t \tag{2.14}$$

[5]Similar type of specifications have been suggested both in the agricultural sector (Mallick, 1993) and in the industrial sector (see Nayyar, 1995) of the Indian economy.

The above equations are the three new equations added to the KK model. In addition, we modify agents' expectations as forward-looking[6] and specifically are formed rationally for the relevant future variable, namely expected inflation in the present model. So expectations of inflation (p^e) are assumed to be generated in backward looking as in KK and in a forward-looking model-consistent manner, suppressing equation (2.11) to see differences in model properties. The 14 equations of the model determine values for the 14 endogenous variables conditional on the exogenous variables and policy instruments. The extended model has been summarized in Table 1.1 (I2).

3. ECONOMETRIC EVIDENCE FOR THE INVESTMENT MODEL

The model contains 20 structural parameters and 2 adjustment parameters. Although the complete model could have been estimated as a system, we chose to follow KK and the same parameter values with a minor change in 4 parameters in the demand for money and exports equations in order to ensure the dynamic stability of the model. All the parameter values are listed in Table 1.2. For the new behavioural equation (2.12), the coefficients are estimated using Indian data. The annual data from 1950-51 to 1994-95 have been compiled from various issues of Economic survey [Government of India (GOI)], and Report on currency and finance [Reserve Bank of India (RBI)] respectively. Assuming inflation expectations as static, the real interest rate (RIR) is calculated as nominal deposit rate (r) minus the current inflation rate. When we solve the model in the next section, inflation expectations (p^e) will be generated in the model in both backward and forward-looking manners.

Recent years have witnessed a phenomenal upsurge of interest in the methodology of econometric modelling and the analysis of time series exhibiting homogeneous non-stationarity due to autoregressive unit roots. Here, first we examine each time series and see whether it is stationary employing the unit root tests. Table 1.3 presents the results of unit root tests using the annual time-series data from 1950-1994. In order to avoid difficulties with the logarithm of a negative number, *RIR* has been included without taking its logarithm. Based on the ADF test, it is evident from Table 1.3 that both the investment series IRP_t and IRG_t except RIR_t are integrated of order one or stationary in the first-differences. The ADF statistics are calculated without and with time trend for level data and first differences. The null hypothesis of a unit root in the univariate representation cannot be rejected for the variables in levels. So the results are compatible with the hypothesis that nonstationarity characterises the variables.

[6]Although the perfect foresight assumption is a bit strong for a developing economy, the modelling effort for the Indian economy in the nineties has examined the sensitivity properties of macroeconometric models with rational expectation in prices, such as Ghani (1991), and Rastogi (1994).

Table 1.2. Parameters employed in the simulations

The parameters imposed on the model to run the simulations are reported in below:

Equation		Parameter	Value
1. Demand for money:	Income	a_1	0.55
	Interest rate	a_2	0.20
	Expected inflation	a_3	0.35
2. Imports:	Adjustment	b	0.40
	Income	a_4	0.41
	Relative price	a_5	0.20
3. Exports:	Capacity output	a_6	0.30
	Relative prices	a_7	0.10
		a_8	0.30
		a_9	0.10
4. Inflation:	Excess Money demand	a_{10}	0.33
	Foreign inflation	a_{11}	0.27
5. Real output:	Real private credit (current)	a_{12}	0.06
	(lagged)	a_{13}	0.03
	Output gap	a_{14}	0.90
	Government Expenditures	a_{15}	0.04
	Exports	a_{16}	0.05
6. Capacity output:	Capital	a_{17}	0.18
	Labour	a_{18}	0.59
7. Expected Inflation (adjustment)		g	1.00

Table 1.3. Unit-root tests

	ADF in LEVELS		ADF in FIRST DIFFERENCES		
VARIABLES	WITHOUT TREND	WITH TREND	WITHOUT TREND	WITH TREND	~I( )
Log(IRP)	1.0092	-1.9217	-5.7846	-5.9363	I(1)
Log(IRG)	-0.91615	-2.4860	-5.9162	-5.9529	I(1)
RIR	-4.9727	-4.9279	-7.3229	-7.2234	I(0)
ECM	ADF test statistic in levels -3.1436		Phillips-Perron test in levels -3.121123		I(0)

Notes: 95% critical value for the ADF statistic (with intercept and no trend) = -2.9320
95% critical value for the ADF statistic (with intercept and trend) = -3.5189

To see whether these nonstationary series move together, we need to estimate a linear relationship between them. Given the presence of unit root, a precondition for the existence of a stable steady state relationship is cointegration between the variables. The variables are said to be cointegrated if each variable has a unit root in its univariate representation and some linear combination of these variables is stationary (Engle and Granger, 1987). Though there are several tests of cointegration, here we opted for the cointegration approach proposed by Phillips and Hansen (1990).[7] So parameters of the single cointegrating relation are estimated by the fully-modified OLS procedure.[8] The results are obtained by using Microfit version 4.00 (see Pesaran and Pesaran, 1997). On the basis of the above-mentioned specification, the empirical results are presented in Table 1.4.

Table 1.4. Estimation of the Investment Equation

Long-run model is based on Fully Modified Phillips-Hansen regression

Long run equation:

Ln(IRP) = 0.43437 + 0.98148 *Ln(IRG) - 0.0019776*RIR
(2.1416) (42.2646) (0.30257)

Short-run equation:

Δln(IRP) = 0.62218 *Δln(IRG) - 0.011342*RIR + 0.0477*Δln(IRP(-1)) - 0.30098*EC(-1)
(2.9752) (-2.7594) (0.2744) (-2.5733)

Diagnostic Tests:

A:Serial Correlation	F(1, 36) = 0.40109 [0.531]
B:Functional Form	F(1, 36) = 0.67906 [0.415]
C:Normality	$\chi^2(2)$ = 0.63949 [0.726]
D:Heteroscedasticity	F(1, 40) = 0.19678 [0.660]
S.E. of Regression	(s) = 0.17703

Notes: Figures in the parenthesis are *t* values; Numbers in the square brackets are the probability values; A:Lagrange multiplier test of residual serial correlation; B:Ramsey's RESET test using the square of the fitted values; C:Based on a test of skewness and kurtosis of residuals; D:Based on the regression of squared residuals on squared fitted values.

[7] In general, the asymptotic distribution of the OLS estimator involves the unit-root distribution and is non-standard and hence carrying out inferences using the usual t-tests in the OLS regression will be invalid. To overcome these problems appropriate corrections are required. Phillips-Hansen's fully-modified OLS (FM-OLS) estimator takes account of these in a semi-parametric manner.

[8] This procedure has the drawback that, in the case of more than two time series, more cointegrating vectors may exist. However, a preliminary investigation for the presence of other cointegrating vectors via the multivariate Johansen procedure did not yield different results, which are reported in Table 1.5.

Table 1.5. Johansen Cointegration Test

Eigen value	Likelihood Ratio	5% critical value	1% critical value	Hypothesized No.of CE(s)
0.4547	34.2839	29.68	35.65	None*
0.1854	8.8135	15.41	20.04	At most 1
0.0048	0.2024	3.76	6.65	At most 2

*denotes rejection of the hypothesis at 5% significance level
LR test indicates 1 cointegrating equation (CE) at 5% significance level

Table 1.6. Granger bi-variate causality between IRP and IRG

Null Hypothesis	Obs	F-Statistic	Probability
IRG does not Granger cause IRP	43	8.02374	0.00124
IRP does not Granger cause IRG	43	0.65182	0.52682

The results, in general, conform to the earlier apriori expectations. Moreover, it is interesting to note that the long-run coefficient associated with public investment is highly significant at all levels of significance under this specification. In addition, the bi-variate Granger causality tests show that the causality runs from government investment to private investment, not other way round.[9] The results exhibit strong cointegration among the variables and the relationship constitutes a stationary time-series with a constant mean (see Figure 1.1). Cointegration implies that there exists an ECM of the above cointegrating equation. The ECM is estimated using OLS with lagged differences for all the variables. The ECM regresses the current value of the dependent variable, in stationary form, onto its own lagged values, current and lagged values of the stationary forms of the independent variables, and the lagged error term from the cointegrating relation. The general to specific method is used to find a parsimonious representation of the relationship; that is, variables are deleted from the most general specification using the F-test of jointly zero coefficients. The diagnostic test statistics indicate that there is no evidence of serial correlation, of heteroscedasticity, of non-normality of the residuals, and of misspecification (see Figure 1.2). So the short-run model passes all the diagnostic tests and the EC term is quite significant in

[9]Theoretically, the reverse causality could be possible as the increase of private investment increases income, which in turn could create demand for social infrastructure and hence increase in government investment. But empirically we show that this causality does not hold. The Granger test results are reported in Table 1.6.

$\Delta ln(IRP)_t$, and $\Delta ln(IRG)_t$ influences change in private investment to a large extent, since the estimate (0.62) is highly significant. The error correction term being significant implies that the private investment adjusts in the short run to a disequilibrium in the long run relationship by 30 per cent. The results of the estimated long-run and short-run model are presented in Table 1.4.

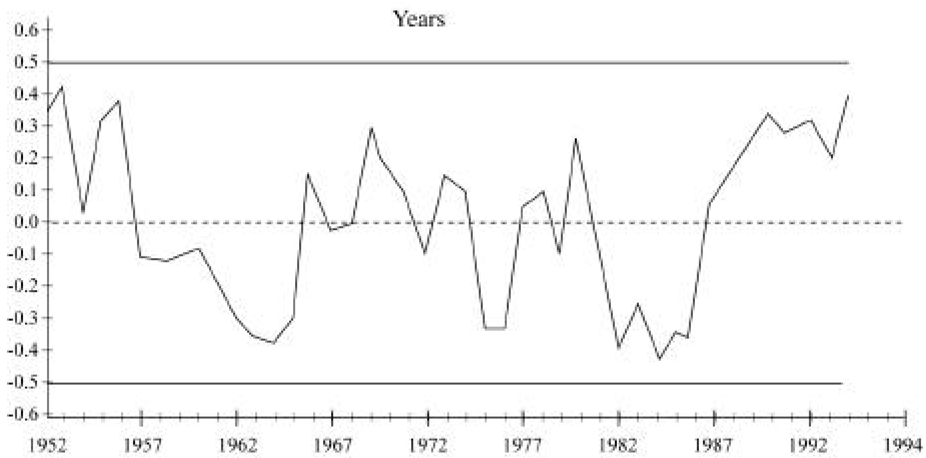

Figure 1.1. Plot of the Cointegrating Relation

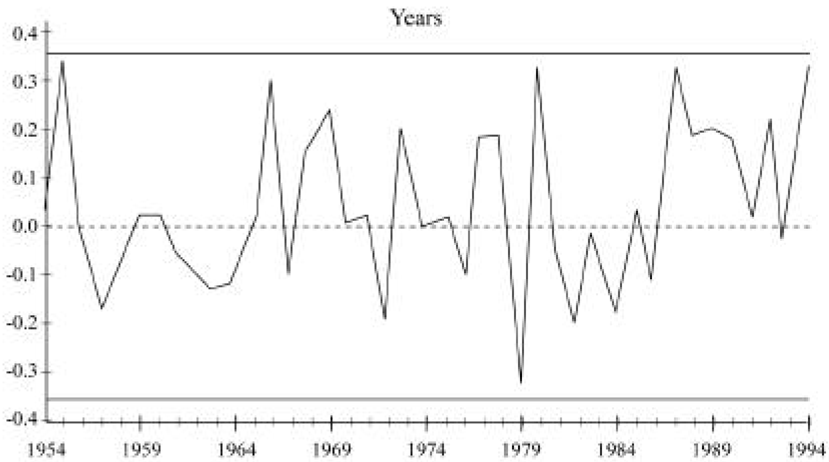

Figure 1.2. Plot of Residuals of the Dynamic Equation

4. DYNAMIC RESPONSES TO POLICY SHOCKS

In this section we assess the effects of single policies and different combinations of policies on growth, inflation and trade by performing simulation experiments, particularly the deterministic dynamic simulation method. The exogenous data used in the simulations are for the Indian economy. First, for each period, actual values of all the exogenous data are imposed on the model yielding baseline series for the simulated variables. Second, the model is simulated by adding shocks to the exogenous variables as designed in the KK model. The magnitudes of the shocks in the basic model are same as the policy shocks (both domestic and foreign) in the KK model: a permanent reduction in total government expenditure, devaluation of the official exchange rate, and reduction in the stock of domestic credit to the private sector. In the extended model the separate roles of government consumption expenditure, investment expenditure, and interest rate shocks are examined. Model solutions for the forward-looking expectations were obtained using the Fair-Taylor algorithm (Fair and Taylor, 1983) in *WINSOLVE* (Pierse, 1996). The simulation analysis has been carried out for, first, the basic model (KK's model), second, the extended model, third, with rational expectations. The model is highly aggregative and thus focuses only on what are considered the most important macroeconomic relationships. The simulations conducted with different variants start with the assumption that the authorities wish to achieve an increase in economic growth.

A. The Basic Model

In the basic model, we perform the policy shocks for four endogenous variables such as output growth, inflation and BOP (exports and imports) in the model. The shocks are first accomplished independently and then combined as a policy package to discern its overall impact. The policy package consists of an unanticipated permanent reduction in government expenditure and domestic credit by 10 per cent, and devaluation by 10 per cent. Chart 1.1 (figs.1-4) shows percentage deviations from baseline values for the four endogenous variables. The reduction in government expenditure has a short-run expansionary effect on output growth and BOP of the economy; and a permanent contractionary effect on inflation and capacity output. Consider first the case of the output response when the nominal government expenditure is shocked by 10 percent. The dynamic negative response of output in case of G is due to the fact that the rate of growth of output would decline at the beginning of the program in view of the tighter fiscal policy restraining aggregate demand and then starts to rise as inflation declines raising real domestic credit and real government expenditure. The general improvement persists for about two years and eventually the growth rate approaches its original level.

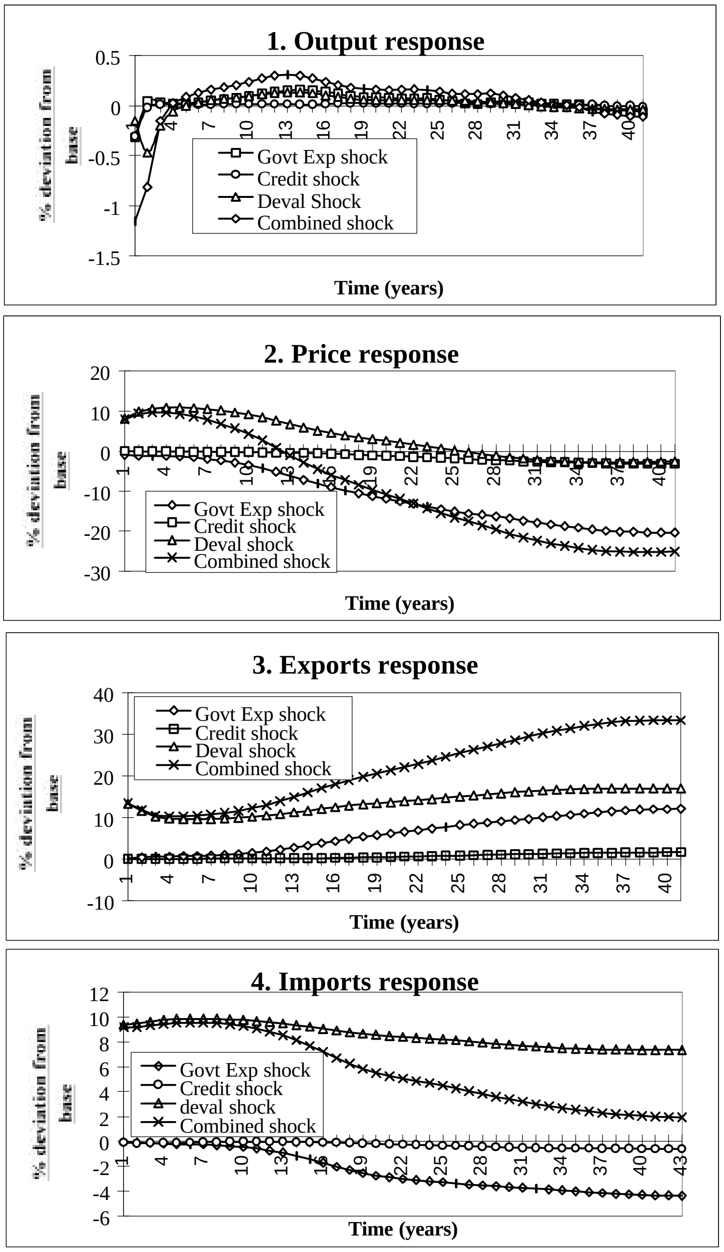

Chart 1.1. Simulation of the Basic Model

This contradicts the Keynesian viewpoint in the short run that government spending is necessary to stimulate the economy and generate growth. This contradiction may be because of the problem of wasteful spending resulting in high fiscal deficits and national debt burdens. So in this simple model, reduction in government spending increases output due to lower absorption. Nevertheless the importance of fiscal deficit reduction in long-term economic stability cannot be under-estimated. Now the question is whether the government really reduces the current wasteful spending or they resort to reduction in capital expenditures which has a positive impact on capacity output growth, in the process of fiscal adjustment. Since KK's model makes no distinction between these two types of expenditures, we cannot say anything about their impact effects. The existing evidence in the Indian economy shows that there has been a significant decline in the gross investment in the public sector (see Mallick and Kumar, 1995), which means that this decline must be contributing to the decline in the capacity output growth of the economy. Hence the short-term increase in output growth after one period due to government expenditure reduction in KK's model is deceptive.

A reduction in the rate of growth of domestic credit to the private sector results in decline in total domestic credit growth. This will directly reduce the growth of output, although the effect will be dampened by the fall in domestic inflation that keeps the rate of growth of real credit from declining as much as it would otherwise. Here output falls because of the restrictive monetary policy working towards lowering the rate of growth of output in the first period and then improves until it reaches the steady state.

A devaluation in the context of this model has two distinct effects. First, it creates a wealth effect through the increase in domestic prices. Both the growth rates of real credit and real government expenditures would decline as a result, and thus real output growth would fall. Second, as real exports begin to rise in response to the change in relative prices, output is stimulated. The way the model is set up, it would be expected that devaluation would be contractionary in the short run as the wealth effect initially dominates the relative price effect. Later on, the process is reversed and devaluation becomes expansionary. As far as the foreign exchange bottleneck is concerned, in the long run many DEs experience difficulties with their BOP due to a low-income elasticity of demand for their exports on the one hand and a high-income elasticity of demand for imports on the other. KK have modelled exports supply instead of exports demand equation. In the imports equation, the income elasticity of demand coefficient appears to be very low, which might not increase imports and hence the gap gets narrowed with the increase in exports.

Chart 1.1 also shows the combined effects of 10 per cent reduction in the nominal government expenditures and domestic credit to the private sector, and 10 per cent devaluation within the basic model. Since credit to the public sector is given by equation (10), any reduction in the domestic credit takes the form of a reduction in the credit made available by the banking system to the private sector.

Since price adjusts in the model, these policies translate into real changes in the short-run. The capacity output growth would decline as the combined policy package does not increase the capacity output growth, for the KK model does not contain any mechanism which could raise investment and thereby the economy's trend growth rate of capacity output. Unless capacity output growth increases, the targeted output growth cannot be met. This points to the fact that investment must be made endogenous by disaggregating it into public and private, and then the question is to examine whether cuts in public investment constrain the supply response of the economy in the medium-term.

B. The Extended Model

The extended model contains the equations from (2.12) to (2.14). Now in the extended model we examine the impact of four types of shocks including policies that increase the level or rate of growth of capacity output in the economy. Instead of total government expenditure we have government consumption expenditure and government investment expenditure (as a supply-inducing policy) separately. Chart 1.2 (figures 1 to 6) presents those simulations of both independent and combined shocks. The effect of consumption expenditure shock on output is the same as the total government expenditure in the KK model. The investment shock (Chart 1.2, fig.2) to output growth shows a continuous decline in output, which means that the extended model is basically an investment-led growth model. In case of the combined shock (consumption expenditure, credit and devaluation shocks) the output growth declines initially as KK model (although not by the same proportion). If the combined shock contains a reduction in the investment expenditure, then the output growth and capacity output growth would decline permanently as investment is the driving force for output growth in the model. This response is same as the output response to investment shock, for the responses are additive as the model is linear.

Whereas expenditure shocks show a decline in inflation in the basic as well as in the extended model, a devaluation shock in both the models results in gradual increase in inflation and then declines to the steady-state [see Chart 1.1 (fig.2) & Chart 1.2 (fig.3)], which is quite evident from the initial effect of devaluation. Since in DEs like India, the demand-management policies such as a cut in government expenditure falls on a reduction in government investment expenditure leading to a decline in capacity output growth, the adjustment programs are unlikely to be growth-oriented contrary to the claim made by KK. The model also brings out apparently the fact that the reduction in investment expenditure opens up the way for a decline in capacity output growth thereby a contraction in real output leading to an increase in inflation. Considering domestic credit as a major component of the money supply, reduction in domestic credit to the private sector by 10 per cent brings down inflation marginally and remains stable after two years, which indicates the importance of tight credit policy in the standard stabilisation program (fig.2 in Chart 1.1 and fig.3 in Chart 1.2). The combined shock demonstrates an initial decline in output, which improves after a period in the KK and extended model, in the absence of an investment expenditure shock.

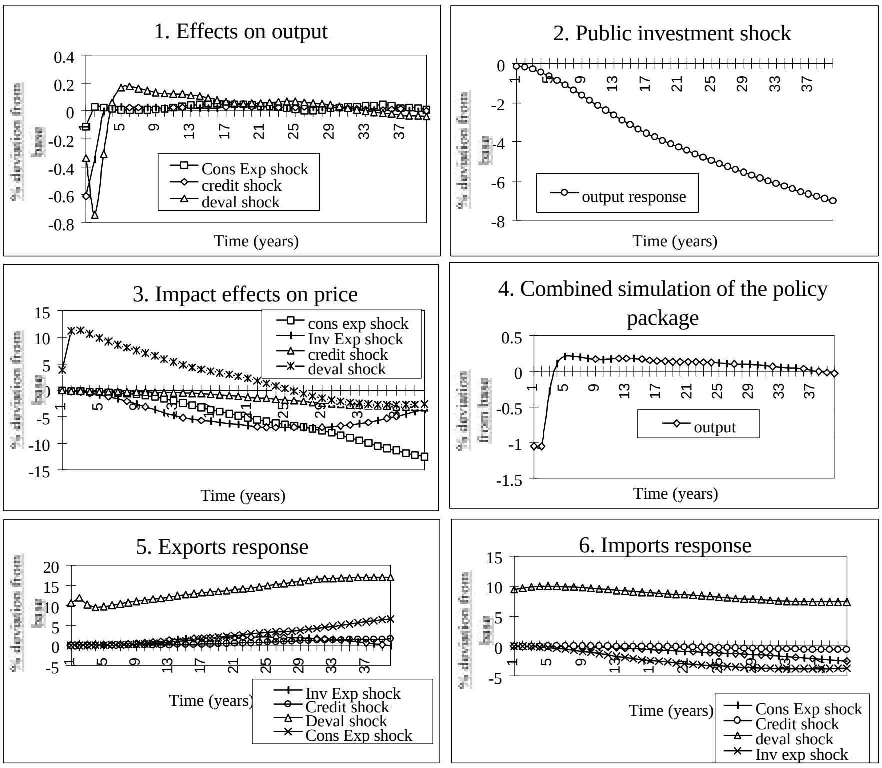

Chart 1.2. Simulation of the Extended Model

Moreover, in this model, another question that we address here is whether financial liberalisation can stimulate investment and growth. We simulate an one percent increase in nominal interest rate, which leads to decline in output growth in the long-run because of the feedback that comes through the inclusion of the dependence of private investment on real interest rate (see Chart 1.4). In the early 1970s, McKinnon-Shaw (MS) hypothesis (McKinnon, 1989) in their analysis of financially repressed DEs, attributed the poor performance of investment and growth in DEs to financial repression. Interest rate ceilings, high reserve ratios and directed credit programs were viewed as sources of financial repression, the main symptoms of which were low savings, credit rationing and low investment. During the 1980s and 1990s, liberalisation of financial markets have thus been suggested, so that with the real rate of interest adjusting to its equilibrium level saving and the consequent expansion of total real supply of credit would then induce a higher volume of investment. Economic growth would, therefore be stimulated not only through the increased investment but also due to an increase in the average productivity of capital. But the unsuccessful evidence of the financial liberalisation is because of the existence of macroeconomic instability and inadequate banking supervision. Currently in the Indian economy, the experience of highly positive real interest rates, possibly triggered by fiscal instability, indicate a poorly functioning financial system.

The MS school expects financial liberalisation (institutional interest rates rising towards their competitive free-market equilibrium levels) to exert a positive effect on the rate of economic growth in both the short and medium runs, whereas the Neostructuralists predict a stagflationary (accelerating inflation and lower growth) outcome from financial liberalisation in the short run and possibly a positive influence in the medium run through a dominant saving effect (Fry, 1997). In practice, it is virtually impossible to isolate the effects of financial components of the reform package, as most cases of financial liberalisation are usually accompanied by other economic reforms (such as fiscal, trade and foreign exchange reforms). However, we have examined the effect of one per cent increase in interest rate within our extended model, which suggests a Neostructuralist outcome of low growth and high inflation, and a deterioration in trade balance (Chart 1.4).[10]

C. Modelling Expectations

Since expectations are treated in a simple fashion and adoption of an adjustment program may alter expectations, there is a need to introduce model-consistent expectations instead of adaptive expectations in inflation in the KK model. In Chart 1.3 we present the simulations assuming that the expectations of inflation are generated rationally within the extended model, so that expected inflation is equal to the actual rate of inflation in the future period. The shock analysis of various policies is carried out with rational expectations in the extended model. The results are different in the short run. It has a short-run effect in changing the magnitudes. Credit shock and devaluation shock behave in the same fashion as well (see Chart 1.3, fig.1).

[10]This finding however cannot be used as an argument against the MS model, as MS assume a dual structure with a secondary financial market which remains to be modelled with a richer mechanism.

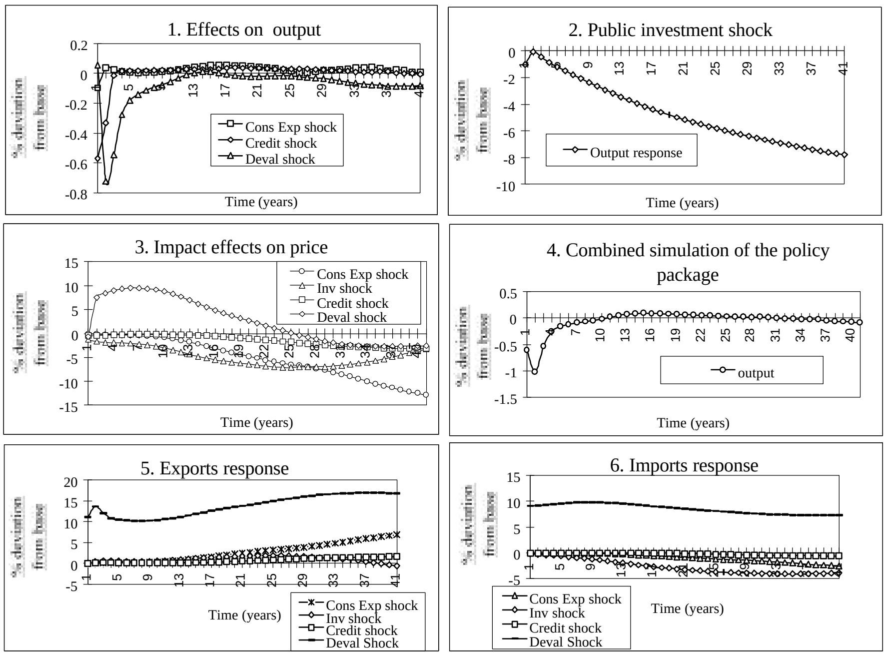

Chart 1.3. Simulation of the Extended Model with Rational Expectations

The assumption of model consistent expectations make things different for the simple reason that when inflation is expected to be higher after introduction of a reform program, there will be lower money demand and hence high inflation thereby lower actual output growth in the first period. Because of model-consistent expectations, output in the next period due to investment shock increases, and then declines permanently (Chart 1.3, fig.2). One interesting thing that we notice with the combined shock is that the output declines in the first two periods and slowly improves as in the independent shocks. But there has been a change in the magnitudes due to the forward-looking expectations. In case of an investment shock, output declines in the first period and because of the low price expectations, output improves for next period and then declines permanently as it was before without rational expectations.

In these simulations, we find rational expectations playing very little role in changing our results. The sensitivity of expectations is prominent in the short run. Moreover, the change in short run properties due to rational expectations is not a very uncommon result in the literature on macroeconometric modelling. For example, Fisher et al. (1992) and Bikker et al. (1993) show that the switch from adaptive to rational expectations dynamics affects only short-run properties of the model (for an elegant discussion, see Wallis (1995)).

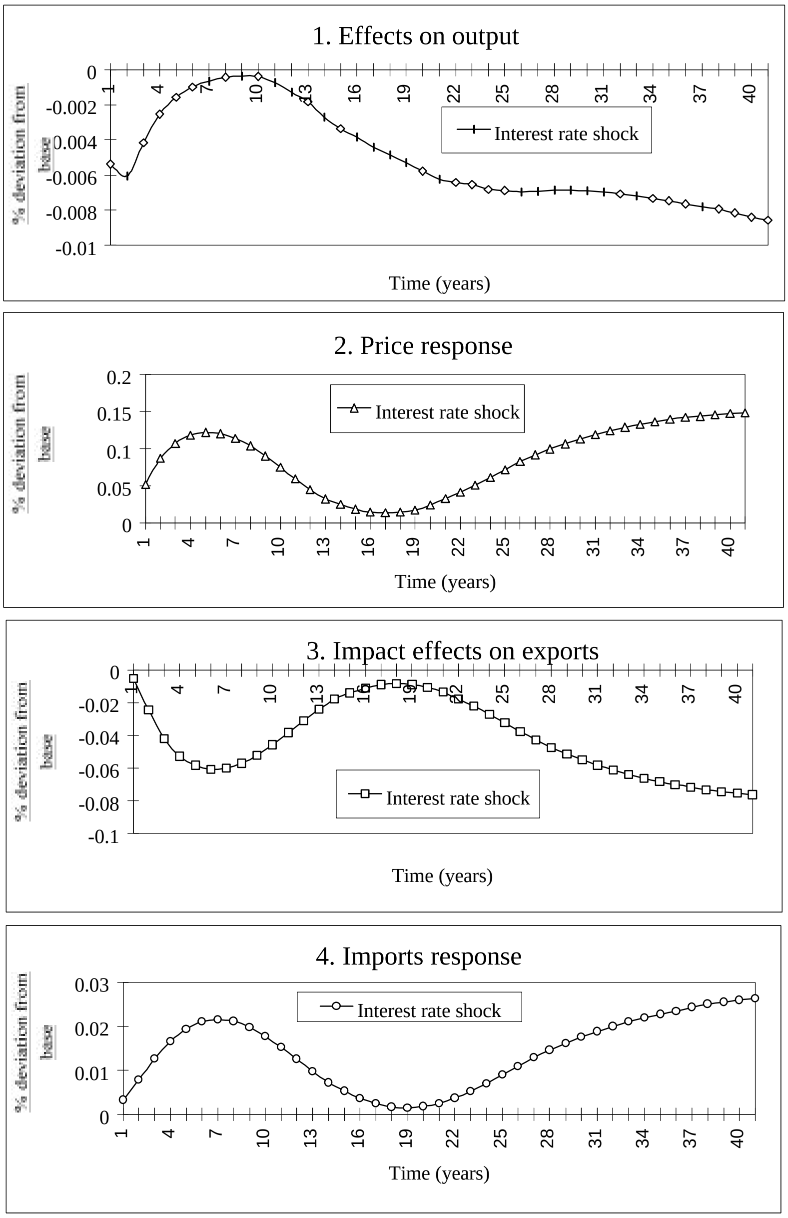

Chart 1.4. Simulations of the Financial Liberalisation

In sum, a government expenditure reduction giving rise to increase in output growth after one period is illusory, since when we disaggregate G into CG and IRG, and shock public investment as an indicator of fiscal policy, we find that it results in a constant decline in output growth in the present model. Though the perfect foresight assumption does not change the results very much in the medium-term, it does change the short run properties of the model.

5. CONCLUSION

The purpose of this paper was to analyse a small, but well articulated and internally consistent, dynamic macroeconomic simulation model for a representative DE that relies on familiar macroeconomic theory and in which expectations are formed rationally. The model has been intended to be suitable for the analysis of general equilibrium interactions among the key macroeconomic variables that typically concern policy makers in such countries. Hence public investment to maintain or expand infrastructure is complementary to private investment and any increase in infrastructural investment would undoubtedly give rise to higher output growth in the economy. The assumption of rational expectations does affect the short-run adjustment process, leaving the long-run implications unchanged. The present exercise reveals that the contractionary fiscal policy taking the form of a cut in real public sector investment is by no means growth-inducive in the medium term.

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