Devaluation, Liberalisation and the Structural Linkages Between India's Foreign Trade and National Income

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Section I: Introduction

For a developing country structural links between its foreign trade sector and the domestic economy have a crucial bearing, especially in terms of the results achieved by a package of policy reforms. Typically the latter includes trade liberalisation and currency devaluations. This demands a specification of the nature of these structural links in terms of a macro-economic model which takes note of these relations. These aspects, however, are sometimes overlooked in the prevailing literature.

Attempts are made, in the present paper, to overcome such lacunae in analysis by providing a macro model of the Indian economy which is based on a specification of these structural linkages between GDP, exports and imports. Data relating to the Indian economy for 1973-89 has been used for the purpose of an econometric testing of the model The period chosen includes the years of a "liberalised regime" which began in 1985-86 and preceeded by the earlier years of a "trade regime" (1973-74 to 1984-85) when controls were relatively prominent. Liberalisation in India has been marked by both devaluation of the rupee and wide-ranging trade decontrols.

The model, set up in Section II of this paper specifies the pattern of structural linkages between India's GNP, exports and imports in terms of a simultaneous equation system. The specification, as can be seen from an econometric testing of the model in Section III enables us to identify the repercussions of policy changes on the size of India's trade deficit and GNP. An attempt has been made to quantify the net effect of real depreciation of the rupee (changes in RER) on the three variables in terms of the structural relations specified in the model as a whole. Finally we explore the possibilities of parametric shifts in the functional forms relating to the three respective variables as could result from liberalisation efforts (excluding devaluation) under the "liberalised regime". Evidently the exercises situate the recent policy changes in the economy by having a reference to the pattern of structural interdependence between the different activities of production, exports and imports.

A crucial aspect of our approach which is reflected in the specification of the model deserves here a special mention. Analysis of the structural links between GDP and foreign trade in this paper rests on the notion that imports and exports can be respectively treated as direct and indirect inputs to the production process in the economy. While imports provide the physical inputs needed for production in the domestic economy exports indirectly provide for them by procuring the requisite finance from abroad. Treating exports as well as imports as inputs to the aggregate production process indicates a marked departure from the conventional demand deficiency models where foreign trade is reckoned in terms of its demand generating capacity. In India with exports earnings or imports payments each forming less than 10 per cent of the country's GDP it is probably legitimate to underplay the demand generating/repressing role of the trade balance in the economy. Exports, however, play

a crucial role in providing exchange earnings which supplement the country's import capacity. With moderate to high degrees of dependence on imported inputs the countries production process may thus come to a halt if the flows of imports are interrupted. This is typical in a country with a foreign exchange bottleneck, one where exports serve as indirect inputs to the productive system. With external debt and the debt related contractual obligations increasing relative to the domestic output and export earnings net inflows of external finance tends to taper off. Exports have an additional significance under such situations, by providing the finance needed for additional imports. For a country like India where the potentials of a large home market often remain unexplored because of the difficulties of financing imports which are vital to the production process, exports tend to have significance more as a foreign exchange earner than a demand generating activity.

Viewing foreign trade as a supply (production) augmenting rather than as a demand generating/contracting factor also affects the implications of important policy changes like the depreciation of local currency on the domestic economy. It has been pointed out that devaluation may turn out to be contractionary despite an improved trade balance when a redistribution of output from wages to profits (and rents) in the domestic economy causes an upward shift in the aggregate savings propensity (Krugman and Taylor, 1978). The reasoning however is based on the effects of devaluation on aggregate demand than supply. In terms of our argument devaluation may turn out to be contractionary by curtailing the availability of imports and hence the supply of aggregate output. This may happen when devaluation causes adverse movements in the terms of trade of the country, thus reducing the volume of imports which the country can afford. The sequence has been earlier described by us as an "import-led GDP compression" which in the present case is triggered off by

devaluation, (Gylfason, 1983 and Sen and R.U. Das, 1991). In a similar manner liberalisation measures (other than exchange rate adjustments) also can have contractionary effects on domestic GDP by raising the import content of output when the measures have no positive effect on export earnings. A similar result, without a complete set of explanations has been offered earlier by Edwards (1986) to show the contractionary effect of real devaluation in the short-run. The model set up in Section II and the results of the econometric exercise reported in section III address the following questions:

a. What are the structural links between domestic output and foreign trade in the Indian economy? Do these provide a basis for treating imports (and export earnings) as inputs to the production process?

b. Can domestic output be affected by changes in India's real effective exchange rates, keeping in view their impact on trade and the structural links between trade and and domestic output?

c. Can other forms of liberalisation (especially those which affect trade) influence the changes in domestic production and trade?

The three issues would be taken up in Section III where the model set up in section II is put to an econometric exercise.

Section II: A Macro-Model of Structural Linkages in the Indian Economy

The introductory remarks provided in the preceeding section can now be used to formulate the following model for the Indian economy:

$$Y_{dr} = \beta M^{\tau}_{r} \ , \ \beta, \tau > 0 \qquad (1)$$

$$M = M(RER, X, Y_d) \qquad (2)$$

$$X = X(RER, XS, Y_f) \qquad (3)$$

$$TD = M-X \qquad (4)$$

where

Y_{dr} = real GNP of India

Y_d = value of India's GNP

M_r = real imports of India

M = value of India's imports

X = value of India's exports

RER = trade-weighted index of real effective exchange rate for the rupee

Y_f = trade-weighted index of GNp of 20 major trading partners, at current prices.

TD = value of India's trade deficit.

XS = export subsidies.

While Y_{dr} and M_r are calculated in real units, all other variables, Y_d, M, X and TD are expressed in units of dollar, which is arrived at by converting the current rupee values at current rupee-dollar exchange rates. Y_f is obtained in dollar units.

The essence of our argument is captured by equation (1) in terms of the output supply function Y_{dr} which depends on the flow of real imports M_r. The equation can be rewritten as:

$$Y_d = \beta M^{\tau} (RER)^{\tau} (pe)^{1-\tau}$$

or $$\ln Y_d = \ln \beta + \tau \ln M + \tau \ln RER + (I-\tau) \ln (pe) \qquad (1a)$$

The dollar values Y_d and M in equation (1a) has been arrived at by converting the respective rupee values (volume x rupee prices, p) at e, the nominal dollar exchange rate for rupee. Equation (1a) specifies, for each 1% rise in RER, the percentage change in Y_d, given by τ provided p and e remain constant. Evidently, Y_{dr} would also be subject to the same order of change as long as changes in (pe) are ruled out.

Equations (2) and (3) provide the functional forms of the import and export value equations. RER provides the role of a price relative between domestic and foreign goods in both functions. A depreciation of rupee, indicated by a drop in RER, would exercise a price-effect the direction (sign) of which may turn out to be different for exports and imports when the commodities face an elastic demand. The standard behaviourial impact is captured by Y_d and Y_f in the respective equations for M and X. X, the value of export earnings influence dollar value of imports in equation (2) by providing the requisite foreign exchange. In equation (3), XS, the level of export subsidies influences the level of export earnings by changing their competitiveness. TD,the dollar value of trade deficit is spelt out in the identity given by (4).

The model can be used to test the impact of policy changes like devaluation on Y_d, X and M. In equations (2) and (3) the coefficients to RER indicate the partial elasticity of the

respective M and X functions vis-a-vis changes in RER. The overall impact on the three separate variables would however be determined by the pattern of interdepence woven in terms of the structural linkages in the model.

The following is now offered as a testable model

$$\ln Y_d = \beta + \tau \ln M + \tau \ln RER + (I-\tau)\ln (pe) + \tau_1 D \quad (5)$$

$$\ln M = \alpha_0 + \alpha_1 \ln x + \alpha_2 \ln Y_d + \alpha_3 \ln RER + \alpha_4 D \quad (6)$$

$$\ln x = \Theta_0 + \Theta_1 \ln Y_f + \Theta_2 \ln RER + \Theta_3 \ln xs + \Theta_4 D \quad (7)$$

$$TD = M - x \quad (8)$$

where the dummy variable D is 1 for the period 1985-86 to 1989-90. D captures the impact of liberalisation which began during the period 1985-86. The entire period 1973-74 to 1989-90 as mentioned in section I can be broken up into a "trade-regime" in India during 1973-74 to 1984-85 and a second period which relates to the years of "liberalised regime" since 1985-86. While data for 1990-91 and 1991-92 are available there is evidence that imports were artificially restricted by measures like trade credit restrictions. This invalidates the functional form specified for our import function during these years and we have excluded these years from our empirical exercise.

Equations (5) and (6) constitute a simultaneous equation structure where the parameters can be estimated by 2SLS subject to the restrictions on parameters of equation (5). However multicollinearity problems arise in equation (6) which may be due to the simultaneous existence of X, Y_d and RER. This can distort the signs of the coefficients. The problem has prevented us from using the 2SLS method. Instead we prefer to carry out an indirect least square technique in order to estimate the reduced form parameters. The corresponding equations are

$$\ln Y_d = \mu_1 + \mu_2 \ln RER + \mu_3 \ln x + \mu_4 \ln (pe) + \mu_5 D \quad (9)$$

$$\ln M = \delta_1 + \delta_2 \ln RER + \delta_3 \ln x + \delta_4 \ln (pe) + \delta_5 D \quad (10)$$

where

$$\mu_1 = \frac{\beta+\tau\alpha_0}{1-\tau\alpha_2}, \quad \mu_2 = \frac{\tau(1+\alpha_3)}{1-\tau\alpha_2}, \quad \mu_3 = \frac{\tau\alpha_1}{1-\tau\alpha_2}, \quad \mu_4 = \frac{(1-\tau)}{1-\tau\alpha_2}$$

$$\delta_1 = \frac{\alpha_0+\alpha_2\beta}{1-\tau\alpha_2}, \quad \delta_2 = \frac{\alpha_3+\alpha_2\tau}{1-\tau\alpha_2}, \quad \delta_3 = \frac{\alpha_1}{1-\tau\alpha_2}, \quad \delta_4 = \frac{\alpha_2(1-\tau)}{1-\tau\alpha_2}$$

$$\mu_5 = \frac{\tau_1+\tau\alpha_4}{1-\tau\alpha_2}, \quad \delta_5 = \frac{\alpha_2\tau_1+\alpha_4}{1-\tau\alpha_2}$$

It may be noted that δ_2 in equation (10) represents net percentage change in M for 1 per cent change in real effective exchange rate (RER) holding X and (pe) constant. However, x is also a function of real effective exchange rate, therefore, total change would be higher or smaller than δ_2 depending upon the elasticity of real exports with respect to RER (Which determines the sign of Θ_2). Furthermore, δ_2 can be decomposed into two parts, namely direct impact of RER on M (which we may call `price effect') and change in M due to change in India's nominal GNP (US$), which we propose to call `income effect'. μ_2 represents net percentage change in real output (holding (Pe) constant) due to 1 per cent change in RER.

The OLS estimates (with t value in parentheses) are as follows:

$$\ln Y_d = \underset{(-3.20)}{-7.23} + \underset{(2.12)}{0.72} \ln RER + \underset{(4.21)}{0.71} \ln X + \underset{(2.34)}{0.53} \ln (pe) + \underset{(4.56)}{0.22} D \quad (11)$$

Time period : 1973-74 to 1989-90, $R^2 = 0.98$, $\bar{R}^2 = 0.97$, Lagrange Multiplier Test of first order serial correlation, F (1,11) = 0.02

$$\ln M = \underset{(-2.96)}{-5.44} + \underset{(3.12)}{0.82} \ln RER + \underset{(6.15)}{0.80} \ln X + \underset{(6.58)}{1.14} \ln (pe) + \underset{(3.15)}{0.12} D \quad (12)$$

Time period : 1973-74 to 1989-90, $R^2 = 0.99$, $\bar{R}^2 = 0.97$, Lagrange Multiplier Test of first order serial correlation, $F(1,11) = 0.08$

$$\ln x = \underset{(6.67)}{7.08} + \underset{(10.58)}{0.72} \ln Y_f - \underset{(-1.96)}{0.37} \ln RER + \underset{(2.31)}{0.13} \ln(XS) - \underset{(-4.66)}{0.21} D_1 \quad (13)$$

Time period: 1973-74 to 1989-90, $R^2=0.98$, $\bar{R}^2=0.98$, Lagrange Multiplier Test of First order Serial Correlation, $F(1,11)=0.58$

Section III: Interpreting the Results

Several comments are in order to interpret the various parameter estimates in equations (11) - (13). First D, which can be called the liberalisation dummy has been found significant for both output and import functions, respectively provided in equations (11) and (12). A positive and significant coefficient for D in either equation indicates that liberalisation efforts since mid eighties could favourably affect output when their impact on imports were also favourable. Positive influences on Y_d and M (both dollar values) also indicate similar impact on the real variables Y_{dr} and M_r as long as RER, and (pe) are all held constant. (The reader may recall the transformation of Y_{dr} to Y_d in equation (2)). In absence of additional export earnings, the rise in imports were debt-financed, a point which we would take up later while interpreting the deviations between actual and estimated TDs. The point is all the more relevant as we observe the insignificant coefficient of D in the export function. However, extraneous forces like the stoppage of crude oil from India in April 1985 (following the setting up of domestic refineries) make it meaningful to incorporate an additional dummy

variable D_1, in equation (13) with value 1 for 1985-86 and 1986-87. Effects of RER on X indicate a negative and significant coefficient, implying that real exports from India are price elastic. However the RER-import relation cannot be empirically checked because of a mis-match between the reduced form parameters and the structural parameters. This prevents us from obtaining an unique solution for α_3 in equation (6) which is crucial to check the partial elasticity of real imports with respect to RER. The rather opposite movements in RER and M except during 1979-80 to 1984-85 (Figure 1) can possibly be interpreted by the intuitive reasoning that in India real demand for imports had been price (and hence RER) inelastic over the period.

The crucial parameters τ and τ_1 in the structural equation (5) can now be obtained by estimating the equation using the 2SLS method, subject to the restrictions on the parameters. The estimated equation with t-values in parentheses are given as follows

$$\ln Y_d = \underset{(-3.20)}{-3.90} + \underset{(3.99)}{0.45}\ \ln M + \underset{(3.99)}{0.45}\ \ln RER + \underset{(4.69)}{0.55}\ \ln (pe) + \underset{(4.75)}{0.29} D \qquad (14)$$

time period 1973-74 to 1989-90

DW = 1.62, R^2 (between observed and predicted) = 0.94

Holding the other variables (M and pe) constant, 1% rise in real imports would, in terms of equation (14), bring in a 0.45% increase in real output a result which is revealing.

Figure 1

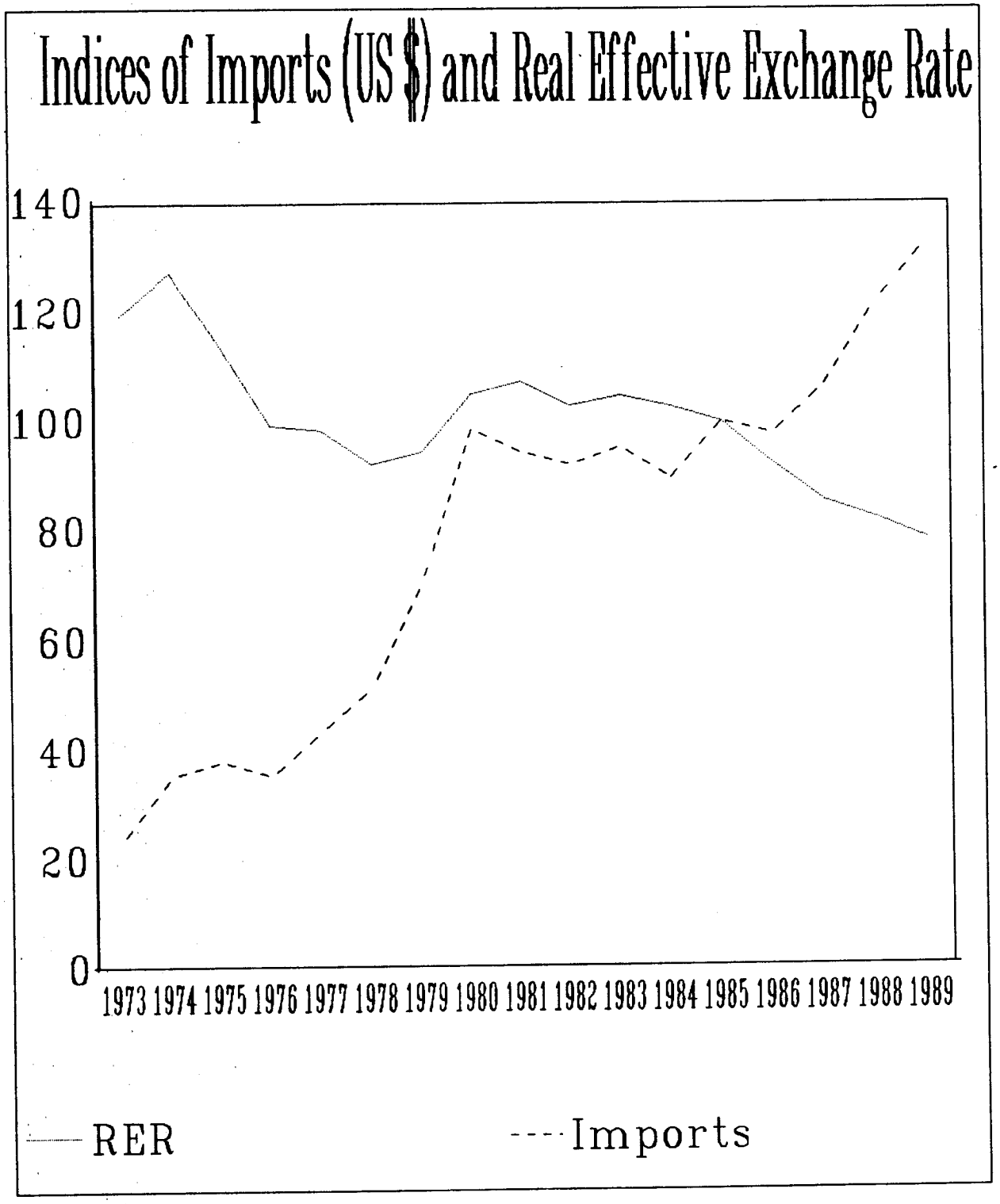
Indices of Imports (US $) and Real Effective Exchange Rate
140
120
100
80
60
40
20
0
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
RER
Imports

Table 1

Percentage Changes in RER, Estimated Imports and Estimated Real Output

Year	RER	Estimated imports	Estimated real output
1980-81	11.42	5.90	5.25
1981-82	1.99	1.05	0.91
1982-83	-4.09	-2.19	-1.88
1983-84	1.84	0.97	0.84
1984-85	-2.00	-1.06	-0.92
1985-86	-2.72	-1.45	-1.25
1986-87	-7.80	-4.21	-3.58
1987-88	-7.37	-3.97	-3.39
1988-89	-3.74	-2.00	-1.72
1989-90	-4.62	-2.47	-2.12
1990-91	-2.29	-1.22	-1.05
1991-92	-12.40	-6.77	-5.70

Notes: 1. Estimated imports and real output show percentage changes in imports and real output caused by changes in real effective exchange rate with a ceteris paribus assumption relating to other independent variables. These have been estimated by using equations (11) and (12) after substituting equation (13) for lnx.

2. Imports are measured in US$.

3. A negative sign in column 2 indicates depreciation.

Table 2

Percentage Changes in RER, Actual Trade Deficit and Estimated Trade Deficit

Year	RER	Actual trade deficit	Estimated trade deficit
1980-81	11.42	118.82	43.56
1981-82	1.99	-12.36	5.61
1982-83	-4.09	-12.21	-11.23
1983-84	1.84	3.20	5.51
1984-85	-2.00	-22.65	-5.78
1985-86	-2.72	57.98	-8.33
1986-87	-7.80	-16.48	-26.44
1987-88	-7.37	-15.29	-33.37
1988-89	-3.74	9.07	-24.69
1989-90	-4.62	-15.93	-40.33
1990-91	-2.29	27.63	-32.97
1991-92	-12.40	-73.94	-277.01

Notes: 1. Trade deficit is measured in US$.
2. Estimated trade deficit shows percentage changes in trade deficit due to percentage changes in real effective exchange rate holding all other exogenous variables constant.

Tables 1 and 2 provide the results of a simulation exercise where the estimated values are arrived at by using equations (11) and (12) after substituting equation (13) for lnx, with a *ceteris paribus* assumption relating to other independent variables in these equations, estimates are provided for annual percentage changes in M, Y_d and TD caused by actual percentage changes in RER during the years 1980-81 to 1991-92.

The major finding of the simulation results reported in tables 1 and 2 relate to the net effects of the annual depreciations in the real effective exchange rate of the rupee on domestic real output and the dollar value of India's trade deficit during each year. A reduction in the estimated size of the trade deficit, achieved through a cut in import volume, explains the

simultaneous drop in the estimates for real output. Thus real depreciation achieves an improvement in trade balance at the cost of domestic growth - a sequence which is based on the theme of an import-led GDP compression in a foreign exchange constrained as well as import dependent economy. The process also describes the possibilities of devaluation leading to a GDP contraction - for reasons which have been discussed earlier. The simulations exercises incorporate the various causal relationships which often move in opposite directions. For example while a drop in RER reduces output, a simultaneous increase results in dollar value of imports (provided real demand is price inelastic) and in dollar value of exports (provided real demand abroad is price elastic). The rise in dollar value of exports is likely to increase dollar value of imports while the reduced dollar value of output would reduce imports in dollar.

Aggregate effects of a real depreciation (or appreciation) on real output and the trade deficit in dollar terms are thus rather complex in terms of the functioning of our structural model. A simplistic approach, by calculating the partial elasticity of the trade variables vis-a-vis RER thus leads to false diagnosis as well as solutions.

Attention needs to be drawn, before offering our concluding observations, to the disparity in Table 2 between the actual and the estimated annual dollar values for trade deficits. Actual trade deficit narrowed by a margin which was much smaller after 1985-86 compared to the narrowing of the estimated trade deficit. Since the latter was calculated on the basis of changes in RER alone, the deviations can be related to simultaneous changes in the remaining variables, and especially in D which acquired an explanatory power during the `liberalisation regime'. Debt financed imports were rather common during the late eighties (Mundle and Mukhopadhyay, 1993; Sen, 1994). But for the `changes'

initiated in the economy as liberalisation package and also in the remaining variables which include both domestic prices (P) and foreign income (Y_f) throughout the entire period, actual trade deficit could have been narrower, as indicated by the estimated numbers.

Section IV: Concluding Observations

What then, is the upshot of the preceeding exercise in terms of the relevance of the structural linkages in the Indian economy for trade and exchange rate policies?

The major finding of this paper relates to the need to consider the structural linkages between different sectors including foreign trade. As pointed out in our study, these structural links are of crucial significance in determining the impact of policy changes in the economy. To be specific, our study indicates that in India imports have a crucial bearing on growth rate of output - presumably because of the nature of imports which mostly consist of raw materials and intermediates needed for production. A tendency, observed during the liberalisation regime since 1985-86, for an added degree of this functional dependence between imports and GDP is borne out by results which indicate upward shifts in both import and output functions during these years. Evidently the increased level of imports contributed to additional output. Data for 1990-91 and 1991-92 indicate a reverse process with simultaneous declines in both imports and the GDP.

This paper does not analyse the implications of changes in the capital account of the country's balance of payments as resulted from liberalisation. Resort to debt financing

during the late eighties when imports rose very fast resulted in steep increases for debt services. The debt difficulties led, during the nineties, to a GDP compression which was triggered off by a slowing down of imports.

The other important finding of this paper relates to the implications of major instruments of trade policy like devaluation for the economy. Unlike what is usually postulated in the literature, effects of devaluation on the country's trade deficit and the GDP are determined by the interplay of a structurally interdependent system, thus ruling out the relevance of the simplistic exercises implicit in partial approaches.

The net effect of changes in RER on domestic output and trade deficit would depend on the individual effects on imports, exports and output which work on each other. Evidently the structural linkages between the dependent variables and the relation of each to the policy instruments or other parameters are both crucial in determining the final effect of RER. While our estimates indicate a narrowing of trade deficit at cost of growth during the period the story can not, for obvious reasons, be treated as universal. Thus RER may have a very different impact on GDP and the trade deficit when the structural links and the functional forms of these variables are different.

In our analysis we have stressed the need to treat both imports and exports as essential inputs to the productive process. The approach which deviates from the demand generating/ contracting role of foreign trade, is based on the structural dependence of GDP on imports and of the latter on export earnings. The possibility of a `devaluation - led-contraction' in our model arises out of supply (and not demand) adjustments.

We have observed that in India devaluation has narrowed down the size of the trade deficit. However the actual narrowing has been much less compared to the estimated net RER effects in terms of the model. This presumably is related to the operation of factors like liberalisation or debt financed imports which pushed up imports.

Finally, as a note of caution we stress the need to consider the changes in the country's balance of payments as a whole. The difficulties of maintaining and sustaining debt-financed imports are not captured by the model. A complementary analysis, specifying the exact pattern of adjustments between the current and capital accounts is needed to understand the full impact of policies like exchange rate adjustments and liberalisation.

Data Appendix

Data used to test the model include the time series for the respective variables for the years between 1973-74 to 1989-90. Sources for Y_d, M and X are Economic Survey of the Government of India for the relevant years. Rupee values at current prices have been converted to dollar at the prevailing exchange rate. For Y_f, the data source is International Financial Statistics of the IMF. Data sources for XS goes back to the Ministry of Commerce, Government of India. The data on real effective exchange rate (RER) have been obtained from the Reserve Bank of India Monthly Bulletin , July and November 1993. The real effective exchange rate is the nominal effective exchange rate for the rupee based on total trade weights of 36 countries deflated by the effective relative price between India and its trade partner countries based on the same weights. See also Economic and Political Weekly, January 15, 1994 for a rigorous discussion on the construction of NEER and REER indices by various authors and the Reserve Bank of India.