CHAPTER 5
Methodology and Empirical Estimation

1. Introduction

The available studies in the literature relating to the impact of foreign capital on economic growth of developing countries, have two major shortcomings. First, the growth performance should include, inter alia, the domestic savings rate, foreign capital, and export performance\(^1\) as explanatory variables. While foreign capital, per capita income, growth rate, and export performance are important determinants of savings behaviour, the estimates obtained from regression analysis will be biased if any of these variables are omitted. Second, the common approach in most of these studies, barring a few ones\(^2\), has been to specify some sort of single equation models for savings and for growth rates and include foreign capital inflows, either in their aggregate form or in a somewhat disaggregated form, among the determinants of these two variables. Although this approach, while useful as a first approximation, yet is rather deficient. There exists, however, a substantial body of literature, both theoretical and empirical, to suggest that savings and growth rate affect each other. This means that for a proper appreciation of the quantitative magnitudes of
the of foreign capital inflows, we must allow for this simultaneity. In other words, foreign capital affects savings and growth both directly, as in single equation models, and also indirectly, because of the interdependence between savings and growth. This total effect, which consists of both the direct and the indirect effects, may be different from the direct effect both in terms of magnitude, and sometimes even more significant, in terms of the direction, i.e. the sign of total and the direct effect may be opposite.

To remedy these problems, we attempt to specify a simultaneous equations model\(^3\) in which both savings and growth are treated as jointly dependent variables and which also includes export performance among other variables. We also disaggregate foreign capital inflows into foreign aid and foreign direct investment.\(^4\)

2. The Model

Consider the simultaneous model contained in equations (1) and (2):

\[
\begin{align*}
S/Y &= a_0 + a_1G + a_2 \text{AID} + a_3 \text{FDI} + a_4 \text{DR} + a_5 \text{CX} + u_1 \quad (1) \\
G &= b_0 + b_1 \frac{S/Y}{Y} + b_2 \text{AID} + b_3 \text{FDI} + b_4 \text{GL} + b_5 \text{CX} + u_2 
\end{align*}
\]

\(a_1 > 0\) \(a_2 < 0\) \(a_3 < 0\) \(a_4 < 0\) \(a_5 > 0\)

\(b_1 > 0\) \(b_2 < 0\) \(b_3 < 0\) \(b_4 > 0\) \(b_5 > 0\)
where:

- \( S/Y \) = gross domestic savings rate measured as percentage of GNP;
- \( G \) = growth rate of GNP;
- \( AID \) = net foreign aid as percentage of GNP;
- \( FDI \) = net foreign direct investment inflow as percentage of GNP;
- \( DR \) = dependency rate as the percentage of population between 0-14 years and over 60 years of age;
- \( CX \) = change in exports as percentage of GNP;
- \( GL \) = rate of growth of labour force;
- \( u_1, u_2 \) = stochastic error terms

The structural model described above consists of a savings equation and a growth equation, each having an independent meaning and identifying a behavioural relationship in the system. The two equations in the model are expressed in linear form, both in variables and parameters. The equations contained in the model are stochastic in nature because each equation has, in the right hand side, in addition to the explanatory variables, an error term \( u_i \), to account for omitted variables and other factors affecting the relationship. These error terms are assumed to have certain well-defined probabilistic properties. The model consists of two endogenous variables (\( S/Y \) and \( G \)) and five exogenous variables (AID, FDI, DR, CX, GL). The expected signs of the various coefficients are shown.
immediately below them. Given the controversy among the economists, the signs of $a_2$, $a_3$, $b_2$ and $b_3$ could either be positive or negative.

Before we proceed further, it should be emphasized here that the coefficients estimated from the structural equations measure only the direct effect of the relevant explanatory variables on the relevant endogenous variable, in contrast to the total effect. The latter effect is given by the reduced form coefficient which incorporates both the direct and indirect effects of an exogeneous variable on the relevant endogeneous variable.

3. A brief discussion of the Structural Equations

We now turn to a brief discussion of each equation in the model described above.

3.1 Savings rate Equation:- This equation contains growth rate of income (G), foreign aid (AID), foreign direct investment (FDI), dependency rate (DR) and export variable (CX) as explanatory variables.

The arguments for the inclusion of the growth rate of income and dependency rate can be found in the survey paper by Mikesell and Zinser. The inclusion of growth rate of income has been suggested, among others, by Houthakker, Modigliani and Swamy. The growth rate variable in explaining savings behaviour is justified on the ground that rapid income growth changes relative
income and life-time consumption patterns, and increases transitory income in relation to permanent income, the former influencing the savings rate more strongly and directly than the latter.

The case for the inclusion of the dependency rate has been strongly argued by Leff. Dependency rate is related to the birth rate and the latter has significant impact on the age distribution of the population. Following Modigliani-Brumberg-Andos' (MBA) "Life Cycle Hypothesis", it is postulated that age distribution of population will influence the savings behaviour. Leff has formulated an empirical model in which he used dependency rate variable to reflect the age composition of the population and in this formulation, dependency rate will exert negative influence on the savings rate because as the percentage of dependents in the population increases, the potential for savings decreases as additional people have to be provided with the given resources.

The inclusion of foreign capital inflows (measured as an aggregate) has been suggested by Rahman, Gupta, Griffin and Enos, Chenery and Eckstein, Landau, Weisskopf, Dacy among others. However, Papanak has gone a step further and suggested the inclusion of different components of foreign capital inflows. But, a priori, it can be argued that since the different components of foreign capital inflows are not
homegeneous, it follows that their effects on saving rates need not necessarily be the same, at least quantitatively.

The case for inclusion of export variable is justified for several reasons. First, exports (especially of primary products) often produce highly concentrated income and standard savings theory shows that the propensity to save from such income is high. Second, countries whose export performance is good tend to face fewer foreign exchange constraints on investment and, therefore, tend to provide more of an incentive to save. Third, to the extent that trade taxes are a major source of revenue, exports tend to increase Governement savings.

3.2 Growth Rate Equation :- This equation contains savings rate, foreign capital inflows, growth rate of labour force and export variable as explanatory variables.

The inclusion of savings rate and the foreign capital inflows in this equation is justified on the ground that rate of capital formaition is the prime determinant of the rate of growth and that domestic and foreign resources have different quantitative effects. Sommers and Suits, in their study used investment as the only variable explaining growth. Robinson, also reported overwhelming impact of capital formation on economic growth.

The inclusion of rate of growth of labour force is justified within the framework of neoclassical production
function. Assuming a production function with neutral technical change, \( Y = A(t) f(K,L) \), a positive effect on the growth rate of income is hypothesised.

The export variable is included in this equation for a number of reasons. First, exports enable countries to specialize in the production of commodities in which they have a comparative advantage; resources thus saved can be used for investment. Second, trade provides a vent for surplus commodities which bring otherwise unemployed resources into use. Third, trade can expand production possibilities through its effect on such factors as competition, access to new knowledge, technology and ideas; these are the so called "dynamic gains" from trade. Fourth, trade enables countries to purchase goods from abroad. If there are no domestic substitutes available, the ability to import can relieve bottlenecks in production and thus increase savings and investment; and imports may simply be more productive than domestic resources.

4. Estimation of the Model

The two-equation model specified above is exactly identified. We have estimated the model using the time series data for the Indian economy for a 25-year period, from 1955-56 to 1979-80. In estimating the model, the ordinary least squares (OLS) and Theil and Basmann's

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Two-stage least squares (2SLS) methods have been used.

The OLS method may be termed as single equation method while 2SLS method may be termed as simultaneous equation method. Apart from the fact that single equation estimates are subject to bias²⁸, they are also presented and discussed. This is due to two reasons. First, most of studies/findings on the relationships between foreign capital inflows on the one hand, and the economic variables of the present study on the other, are based on the single equation method. Our single equation estimates are, therfore, expected to serve the comparative purposes. Second, it is interesting to find out the extent of the difference between the single equation estimates and the simultaneous equation estimates when the same data are used. Such a difference is expected because the single equation estimates include only the direct effect of the explanatory variables, while the simultaneous equation estimates take account of total effect, both direct and indirect.

We have also estimated the model using the single equation method (OLS) and upto two-year lag in foreign capital inflows, i.e. AID and FDI. The estimation results are given in Tables 5.1 and 5.2 below.
Table 5.1

Estimation of the two-equation model for the Indian economy by OLS method: 1955-56 to 1979-80

1. Saving \( S/Y = -17.404 + 0.026 \, G - 1.520 \, AID - 14.077 \, FDI \)
   \( \text{Function} \) \( (0.425) \quad (0.157) \quad (2.048)^* \quad (1.659)^{**} \)
   \( + 0.439 \, DR + 3.370 \, CX \) \( R^2 = .58, \bar{R}^2 = .47 \) \( \text{df} = 19 \)
   \( (0.915) \quad (2.386)^* \) \( \text{DW} = 1.01 \)

\( = -63.008 + 0.062 \, G - 1.486 \, AID \) \( \text{(1-yr. lag)} \)
   \( (1.230) \quad (0.339) \quad (1.643)^{**} \)

\( - 15.399 \, FDI \) \( \text{(1-yr. lag)} \) \( + 0.968 \, DR \)
   \( (1.741)^{**} \quad (1.596)^{**} \)

\( + 3.265 \, CX \) \( R^2 = .53, \bar{R}^2 = .40 \)
   \( (2.315)^* \)

\( = -33.252 - 0.003 \, G - 0.067 \, AID \) \( \text{(2-yr. lag)} \)
   \( (0.583) \quad (0.017) \quad (0.070) \)

\( - 24.667 \, FDI \) \( \text{(2-yr. lag)} \) \( + 0.602 \, DR \)
   \( (2.869)^* \quad (0.888) \)

\( + 4.379 \, CX \) \( R^2 = .53, \bar{R}^2 = .40 \)
   \( (2.891)^* \)

2. Growth, \( G = 3.559 + 0.065 \, S/Y + 0.104 \, AID - 2.667 \, FDI \)
   \( \text{Function} \) \( (0.545) \quad (0.215) \quad (0.105) \quad (0.213) \)

\( + 0.001 \, GL - 2.439 \, CX \) \( R^2 = .07, \bar{R}^2 = -.17 \) \( \text{df} = 19 \)
   \( (0.001) \quad (1.151) \) \( \text{DW} = 2.2 \)

\( = 2.307 + 0.070 \, S/Y + 0.973 \, AID \) \( \text{(1-yr. lag)} \)
   \( (0.396) \quad (0.265) \quad (1.025) \)

\( - 9.313 \, FDI \) \( \text{(1-yr. lag)} \) \( + 0.246GL - 2.423 \, CX \)
   \( (0.797) \quad (0.372) \quad (1.192) \)

\( R^2 = .12, \bar{R}^2 = -.10 \)
\begin{align*}
&= 3.919 + 0.010 \text{S/Y} + 0.515 \text{AID} \text{ (2-yr. lag)} \\
&\quad (0.608) (0.035) (0.444) \\
&- 6.828 \text{FDI (2-yr. lag)} + 0.924 \text{GL} - 1.937 \text{CX} \\
&\quad (0.527) (0.102) (0.866) \\
&\quad R^2 = .08, \bar{R}^2 = -.15
\end{align*}

Note: t-ratios are shown in the parentheses below the coefficients.

* shows significance at 5% level.
** shows significance at 10% level.

d| Table 5.2

Estimation of the two-equation model for Indian economy by 2SLS method: 1955-56 to 1979-80

\begin{align*}
1. \text{Saving } \text{S/Y} &= -17.168 + 3.012 \text{G} - 1.157 \text{AID} -14.018 \text{FDI} \\
&\quad (0.333) (1.065) (1.448)^* (1.659)^** \\
&\quad - 0.137 \text{DR} +10.163 \text{CX} \\
&\quad (0.191) (1.547)^** \\
&\quad R^2=.60, \bar{R}^2=.50 \text{ df=19}
\end{align*}

2. \text{Growth, G} = - 2.846 + 0.386 \text{S/Y} + 0.468 \text{AID} + 2.628 \text{FDI} \\
\quad (0.142) (0.390) (0.321) (0.131) \\
\quad - 0.034 \text{GL} - 3.541 \text{CX} \\
\quad (0.052) (0.915) \\
&\quad R^2=.07, \bar{R}^2=-.16 \text{ df=19}
\end{align*}

Note: t-ratios are shown in the parentheses below the coefficients.

** shows significance at 10% level.
5. Analysis of the Empirical Estimation

5.1 Domestic Savings: Gross domestic saving has played a positive role in the growth of GNP in India. There are various factors which might have affected the savings rate. Among them, growth rate of GNP, foreign aid, foreign direct investment, dependency rate and export variable have explained about 60% of the saving rate in India.

Theoretically, the growth rate of GNP has a positive effect on the savings rate. We have also obtained a positive relationship between them, both by using OLS and 2SLS methods, although the relationship is insignificant both at 5% and 10% levels of significance.

The coefficients of AID and FDI in the savings function based on OLS and 2SLS methods are found to be negative. Using OLS method, the coefficient of AID is significant at 5% level, while that of FDI is significant at 10% level. Using 2SLS method, both the coefficients are significant at 10% level. The negative effect of foreign direct investment is more pronounced than that of foreign aid. The result is not surprising because foreign direct investment, more than foreign aid, could distort the pattern of investment in favour of conspicuous consumption, thus reducing the savings rate to a greater extent. Thus, the effect of foreign capital inflows on the savings rate appears to be non-positive. The present
evidence, therefore, lends support to the findings that have suggested for a strong negative association between foreign capital and domestic capital formation in the developing countries, the so called 'decapitalization thesis' of Rahman (1968), Griffin & Enos (1970), Weisskopf (1972), Gupta (1975), Areskoug (1976), Bornschier (1980) and others, which postulates that foreign capital crowds out or substitutes for domestic investment in the recipient countries. However, a negative statistical relationship between foreign capital inflows and domestic savings cannot necessarily be interpreted as a weakening of the development effort; it may simply reflect the fact that a proportion of foreign capital is consumed. In our case, it might suggest the consumption of a part of foreign capital and the relaxation of the saving efforts by the Government of India with the receipt of foreign capital.

Dependency rate is expected to have a negative effect on the savings rate. We have also found a negative relationship between them using the 2SLS method, although its coefficient is not statistically significant. But using the OLS method, we found a weak positive relationship between them.

Exports are also expected to have a positive effect on the savings rate. Our results also exhibit a positive relationship between them. The coefficient of the export
variable using OLS method is significant at 5% level, while using 2SLS method it is significant at 10% level. Thus, exports appear to have a significant positive effect on the savings rate in India.

The lagged values of AID and FDI (upto 2 years) do not seem to have much effect on the savings rate. In fact, our results show that $R^2$ drops from about .60 to .53 when the foreign capital inflows are lagged 1 year. However, the coefficient of FDI becomes significant at 5% level when the foreign capital inflows are lagged 2 years while $R^2$ remains .53.

5.2 Rate of growth of GNP :- In the estimating model, the growth rate of GNP is made dependent on domestic savings rate, foreign aid, foreign direct investment, rate of growth of labour force and the export variable.

Before we interpret our results, we would like to make the following observation:

The value of $R^2$ for the growth equation is very low and $\bar{R}^2$ is even negative. The low value of $R^2$ may be due to the estimation of the growth function without intercept. In such a situation, the ratio of the explained sum of squares (ESS) to the total sum of squares (TSS) may not be within the range of 0 and 1, and hence normal interpretation of $R^2$ is no longer valid. Consequently, one cannot suggest that the low $R^2$ for the growth equation is
an indication of the inadequacy in explaining the growth of GNP by the variables S/Y, AID, FDI, GL and CX. Economic growth is a complex phenomenon. Besides these variables, there are a host of other variables that can influence growth and may explain, to a great extent, the variation of the growth of GNP. These variables include climatic factors such as index of rainfall; proportion of agricultural output to non-agricultural output; possession of minerals and other scarce natural resources; political instability; non-availability of skilled manpower etc. These variables are not included in the growth equation of our model as the primary focus of our study is on the impact of foreign capital on economic growth rather than the estimation of growth function. However, if we could somehow include all the above-mentioned variables in the growth equation, it is quite likely that $R^2$ as well as the statistical significance of the estimated coefficients of the variables may increase. We now turn to the interpretation of our results.

Theoretically, savings rate should have a positive effect on the growth rate of GNP. We have also found that the estimated coefficient of the savings rate is positive, both by using OLS and 2SLS methods. However, this coefficient is not significant statistically for reasons mentioned above.

The effect of foreign capital inflows, i.e. FDI and AID on
the growth rate of GNP is also positive, while our OLS results show that the estimated coefficient of AID is positive and that of FDI is negative. For obvious reasons, the estimated coefficients of FDI and AID are not significant statistically. The positive effect of FDI on growth is more pronounced than that of AID, which means FDI has contributed significantly to economic growth and efficiency in India. In addition to financing capital formation, it has facilitated the transfer of technology and managerial skills. The result is not surprising because FDI, in search of profits, goes directly into profit producing, and hence, directly productive activities (DPA), while much of the foreign aid, in addition to being politically determined as to its volume and direction, goes into the formation of social overhead capital (SOC) rather than DPA. We, therefore, conclude that our evidence does not support the result of a negative relationship between economic growth and foreign capital in developing countries as suggested by Griffin and Enos (1970), Stoneman (1975), Bornschier (1980) and others. In other words, the presence of MNCs seems to have had positive impact on the growth rate of GNP in India for the time period under consideration.

Both the rate of growth of labour force and exports are expected to have a positive effect on the growth rate of GNP. But our results show that they have negative effect. Using 2SLS method, we find that the estimated coefficients
of GL and CX are negative and statistically insignificant. However, using OLS method the estimated coefficient of GL is positive but statistically insignificant, while the estimated coefficient of CX is negative but significant at 10% level.

The lagged values of FDI and AID (upto 2 years) slightly improve our results. The $R^2$ increases to .12 from .07 and the t-ratios pertaining to the variables increase when the foreign capital inflows are lagged 1 year. However, our results do not show much improvement when FDI and AID are lagged 2 years.

6. **Concluding Remarks**

The main results that emerged from estimating the simultaneous equations model may now be summed up as under:

First, overall the results show that the presence of MNCs has been of important consequence to economic growth in India for the period under consideration. The overwhelming evidence is that significant positive relationship exists between foreign direct investment and economic growth. In other words, foreign direct investment has contributed significantly to economic growth and efficiency and has facilitated transfer of technology and managerial skills to India.
Second, while the role of multinationals appears rather strong, the role of domestic factors contributing to economic growth is negative except domestic savings rate. The domestic savings rate has had a positive significant impact on economic growth in India.

Third, the results of domestic savings model show a significant negative relationship between foreign capital inflows (FDI and AID) and the domestic savings rate in India, and hence support the so called "decapitalization thesis". In other words, FDI seems to have crowded out domestic savings in India. This, however, should not be taken to mean as a slackening of the development effort by the Government of India. It may simply mean that a part of foreign capital is consumed. In other words, there is a relaxation of the saving effort on the part of the Government of India with the receipt of foreign capital. The results on the domestic variables show that they have theoretically expected signs and out of the three domestic variables - the growth rate of GNP, the dependency rate and exports - only exports show statistically significant impact on the domestic savings rate. The latter result is quite expected and has been reported by others in literature.
Notes and References


3. We have used a modified version of the model fitted by Gupta and Islam, op. cit., in their cross-section study of 52 developing countries.

4. Unlike Papanek (1972), Gupta (1975), and Gupta and Islam (1983), we have not considered 'other foreign inflows', which are essentially short-term flows and comprise primarily of errors and omissions and not, strictly speaking, policy variables.

5. An endogenous variable is one whose value is determined within the model. In contrast, an
exogenous or predetermined variable is one whose value is determined outside the model.

6. Another commonly included variable, the per capita income was excluded as it was highly correlated with foreign direct investment (FDI) variable.


22. See Rana, P.B. and M.J. Dowling, op.cit.


28. The bias arising from the application of OLS to an equation belonging to a system of simultaneous relations is known as simultaneous equation bias. It originates from the violation of one of the assumptions of OLS viz. E (u|X) = 0, i.e. it arises from the dependence of the explanatory variables and error term.
