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**PLANNING FOR TRADE :  
AN EXERCISE IN THE INPUT-OUTPUT FRAMEWORK FOR  
THE INDIAN ECONOMY**

**A THESIS SUBMITTED TO  
THE UNIVERSITY OF POONA FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY  
(ECONOMICS)**

**BY  
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(DEEMED TO BE A UNIVERSITY)**



**JUNE 1998**

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**JUNE 1998.**

## CERTIFICATE

Certified that the work incorporated in the thesis, " Planning For Trade : An Exercise In The Input-Output Framework For The Indian Economy", submitted by Ms. Amita Dharmadhikary-Yadwadkar, was carried out by the candidate under my supervision. Such material as has been obtained from other sources has been duly acknowledged in the thesis.

Date : 19<sup>th</sup> JUNE 1998.  
Pune.

  
P. Venkatramaiah  
Supervisor

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## LIST OF SYMBOLS AND ABBREVIATIONS FREQUENTLY USED

$\lambda$	=	Eigen Value
$\lambda^*$	=	Highest Eigen Value
A	=	Input-Output Coefficient Matrix
ASI	=	Annual Survey Of Industries
B	=	Capital Coefficient Matrix
BOT	=	Balance Of Trade
C	=	Consumption
CCM	=	Capital Coefficient Matrix
COR	=	Capital Output Ratios
CSO	=	Central Statistical Organisation
EP	=	Export Promotion
EX/E	=	Exports
F	=	Final Demand
$G^*$	=	Maximal / Von Nuemann Growth Rate
G/g	=	Growth Rate
GDP	=	Gross Domestic Product
GFCF	=	Gross Fixed Capital Formation
GNP	=	Gross National Product
I-O	=	Input-Output
I/Im	=	Imports
ICOR	=	Incremental Capital Output Ratios
IS	=	Import Substitution
NAS	=	National Accounts Statistics
NEP	=	New Economic Policy
NNP	=	Net National Product
NSSO	=	National Sample Survey Organisation
OLS	=	Ordinary Least Squares
POL	=	Petroleum Oil Lubricants
X	=	Gross Output
$X^*$	=	Eigen Vector
Z	=	Surplus / Deficit Vector



## CHAPTER ONE

### INTRODUCTION

---

#### THE CONTEXT :

Liberalization of India's foreign trade sector was one of the main agenda of the New Economic Policy (NEP) which was introduced in June, 1991. The Indian economy was opened up and a liberal trade regime prescribed. The argument was that open economies lead to a more efficient allocation of resources. Therefore, opening up will enable the Indian economy to achieve a higher growth rate.

India's growth rate has stagnated around 3.5% p.a. over the years. India's Net National Product (NNP) at constant prices (1980-81) shows an average annual increase of 3.4% between 1950-51 to 1980-81. The failure of the economy to achieve a higher growth rate is attributed to the macro economic policies pursued by the country. It is believed that an appropriate trade policy can help to push the economy to much higher levels of growth.

India's trade policy orientation, which was that of import substitution (IS) till about 1980, has since then gradually, and rapidly after 1985, changed to Export Promotion (EP) through Import Liberalisation.<sup>1</sup> Planners feel that the import substitution policy which was pursued for a long time is no longer as relevant. It did protect the Indian industry and led to its diversification. However, it has not helped to correct our continuously worsening trade deficit. Hence, the new economic policy emphasizes export promotion.

The changes in the trade policy, along with others (in the context of the NEP) are being undertaken with the hope that they will stimulate exports and improve the Balance of Trade (BOT) position. It is also expected to help the economy to achieve a higher growth rate as in the case of the four Asian economies - Taiwan, Singapore, South Korea and Hong-Kong.

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<sup>1</sup> Sen Sunanda and Upendra Das (1992) , pp 1

It is as though the theory of "International Trade as the engine of growth" has had a rebirth in the present day context of liberalisation being followed by several countries and the experiment being successful in some countries. Economists such as Krueger, Balassa and Bhagwati support trade liberalisation. Their studies show that export growth contributes to economic growth. Krueger's study based on pooled data for 10 countries, shows that "an increase in the rate of growth of exports of 1 percent will increase the rate of growth of GNP by just over 0.1 percent". Giving an example the author cites "For South Korea, for example, the 40 % average annual rate of growth of exports during the late 1960's would according to this estimate have accounted for 4 % faster growth in real GNP compared to the period of stagnant export earnings in 1950s". (Krueger Anne 1978, p 273-274)

Balassa concluding his study of a pooled data of 11 countries states " .. in indicating that export growth favorably affects the rate of economic growth over and above the contributions of domestic and foreign capital and labour, the estimates presented in this paper provide evidence on the benefits of export-orientation as compared to policies oriented towards import substitution." (Balassa Bela 1978 , pp 188)

There are economists who have reservations about liberal trade policy being the answer to the problem of economic growth. This group consist of economists like Lance Taylor, Albert Fishlow, Alan Hughes, Tariq Banuri. According to Tariq Banuri, the authors advocating liberal trade "suggest, explicitly or implicitly, that their argument are vindicated by the recent successful experiences of the East Asian economies and the dismal performance of the Latin American Societies. To this Banuri argues that "Outward oriented policies do not lead either to trade openness (defined as a higher ratio of exports to GDP) or to benign financial openness (absence of capital flight). The appropriate degree of openness is different for different societies and attempts to impose a universal solution by force have been costly as well as ineffective. Larger samples of countries do not reveal a significant empirical relationship between economic growth and outward orientation or export promotion. Most importantly, even in the unlikely event that the connection between free markets, government policies and economic performance

in the East Asian countries were to prove conclusive, it would still not be duplicated in other country." (Banuri Tariq 1991, p 8)

Fishlow, commenting on the differences in the Latin American and East Asian economies, says "For Latin America, already industrialized and with higher income and wages, the export market was never conceived as the basis for the growth of the manufacturing sector; its function was to supply needed foreign exchange and there was still heavy dependence on resource based exports. For Asian NICs, the foreign market oriented domestic investment in industry, first in labour intensive goods with low wages and later in others, exports were the instruments of industrialization." (Fishlow, A.1991, p.157)

Looking at both sides of the argument, for and against liberal trade policy, one point emerges clearly and there is complete consensus of both sides on this point. Both policies are advocated with aim of achieving the highest possible economic growth. If economic growth is the objective while choosing a trade policy for a particular economy, one must know the role of trade in the growth function of the economy in question. Whether trade or exports can be the "engine of growth" may depend on each economy, its structure, its level of development, and the importance of trade vis à vis other variables in its growth function.

### ***FOCUS OF THE STUDY***

If maximum growth is the aim of any trade policy, then why not make economic growth the objective variable to be maximized; maximize it (i.e. growth rate) and study the impact on the trade sector. Thus, the problem of trade and economic growth can be looked at, in another way and posed as follows : The main objective being balanced economic growth, given our economic structure, what implication does maximizing the main objective variable i.e. growth rate have for the country's imports and exports? Which goods are rendered importables and which exportables, if the economy wants to achieve a high growth rate?

In case of Indian imports , it is seen that these are mainly of capital goods, chemicals and petroleum oil and lubricants (POL). All these are crucial inputs in

the production process. Thus, these imports are necessary to maintain our current growth rate. At the same time, it is not necessary to increase imports indiscriminately. Since imports are a drain on the country's resources, only those required should be imported. So, knowledge of which imports are required for growth and which could become bottlenecks in the growth programme, is essential.

To meet the above import requirements of the economy, the economy needs to export enough to be able to cover the import bill. However, while exporting, it is necessary to plan exports in such a way that the surpluses generated by some sectors in the economy are optimally utilised to earn the required foreign exchange. Planning is also necessary to ensure that only surpluses are exported and that in the bid to export more to earn more foreign exchange, we do not take away some crucial inputs required by the economy for growth. If this happens, it could lead to inflation and this would erode the competitiveness of our economy.

Considering the above points, the choice of a trade regime may not be a simplistic one between Import Substitution or Export Promotion. What is required is careful planning for exportables and importables. Following any one policy of either Import Substituting Industrialization or Export Oriented Industrialization to overcome an unfavorable BOT and to enhance economic growth, may not necessarily lead to the best option being exercised. In case of some sectors it may be advisable to go for export promotion. It would be of immense interest to delineate these sectors; to give the policy maker alternate scenarios, where a particular target growth rate for the economy would allow for a certain level of exportable supply and necessitate a particular level of imports. *Therefore, a disaggregated analysis of the impact on the trade sector of a growth enhancing strategy would be more useful than a macro view.*

A disaggregate study would reveal the structure and composition of Indian exports and imports as against total imports and exports. The Input-Output(I-O) framework which enables a study at the sectoral level and links the macro variables simultaneously, seems appropriate to examine this problem. Here the variables

under study (growth and trade) can be modeled like in a macro model and the results can be got at aggregate level.

The main criticism against using the Input-Output technique is that it is based on technical rather than market relationships. Given the present day emphasis on market orientation, it is the price which is the dominant and determining factor. The Input-output method is based on the technical relationships rather than on market relationship. In free market economies, the market relationships determine the demand and supply. However, in really free markets or in ideally free markets, the price is expected to converge towards the cost of production. Using the Input-Output method, means finding out what the market should target to achieve, if it is to work efficiently. In other words, it can help to identify the equilibrium level that the market should gravitate towards.

Another criticism that is leveled, is that if the free market policy has been adopted, what is the need for planning or knowing the multisectoral linkages amongst the various sectors of the economy and among the variables like growth rate, exports and imports? Each sector will be driven by market forces and that will determine the prices and the levels of exports and imports. Be that as it may, a breakdown of the market mechanism, which can occur due to bottlenecks or gluts, can be quite harsh for the economy. So, even if the economic units are allowed free play in the market, knowledge of intersectoral linkages and dependency of one sector on another is essential for the planner to undertake indicative planning to avoid a breakdown or to rectify one.

Thus, this study tries to examine the trade pattern most appropriate for achieving the maximal growth rate for the Indian economy. The maximal growth rate of the economy is defined as the von Neumann growth rate which shows the maximum possible rate at which the economy will remain in equilibrium. The specific objectives of the study are given at the end of chapter II, following the review of literature. The scheme of the study, divided into seven chapters, is given below.

*CHAPTER I* comprises of the *introduction* and sketches the chapter scheme of the study.

In *CHAPTER II*, we examine the available literature to see how trade and growth are related. One of the objectives is to see the evidence for export growth causing income growth. Both macro level (for single country and cross country) and micro level (commodity wise for India) studies are reviewed. Secondly, review is undertaken with a view to see what are the major factors influencing Indian export growth and import demand. Some studies undertaking causality tests are also reviewed to see if there is any evidence of the direction of causation between export growth and income growth and imports.

Looking at the nature of the evidence found in literature, we have decided to study exports and imports based on domestic demand and supply conditions. For this we use a growth model, which also enables us to study the economy at the sectoral level; namely the Input-Output Framework.

In *CHAPTER III*, we therefore look at the Input-Output(I-O) Framework. We note that growth cannot be adequately modeled in the Static I-O framework. Hence we review the Dynamic I-O model put forth by Leontief and some of its applications.

The applications of the dynamic I-O model are very few as it involves use of a very large amount of data namely the Input-Coefficient matrix and the capital coefficient matrix. In the Indian context the literature on this is even more scarce. We review the Exkaus-Parikh model, Mathur's model and the Cambridge Growth model in this chapter. It is decided to use Mathur's version of the Dynamic I-O model for the purpose of this study; to model growth rate and find the resultant exportable surplus sectors and importable deficit sectors.

As the use of the Dynamic I-O model involves the use of the Capital Coefficient Matrix (B) which is not available for India for recent years, we attempt to estimate the "B" matrix for India. This is one of the major tasks undertaken in this study.

**CHAPTER IV** deals with the theoretical aspects of building a B matrix for India. A review is undertaken of earlier independent attempts made by some authors to estimate the "B" matrix for India. A review is also done for the theoretical aspects of the B matrix. The case for incorporating the unregistered manufacturing sectors is considered. This is the first attempt at incorporating the unregistered manufacturing sector into the B matrix.

The B matrix is estimated using sectoral Incremental Capital Output Ratios (ICORs) and the capital structure (by type of assets) of each sector. This chapter reviews the methodology of estimating ICORs and the various issues involved like gross/net, value added/value of output, time lags and ICORs at current and constant prices with the objective of estimating ICORs for a B matrix.

In **CHAPTER V** we look at the empirical estimation of the B matrix for the Indian economy based on sectoral ICORs. ICORs are estimated using the regression method at current and constant prices (1991-92). The period is of 13 years from 1980-81 to 1993-94. The  $R^2$  and F and T test are used to validate the regressions. ICORs have been estimated for 4 primary, 30 registered manufacturing and 11 services sectors. For the unregistered manufacturing sectors, the NSSO Report(1995) is used. This gives data for the year 1989-90. This is used to estimate CORs for the single reference year for 19 unregistered manufacturing sectors.

Capital Coefficient columns are generated separately for the registered and the unregistered manufacturing sectors and are then averaged to reflect the average capital structure of the composite manufacturing sectors. All the averaging is done by using the weighted average, the weights being the output of the respective sector/unit.

This chapter also explores data sources for estimating the capital structure of each sector of the economy.

**CHAPTER VI** begins by looking at the theoretical aspect of the maximum balanced growth rate. Some literature is studied to see the maximal growth rate concept and

the similar von Neumann growth rate. Empirical estimates are presented of this maximal possible rate of balanced growth for the Indian economy for 4 years of 1983-84, 1989-90 and 1991-92 and 1994-95. Comparisons are made with estimates of other studies.

The next section examines the investment proportions required for pursuing a maximal growth programme and the changes in this requisite proportion over the years. The comparison is done with the requisite investment proportions obtained by Mathur for the sixties.

In *CHAPTER VII*, the shortfalls and the surpluses of the this maximal growth programme are worked out and are termed as extra importables and extra exportables respectively. The increases required in trade are worked out at the sectoral levels. The structure of the export and import vector is studied. The existing structure and the suggested structure for a von Neumann growth programme are compared and suggestions made for increasing or decreasing the share of commodity exports and imports. We also look at the shortfall in the requirements of the tertiary sectors- which are infrastructure providing sectors- in pursuing the von Nuemann growth programme.

In the next simulation we, separate the tradable and the non-tradable sectors and study the impact on the exports and imports of the tradables for a von Nuemann growth programme. We note that since the von Nuemann programme is the maximum growth programme and would entail a large deficit, we simulate a more feasible growth programme in the next section.

We present a simulation for a five, six and seven percent growth programme for the economy and study the resultant exports and imports. These three programmes entail the final demand vectors - consumption and exports - growing at the target rate of 5, 6 and 7 % .

Finally, in the last section we look at the capital intensity of the existing trade vectors to see whether India's trade pattern confirms to it's assumed relative factor



endowment. Here, we consider the capital intensity by direct capital requirements as well as by direct and indirect capital requirements for the actual trade vectors and the ideal or suggested trade vectors.

## 2.1 ROLE OF TRADE IN GROWTH.

Right from classical times, trade has been viewed as an instrument to increase the national income. The classical economists, particularly David Ricardo and J.S. Mill concentrated their effort on ascertaining these gains from trade. The theory of trade being the engine of growth is well known. In recent times, economists have emphasised the role of exports in economic growth due to "better capacity utilization, economies of scale, incentives for technological improvements and efficient management due to competitive pressures abroad."(Feder ,G1982 p. 1). According to Feder, these are the beneficial aspects of exports as highlighted by the studies of Balassa (1978), Keesing (1967, 1969), Krueger (1980) and Bhagwati and Srinivasan (1978). Another beneficial role that exports are seen to play according to the "two-gap" models of development is to bridge the foreign resource gap. In this chapter, we examine the available literature to see what **empirical evidence** has been put forth for exports playing a significant and positive role in the economic growth of an economy and what are the **major factors affecting Indian exports and imports**.

In the beginning, let us note that almost all the economists have concentrated on exports as growth causing. Imports have not been examined similarly. In recent times, a lot of literature has come up on exports and income growth; on the export orientation and its benefits as seen in the South East Asian economies; of Inward looking policies followed by the Latin American countries.<sup>1</sup>

The literature in this subject is vast. There are two main issues involved; one is the financial liberalisation which focuses on exchange rate, foreign investment and the resultant effect on the trade sector. The other aspect is of trade liberalisation which

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<sup>1</sup> Banuri Tariq (1991) looks at the liberalisation experiences of the Latin American economies, Taylor lance ( 1988, 1991, 1993) looks at the experiences of the developing countries to see if it vindicates the adoption of a particular trade policy.

deals directly with commodities and services; it constitutes import tariffs, export subsidies and the policy aspect of focusing on either liberalising import duties, making them stringent or direct promotion of exports by state interventions through subsidies or other benefits to exporters. In this study we do not attempt an exhaustive review of the work done on the trade sector; we have not looked at studies relating to the financial liberalisation. We have confined ourselves to examining the literature about commodity and services exports and imports and within that to examining empirical evidence.

As we saw in the Introduction, the 1991 Indian trade sector liberalisation was undertaken with the assumption that Import liberalisation will lead to increased production and productivity of Indian manufacturing and therefore will lead to export enhancement which in turn will lead to economic growth. In the light of this we try to see whether the assumption that export growth leads to income growth is vindicated by existing empirical studies. The review is focused on mainly two points:

- 1) To see what evidence is put forth for export growth leading to income growth and how far can it be generalised and recommended for the Indian economy.
- 2) To see what are the factors affecting Indian exports and Imports at the aggregate level and the commodity level. To see whether there is evidence of external factors or internal factors affecting our trade performance.

The following review is therefore not an exhaustive review of the Indian trade sector. Moreover, we have reviewed papers or studies which undertake empirical investigations.

## **2.2 EXPORTS AND INCOME GROWTH: CROSS COUNTRY STUDIES**

In the available literature, cross country correlation or regression studies have been undertaken to test the hypothesis that export growth causes income growth. Different economists use different specifications, different samples and different definitions of the variables measuring income growth and export growth.

Michealy (1976) attempts to look for empirical verification of exports causing income growth. He takes a sample of 41 less Developed Countries, the time period being from 1950 to 1973. He takes a slightly different approach in specifying the income and export variables. He takes the rate of change in per capita product to represent the income growth rate; export growth is represented by the rate of change of the proportion of exports in the national income. He estimates correlation coefficients and finds it be 0.38 (Spearman's Rank Correlation) and 0.480 (Pearson's). From this he concludes that "the hypothesis that export growth and income growth are related is verified" (Michealy 1976 p. 52). Michealy found that the correlation was stronger for high growth countries in the sample, leading him to conclude "that growth is affected by export performance only once countries achieve some minimum level of development". (Michealy 1976 p. 52)

Anne Krueger assessed the effect of exports on GNP for a sample of 10 countries for the period 1954-71. A log-linear regression specification was estimated for each country from time-series data, and the general coefficient for the export variable was obtained. The estimates indicated that "an increase in the rate of growth of exports of 1 percent will increase the rate of growth of GNP by just over 0.1%." (Krueger 1978 p.273-274). Balassa (Balassa 1978) used correlation and regression methods to estimate the effect of export growth on economic performance for a sample of 11 countries for the period 1960-73. A positive effect of export growth on income growth was observed (Balassa 1978,p184.). He pointed out that growth of GNP, rather than that of GNP net of exports, was the most appropriate variable for assessing the total effect of exports.

Kavoussi Rostam's (Kavoussi 1982) is another such study. According to the author, the earlier studies carried out in similar vein were restricted in respect of their samples. The author has therefore used a much larger sample than before, of 73 developing countries, for the period 1960-1978. He also makes an attempt to distinguish between exports of primary and manufactured goods. To model exports, the author uses the average annual real growth rate of merchandise exports (RX); and for income expansion, he uses the average annual real growth rate of the GNP. The

Spearman's rank correlation for the entire sample is 0.537, that for low income exporters of primary products (in which category India would fall) is slightly lower at 0.359. Commenting on the results the author says "strong association between exports and growth is not limited to middle income countries, and in low-income economies the correlation between growth rates of exports and GNP is not weak, as assumed by Tyler. (Kavoussi 1982, p.244). He further adds, "exports of manufactured goods tend to strengthen the association between export expansion and economic performance in middle income countries." (Kavoussi 1982,p.245)

Kavoussi also studies the contribution of export growth to income growth using regression equations for the data. The results show that in less advanced countries, export expansion enhances the growth of total factor productivity, regardless of composition of exports. Whereas in the more advanced countries, the effect of export expansion on the growth of total productivity is very sensitive to the share of manufactured goods in total exports. Thus his paper indicates that even for economies exporting primary goods, exports can play an important role in the growth process of both the low and middle income countries. In this paper the sample considered is sufficiently large, and a significant and positive association has been concluded between export growth and income growth. However one can say that as exports are included in the GNP; using the average annual growth rate of GNP and its component, average annual growth rate of exports, is bound to show some correlation. Also most countries included in the sample are small countries.

Rati Ram (Rati 1985) criticising the earlier studies, cites the need "to be able to make a reasonably satisfactory transition from statements about correlational patterns to some judgment about the causal structure" (Rati 1985, p. 416). Having said this, however, the author goes on to use a similar specification of a regression equation of the production function type, treating exports as a production input as used by the earlier authors for a sample of 73 LDCs for the period of 1960-70 and 1970-77. This specification is similar to those "adopted by Bela Balassa, William Tyler and others" (Rati 1985, pp. 417). His results lead him to conclude that export performance does seem important for economic growth. Importance of exports seems to have increased

during the 1970s. He also finds that export performance is important for growth even in the low- income LDCs in 1970-77.

The studies surveyed above, were basically cross section studies. The efficacy of generalising their result for the universe or for a specific country would depend upon the adequacy / appropriateness of the sample chosen. Only two studies - Rati Ram and Kavoussi's have large samples.<sup>2</sup> Also, most countries in the sample of developing countries are small economies. India as an economy, though it is a less developed one and also a low income one, is somehow difficult to categorize with other such economies. It is a vast economy, with a vast resource base, a large and diversified manufacturing base. Hence it may not be appropriate to apply this result to India.

Also, the papers/studies reviewed earlier implicitly assume that export growth leads to increased income. The direction of causation is assumed to work from exports growth to income growth. While this may be the case for small economies with limited resource base where exports are a large proportion of their GNPs, is it also the case for large resource based economics such as India? Are exports the main propeller for growth? In an attempt to test the contribution of exports to growth vis a vis other variables, Balassa in his model for a pooled sample of 10/11 countries included other variables i.e. investment, labour and exports. He found the  $R^2$  improving when exports was added as a variable; but the coefficient was much smaller than that for investment, or labour. ( Balassa 1978, p.185 ) Therefore, exports may not always be the propeller for growth.

In Bokil et al 's study of the " Structure of India's Trade Dependence" , they posit that economic growth in India's case is dependent more on internal factors than external ones. They say ".....we do not inquire into the influences that operate from trade to growth, which we believe are weak" ( Bokil et al 1981,p.2) While concluding their study, the authour state " ...our view deserves a strong support from Kuznets and fromChenery and his associates, whose empirical findings tend to highlight a decisive

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<sup>2</sup> Kavoussi's sample does not include India (Kavoussi 1982, p.245).

role played by the size and the resource base and a negligible role played by trade policies in economies of moderate size." ( Bokil et al 1981,p. 122).

There are some studies which address the question of causality in case of exports and income growth, which could provide some indication about the direction of causation.

### 2.3 EXPORT AND INCOME GROWTH : DIRECTION OF CAUSATION

Sanjeev Gupta (Gupta 1985) has attempted a causality test for the two variables- export growth and income growth. He uses the Haugh (1976)<sup>1</sup> and Sims (1972)<sup>2,3</sup> test. He tested the variables for South Korea and Israel; on data for a period of nineteen years from 1967 to 1981 for Israel and from 1960-79 for South Korea. The results show that causality runs bidirectionally between export growth and economic growth. Though the study is limited to only two countries and is beset with the usual problems of testing, the results do indicate that exports need not always be the propeller for growth. In the author's words "the other implication of bi-directional causality is that export growth can no longer be treated as an exogenous explanatory variable in regressions with GNP<sub>t</sub> growth as the dependent variable."(Gupta, S. 1985p.58). Though this study questions the wisdom of assuming export growth to lead to income growth, it cannot say anything about the Indian trade sector.

Sukumar Nandi and Sanjib Basu (Nandi and Basu 1993) attempt to test the causality between income growth and export growth for a sample of 12 countries using the Sims<sup>4</sup> test. The countries include India, Korea, Singapore, Malaysia, Japan, Indonesia, Pakistan, Philippines, Germany, Italy, Nigeria and Kenya. The period taken is of three decades from the 1960s onwards. The authors find 4 types of mechanism at work. For Singapore, Germany and Kenya, there appears no causality. India, Italy, Nigeria, Indonesia, Pakistan show export growth inducing income growth.

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1, 2 Haugh's Test is a tool to test the independence or dependence between series and Sims procedure is needed to determine the direction of causality ( Gupta, S (1985) p. 54).

3 Haugh, L.D. (1979) : "Checking Independence 2. Sims, Christopher A (1972) : Money, Income & Causality

<sup>4</sup> See footnote 3 of this chapter.

Korea and Philippines show income growth causing export growth. Japan and Malaysia show both way causality.

Comparing these results with those of Gupta's (Gupta, S 1985) for South Korea, as that is the only common country, we see that Nandi and Basu find one way causation from income growth to export growth where as Gupta finds a two way causation using the same test for almost similar time period. The data sources however are different. Gupta uses the Handbook of Korean Economy 1980 and Nandi and Basu use the International Financial Statistics, 1990. (IMF).

For India, Nandi and Basu find, for the period 1960 to 1988, that export growth causes income growth<sup>5</sup> and hence advocate export oriented industrialisation. A lot more research into this aspect of the question is needed before anything can be stated with even a moderate degree of certainty. However, it does warrant a need to ask whether Indian exports could be supply driven? Imports as a variable in growth have been more or less ignored in the literature maybe because imports are viewed as mere leakages in the growth function. In the following section, we attempt to examine the empirical evidence put forth for the Indian trade sector.

Do exports propel income growth in India? Or does income growth propel exports? If we see the question as follows: If exports are demand driven, then exports may be termed as the independent factor and growth as dependent (on it) If however we say that exports are supply driven (production driven) then it implies that income growth

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<sup>5</sup> A sidelight of Nandi and Basu's paper is a discussion of the theory underlying the causal link between the two variables of export growth and income growth. According to the authors, the hypothesis that export growth causes income is based on the Keynesian theory of generating demand, which would lead to use of idle capacity and increased production. But as they rightly point out, though the acceptance of only one way causation has been criticised, no body has put up a theory to explain how the alternative could work i.e. income growth causing export growth. They attempt to explain it through the price mechanism as follows: Increase in output will depress domestic prices, making the ratio of International Price/Domestic Price increase. This will lead to increased exports. This seems plausible especially in the context of India, where research has indicated that domestic factors play an important role in the release of a sustained exportable surplus. Studies which examine Indian exports at a disaggregate level. i.e. Bhagwati, DaCosta, Kelkar etc; do indicate the crucial role of domestic factors like droughts, home market demand and domestic price rises and sustained production to explain the



is the independent variable and exports are the dependent (on it.) So the question of exports being supply or demand driven is subsumed in the question whether income growth causes exports growth or export growth causes income growth.

#### 2.4 TRADE AND GROWTH : THE INDIAN EXPERIENCE

A number of studies have analysed the trade and growth nexus for the Indian economy. We review the studies of Bhagwati and Srinivasan , Bokil et al, Da Costa, Gupta and Keshava , Kelkar and Sharma , Patra and Ranjan , Mukherjee, S and Sen, Sunanda.

Mukherjee in her paper tries to test the hypothesis that increase in exports induces income growth for a single country over a 30 year period. This is done in the background of substantial evidence available in literature which points to the fact that export growth is highly correlated to income growth in case of cross country studies. (Mukherjee 1987, p. 52).

She tries to model the two variables i.e. export growth and income growth in various ways. She tries to find the correlation and regression coefficients for the two variables. She even tries using the income variable net of exports (Mukherjee 1987,p.57). However, all the different variations give only one result i.e. export growth induces income growth is not proved conclusively in any of the different functions. To put it in the words of the author "The empirical investigation that has been carried out fails to accept in a decisive manner, the hypothesis that an increase in the growth rate of exports will lead to a higher growth rate in national income. Only two regression equations come out with positive but statistically insignificant coefficients." The author concludes, "As far as the long run objective of stimulating the growth rate of the economy is concerned, exports do not seem to have a positive role." (Mukherjee, S 1987, p 58) The plausible reason for this is put forth as a high income elasticity of imports. So, she says that a high export growth and its earnings are leaked out in the form of high imports and therefore do not have the expansionary effect on income.

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fluctuating export performances of some of India's key exports like tea, cotton and engineering goods. These will be discussed a little later.

The other reason put forth is the low size of exports to the national income which the author says was around 6.3% of the national income in 1980-81. The second reason seems more convincing than the first. In fact, if export growth gets translated to import growth, it should in turn fuel income growth, as most of India's imports are for the manufacturing sector i.e. intermediate goods (POL, raw materials) and investment goods (capital goods). However, as the author has specified (Mukherjee 1987, p 58), a large part of the imports were food imports. That would probably explain why the export growth fails to translate to income growth in India. Also Mukherjee finds the coefficient for exports is statistically insignificant, indicating therefore that for India at least, as of now the export sector is not yet a dynamic sector. These findings are of course only upto 1980-81. Over the decade of the 80s the exports and imports composition may have changed. A fresh look at the question is called for.

Another important study on India's trade is by DaCosta (DaCosta 1990). Here too the author attempts to find the behavior of exports over the period of study and to find what factors are responsible for it. The period of study is 1970-71 to 1985-86. It is a recent study covering some years when India witnessed a liberalized trade regime.

Commenting on the overall export performance, the author contends that overall export performance was good in the seventies and poor in the eighties (DaCosta 1990, p. 77). His proposition is that quantum of exports is associated positively with the real income of the industrial countries (proxy for world real income) and competitiveness of our exports captured by the real effective exchange rate. The author does recognise the importance of the domestic economy in the determination of India's export performance. But he has not tested it as a separate variable. He says ".... since the domestic price movements, consequence on the changes in the Indian economy are already incorporated in the export function via the real effective exchange rate, we refrain from using a separate explanatory variable to reflect the movement in the domestic output."<sup>6</sup> (DaCosta 1990 p. 99). The study is able to get

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<sup>6</sup>The export function is specified as

$$Q_x = f_1(Y_{1c}, R_c, D_0)$$

$Y_{1c}$  = real income of industrialized countries

$R_c$  = real effective exchange rate.

a good fit and the estimated and actual exports are quite close. In that we can say that the study has captured the export variable accurately. However it remains a macro study. It has not disaggregated the exports and fitted regressions for export groups.

The result of the study is that exports have an elasticity of 1.00 w.r.t. the world real income variable and elasticity w.r.t. to real effective exchange rate is - 0.76. Summarizing the findings, the author observes that "the real effective exchange rate has emerged as an important determinant in the movement of exports and of trade balance over the fifteen-year period. (DaCosta 1990, p. 110). He further adds "except for the early seventies and for the terminal year when exchange rate played some part, the major forces at work on India's terms of trade have been external in origin : real growth and inflation rates in the industrial countries. (DaCosta 1990,p. 112).

Based on this finding, the author Da Costa, advocates that "it is therefore essential that when the world economy is experiencing even moderate growth, India should ensure the availability of exportables. This has not always been the case in the period studied. The focus of policy must, however, be on the domestic factors, that is, on factors which have a bearing on the volume of exports and volume of imports. Three of these suggest themselves for consideration : India's real income, import policy and the country's inflation rate relative to that in the industrial economics. It is (therefore) necessary to study more effectively the import - export nexus, so that the country can, as quickly as possible, move out of the stalemate of high imports, low exports and massive trade deficits financed increasingly by commercial borrowings" ( DaCosta 1990 p.114).

In case of exports and over all trade policy, DaCosta has stressed addressing the problem of export-import nexus, inflation rate and growth of the Indian economy which is commensurate, in terms of quantum and composition, with the needs of her people. To put in the words of the author: "we see, for the immediate future, three broad areas for policy on India's balance of payments. First, a policy which will ensure, within the constraints imposed by the external, growth of the Indian economy

which is commensurate, in terms of quantum and composition, with the needs of her people. Secondly, a policy which will monitor with greater effectiveness the import-export linkages, and which will create an environment wherein the motivation to exports becomes a normal part of an activity in which the country has a revealed or potential comparative advantage. Finally, a policy which will impose fiscal discipline and keep inflation rates down, preferably below levels in the industrial countries." (DaCosta 1990 p 115-116)

In another recent study of India's trade by Gupta G.S. and H. Keshava (Gupta and Keshava 1994) the authors attempt to find elasticities of exports and imports - both price and income. The function they specify is as follows for Exports:

$$X = f(Y_w, P_x/P_w, D_1, D_2)$$

X = real exports

Y<sub>w</sub> = world income

P<sub>x</sub>/P<sub>w</sub> = domestic / international Price

D<sub>1</sub> = Dummy for 1966 devaluation

D<sub>2</sub> = Dummy for economic liberalization of 1980 onwards.

The time period for this study is from 1960-61 to 1990-91. The OLS method was used. Alternative functional forms - linear and loglinear were tried, the best equation for each of the two was chosen. The results were an world income elasticity of exports = 0.5. and an income elasticity of imports = 1.18. The price elasticity of exports was -0.68. The authors conclude that India's exports are generally price inelastic. The authors have further attempted to project the growth rates in India's real exports and imports using the elasticities estimated and growth rate of the explanatory variables.

The results show that exports are expected to grow at 4.1% p.a. while imports at 5.4% p.a. Thus they posit a increasing trade deficit. The authors conclude that "the results on the effectiveness of the 1966 devaluation and post - 1980 liberalization policy indicate that the recourse to such measures and other non-tariff factors can help India to alleviate or at least reduce its external imbalance problem." ( Gupta and Keshava

1994, p.17 ) The study estimates price and income elasticities but does not go further to explore the determinants of imports and exports in detail.

We see that in most of the studies reviewed above, the domestic factors in case of exports are crucial; both domestic supply and domestic demand. There are indications that domestic supply and demand play a significant role in determining exports vis a vis the external factor. Though DaCosta and Gupta and Keshava studies find that the external factors are more important influences on Indian trade, DaCosta advocates that the focus of policy should be the domestic variables and Gupta and Keshava find exports to price inelastic. However this factor i.e. domestic demand and supply, affecting exports has not received much attention in literature. In the export function, the domestic supply variable is measured by Index of Industrial Production. Again this at best a crude measure. Also this does not take into account the domestic demand. In a particular year, the domestic demand may be high or low and despite the production growing at a steady level, the fluctuating levels of domestic demand may lead to fluctuating levels of exports.

As stated earlier, imports have not received the same scrutiny as have exports in enhancing the growth of the economy. Sen and Mukhopadhyaya (Sen and Mukhopadhyaya, 1994) and Mallick, S (1994) are two studies which look at income, exports and imports of India and the linkages amongst the three.

Sen and Mukhopadhyaya attempts to provide a "macro model of the Indian economy which is based on a specification of (these) structural linkages between GDP, exports and imports." (Sen, S and Mukhopadhyaya 1994,p.2364) . The period of study is 1973-74 to 1984-85. She tries to test econometrically, the " repercussions of policy changes on the size of India's trade deficit and GNP " (Sen,S 1994,p.2364). The policy changes include the liberalised regime. She has made a different assumption regarding the linkages between income (GDP), exports and imports. She postulates that imports cause growth and exports provide the much needed foreign exchange for procuring the 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." (Sen,S 1994,p.2364) " In our analysis we have stressed the need to treat both imports and exports as essentials inputs in the production process. The approach which deviates from the demand generating contracting role of foreign trade is based on the structural dependence of GDP on imports". (Sen,S 1994,p.2364) This assumption is supported by her finding that "..... 1 percent rise in real imports would ....bring in a 0.45 percent increase in real output.... ." (Sen,S 1994,p.2366)

Mallick's study (Mallick, S 1994 ) also looks at exports, imports and economic growth of an individual country, India. Mallick incorporates import growth as the link variable between export growth and income growth. He therefore uses a trivariate model to explore how the causation works between export growth and income growth. He uses data on NNP at Constant Market Prices, Exports and Imports for India for a period of 40 years from 1950-51 to 1991-92, annual data. He uses the Vector Autoregression to test the linkages.

With smoothed data, he finds that imports are influenced by income which in turn influence exports<sup>7</sup>. According to him "The causation from income to exports is of a great deal of statistical significance because, while the test that income causes exports is statistically significant at 2% level, the evidence that imports cause exports is weak." ( Mallick, S 1994 p. 11). The causality test for exports suggests a causal link from income to exports and no causation from exports to income. These results suggest that the direction of causality is unidirectional from imports growth to income growth and from income growth to exports growth. The main result of the paper is a rejection of the hypothesis ports induce income growth in the Indian context.

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<sup>7</sup> In case of use of original data, he finds imports as being the exogenous variable leading to income growth which in turn causes export growth (Mallick, S. 1994 pp 11).

Thus, Mallick's paper finds that exports may not cause income growth for India. His other finding -- that of imports being the link variable and influenced by income - is also interesting. For imports are rarely considered important for growth functions. His findings indicate that it may not be so at least as far as India is considered. Both Sen and Mallick's studies indicate that it is imports which are more important for India as growth stimulants rather than exports. However exports are important as foreign exchange earners.

These are studies which model the overall/total export and the variables that influence them, so that we can infer from such functions, which factor is important. All these studies estimate the total export function. However to infer from these, and generalize the results for each commodity would be erroneous. For total exports, it may turn out that the world demand is a more important factor than domestic supply. From this to advocate a promote export policy by helping them achieve a lower price internationally (subsidies) is a hasty step.

We need to know the composition of Indian exports. Are all of these demand driven? are some supply driven? A disaggregate study for exports and imports is called for. It will be the right place to quote Lance Taylor's observations about the spectacular performance of the South Korean economics amongst all those which opted for export oriented industrialization : " It is true that among the countries which opted for an outward-oriented strategy, South Korea was far more successful than others, but its success was due, less to the exchange rate policies than to the direct state promotion of exports." (Taylor, L p.62-63). If State intervention is necessary to ensure a good performance of exports than we need to know which sectors have the potential to be high export sector.

## **2.5 EXPORTS AND FACTORS AFFECTING EXPORTS**

As we have seen earlier, exports have been studied by a lot of economists for their contribution to economic growth. However, most of the studies are at the macro level; where the magnitude of total exports is studied. Disaggregated studies, addressing the problem of the structure and composition of India's exports are very

few. In the paragraphs to follow, we review a few of the important ones carried out for the Indian economy.

Jagdish Bhagwati and T.N. Srinivasan ( Bhagwati and Srinivasan 1978) conducted a study on the 1966 devaluation of the Indian currency and the related changes in the foreign trade regime. They attempted to find out whether the devaluation was successful in increasing exports. Their study spans the period from 1950 to 1970. Indian exports have been modeled to see which factors explain their behaviour. They divided exports into traditional - mainly tea, jute and cotton and non-traditional - engineering goods, chemicals and Iron and Steel. They tried separate regressions for the main non-traditional and traditional exports

**2.5.1 Non-Traditional Exports:** They find that the policy of devaluation was successful in case of non-traditional exports as "these expectations were indeed to be fulfilled in the case of non-traditional exports. On the other hand, traditional exports actually decline." ( Bhagwati & Srinivasan 1978 p.130).. Commenting on the equation or the variables to be used in the function explaining non traditional exports, they say, "In our analysis, one of the explanatory variables in the regression relation for exports is the domestic output of the same group of commodities .... ; more or less appropriate proxies have been used to reflect domestic demand." (Bhagwati & Srinivasan 1978 p.133). In a related footnote, however, the authors state, "foreign demand was introduced through a time-trend variable, but in all cases, this variable did not have a statistically significant coefficient and has been omitted." <sup>8</sup> This means that foreign demand is not a very significant factor for non-traditional exports according to Bhagwati's study.

For *engineering goods*, the export function is specified as "a function of domestic production, domestic demand, (for which we take as proxy the domestic gross real investment) and we also introduce a dummy variable *D.*, to capture the effects of devaluation."(Bhagwati & Srinivasan 1978 p.133). Coefficients of all explanatory

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<sup>8</sup> See Bhagwati and Srinivasan (1978), p.149 footnote number 6.



variables are statistically significant and of the expected sign. For *Iron and Steel*, a somewhat similar specification is used; domestic output in physical units and domestic demand is proxied in the same way as in the above, by the gross fixed real investment. All variables have significant coefficients and expected signs. For *chemicals* the equation is slightly different; for domestic output an index relating to chemicals in the index of industrial production" is employed; domestic demand is proxied by the index of industrial production.

Summing up the results, the authors say that "we have some evidence that devaluation and export subsidies altered the export performances of engineering goods and of iron and steel for the better. But domestic supply and domestic demand conditions, reflecting mainly the fact of recession, were also of importance here and for chemicals as well (Bhagwati & Srinivasan 1978,p.135).

**2.5.2 Traditional Exports:** Among the traditional exports examined are jute textiles, tea, cotton textiles, where in lies India's comparative advantage. The equation for *jute* exports was specified as depending on domestic output of jute textile and the index of industrial production. The latter one supposes is meant to capture the domestic demand for jute textiles. Commenting on the results the authors say "... had droughts of 1965-66 and 1966-67 not reduced the output of raw jute and hence that of jute textiles, exports would have been higher in those years." (Bhagwati & Srinivasan 1978,p.136).This clearly shows that the domestic production is thought to be a crucial factor.

In case of *tea*, the authors tried several models, incorporating the domestic and export markets. The results they say are not encouraging "It appears that the proportion of output exported is influenced more by domestic demand pull than by relative realization from sales in export markets compared with domestic sales. The income variable has a significant negative coefficient and the price variable has a coefficient with the right sign but is not statistically significant." (Bhagwati & Srinivasan 1978,p.137). Again it appears as if domestic demand is a more crucial factor determining exports.

In case of *Cotton Textiles* the authors were not able to fit any regression successfully to explain the decline in cotton textile exports. But they consider it to be "a result of increasing uncompetitiveness of Indian textiles in the world markets, resulting even in the lack of fulfilling of the assigned quotas by India in the export market ...". (Bhagwati & Srinivasan 1978,p.142). Citing Nayyar's detailed study on cotton exports they quote "Nayyar concludes that the slow growth in world demand for textiles during the 1960s is probably not a factor in the stagnation (and even decline) in Indian cotton textile export earnings. .... The domestic rises in cost plus lack of modernization plus domestic absorption seems to have been the major factors, according to Nayyar's analysis (though his conclusions are not supported by econometric analysis in this instance)". (Bhagwati and Srinivasan 1978,p.142).

While summing up, the authors say, "The statistical evidence would thus seem to indicate that the drought did indeed cut significantly into jute textiles exports and that the decline in tea earnings was largely the reflection of a secular adverse trend explained by growing domestic demand resulting from income expansion. The continuing sorry performance of cotton textiles exports since 1966 is probably also to be explained in terms of the relative unprofitability of export sales at the export price realization that existed prior to June 1966 and was accentuated by subsequent increases in the domestic price level. (Bhagwati and Srinivasan 1978 p.144)

The interesting point that emerges from this study is that, not only in case of non-traditional exports but even for traditional exports, factors like domestic supply (droughts), domestic demand and domestic price level are significant. This study to some extent does address the question of whether trade (exports) are demand driven or supply driven. It indicates that exports in case of India - its traditional as well as non traditional ones may be supply driven. The domestic demand variable in most functions is proxied by variables like fixed investment, or index of manufacturing activity. These may be good proxies but if we can specify them more accurately, it

would lead to a better estimation of the level of possible exports, since this factor seems to be dominant one.

2.5.3 Vijay Kelkar and O.P. Sharma's (Kelkar and Sharma 1976) is a study on Indian exports which explores all the variables that could have influenced Indian exports. The study spans a period of 12 years from 1961-1974. Briefly summarizing the main findings of their study they say "Econometric investigations of this section highlight the role of domestic consumption and of inflationary pressures on the generation of exportable surpluses and on their competitiveness in external markets." (Kelkar and Sharma 1976 p. 285). The study posits that India's share of the world exports may have gone down because of reduction in the growth of supply of the exportables and/or reduction in India's export price competitiveness. (Kelkar and Sharma 1976 pp. 288).

India's supply capacity has been modeled in the form of the ratio of export/NNP. The authors found this to have stagnated around a mean value of 5.2 over the period of the study. They attribute this to droughts and recession. It improved after 1970-71. "The rising export/NNP ratio beyond 1970-71 also indicates the increasing ability of the country to generate exportable surpluses. Rapid growth in the domestic demand of exportable items has, in many cases, led to larger home consumption, resulting in diversion of exportables to domestic market and reduction in the exportable surplus." (Kelkar and Sharma 1976 p. 289).

The authors attribute the slow growth in exports to the disparity in the growth of domestic and export prices. They say "... where as the domestic wholesale price index moved up 214% points, the export unit value index moved up only 190% points; leading to increased profitability of selling at home. Thus inflationary tendencies in the country seem to have affected exports adversely. " (Kelkar and Sharma 1976 p. 289).

The authors, commenting on the results at the aggregate level, say, "The loss of India's share of the world export cannot be attributed only to world demand situation. There is evidence to suggest that the growth in its exports did not keep pace with the growth in its N.I. due to supply constraints, part covertly upto 1970-71." Post 1971-72 upto 1974-75, exports have grown in real terms indicating that export supply has improved and the openness of the Indian economy to the world trade. And finally "domestic inflationary situation is of critical importance in deciding about the profitability of the export markets vis-à-vis the home market." (Kelkar and Sharma 1976 p 290).

According to their study, *sugar, ready-made garments, handlooms and leather products* will increase their share in the total exports. *Marine products and new manufactures like engineering goods, chemical products and rubber and rubber manufactures* have good potential for growth in exports. (Kelkar and Sharma 1976 p. 291-293). This finding is based on the trend in their shares in total exports observed over the period of study.

Addressing the question of factors affecting the supply of exportables, they contend that "it would be incorrect to neglect the supply side altogether" (Kelkar and Sharma 1976 p 294). Their study found a decline in the world share of most of India's traditional exports - tea, cotton cloth, raw cotton, oilseed cake, mica, groundnut oil - jute showed sharp fluctuations. According to the authors "Explanation for loss of world share in individual items is to be sought in terms of supply capability, which is in turn determined by domestic production, consumption and export price competitiveness. The domestic production variable has been tested in the following way: A trend function for each commodity was fitted of the type

$$X = A + B_t \quad \text{where } X = \text{export/output ratio}; t = \text{time.}$$

They found a negative trend in export/output ratio of tea, spices, cotton raw and coal and coke; only coffee, jute manufactures and yarn showed a positive trend. This

means that though domestic production is increasing, exports of these are not increasing at the same rate.

The authors note that "India's capacity to export was greatly weakened by the increasing domestic demand. A faster growth in domestic prices of exportable items has two effects. One - it raises the export prices but not as much as the domestic prices rise - so producers find it profitable to sell in the domestic market.

Secondly due to price rise the competitiveness in the world market is eroded. Thus price rise is also a major factor affecting export growth. Price rise a complex phenomenon, depending on many other conditions in the economy, but one way to prevent price rises is to plan for domestic demand and not let it go unattended.

The study also attempts to estimate the elasticity of substitution between Indian goods and the rest of world's good. Their evidence "suggests that India faces stiff competition in all important export items listed above viz., raw sugar, raw cotton, coffee, pepper and tobacco. The evidence in the above paragraphs amply demonstrates the desirability of maintaining the domestic price line and increasing export price competitiveness to make exports more profitable to exporters." (Kelkar and Sharma 1976 p. 304).

In Kelkar and Sharma's study of Indian export, we find an emphasis on supply factors. They studied commodity exports of India from 1961-1974. Since they found that domestic supply of exportables to be a dominant factor affecting the share of India's exports in world, they tried to specify regression equation which took into account exportable surplus. According to them "To see the joint impact of production and consumption on exports and export/output ratio", the following equation has been used : (Kelkar and Sharma 1976,p 297)

$$4. X = a_2' + b_2' (O + M + S - C) + C_2' (E)$$

X = quantum of exports

O = output

M = imports

S = opening stocks

C = domestic consumption

E = real private consumption expenditure

The above equation attempts to state that exports are a function of some minimum level of exports required i.e. the intercept  $a_2'$ ; of the constant term, exportable surplus  $(O + M + S - C)$  and of private consumption expenditure (E).

The results show that the coefficient of the exportable surplus is around 0.7, 0.6, 0.8, 0.4 for most exports and lower at 0.1, 0.08 for a few. The  $R^2$  is satisfactory and high in most equations. It is noticeable that the coefficient of the exportable surplus is high for goods which are for intermediate consumption like Cement (0.7674), Rubber tyres and tubes (0.6231), finished steel (0.8384), Raw cotton (0.8209), Cotton yarn (0.8261), Iron ore (0.8938).

This implies that domestic production requirements make competitive demand on the output of these sectors. It is important to know what is the domestic demand made on these sectors. The authors have attempted to fit a Domestic Consumption Function to all the important exportable items. They have divided the exportable items into two groups of (1) Consumer Goods and (2) Semi Finished Goods and Raw Materials.

A typical equation for consumer good export looks like

$$\log C_1 = a_2 + b_1 \log E \dots (I)$$

where  $C_1$  = Consumption Index of the particular good.

E = Private Consumer Expenditure deflated by

GDP (1961-62 = 100) Index.

A typical equation for a Intermediate Good is

$$\log C_1 = a_2 + b_2 \log M \quad \dots \quad (II)$$

where  $C_1$  = Consumption Index (1961-62 = 100)

$M$  = Index of Industrial Production.

Even though Kelkar and Sharma's specification goes much further than most export functions specified, it suffers from the same drawback as the others in case of estimating the domestic requirement (for production or investment) of the exportable goods.

## 2.6 FACTORS AFFECTING IMPORTS

As in the case of exports, disaggregated or commodity wise studies for Indian imports too are few. Of the recent ones Michael Debabrata Patra and Rajiv Ranjan's (Patra and Ranjan 1992) study is one. Bokil et al (1981) also examines the role of imports in India's production at a disaggregate level.

In Bokil et al the authors state, " Our interest was mainly to discover how the principal import categories behave in the face of the changing volume of industrial production and the capacity to import."<sup>9</sup> ( Bokil et al 1981,p.103). They find that " In the sphere of industrial production, the real GNP per capita appears to be a far more important variable than the capacity to import. Thus, the internal variable has a dominating influence compared to the external variable .....This speaks of the strong import dependence . Only in Iron and Steel, Paper and Paper Products, Plastic Material and Resin , Miscellaneous Manufactured Articles were the import elasticities more than one where the import dependence is comparatively weaker. For those products where the import coefficients were negative, the import elasticities were absolutely greater than unity in 8 out of 13 products. This explains the strength of the import substitution in the case of these products and the list contains traditional light manufactures." ( Bokil et al 1981,p.104- 105)

<sup>9</sup> Capacity to import is defined as the sum of gross export earnings ( in post devaluation rupees), net aid inflows and changes in foreign exchange reserves" ( Bokil et al 1981,p.103)

While concluding the study the authors state that “ modern industries had a greater pull on imports than traditional ones .....We found that a set of traditional industries had very low import dependence ratios..... and offered no scope for import substitution..... All this adds up to a good evidence pointing towards the fact that import substitution has reached saturation round 1970-75, when to sustain existing and growing output levels, more and more imports were needed resulting in what we called ‘ the negative import substitution’ ” (Bokil et al 1981,p.121)

2.6.1 Patra and Ranjan's study (Patra and Ranjan 1992) spans a period of 19 years from 1970-71 to 1988-89 The authors mainly address the problem of "errors arising out of estimating the aggregate import function without taking into account the differential response of individual categories of imports" (Patra and Ranjan 1992 pp. 84). A succinct summary is given on the changing nature of imports.

The main criticism by the authors about the earlier studies is that they were all aggregative in nature. The authors specify import demand function for different categories of imports. According to the authors, "the explanatory variables were chosen so as to identify demand effects only" .... therefore Gross Domestic Product (GDP) at factor cost was selected as a measure of real activity in the economy. (Patra and Ranjan 1992 pp. ).

$$QM = f[GDP_{FC}, PM, PD, DP, FAP]$$

QM = Quantum of Imports

GDP<sub>FC</sub> = Gross Domestic Product at factor cost

PD = Domestic Wholesale Price

PM = Unit Value of Imports

DP = Domestic Production

FAP = Real Foreign Assets

The period was from 1970-71 to 1988-89 In double-log form

$$\log QM_t = a_1 + a_2 \log GDP_t + a_3 \log (PM) + (-) (PD)_T + a_4 \log DP + a_5 \log FAP + (1- ) \log QM_{T-1} + et$$



If we examine the specification, we see that most variables are well represented for e.g. relative prices by PM/PD, availability of foreign exchange by FAP, domestic availability of substitutes by DP. However, again the variable attempting to capture the domestic demand or domestic production requirement, which would be of considerable importance in a majority of Indian imports, is represented by a not very specific measure like the GDP at factor cost.

Majority of the import categories had significant and positive income elasticities. Imports like beverages, fruits and vegetables, paper, textile yarn, iron and steel and electrical machinery were significantly price elastic. The domestic production variables intended to capture excess demand met by import substitution efforts was significant only in respect of beverages, and tobacco, petroleum crude and electrical machinery. This implies that at least for the period covered, most imports are not substitutable; they are necessary imports. However, the price elasticities obtained were such that it led the authors to conclude that "the size of the coefficient of price elasticity dispels the conventional pessimism attached to the efficacy of price related policy measures in influencing import behaviour" ( Patra and Ranjan 1992 p. 93).

"Domestic economic activity embodied in the income variable emerges as the basic determinant of demand for almost all categories of imports .... (because) .. imports consists largely of raw materials and intermediates and of items for direct consumption." (Patra and Ranjan 1992 pp 93). The authors add, "However, for various import categories high income elasticities are accompanied by high price elasticities." (Patra and Ranjan 1992 pp. 93)."Thus, it emerges that imports are indeed amenable to policy action even over the medium term." (Patra and Ranjan 1992 pp. 97).

Patra and Ranjan's paper attempts to study the overall as well as disaggregated import demand functions. They do this by finding disaggregate elasticities, first; next they find the overall elasticity for imports as a weighted aggregate of these and compare this to elasticity for total imports. This leads them to conclude "Knowledge of the structural determinants of import demand is essential for determining the content of

import management policies. It is important to recognize that the heterogeneous character of India's import need clearly suggests a disaggregate approach,"(Patra and Ranjan 1992 pp. 93)

Patra and Ranjan's is the only disaggregated study for imports of India in the recent times. As was noted earlier, most studies on trade, focus on exports; however for India, imports are equally important because they, even to date, "consists largely of raw materials and intermediates which enter production processes at various stages and of items of direct consumption. The import planner is thus confronted with a trade off between import regulation and the needs of growth" (Patra and Ranjan 1992 pp. 93)

**2.6.2** Another study which deals with Indian imports that of DaCosta ( Dacosta 1990). He studies imports from 1970-71 to 1985-86, which is almost the same period as covered by Patra & Ranjan's study. The function specified is as follows:

$$Q_m = f_2 (Y_1, U_m/UI, D_1)$$

$Q_m$  = Quantum of Imports

$Y_1$  = India's real income

$U_m/UI$  = Relative Price of Imports.

$D_1$  = Dummy to capture structural shift

DaCosta finds that the income elasticity of imports is 1.26 and price elasticity is -0.29. Comparable elasticities from Patra & Ranjan's study are at 1.57 (1.44) and -0.42 (-0.60) . So DaCosta's estimates are slightly on the higher side compared to Patra and Ranjan's.

## **2.7 CONCLUDING REMARKS**

Having seen the literature on the empirical investigations of the Indian trade sector, we can say that the discussion on the disaggregate studies of Indian exports (Bhagwati, Vijay Kelkar) shows the predominance of the domestic production variable on export growth. The section on import functions shows what has been the

a priori judgment, that imports are a key input in India's production as intermediates and capital goods and a disaggregative view of import requirements is necessary.

Since domestic factors seem to be dominant, in influencing the export performance and determining the level of imports, we will attempt to study the problem of growth and trade focusing on the domestic demand and supply. To do this the input output framework seems suitable as it can trace the per unit requirements accurately, and also enable one to work out the direct and indirect requirements.

## **2.8 UTILITY OF THE INPUT-OUTPUT FRAMEWORK FOR A DISAGGREGATE STUDY OF THE TRADE SECTOR**

It is easy to model imports and exports as variables in the growth function of an economy at the macro or aggregate level. These types of models have been attempted earlier. What is not always easy is to attempt a disaggregate approach and yet link the variables at macro level. The Input - Output framework enables a researcher to do just that. The vector of the variables involved (say exports, imports, consumption, investment, production) can be modeled in a functional form; the vector form implies that various sectors of the economy can be considered.

The specification of the variable of domestic demand in almost all studies on Indian exports (Bhagwati and Srinivasan, Gupta and Keshava, DaCosta) is done by using GDP or Index of Industrial Production. Though the price variable (relative prices) is captured quite accurately, the variable for domestic demand gets represented by such broad measures. The I-O can overcome this drawback, since, its specification of the matrix 'A' is based on the detailed and observed input requirements of each good (or sector) from every other. Here we will have the full blown 'A' matrix to map the domestic production requirements of a particular good.

Similarly, in case of imports, the variable attempting to capture the domestic demand or domestic production requirement, which would be of considerable importance in a majority of Indian imports, is represented by a not very specific measure like the

GDP at factor cost. This is true for most specifications of import equations. (See - DaCosta, Mukherjee). Here again, the I-O technique provides a more accurate system for tracing the domestic requirements (whether for production or investments) of each commodity and therefore estimating the import requirement in greater detail. So, if one can estimate these variables of domestic demand a little more accurately, it can throw some light on the role of this factor in India's trade.

Given this, we look at the I-O methodology, which though not very frequently used, can overcome both the earlier mentioned drawbacks. The I-O method for one can estimate the domestic demand much more accurately than indices, as it is based on the detailed input structure of each sector. Thus, it can estimate the exportable surplus and importable deficit more accurately.

Secondly, it can combine the macro as well as the sectoral link, as each variable is represented by a vector wherein the composition and structure of that variable gets reflected. Thus, each sector is linked with every other and overall the variables like exports, imports, growth rate, investments etc. can also be linked to each other. Thus, simultaneously we get the integrated macro link as well as the advantages of the disaggregated approach.

## 2.9 LIMITATIONS OF THE I-O METHOD

Considering all this, the I-O seem to be a proper methodology to study the variables and the problem at hand. Of course the I-O method cannot take into account relative price effect as in the case of the regression method. However, the price and income elasticity aspect of the Indian trade sector have already been studied by various authors. Hence we would like to concentrate on the domestic demand and supply factor.

This does not amount to saying that knowledge of elasticities is not necessary. On the contrary, both approaches are complementary. Both approaches together will give a comprehensive idea of the working of the trade sector or how it should be made to work. The elasticity approach gives an idea of exports or imports and the extent of their dependence on the relative price movement and world income. This can be used to determine the amount or level of subsidy required to promote exports or the amount of tariff to be levied on imports

Identifying exportable surplus sectors and importable deficit sectors of the economy based purely on the domestic demand and supply gives an idea of which goods can be exported and which can be imported keeping in mind domestic requirements. It will also show the place of the trade sector in the total economy not as it exist but as it ideally should be. It will give the composition of the required trade vectors for the economy's growth programme. This can be used to determine the sectors to which the export subsidy, import tariff or other promotional measures can be targeted.

If a good is exportable due to domestic availability, the aim of the policy maker should be to find the right market and the right price for it; if some good is exportable based on the good price it fetches in the international market but we do not have a comparative advantage in it, the policy maker should attempt to develop its domestic production and productivity.

Working out the exportables and importables based on the domestic demand and supply will give an idea of the areas of the economy which are naturally strong and naturally weak. This aspect has not been studied in great detail so far hence this can shed light on a hitherto unexplored factors affecting India's trade performance and requirements.

## **2.10 OBJECTIVES AND SCHEME OF THE STUDY**

The objective of the study is to identify the exportables and importables sectors for the Indian economy taking into account the domestic demand and supply factors under

conditions of the economy achieving its growth potential. The study uses the input-output framework.

The specific objectives of the study are:

*Firstly*, to assess the investment proportions required for the economy to pursue a high growth path like the von Neumann growth path, using the Input-Output Methodology.

*Secondly* to assess how trade can be used as a balancing factor to achieve this maximal (von Neumann) growth path.

*Thirdly* to compare the existing trade pattern to the desired one as shown by the model.

The specific steps involved in trying to achieve the above mentioned objectives are:

1. The construction of a Capital Coefficient matrix (for both, the organised and the unorganised sectors)
2. Estimating the maximum possible rate of balanced growth and the necessary investment proportions vector.
3. To examine how the imports and exports vector can be used as balancing vectors for a maximal growth programme.
4. To assess whether the existing and recommended trade vectors are in tune with resource endowment of the economy.

In the next chapter, we look at the Input-Output Method in some detail and the Leontief's dynamic I-O model in particular which has been used earlier to study economic growth and the trade sector. The model, its different versions, its assumptions, criticisms, shortcomings and advantages will also be discussed in detail in the next chapter.

**CHAPTER THREE**

**METHODOLOGY : THE DYNAMIC INPUT-OUTPUT SYSTEM**

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**3.1 THE INPUT-OUTPUT SYSTEM - AN INTRODUCTION**

The Input-Output system plays a crucial role in the empirical estimation of the major parameters in our study. Further, a necessity arose to construct a capital coefficient matrix as this was not readily available for the Indian economy. Hence, we will discuss at some length the Input-Output system in the following.

The Input-Output System of studying an economy was developed by Wassily Leontief in the thirties. According to Bharadwaj and Mathur " It has rendered the general equilibrium system empirically manageable by suitable simplifications to handle quantitatively economy wide systems rather than particular parts thereof and thus illuminate the nature of the (real) economic structure. Furthermore, this technique has enabled to incorporate in our analysis larger and simultaneous variations as well.... this and related techniques which take a disaggregated and simultaneous view of economic activities have had far reaching consequences. " (Bhardawaj and Mathur 1967 p. 2).

The basic Input Output Relations are written in compact vector/matrix notation as:

$$\begin{aligned} AX + F &= X && \text{where,} \\ \text{OR} &&& A = \text{I-O Coefficient Matrix,} \\ X - AX &= F && F = \text{Final Demand Vector} \\ (I-A)X &= F && X = \text{Gross Output} \\ X &= (I-A)^{-1} F \end{aligned}$$

$(I-A)^{-1}$  is called the Leontief Inverse. This gives the direct and indirect requirements of producing a unit of any commodity. This is the open static Leontief Input-Output System. In the Closed Static Input-Output System, consumption is treated as the endogenous variable. The closed system will have  $n+1$  rows and columns.

In matrix notation,

$$(I-A)X = C \quad \text{where } A = \begin{matrix} A & C \\ L & 0 \end{matrix}$$

C = denote final consumption vector

L = denote the value added vector

### 3.1.1 THE STATIC I-O MODEL

Gross Output 'X' is used for either inter- industry requirements, consumption, investments or exports : Thus

$$X = AX + C + I + (E - M) \quad \text{I= Investment, E= Exports and M= Imports.}$$

where 'A' is the Input Coefficient Matrix and 'AX' shows the total inter industry production requirement. Putting together all the vectors of final demand i.e. C, I, E, M and denoting these by 'F'

$$X = AX + F$$

$$X = (I-A)^{-1} F$$

All the variables dealt with, are in the vector notation. So X, C, I, E, M and F are vectors of the order (n x 1); where as 'A' is a matrix of the order (n x n). This system, called the Open Static Leontief Input-Output System, makes the following assumptions

1. All production process require fixed inputs. All sectors have constant returns to scale. Thus, if a typical column of the 'A' matrix shows the fixed input coefficients required to produce 1 unit of that good, to produce 2 units of the same would require 2 multiplied by that column. Thus increasing or decreasing returns to scale cannot be represented.
2. Each sector produces only one product. Joint products are ruled out.
3. Each column shows an input structure of that sector. In reality the several firms which comprise the industry / sector may be following different production techniques. Having one column for every industry implies an assumption that every firm is following that production technique.

Mathur, commenting on the technique of Input-Output says, " The Closed I-O model fused theoretical clarity with empirical contents. It not only provided a framework of meaningful description of economic interconnections, but also gave us the means for



finding out the short period effects of any economic policy or data change. This techniques provide a very good tool for planning, estimating requirements of planned growth rates". (Mathur and Venkatramaiah 1969 p. 5-6)

Work with the 'A' matrix is by and large fairly established in India. The CSO publishes an Input-Output Transaction table at regular intervals. The Planning Commission uses the I-O method to make the estimates for Plans, to project material balances etc. In case of trade, work in this area has gone ahead, where the Import Matrix is used; so that the domestic and import requirements of any given final bill of goods can be estimated separately. This would give a fair idea of the import dependence of our production structure.

The Input-Output technique has been used earlier to model the trade sector. However the focus has remained on imports. As the I-O technique is conducive to estimating the input requirements, in case of international trade it has been used to generate the import matrix. The Planning Commission in its Technical Notes, has been publishing an Import Matrix for India since the Seventh Plan. Some individual scholars too have attempted it. Dhanmanjiri Sathe in her unpublished Ph.D thesis estimated import matrices for the Indian economy for a few years.

### 3.1.2 IMPORT MATRICES

Suppose the import matrix is designated as  $A^m$ . A typical column of  $A^m$  would show the imported inputs per unit of output used by that industry in its production process. A typical row would show, the distribution of imports across the different user industries. Now if  $A^m$  is known, we can have an  $A^d$  i.e. domestic input matrix such that

$$A = A^m + A^d$$

The use of  $A^m$  and  $A^d$  can help to estimate the import and domestic input content of the final demand vectors. The import matrix can be used to estimate the import intensity of production, consumption and exports.<sup>1</sup>

<sup>1</sup> Studies which have involved this type of work are Bharat Hazari (1968 b), Atul Sharma (1990), Sathe, D (1990). The equation used by Atul Sharma (1990) is : Import Requirement  $F = A^m [I - A]^{-1} F$ . Bharat Hazari uses a slightly different equation. Sectoral Imports =  $A^m [I - A + A^m]^{-1} F$ . Sathe

The problem with using Import Matrices for empirical work is that the methodology used to estimate them is still crude. Total imports of a sector are distributed pro-rata across using sectors, based on the distribution of domestic output across using sectors. This implies that we are imposing a strong assumption about the use of the domestically produced good and imports on each sector. This limitation exists because data is not sophisticated enough to chart how the imported goods are used in the various sectors of the economy. V.R Panchmukhi (1967) did attempt at casting an import matrix based on actual use for the year 1962, but such matrices are not available for very recent years.

### 3.1.3 LIMITATIONS OF STATIC I-O MODEL FOR MEASURING GROWTH

Import matrices and I-O models using import matrices, concentrate on one aspect of trade. Also, the question of the growth of the economy and its trade requirement cannot be satisfactorily studied in a static framework even after differentiating between a domestic "A<sup>d</sup>" matrix and an imported inputs matrix "A<sup>m</sup>". Consider,

$$X = (1-A)^{-1} F$$

This equation implies that for any prescribed or targeted Final Demand Vector 'F' we can obtain the compatible gross output vector 'X'. However this assumes that the necessary capital stock requirements are available. Such an assumption is justified if our requirement to produce the gross output vector X is less than or equal to the capacity available in each industry. If however, the gross output vector, X needs more stocks than are available, then additional capacity should have been created earlier. This would mean the inclusion of investment which was considered as one of the constituents of final use within the model.

Suppose we want that consumption should grow by 5% and therefore the target 'F' vector would be say F' then using the static I-O model,  $X' = (1-A)^{-1} F'$  will tell us how much increase (X' - X) in gross output is needed to increase final consumption

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estimated the import matrices for India for several years and studied the backward and forward linkages of the trade sector.

by the prescribed amount. But how will the economy produce this extra output? Using the Static I-O implied that we are assuming that the economy has enough Capital Stock, so that the required increase in output can be made.

However, if Capital Stock is not always available, to increase production, it may be necessary to increase capital stock. Thus, for studying the growth and its requirement, the Static I-O is not adequate. It cannot measure the Capital Stock required for production or required for increased production.

### 3.2 THE DYNAMIC INPUT-OUTPUT SYSTEM

The dynamic I-O model, is an extension of the static I-O Model. It was put forth by Leontief (Leontief, W. W. 1953) in his empirical study of the American economy in 1953. According to Dorfman et al, "the dynamic input-output system is a straightforward generalization of the static model". Its distinguishing characteristics are the same, i.e. (1) joint products are ruled out and (2) for each output there is only one possible activity or technological process, with fixed proportions" (Dorfman et al, 1958 p. 283).

The "A" matrix tells us about the current flow of goods for production. More precisely the 'A' matrix shows the input structure in detail for every sector. Describing a typical column of an 'A' matrix, Leontief writes, "A complete set of such coefficients pertaining to any one particular industry determines the flows of labour, all kinds of materials, fuels, replacements parts etc. which this industry would have to absorb per unit of time, say per month, or per year, in order to be able to produce a given flow of output..... These input coefficients do not reflect however, the stock requirements of the economy, they do not and cannot explain the magnitude of those input flows which serve directly to satisfy the capital needs of all its various sectors; either as additions to fixed investment in the form of permanent improvements, buildings and different kinds of equipment or as an increase in the necessary inventories of raw material, goods in process etc. However, every industry requires, apart from these, some stocks to carry on the production activity. These may be of various forms such as buildings, machinery, other fixed assets, stocks of raw material and goods in the process of production." (Leontief, W 1953, p. 55)

According to Leontief, "Dynamic theory (thus) enables us to derive the empirical law of change of a particular economy from information obtained through the observation of its structural characteristics at one single point of time". Referring to the Dynamic I-O model, he says, "the theory described below represents a dynamic extension of the static input-output scene. It is not a general theory, if by general one means a formulation which, for the sake of conceptual completeness incorporates all the hypothetically relevant determinants of the process to be explained.....". (Leontief, W 1953 , pp. 53)

Explaining the difference between the static and dynamic I-O models, Leontief says "Static I-O analysis describes the economic system in terms of mutually interrelated and structurally conditioned, simultaneous flows of commodities and services. The dynamic element - the dependence of the future on the past states of the system - can and usually has been accounted for in the theoretical explanation through the introduction of structural time lags, of structural stock-flow relationships, or of a combination of both" ( Leontief , W 1953 p.54 )

While recognising the importance of incorporating the time lags in the formulation of any dynamic model attempting to explain economic behaviour, Leontief goes on to justify why the incorporation of only stock-flow relationship is adequate to study the dynamics of any economic system. He argues thus : "....an observed lag between the variation in the stream of inputs absorbed by an industry and the corresponding changes in the level of its output can often be traced back to its changing capital requirements based on technologically determined stock-flow ratios between the amounts, i.e. the stock of equipment, building and inventories of materials, on the one hand, and the corresponding capacity to turn out the actually observed stream of finished products, on the other hand. In general, stock-flow ratios are more observable than lags between flows. It is interesting to note in this connection that the conventional standards of behaviour, the rules of the thumb actually, or at least apparently, adhered to by the practical decision makers in economic enterprises - ..... - most often are formulated in terms of some normal period of turnover, desirable inventory ratios and other similar stock-flow

relationships; these conventional rules hardly ever contain explicit references to desirable or normal time lags. This is the reason why stock-flow relationship, rather than structural time lags or a combination of both are relied upon this initial attempt at a dynamic approach to empirical input-output analysis"<sup>2</sup>. ( Leontief, W 1953 p.54-55 ).

In the static model, those inputs that satisfy the capital needs are a part of final demand. This implies that in the static I-O model, investment is treated as exogenous. When we are talking of a growth model, we look for variables that cause growth or account for growth. Investment has always been taken as the key variable. Capital stock or increase in capital stock, which is nothing but investment, becomes a variable that explain growth and which causes growth. As growth rate has been made the objective variable, the target which we want to change or aim for, investment as one of its key causes, automatically becomes an endogenous variable. Therefore to treat growth rate as the objective to be maximised, we have to treat investment as dependent on it and no longer as given. In such a scenario investment is necessarily a variable to be determined, not taken as given. In the Leontief Dynamic I-O model, investment is endogenised as the "B" matrix and investment is determined by the target rate of growth and the capital structure as shown by the "B" matrix.

Before explaining the dynamic I-O model, it is pertinent to note that growth would depend upon two variables - capital and labour. Labour is not explicitly referred to in the dynamic I-O model. In that sense the use of such a model for studying the growth rate would lead to a partial analysis. However, labour can be very easily included in the model, in terms of an augment 'A' matrix; where the last row and last column is attributed to labour input in the production process. In India, the main bottleneck in its economic progress has been the lack of capital and not labour. India is assumed to be a relatively labour surplus economy, so even if we assume that the necessary labour for any given growth programme and its attendant capital investment, is available, it will not be a very strong assumption.

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<sup>2</sup> Leontief puts forth a mathematical procedure for including structural time lags as well; however, it is beyond the scope of this work to review that (See Leontief 1953; Mathematical Note 2 pp. 82).

### 3.2.1 THE DYNAMIC I-O MODEL

If the additional output capacity required is given by the vector  $\Delta X$ ; then the capital stock required to be able to produce this would be given by  $B \Delta X$ ; adding to the static equation, we get

$$X = (1-A)^{-1} F + B \Delta X \quad \text{or} \quad (1-A) X = F + B \Delta X$$

$$X - Ax - B \Delta X = F$$

As  $\Delta X$  signifies a change/increase in  $X$ ; if we want it grow at a rate of  $g_i$ , then putting  $\Delta$  as "g" we get:

$$\Rightarrow X = [I - A - gB]^{-1} F$$

This is the dynamic input-output model as put forth by Leontief. This incorporates the economic growth, making investment an endogenous variable. Thus investment depends upon the capital structure of the economy as shown by the  $B$  matrix and the required growth of the final demand 'g'.

### 3.2.2 THE CAPITAL STOCK MATRIX

Stocks needed in the production process can also be put in a matrix form analogous to the current flow matrix.

If  $S_{ij}$  = Total stock of the  $i$ th good held by the  $j$ th industry. Dividing each of these entries by the yearly output of the relevant industry, we obtain a **Capital Coefficient Matrix**, usually labeled as 'B'

where,

$$b_{ij} = \frac{S_{ij}}{X_j}$$

Each column of this 'B' matrix lists the stock requirements per unit of output of the particular sector of the economy. "It can be called the capital matrix or the capital structure of the economy. Together with the ..... 'A' matrix, it summarizes the primary structural information required for the derivation of the general dynamic properties of a given economic system.

### 3.3 THE DYNAMIC I-O MODEL AS A PLANNING TOOL

The dynamic Input-Output technique as put forth by Leontief can be put to good use as a programming and planning tool. This model or the linear programming model which maximises one variable subject to certain constraints, is extremely useful to plan for specific targets of any economy for any of its known constraints. As Eckaus and Parikh note "Unless (such) alternatives and their implications are made explicit, informed choices cannot be made. The models presented here are designed to generate policy alternatives and explore the implications of any given set of objectives. Consequently, the models can also be used to test the feasibility, consistency and political acceptability of plans made by other, less formal methods". (Eckaus-Parikh 1968 p. 1)

Describing the technique of linear programming, they say "In this technique, a specific objective or criterion function is maximized subject to constraints that describe the relevant technological, economic and social behaviour relationship". (Eckaus-Parikh 1968 p.2)

Commenting on the advantages of this technique, they say that "it is, first of all, a better approximation to the real context in which policy is made than are static and aggregative models (Eckaus-Parikh 1968 pp2)". "The model is useful in testing the feasibility of a prescribed target set of output capacities". (Eckaus-Parikh 1968 p. 10).

The authors list out the benefits of "programming models for making development policy". (Eckaus-Parikh 1968 p. 19). Firstly, they say, "We believe that no other known method does as well in providing a consistent analysis of intertemporal and intersectoral relationships and economic goals. Whatever the means of implementation, decisions will have to be made on the amounts of government savings, on whether to start another steel plant next year or build more power facilities or to allocate foreign exchange to importing mining equipments. These decisions should be coordinated with all the sectoral development plan and the national goal. We believe the models indicate how this can be done in a manner superior to that of existing techniques...(These techniques) ... " make the issues involved in planning more explicit than do informal and partial techniques. Second, the models

inspire the development of data that might otherwise be ignored. Finally, the models emphasize the importance of exploring alternatives and designing planning methods for high speed computation, rather than, as has generally been the case, concentrating on the preparation of only a single plan. With these techniques, it becomes possible to trace the outlines of a number of alternative plans and to substantially increase knowledge as to the choice available. Planning is a continuous process. There are often unexpected shortfalls in production and delays in completion of new facilities. There are occasionally unexpected increases in output and windfalls in foreign exchange earnings .....(Thus, such ) continuous adjustment and readjustments of means and ends ... require quick and flexible techniques of analysis." (Eckaus-Parikh 1968, p.19)

The programming models (i.e. multisectoral planning model) should be considered as tools which can be used continuously in a variety of forms designed for particular problems . (Eckaus-Parikh 1968, p.19). The linear programming model or the I-O multisectoral model is just such a flexible model. It can be used in either of the following ways.

- a) Firstly, some variables are treated as exogenous, and some target level is set for them, say for e.g. consumption . Say a 5 % growth of consumption is desired and set as a target. The model can work out all the direct and indirect requirements implied by this target. As solution, it will calculate all the sectoral requirements needed, and allocate resources to their production. If the targets are feasible no other allocation of resources will reach the targets.
- b) Secondly, without specifying any terminal conditions, but specifying some constraints, we can estimate the terminal levels of the dependent variables. For e.g. if we have a certain level of supply of all goods, then the growth rate of consumption is determined by that.

Both approaches enumerated above will be used in this study

1. Given the existing conditions or parameters of India's economy, i.e. taking these as constraints, we will find the maximum achievable growth rate of the Indian economy.



The constraints that we will consider are technical (expressed in monetary terms). We will not be considering the financial aspects of the problem. The constraints are: the present input structure of each sector of the economy (as shown by the 'A' matrix) and the capital required to produce one more unit of output in each sector or the C.O. R (as shown by the 'B' matrix). From this run, we will get as solution a maximum possible growth rate. However, this growth rate may yet not be achievable in the real economy as other constraints may be operative. So from here we get only a technically possible maximum growth rate. However, even this is useful. It is always useful to know what the ceiling is.

2. The second approach requires specifying some target as a desired goal and then computing the direct and indirect requirements for meeting the same, of all sectors. The approach can be used to study the trade off between the overall growth rate of the economy and the BOT. Thus, for different levels of growth what are the levels of exports possible and imports required?

Historically the two gap models of development stress on two obstacles to development - savings and foreign trade. Thus, foreign trade can be used to fill the gap which will ensure that a high growth programme is not abandoned for want of resources domestically. Conversely, a growth programme can be adjusted keeping in view the foreign trade constrain.

No economy in contemporary times can remain a closed economy, even if it has the technology and resources to produce all that it requires. In today's complex world, all economies are becoming more and more interdependent. In case of developing countries, trade and aid do play a major role in its developmental programme. Today, many economies have achieved rapid growth due to emphasis and proper management of their trade sectors. Mathur's modified version of Leontief dynamic model therefore seems tailor-made to study the place and strength/role of the trade sector in the country's growth programme.<sup>3</sup>

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<sup>3</sup> Mathur's modified version of the Leontief dynamic Input-Output model will be discussed in detail in Chapter Six of this study.

One of the things that the model can tell us is given the present day structure of the Indian economy (the production technique as shown by the A matrix and the state of technology as shown by the B matrix) is : what is the maximal steady growth rate that the economy can achieve. Secondly, it can tell us what the structure of investment should be (as shown by the associated eigen vector) to achieve this maximal steady growth in the shorter possible time. Thirdly, by running different simulations one can work out the trade (import/export) implications of different growth programmes. For e.g. if the Ninth Plan has set a target of 6.5% as the economic growth rate to be achieved, we can by feeding this in the model work out the import requirements and exportables from the model; necessary to sustain or bring about the growth rate. Various alternatives can be tried. Exports can be made exogenous if we want and the implications of meeting the target in terms of requirements of other goods can be made. All in all it is great planning tool, where alternatives and their implications can be studied.

#### **3.4 LIMITATIONS OF THE DYNAMIC INPUT- OUTPUT MODEL**

The model and any exercise based on it has of course various limitations. First and foremost is that since it is in the I-O system, it suffers from all the limitations of the I-O model. It is based on the assumptions of fixed coefficients in every production technique. It shows input coefficients at a point of time which we are using for predicting future supply / demand situation. From this it follows that, we cannot use this for long term prediction. It is essentially a short term tool. Considering the fact that lengthy and extremely time consuming computations are required, the gains are less. It gets outdated fast. The coefficients have to be continuously updated.

Another limitation is that constant returns to scale are assumed. Thus, to double output, we need to double inputs. This assumption may lead us to overestimate resource requirements at times.

It does not consider the financial sector of the economy at all. Though all the input and output are expressed in value terms, all financial transactions and their impact on the values of the real variables gets neglected. It is not a general

equilibrium analysis. The above were problems that arise in the I-O framework itself. Now we look at some problems peculiar to the dynamic model.

Many authors (Bulmer Thomas (1982), Chakravarty(1969) Dorfman (1958)) have criticised the dynamic I-O model on the grounds that it is unstable<sup>4</sup>. As Bulmer Thomas notes ..... "the inverse of the capital matrix (B) is involved in the solution ..... this matrix will consist mainly of zeros so that it will be singular and cannot be inverted.....". (Bulmer-thomas 1982, p.223). However, we may note that this will not apply to Mathur's modified version of the dynamic model, as it does not involve the inverse of the B matrix..

Another serious limitation is put forth by Bulmer-Thomas. According to the author " (even) If the country in question does have a significant capital goods industry, it is not necessarily the case that accelerator type relationships are the best way of explaining the demand for capital goods; the price elasticity of substitution for the capital goods is generally thought to be low while the cost of establishment of a capital goods industry is generally thought to be high, while the establishment of a capital goods industry will take place through import substitution, thereby distributing the assumed stable relationship implied by a fixed capital coefficient matrix. In LDCs.....additional demand will frequently be met by making better use of installed capacity rather than by additions to capacity. Another serious methodological problem occurs because of the lags which arise in practise between installation of capital goods and increases in capacity." (Bulmer-Thomas, V 1982 p. 176)

According to Andras Brody (1970; pp45) "Using the "B" matrix involves many assumptions, summarised as:

1. The output increases only by investing and that there is no underutilisation of capacity.
2. The new investment is made according to the already existing technology. This means that the new investment is not leading to any technological change."

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<sup>4</sup> Chakravarty, S (1969) discusses the instability aspect of the dynamic I-O model in Chapter six section 6.7 p.158-171. This criticism of the dynamic I-O model was put forth by Dorfman et al (1958) too and is discussed in more detail in Chapter Six of this thesis.

These limitations are valid to a certain extent. However, for the second criticism by Brody, on the I-O model not being able to capture the new technology, the following counter argument can be made: Since technological innovations come in, in the beginning only to the leading firms of some or most industries, it takes time for any technological innovation to spread to all the firms of all sectors of the economy. In a macro model, we are trying to find the average technical structure of each sector which consist of several firms or industries and predict the near future requirements of capital goods based on this. Therefore despite this shortcoming, the model will not give very absurd results.

Another limitation that should be pointed out is the following: Though the Leontief Dynamic I-O model is called dynamic as against static, it is something of a misnomer. The model is not based on time series data and therefore is not dynamic in that sense. It is at most a comparative static model. An I-O model which is dynamic in the real sense, that is it takes into account past time periods, has been put forth by Leontief<sup>5</sup> but is beyond the scope of this work to review that.

Notwithstanding these criticisms, a growth model based only on the "A" matrix would be of limited use. Although using a "B" matrix would involve many assumptions and limitations as stated above, it would be better to improve estimation procedures and data collection and reporting techniques rather than do away with the use of the Capital Coefficient Matrix altogether.

### **3.5 THE EMPIRICAL APPLICATION OF THE DYNAMIC I-O MODEL FOR INDIA : A SELECT REVIEW**

The dynamic I-O model has extremely interesting applications for a developing economy like India. Commenting on the endogenising of investment in the Input-Output framework, Bulmer Thomas says. . . "the technique (of constructing a "B" matrix) is only appropriate where there is a relatively advanced capital goods industry (which is true of only a few of the larger LDCs), because where capital goods are imported one can ignore the interaction between output increases and the capital

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<sup>5</sup> See Leontief, W.W. 1953, mathematical Note 2 on p.82

goods industries or capital goods are required". (Bulmer-Thomas, V 1982 p.222). In India, there is capital production as well as a diversified manufacturing base. In the early days after independence, it was felt that investment should be made in basic and heavy industries (iron and steel, railways) to ensure a continuous long term growth of the economy. Today, only the sectors requiring investment have changed.

The above dynamic model has been used for India but very sparingly. Three studies that have used it are : the Eckaus-Parikh study (Eckaus Parikh 1968), Jagdish Bhagwati and T.N. Srinivasan ( 1978) and Mathur (1967). The Cambridge Model (Stone and Brown 1962 ) also uses the dynamic I-O model in an interesting way for the British economy.<sup>6</sup>

Coming to India, the Eckaus - Parikh model used a similar approach, describing it as "a multisector planning model" to study among other things the balance of payments situations for India by trying different simulations. Bhagwati and Srinivasan (1978), in their study used the same model to estimate the effects of a hypothetical growth rate of exports" on the balance of payments situation." Both these used the dynamic Leontief Input - Output model for India in the sixties. Mathur also examined the von Nuemann growth rate and its trade implications using a modified dynamic Leontief Input-Output modified to study the Von Neumann growth rate<sup>7</sup>.

All the three studies referred to above, use the dynamic I-O Leontief model. The difference lies in the a priori assumptions about the variables, made by the authors. Both, the Eckaus-Parikh study and Bhagwati's assume exports to be the independent variable and growth, the dependent one. This assumption is implicit and not spelt out explicitly. So they both start out with an assumed rate of growth of exports and trace its repercussions on other variables like balance of payments, (foreign exchange availability, import availability and production and growth). Mathur on the other hand treats both imports and exports as residual variables to be estimated from the model.

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<sup>6</sup> This is not an exhaustive list of the applications of the dynamic I-O model for India. Other authors have used it or used the B matrix to estimate capital intensities etc.

<sup>7</sup> The von Neumann model (to be discussed in the Sixth chapter) basically is a general equilibrium model and it has similarities with the Leontief's dynamic I-O model

So he starts out with an assumption about the growth rate itself. He works out the requirements of meeting realizing this growth rate in terms of other variables like Investment, Imports. Exports are treated as residual. (He does assume minimum exports). In the light of the evidence as seen in the survey of literature in Chapter II, about Indian exports being dependent on a sustainable exportable surplus produced (or on the economy's growth rate), it would be interesting to study growth rate and exports and imports as done by Mathur.

**3.5.1** The Eckaus-Parikh model (Eckaus- Parikh 1968) deals with the Indian economy in the 1960s. It uses a combination of the I-O techniques and econometrics to model the economy. They explore several alternative paths for the economy by putting different constraints like a saving constraint, a BOP constraint and capacity constraints. The model is for eleven sectors for the Indian economy in the sixties. Trade has been modeled in the following way: Exports  $E(t)$  are determined outside the model structure and are given. As the author's say: This is not a fully satisfactory procedure since except in extreme cases, exports depend on domestic prices, which in turn depend on the amount and composition of productive resources and finally on comparative advantage". They go on to add "If a demand schedule for exports is estimated outside the model then the choice between export promotion and import substitution can be made. (Eckaus- Parikh 1968 p. 27)

Imports, are segregated into competitive and non-competitive. Non Competitive imports are determined "by multiplying the diagonal matrix  $m_1(t)$  of fixed import coefficient by the vector of domestic outputs. Competitive imports are modeled so as to "provide(s) some scope for choice .... (Eckaus- Parikh 1968 p. 31) ..A foreign exchange constraint is imposed to determine competitive imports. Thus we can say that exports and imports in this model are independently determined; imports emerge to some extent from the model. But there seems to be no specific link between growth and exports. Imports, i.e. complementary imports depend on growth as they are made a fixed proportion of production requirement.

**3.5.2** The Cambridge Growth model 1962 (Stone and Brown 1962) is a comprehensive economy wide growth model for the British economy. It attempts to

build a SAM for the British economy. The study deals with trade in the following way: One approach - begins from an assumed level and pattern of exports and assumed finance available. These finances determine the level and pattern of domestic production and of imports required to meet the general growth assumption. The second approach is to take demand for imports as generated by the growth assumptions then the level of exports necessary to sustain the flow of imports are calculated.

In the Cambridge model too, imports are divided into complementary and competitive. Complementary imports are determined proportionately to the level of output. Competitive imports are treated as substitutes for British goods. In the version of the model where exports and financial flows are fixed, competitive imports act as the residual item. To quote further. "In other words their total level is determined once the other factors are known. If we follow the other alternative approach, namely link these imports with the total demand for commodities in question, then either the level of exports or the financial flows must become the residual item." ( Stone and Brown 1962,p.6)

The treatment of imports in the Cambridge Model is somewhat similar to that of the Eckaus-Parikh model. Imports and exports are used alternatively as residual or balancing items. A comment by the authors relating to the pattern of competitive imports: "The idea behind it (treatment of competitive imports) is that imports of individual competitive products are linear functions of their total. It might be better to assume that the different competitive imports mere linear functions of the direct and indirect demands generated by consumption, investment and exports." ( Stone and Brown 1962 p. 60)

**2.5.3** Mathur's study of the Indian economy for 1960 is a similar approach to model the Indian economy. His model is quite compact although it is an economy wide model. Unlike the other studies, he has left out the financial sector totally out of his model. His focus rather than being on Balance of Payments is on Balance of Trade. He focuses only on the real variables like output, consumption, investment and trade. Variables like financial capital, savings, foreign exchange and prices are left out.

In his adaptation of the dynamic Leontief model to estimate the von Nuemann rate of growth and von Nuemann Ray for investment, Mathur has linked the variables of consumption, its growth rate, investment requirements for this growth and domestic availability or capacity production. He has given trade a slightly different treatment than in the model discussed above. There is no separate equation for estimating exports and /or imports. Both these variables emerge from the model as residuals. The model is flexible enough to examine the alternative where exports are exogenously specified and imports act as the adjusting residual. He has however not separated the complementary and competitive imports. The Trade Vector emerges as the residual balancing item after the domestic availability is used to meet consumption, investment and export requirements. The investment is of two types - one is to meet the minimum growth rate of consumption and the other is to achieve the maximum possible growth rate for the economy.

Thus consumption is exogenous, minimum growth rate is exogenous; the other variables - investment is endogenised and trade becomes/ partly exogenous and partly residual. This approach can tell us the comparative advantage of the sectors of the economy - whether they are suitable for export promotion or import substitution. The surpluses remaining in the system are termed as exports and the deficits are imports. Thus trade is treated as the balancing item here with the burden of adjustment falling on both - exports and imports.

Though all the above studies basically used the same model, i.e. the dynamic I-O model, they differed in their approach to the treatment given to the trade sector in the model. The Eckaus-Parikh and Bhagwati and Srinivasan studies, both treated exports as exogenous variables. Imports were treated as endogenous variable depending on the total output/production. In some runs of the model, were imports treated as exogenous. The growth rate was the dependent variable.

As against this Mathur treated the growth rate as the independent variable and the trade vector or exports and imports were treated as the emerging residuals or endogenous variables. Thus, he used the model and demonstrated the particular use



the model could be put to. For different growth rates, we get different levels of exports, imports.

He modified this basic Leontief model to estimate the highest possible growth rate, the economy can reach given the constraint of the technology of production (as shown by the 'A' matrix) and the constraint of the Capital Structure/Efficiency (as shown by the 'B' matrix).

### 3.6 APPROACH ADOPTED FOR PRESENT STUDY

Considering the above approaches, we have decided to follow Mathur's approach. This is because it looks at trade differently than the other studies. Trade - both exports and imports - emerge as residuals. The difference in the two approaches lies in the fact that the first approach attempts to capture the trade relations with other economic variables (domestic and international) as they are or as they exist, to capture as exactly as possible the factors that determine the trade variables. In Mathur's approach he has treated trade as the balancing item - so that the trade vector is what will balance domestic supply and domestic demand. The stress is on how the trade vector should ideally be. As noted earlier, in econometric exercises of trade, exports and import equations for commodities are specified. However in these, the price factor, relative price factor is given more importance. Exports are postulated to be demand driven. The supply side (domestic supply for exports and domestic supply as substitute for imports), though not totally unrepresented in these equations, is not examined in great detail. Import requirements are specified as some fixed proportion of production (based on  $A^m$  matrix for sectoral level studies and on Index of Manufacturing activities in case of econometric studies).

Mathur's approach focuses on estimating all the demands on the available output - irrespective of origin i.e. domestic or imported. Thus it attempts to find only the essential imports assuming that imports and domestic output of all sectors are substitutable. This is a slightly strong assumption, but it can nevertheless give us an idea of the cut off point for imports. For a country like India, such an assumption would mean that we are overlooking qualitative differences in the two - domestic and imported.

Exports also emerge slightly differently in this approach. Normally exports are mainly made dependent on relative prices and World Demand. The question of adequate domestic supply though not totally overlooked is modeled through proxy variables, or other demands on the output are not given due consideration. Mathur's approach thus seems to be giving emphasis to the not much studied variables in the exports and imports equations.

Requirement of capital goods, can be met either by domestic production or imports or by domestic savings or financial inflows from abroad. Though financial flows are an important source of funds for investment and growth, an I-O model focuses on the flow of goods and services. So in this work it is intended to focus on the capital goods required for growth and the impact of this requirement on total and sectoral imports exports.

### **3.7 LIMITATIONS OF THIS APPROACH**

This is not to say that Mathur's approach gives a complete picture of the trade sector. It can be argued that potential exports and essential imports are all right but one should be able to actually export these potential exports. This is true; but there is no claim that his model can tell us more. Potential exports will help guide the policy maker to select commodities according to their relative importance for export subsidies, export promotional measures and identifying the essential imports sectors and the rate of growth would help policy maker to apply price adjustment mechanism selectively to control BOT deficit without having an adverse impact on essential imports.

### **3.8 THE DATA REQUIREMENTS**

The Dynamic I-O model requires the "A" matrix, the "B" matrix, the consumption vector, the investment vector, the export vector, the import vector, the target growth rate and the gross output. The "A" matrix is available at fairly regular intervals of time, published by the CSO or the Planning Commission. The final demand vectors are available for benchmark years from the same source, for the other years they can be estimated using NAS data. The main problem is the availability of the "B" matrix.

This is not brought out by any official agency. The estimates made by the individual authors like Saluja, Mathur et al, Koti, Hashim and Dadi etc are dated. Hence this study attempts to build a capital coefficient matrix . In the next two chapters, we discuss the methodology and the empirical estimation of the Capital Coefficient Matrix for India, for the nineties.

## CHAPTER FOUR

### THEORETICAL ISSUES IN ESTIMATING THE CAPITAL COEFFICIENT MATRIX

#### 4.1 THE CONCEPT

As in the case of an input - output transaction table, where the current production requirements of various sectors are tabled, a capital stock matrix shows the capital requirements for the production processes. The capital stock in tabular form would look like this:

USING SECTORS ⇒ SUPPLYING SECTORS ↓	1	2	3	....	n
1	$S_{11}$	$S_{12}$	$S_{13}$	....	$S_{1n}$
2	$S_{21}$	$S_{22}$	$S_{23}$	....	$S_{2n}$
3	$S_{31}$	$S_{32}$	$S_{33}$	....	$S_{3n}$
..					
n	$S_{n1}$	$S_{n2}$	$S_{n3}$	....	$S_{nn}$

Here  $S_{11}$  will show the capital stock of variety '1' held by the 1<sup>th</sup> industry. For e. g., if sector 3 refers to electric machinery, and sector 2 to Mining Industry, element  $S_{32}$  will show the stock of electrical machinery held as part of capital stock by the Mining Industry. Thus each column will show the capital asset structure of that sector. For e.g., column 2 will show the value of different types of capital goods held by the Mining Industry.

Each row in turn will show the amount of output of that sector given for capital use to the various using sectors. The third row will show how the output of electrical machinery used for investment/asset purposes as distributed among the various sectors of economy.

A Capital Stock Matrix by its nature will have zeros in many of its places. This is because only few goods qualify as capital assets. So, only rows relating to these goods will have entries against them. For e.g. if we consider an economy divided into thirty sectors / industries, of these only 4 to 5 may be capital goods producing like 'Construction', 'Tools and fixed assets', 'Plant and Machinery', 'Transport Equipment' and 'Other Fixed Assets'. So only the rows relating to these will have entries.

However, looking at the columns, all the sectors in the economy, having a production base will have some capital assets or the other. So, all the columns will make demands on the output of these 4 to 5 capital goods providing sectors. Thus, for a 30 sector division, the Capital Stock Matrix may be of the order of only 4 by 30 or 5 by 30.

The Capital Stock Matrix as described above showed only the Fixed Capital invested in the production activity. Inclusion of working capital will only give the Capital Stock Matrix a more comprehensive character. Working Capital is nothing but Inventories held by business as part of stock

#### **4.1.1 REPLACEMENT INVESTMENT AND NEW INVESTMENT**

Investment requirement is of two types - replacement and new. According to the Series F publication of the UN on "Studies in Methods - Input-Output Tables and Analysis", "These two categories of investment can usefully be termed extension and replacement demand." (UN 1973, p.28). Commenting on the dynamic input-output model Bulmer-Thomas writes, "This technique requires the construction of a capital matrix (B) whose  $ij$ th element shows the requirements of the  $i$ th capital good per unit output. Only new (net fixed capital formation) investment is made endogenous by the adoption of this technique so that replacement expenditures and inventory changes still have to be specified exogenously". (Bulmer-Thomas, V 1982, p.222). However we can endogenise replacement investment too by including this in the B matrix or by estimating two B matrices, one showing the new fixed capital requirement and the other showing the replacement capital requirements. The Capital Coefficient Matrix

will therefore have two parts - One showing change in capital stock needed for replacement, the other showing capital stock for extending purposes. Such a sub-division of matrices into replacement investment and extension investment has been done in the Cambridge Growth Model.<sup>1</sup>

#### 4.1.2 THE CAPITAL COEFFICIENT MATRIX

Now, just as the Input Coefficient Matrix is derived from the Input-Output Transaction Table, a Capital Coefficient Matrix can be derived from the Capital Stock Matrix. The Capital Coefficient Matrix, normally labeled "B" in literature would appear as follows

$$B = \begin{bmatrix} b_{11} & b_{12} & \dots & b_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ \vdots & \vdots & \ddots & \vdots \end{bmatrix}$$

$$b_{11} = \frac{S_{11}}{S_1} \quad \text{or generalising}$$

$$b_{ij} = \frac{S_{ij}}{S_j}$$

A typical column of the Capital Coefficient Matrix will show the proportion of various capital goods required to produce '1' unit of a good of that sector. For e.g. if the first sector is agriculture, the first column will show that proportions of different capital goods required by agriculture to produce one unit of agriculture good.

Thus  $\sum_{j=1,n} b_{ij} = \text{Total Capital-Output Ratio of the } i^{\text{th}} \text{ sector.}$

i.e. the column sum gives the (total) Capital Output Ratio of the sector.

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<sup>1</sup> See Green, M.J (1975): Investment Matrices for the United Kingdom; Their Structure and Use in Forecasting in Gossling (Ed) p.20,28 . Also see Stone and Brown (1962) A Social Accounting matrix for 1960, Vol 2 in A programme for Growth.

#### 4.2 THE CAPITAL COEFFICIENT MATRIX FOR INDIA : A REVIEW

The Planning Commission and the CSO are the two agencies actively engaged in formulating the Indian Plans and generating data for them. The CSO, now regularly brings out a 'A' matrix for the Indian economy. The Planning Commission in its Technical Note accompanying the plan documents also brings out some of the matrices useful to economist and policy maker. It brings out the Import Matrix at a fair level of disaggregation. It brings out data on the tax and transport margins. In the latest note, that to the Eighth Plan, it has also given a Capital Coefficient Matrix. However, that is only on 11 sector matrix table with only 3 capital goods considered - Construction, Machinery + Transport Equipment and Inventories.

As of now, the practice of bringing out a Capital Coefficient Matrix is not yet established in India. Earlier, some scholars have individually attempted to estimate it. Eckaus and Parikh's (1968) study on the Indian economy uses a Capital Coefficient Matrix. They estimated one for the purpose of the study. They estimated the Fixed Capital Matrix for 32 sectors. They first estimated an aggregate capital-output ratio for each sector and "then (to) determine (d) the relative contribution of each of the capital supplying sectors, and finally (to) distribute (d) this over the entire gestation period" (Eckaus and Parikh 1968, p. 66). Their procedure was based on a 1964 Capital Coefficient Matrix, estimated by V. Prakash in Indian Statistical Institutes. The type of capital goods that they took into account were Urban Construction, Rural Construction, Transport Equipment and other Equipment. (Eckaus and Parikh 1968, p. 66)

In Saluja's article (Saluja 1980) on "component-wise capital-output ratio's in the indian economy", he gives a brief summary about the work done in this area. He writes "In India very little work has been done regarding compilation of sector specific capital-output ratios. Bharadwaj (1962) calculated sectoral capital-output ratios for 36 sectors. A start in this direction was made in the Gokhale Institute of Politics and Economics with a 30 sector capital-output matrix, using data from the Annual Survey Of Industries (ASI) and another matrix was prepared for the large

scale industries using balance sheet data. Both these matrices were prepared for the year 1963, using the ASI data. All these matrices related the capital and output of a single year and gave the sector wise and component wise average capital-output ratios. Some work on capital-output ratios was also done in the Indian Statistical Institute. Marginal capital-output ratios were prepared for a 30 sector model and later for a 136 sectors model. Subsequently, the authour worked out the capital-output ratios for the manufacturing industries using time series data on capital employed and output produced. Alagh and Shah (1975) worked out the relationship between machine tools employed and the addition in output produced for the machine tools using industries, for the year 1964 to 1968. The census of machine tools was used to work out the value of the machine tools employed . A capital-output matrix was also prepared by Hashim and Dadi (1974).year 1963.” (Saluja 1980, p. 101 )

Mathur estimated a B matrix for 29 sectors of the Indian economy; of these 6 were Agricultural Sectors, 18 Manufacturing Sectors and 4 Services Sectors. His matrix was slightly different than that of Eckaus-Parikh. Their matrix was “intended to be marginal rather than average” (Eckaus and Parikh 1968, p.66), whereas Mathur attempted to throw up a Capital Stock Matrix which related to data for a particular year. The year taken was 1960. It was a 29 x 29 sector matrix, based on data “thrown up by the Annual Survey of Industries 1960” ( Mathur et al 1965 a ,p. 61). Mathur considered the following types of Fixed Capital Goods :

- a) Buildings and Improvements.
- b) Transport Equipment.
- c) Machinery and Other Assets.

He took into account 3 types of inventories, namely

- i) Stock of finished goods
- ii) Stock of semi finished goods and
- iii) Stocks of material and stores.

He combined the latter 2 types of inventories and distributed them over the column of the capital table in proportion to input coefficients of corresponding industries” ( Mathur et al. 1965 a p.62). The stock of finished goods was “apportioned diagonally” .



(pp 62). Eckaus Parikh . also attempted a similar treatment of inventories, only they did not divide the inventories into stock of finished goods and others. The total inventories were distributed according to the columns of the 'A' matrix.

The main feature to be noted, from the overall methodological point of building a 'B' matrix is that Mathur's table was focused on data for 1 reference year alone i.e. 1960. He used the value of fixed capital in the year 1960, making a correction to "represent the original cost" and not the "depreciated value of the original cost" of capital (Normally, it the latter which is reported in ASI) because as he says "obviously, for a capital matrix, we require the replacement value of the capital" ( Mathur et al 1965 a p.62.)

Mathur does not make any price changes though he admits they are necessary because, "the original cost obtained thus should be adjusted for price changes between the installation year and 1960, for which the capital matrix is being constructed". He justifies ignoring this major adjustment as follows : " No correction for the price changes have been attempted. For this, apart from an index number series for various capital goods, we require temporal pattern of investment in each industry. However, it is hoped that due to the great spurt of investment in the Second Plan period in comparison with previous decades most fixed capital in 1960 would be comparatively of recent vintage and hence absence of this correction may not materially affect the results". ( Mathur et al 1965 a p.63)

For planning purposes; to plan for growth, we need to know the additional capital stock required (or in other words investment - both replacement and new). If we use the capital stock figures of one year it may be misleading. We may not require the same amount and type of investment as is seen this year.

Bulmer Thomas, while surveying the methodological issues in building a 'B' matrix, comments "the balance equation shows that the capital-output coefficients should be

of the incremental rather than average sort; since what is involved is the relationship of the increase in the capital stock of the  $i^{\text{th}}$  good held by the  $j^{\text{th}}$  sector to the increase in capacity of the  $j^{\text{th}}$  sector; if incremental coefficients are needed, the implication is that a matrix of investment flows is preferable to one of capital stocks in order to derive the capital-output ratios, since the ratio of capital stock to output will only yield average capital-output coefficients". ( Bulmer Thomas 1982, p.177).

The Eckaus Parikh Capital Coefficient Matrix is a step improvement over Mathur's as their estimate is based on COR of the sectors estimated for a period of several years; instead of C-O ratio for one year only. However, even this has a limitation. Using Capital-Output ratios will only give us average capital output ratios. For incremental ratios we need a measure which gives the change in capital stock per unit output. So what we really need for planning is an investment flow matrix. As Saluja in his review on C-O ratios says, "It is the incremental ratio that is useful for the purposes of planning. The C-O ratio is incremental when "the change in the capital stock over some interval is related to the change in output in the same or (because of a gestation lags) any other period" (Saluja 1980, p.102). The Incremental Capital-Output Ratio (ICOR) is also a concept used often in Planning exercises. It appears that using the ICOR, instead of the average COR or yearly COR would lead to a superior estimate of investment in capital goods for necessary growth of output.

The ICOR can be computed on a year to year basis. However, ICORs too can show great fluctuations from year to year. One year the value may be higher, the next it may be low. So, using yearly ICOR or a one period investment - output ratio too could be misleading. It may not be so useful for making predictions for future years based on a particular year's data.

As Bulmer Thomas points out "The purchase of capital goods as investment flow by sector  $j$ , is likely to be highly cyclical, it is therefore unwise to base the coefficient matrices on investment flow data for one year alone. With several investment flow matrices for different years, it is possible to construct "average" incremental capital-

output coefficients using regression or other types of analysis". (Bulmer-Thomas 1982 pp 177)

Thus, it appears that the ideal 'B' matrix for planning would be to build up investment-output or investment flow matrices for several years and estimate regression coefficients for each of the investment coefficients. The closest any empirical work in India to this ideal is the "Componentwise Capital Output Ratios" computed by Saluja et al in 1978 and revised in 1980. (Saluja et al 1980)

Saluja et al, could achieve this ideal only for the Manufacturing Sector. For this they took three types of capital goods - buildings, plant and machinery and tools and other fixed assets. Data on book value of (componentwise) capital stock, depreciation and output was taken from ASI, for a period of nine years (1959-1968) for 200 industries. "In the ASI the componentwise net book value of capital stock at the end of each year is available along with total depreciation provision made during the year" (Saluja et al 1980 p.104). It is an intricate task which they have done for a period of nine years on the componentwise capital assets employed by 200 manufacturing industries. As Bulmer Thomas points out, "Investment flow matrices are difficult enough to produce for one year ..... let alone for a series of year." (Bulmer-Thomas 1982 pp 177)

Investment flow matrices are difficult to construct for a series of years. This is because data is not available at such frequency. Total capital stock data or total investment data is easily available for every year for Manufacturing Industries (in Annual Survey of Industries); For Agricultural Sector and Services (in National Accounts Statistics). However, componentwise capital data or componentwise investment data is not available in a time series. Componentwise investment data (i.e. investment in form of buildings, plant and machinery, tool and other fixed assets) are available only at points of time. For e.g. this kind of data for the Indian Manufacturing Sector is available only once in five years (from the detailed 15 volume ASI Report). For unregistered Manufacturing Sector too it is now available every five years. For

other sectors like agriculture, services, there is no standard source of data relating to break up of capital or investment flows. Various agencies/Ministries report this data.

#### 4.3 METHODOLOGY OF ESTIMATING "B" MATRIX

Looking at this data limitation and the objective of building a B Matrix complete and compatible with the available 'A' matrix for computations, it has been decided to construct the 'B' matrix in the following way.

As is ideally necessary, the 'B' matrix will be based on "average incremental capital-output coefficients using regression" (Bulmer Thomas (1978), pp 177). So the matrix will not be computed on the basis of the investment flow data for only one year. The investment coefficients will be based on several years investment and output data to remove the cyclical fluctuations if any.

The limitation will be that total investment rather than component-wise investment will be considered. This implies that average incremental capital output ratios for every sector will be constructed. This would mean total investment required for producing an additional unit of output. The component wise break up will be done later. The average ICOR itself will be broken up into its components using appropriate proportions.

Instead of breaking up total investment data into component wise investment, the method adopted will be to break up the ICOR into its component and distribute it over the column of the Incremental Capital Coefficient Matrix or the Investment Matrix.

##### 4.3.1 THE FIXED CAPITAL COEFFICIENT MATRIX

In this section we will address the main issues involved in construction of Fixed Capital Coefficient Matrix. Having decided that we want to build a matrix based on

incremental rather than average relationships let us further examine the issues involved.

#### 4.3.2 THE CAPITAL ASSET STRUCTURE

The capital structure of any sector is governed by or is dependent upon two parameters:

- 1) The Intensity of its Capital Use
- 2) The Composition of Capital Stock

Thus, each sector will make unique demands upon the capital goods industry of the economy based on these two factors in its production process. The first implies the C-O Ratio or the ICOR i.e. the amount of capital required per unit of output. The second shows the structure and composition of this capital. For e.g. heavy industries may invest a higher proportion of their capital/investment in plant and machinery. Some service industry may invest to a higher proportion in construction.

Thus, in mapping the 'B' matrix, we need to estimate two parameters :

1. The total ICOR<sub>i</sub> of the i<sup>th</sup> sector.
2. The componentwise break up of capital use of the i<sup>th</sup> sector.

These two parameters have to be estimated for each sector of the economy in order to build a capital coefficient matrix. We want to estimate a fixed Capital Coefficient Matrix based on average value of ICOR, the Incremental Capital-Output Ratio i<sub>i</sub>

Now supposing B<sub>1</sub> as shown below is the matrix of the order n,m in question.

$$B_1 = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

$$\sum_{i=1}^n b_{ij} = b_1 \quad b_2 \quad \dots \quad b_n$$

$$\sum_{j=1}^m b_{ij} = b_1, b_2, \dots, b_n = ICOR_1, ICOR_2, \dots, ICOR_n$$

Now  $b_1, b_2 \dots b_j$  are nothing but the column sums or sectoral ICORs.

The method adopted to build the  $B_1$  matrix will be as follows.

1. First, we estimate the  $b_j$  i.e. the sectoral ICORs. Therefore we have the column sums of the fixed capital coefficient matrix.
2. The second step is to distribute these column sums (or ICORs) over the column based on data for componentwise distribution of capital assets. This data on break up of total capital stock into type of capital assets will be collected separately for every sector. Based on this proportion of breakup of capital stock into assets, the ICOR or  $b_1, b_2 \dots b_j$  will be broken up and distributed over the columns of the  $b$  matrix as  $b_{ij}$ s.

In the following section we discuss, the methodology to estimate sectoral ICORs. The method used to obtain the assetwise break up of total fixed capital in the different sectors will be reviewed in the next section.

#### 4.4 INCREMENTAL CAPITAL OUTPUT RATIOS (ICOR's)

Having seen how the capital coefficient matrix is built given the sectoral ICOR estimates, we now look at the methodology used to estimate ICORs in detail. The ICORs have to be estimated keeping in view the purpose that they will be put to, namely to throw up the  $B$  matrix.

The Capital Output Ratio (COR) has been a dominant concept in growth theory. According to Chitale, "The concept of CORs has been a dominant one in the growth theory and developmental plans. Statistically it has been observed that output has grown roughly in proportion to capital in advanced countries; over decades. This.... by itself does not establish a possible explanation of the casual relationship between capital growth and income growth. However, the concept of a constant COR has evolved and it is used in developmental planning. The output is thus made a function

of one factor i.e. capital, and all other conditions are supposed to be fully adaptable through the investment process." ( Chitale 1979,p.1)

According to Saluja, "Capital-Output ratios play an important role in dynamic growth and planning models. In the Harrod-Domar model, a constant incremental capital-output ratio at the aggregate level is assumed to link investment and income growth. In the dynamic Leontief model as also in multisectoral planning models, sector specific incremental capital output ratios are used to relate sectoral investment required for attaining the desired capacity expansion in various sectors" (Saluja 1980,p.101).

The difference between the COR and ICOR is that of between average and incremental. ICOR refers to the addition of stock of capital required to bring about additional output. "Since no effort is made to hold the other factors of production constant during the increase in investment, the output measured is not a return on capital but is the addition to output from all factors of production which are used with a view to investment. The ratio is definitely not a measure of marginal productivity of capital. . ." (Chitale 1979,p.2). According to Chitale "Average COR has limited applications in plan models whilst ICOR is employed to provide a rough measure of investment requirement of a proposed development programme" (Chitale 1979,p.4).

#### **4.4.1 DEFINITIONS OF COR AND ICOR**

The COR for a sector may be defined as the ratio between total capital employed in the sector and the output that is made possible by the capital (along with other factors). Capital may be total or fixed capital. Output may correspondingly be either value of gross output or value added". (Saluja 1979,p. 102)

The ICOR is defined as the ratio of the change in capital stock over some interval to the change in output in the same or (because of lags) any other relevant period.

Therefore ICOR<sub>i</sub> =  $\frac{\text{Change in Capital stock of the } i^{\text{th}} \text{ Sector}}{\text{Change in Output/Value Added in the } i^{\text{th}} \text{ Sector}}$

An ICOR can be for one year or for several years. According to Chitale, "An ICOR derived from a short period in the past is not really what is wanted as a basis for projecting capital requirements. The measurement of ICOR shall be attempted only if data are available for a long period. If the period covered by data is less than two or three decades, efforts should be made to make sure that the period is in some sense normal". (Chitale 1979,p.5)

#### 4.4.2 TIME PERIOD

Chitale advocates estimating ICORs based on long time series of data. This is because year to year the ICOR may show fluctuations. Chitale in his study finds that "a definite trend (however), emerges by taking a five year moving average of these ratios". (Chitale 1979,p.5). Using this trend, if such a trend exists, and ICORs for a recent period, the relevant ICOR for estimating the capital needs can possibly be derived.

The present study has used ICORs based on a data set of 12-13 years, to make predictions. The data period is from 1980-81 to 1994-95. The decade of the eighties marks the beginning of a new trade policy which may have affected capital use/capital intensity of the production process in almost all sectors. With trade becoming more liberal, easier imports of capital goods may have made it possible for industries to use more of high technology goods. In Venkataramaiah et al's study, in the data covered for the period 1972-73 to 1982-83, they find a structural shift within this 10 year period. "A preliminary perusal of the scatter of the capital and value added time series figures in 1982-83 prices for several 2 digit industry groups shows that observations from 1973-74 to 1978-79 appear to lie on one line while the succeeding observations from 1980-81 to 1982-83 seem to be on a different line with the 1979-80 observation falling in between". (Venkataramaiah et al, p8). So, the investment pattern may have changed around the beginning of the eighties.



It would not be correct to base the study on ICORs computed from say 1965 to 1995 or 1960 to 1995 or even 1970-1995. This is because the purpose of estimating ICORs is not to see how the capital intensity or capital productivity has changed over time. The aim is to estimate as correctly as possible the ICORs prevalent in all the sectors in the recent past so that predictions about investment patterns can be made. Thus, a cohesive time period is needed and the 1980-81 to 1994-95 span serves our purpose.

Before going on to report about the data used and the results etc. some other issues connected with estimating ICORs will now be discussed.

#### 4.4.3 VALUE OF OUTPUT / VALUE ADDED :

One of the questions while computing CORs or ICORs that arises is whether value of output or value added data is to be used in the denominator. According to Chitale, "For the output figure in the denominator value added concept of output is considered preferable to sales value since the latter obviously varies widely with a stage of productive process in which the particular industry is placed. Since value added is an income concept it is also more valuable figure of national economic planning". (Chitale 1979,p 2)

According to Saluja "when one relates capital to value added (gross or net), the ratio is useful in knowing the contribution of capital to national income. But if the interest is to find out the investment required to achieve particular plan targets the capital output ratio with gross output is what is relevant." (Saluja et al 1980,p. 102 )

In Venkatramaiah et al's note on "Evaluation of Capital Output Ratios for the Registered Manufacturing Branch of the Indian economy " in which they have estimated capital-value added ratios as well as capital output ratios for the manufacturing sector of the Indian economy, they find that, "while the regression fit for Capital-Output Ratios is quite good ( $R^2$  over 90%) except in a few cases, the same fit for capital value added ratios is relatively poor in a number of sectors ( $R^2$  less than

50%) ..... Thus, our estimates of capital value added ratios are feeble and infirm". ( Venkatramaiah et al). This they attribute to the deflators used to deflate the value added series to constant prices.

In general, in literature it is admitted that notionally the capital to value added ratio should be studied, as value added is more near to an income concept than is value of output. However, as Saluja has remarked in his study as quoted above, the objective of estimating the ICOR or COR should be kept in mind before deciding which series to be used as denominator.

In the present case the decision is simple. Since the aim is to find out the investment required for a particular target growth rate, what the present study needs is to estimate capital output rather than capital value added ratio. Another reason why capital output ratios are required is that we are studying the problem in the input-output framework, hence we need coefficients (ICORs) which are compatible with the other parameters that will be used, namely the 'A' matrix. The 'A' matrix shows input coefficients which are per unit of output. Hence, we need capital coefficients which too are per unit of output. All the ICORs estimated in this study are therefore capital output ratios.

#### 4.4.4 GROSS OR NET

Another question relating to estimation of ICORs is that of using the gross or net value of capital stock i.e. gross or net of depreciation. These questions arise because of the basic characteristic of a capital asset. All the difficulties in the measurement of capital arise because as Chitale explains

- a) capital lasts but does not last for ever.
- b) it takes time to construct
- c) its quality changes as improvements are incorporated.
- d) replenishment and improvement are not distinct acts.
- e) it is utilised to varying degrees at different times ( Chitale 1979,p.4 )

Leaving aside quality changes, the distinction between replacement and new investment aside, and the fact that it may be used to varying degrees at different times, we focus on the basic nature of capital asset which has a long lasting life, but does not last for ever i.e. it depreciates. While computing ICORs what we are trying to estimate the value of capital used or added to the business in a particular year and how much of output it generated.

To estimate the value of the capital asset in the given year, we need to know not only its value at the time of installation but also, its value at current prices, less its depreciation. Depreciation of a machine or a capital asset is difficult to estimate. Moreover, accounting methods are such that the book value of depreciation does not always reflect the actual depreciation of the asset. Thus, while computing value of the capital asset, the choice has to be made whether to value the asset gross or net of depreciation.

If we use the gross value of capital asset, it implies that we assume that asset to function at a fixed level of efficiency till it is finally discarded. As Chitale states ".....the equipment continues to be used at the same degree of utilisation and roughly the same efficiency until it is physically discarded. This means that the life of plant and machinery is often stretched beyond its economic life. This, assumption is probably more valid in developing countries than the one behind the concept of net capital value which writes off capital consumption on technical considerations, accounting practices or tax statutes". ( Chitale 1979, p 2). According to Chitale, for a developing country like India, it would be mapping reality more closely if we use "gross value of capital".

Saluja too recommends using gross value because of the non-reliability of the data on book value of depreciation equalling the real rate of depreciation" (Saluja 1980 p. 102).

Ideally, to estimate the actual ICOR, we need to use the "net value of capital", that is the depreciated value of the capital asset, if the depreciation could be correlated with the decline in the productivity of the capital asset. However, due to data reporting techniques, accounting practices, it is difficult for a researcher to find out the real or actual rate of depreciation of capital assets. Also, this rate may be different for different industries, as also different for different firms of a single industry. There is no way of estimating the real rate of depreciation with even some degree of accuracy by relying on reported/secondary data.

Not much research seems to have gone into the area of how depreciation rates operate in different industries. Dholkia's study on "Behaviour of Capital Output Ratios for the Indian economy, has estimated the gross/net ratio for all 2 digit A.S.I. Industries for 3 main capital assets i.e. buildings and construction, plant and machinery and other fixed assets. "Dholkia's study provides the information that the depreciation rates for these assets in the Indian economy around the decade 1960 to 1970 are 7%, 9% and 12% of gross capital stock respectively for building and construction; plant and machinery and other fixed assets". (Venkataramaiah et al p.4).

In the present study, the following treatment is undertaken. Since the total ICOR is estimated for each sector (i.e. assetwise ICOR is not estimated), the breakup of the depreciation for different assets has not been undertaken. ICORs have been estimated for all sectors on gross basis. Gross ICORs will be used for the 'B' matrix, as the assumption about gross capital value are more in tune with a developing country like India than a net ICOR. Also, if the objective of the exercise is to plan investment for a given target rate of growth, it is better to make use of gross values of ICOR. From this we can have an idea of the average amount of gross investment necessary to achieve a given growth target.

#### 4.4.5 CURRENT AND CONSTANT PRICES

ICOR at current prices will show the ratio of capital asset to ratio of output both valued at current prices. Since it is a ratio, at current prices, it may be actually reflecting the changes in the prices of the two variables along with the changes in the

actual capital output ratio. So it is essential to remove the effect of price changes and therefore compute the ratio taking both series at constant prices.

In this study ICORs were estimated at both current and constant prices. It is to be noted that the value of the ICOR is much lower at current prices than at constant prices. The actual computations and the results are presented in the next chapter.

#### 4.4.6 TIME LAGS

The question of time lags is a tricky one and not much empirical work seems to have been done on this aspect of capital theory. In most studies on estimating ICORs or CORs, an average, across the board time lag for one year is assumed. In Chitale's study, he does away with time lags, "on account of inadequate information on the time phasing of projects and the unstability of the observed time phasing", although he recognises that lags must be taken into consideration. (Chitale 1979, p. 11). In Venkataramaih et al, they have done away with time lag.<sup>2</sup>

Neelam Malhotra in her M.Phil thesis on Capital-Output Ratios, comments on the Planning Commission's and other available studies estimating ICORs as, "The factor causing some reserve in the acceptance of the above results is the absence of time lags. Earlier studies also, either assumed away the time lag or considered a constant time lag for all sectors, but then emphasis was on ACORs, where new capital and the time lag involved in generation of output by it is a small part of the entire capital stock and the resultant output. Thus, these results are not largely influenced by the omission. In case of ICORs, which are considering only investment and change in output caused by the investment, the role of time lag takes a greater place of importance" (Neelam Malhotra 1992, p.60-61 ).

Having noted that lags are important in determining the capital-output relationship, we see that there is little empirical work on the actual lags operating in the economy

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<sup>2</sup> This is seen from the specification of their model  $C_t = A + Bv_t$ .

or in every sector. As Panchmukhi says "In a highly diversified continental economy like India, lags between investment and output could vary in a considerable manner from one sector to the other. Even within a sector lags could be different for different types of investment". ( Panchmukhi 1986, p 33).

Different sectors may have different lag structures. The same sector may exhibit a different lag structure for the registered (factory sector) and unregistered units. Ideally what needs to be done is that the series of change in output and change in capital stock should be examined for each sector. A line graph of both together should be taken for the time period. If the graph shows that the output changes follow a similar pattern to capital stock changes after a year, then a one year lag would be appropriate. If similar changes are occurring simultaneously, then no lag is required, and if no similarity is seen, then too, assumption of no lag can be made.

Actually doing this for the present exercise would mean graphing the above two series for some 45 sectors. The working out of lags structures for different sectors is therefore not attempted here. While estimating ICORs by the regression method, lags were assumed away. Since basic data are 12-13 observations, taking lags would truncate the series.<sup>3</sup>

Lags were tried in the regression model for one sector (agriculture). It was seen that results did not change much. Of course this does not mean that all sectors have uniform no lag structure. But a lot of research needs to be done on it before anything can be said.

#### 4.5 METHODS OF ESTIMATING ICORs

Various authors have estimated ICORs for the Indian economy at different levels of aggregation. V.K.R.V. Rao, Uma Datt Roy Choudhary, Hashim and Dadi, Saluja,

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<sup>3</sup> It is to be noted that an average of the ICORs by Conventional Method (and a one year lag) was very near to those estimated by regression (without a lag).

Broadly, there are two major types of methods used by various authors to estimate ICORs. These have no standard nomenclature in literature, but in Chitale's study he refers to one as the *Conventional Method* and the second as the *Regression Method*. (Chitale 1979, p.13-16 ). The first is where the ICOR is defined as the ratio of the change in value of capital stock to the change in value of output. The other is where a time series of value of capital stock is regressed over a corresponding time series of output/value added.

The Conventional Method :

without lags ICOR a = 
$$\frac{C_t - C_{t-1}}{O_t - O_{t-1}}$$

with lags ICOR b = 
$$\frac{C_t - C_{t-1}}{O_{t+1} - O_t}$$

where C = capital stock, O = Output and t = time period

ICOR b says that the change in capital stock in the 1st year results in an increase in output of in the next year. Chitale has used this method to compute ICORs for the Indian economy as also for some sectors of the Indian economy. The advantage in this method is that yearly values of ICORs can be computed. Though the conventional method gives us yearly values of ICOR and therefore we can see whether the ICOR is rising or falling or remaining stable, there is a limitation to using this method. If ICORs are computed by this method, we will get ICORs values for 10 to 11 years in a row from 1981-82 to 1991-92. Now based on this we can build a 'B' matrix for any of the years. If we want to build it for a recent year, we go in for 1991-92.

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<sup>4</sup> Neelam Malhotra's (1992) M.Phil Thesis gives a critical and comprehensive analysis of some of these studies.

A 'B' matrix based on ICORs of one year, however, will be misleading. Yearly values of ICORs are highly unstable. This is borne out by Chitale's study (Chitale, V.P. 1986).

There are two ways to overcome this : One is to use the regression method as is done by Saluja, Venkataramaiah, Argade et al etc. where the output series is regressed on capital stock series. The coefficient of the X variable will give the unit change in capital stock required for a unit change in output. Of course, the relationship between capital stock and output could either be linear or non-linear, depending on the data for each sector. However, since this study is in effect considering a total of 45 sectors ( 4 primary, 30 registered manufacturing, and 11 services), we do not go into the issue of the nature of this relationship for every sector. We assume a linear relationship and a linear relationship means a stable/single coefficient over the time period. We can get a single coefficient which tells us the average rate of change of the incremental capital - output ratio.

This method has been used by Saluja, Venkataramaiah et al, Hashim and Dadi and Dholkia. The results are fairly satisfactory. This method as the student has seen gives fair results with a good fit for almost all sectors.

The second method to average out the yearly fluctuations in the ICORs computed by the conventional method is by either take moving averages or to take the change of output and capital stock between the two - beginning and terminal - years of the series. This definition of average ICOR has been used by Chitale or as he calls it in his "Conventional Method". The exercise undertaken by the student shows that the ICOR calculated by regression method and by conventional method are very close in value. This is seen for almost all sector. The moving averages can also be computed. As Chitale says using a 5 year moving average gives a trend. This is vindicated in this study too. Here, we get a series of ICOR value for the period under consideration. Here we can see the trend, but we cannot capture it in one figure. So though these (Moving Average) would be an interesting study into the changing values of ICORs, it would not suit the purpose here; which is of estimating on an average the value of



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the ICOR for the  $i^{\text{th}}$  sector. Considering all the above points the regression method seems best suited to calculate the ICORs for this study.

#### 4.6 MODELS USED FOR ESTIMATING ICORS IN LITERATURE:

ICORs have been estimated earlier using the regression method. This is in Saluja, Venkataramaiah et al and Dholakia. The form of the equation specified is simple.

$$Y = a + bK$$

where Y = output

K = Capital stock

Here again the following questions can be raised : do we take the equation as :

$$Y = a + bK \quad \dots \quad (A)$$

$$\text{OR } K = a + bY \quad \dots \quad (B)$$

Using (A) implies that we are making output a function of capital used and using (B) implies that capital invested is being made a function of output.

Now (B) will give the value of ICOR directly i.e. the coefficient 'b' will give the ICOR. However, in case of using (A) 'b' will not give the value of the ICOR. 'b' here will be the output/capital ratio. So if (A) is used then  $\text{ICOR} = 1/b$ . Venkataramaiah et al. have used specification (B) of the equation, whereas Saluja has used specification (A). Since the objective was to compute the ratio and not to test the theory of whether causation ran in a particular direction this issue was not raised.

In the present study the student tried both the version for 2 sectors to see if there was any fundamental difference. Data for agriculture and other transport equipment sector was tested. This was again for current and constant prices. The results obtained as tabulated below.

**Table No. 4.1 R<sup>2</sup> and Standard Error of the Two Forms of Regression Equation**

Sector	By Method A			By Method B		
	ICOR	S.E. of 'b' coeff.	R <sup>2</sup>	ICOR	S.E. of 'b' coeff.	R <sup>2</sup>
Current Price						
Agriculture	1.77	0.01	0.99	1.76	0.04	0.99
Oth. Tran. Eqp	1.22	0.07	0.93	1.14	0.10	0.95
Constant Price						
Agriculture	2.20	0.04	0.92	2.03	0.18	0.92
Oth. Trans Eq	1.81	0.11	0.71	1.29	0.25	0.71

Note: Method A  $Y = a + bK$  Method B  $K = a + bY$

It can be noted that all ICOR values by method B are slightly lower and the Standard Error is slightly higher than by method A. It is interesting to note that the R<sup>2</sup> at two digit decimal places is the same in all 4 cases. Anyhow, since it is the ICOR that we are interested in we shall not go any further into this issue of the specification of the variables; in this study, we use the specification 'A'.

#### 4.7 THE UNREGISTERED MANUFACTURING SECTOR :

In the earlier exercises of estimating the 'B' matrix, the unregistered sector was never considered. (P.N.Mathur, Koti, Saluja, Hashim and Dadi, Venkataramaiah et al ) - only the registered manufacturing activity was considered. This was due to poor data availability with regard to the unregistered manufacturing activity. This is the first attempt at incorporating the unregistered sector.

At the beginning, let it be stated that the data analysis for the unregistered manufacturing sector is not very refined. This is because data for this is not available at the same level of disaggregation as that of the registered manufacturing . Secondly, the data is also not available at the same frequency.

However, the unregistered manufacturing sector is an integral part of the manufacturing activity; a lot of ancillary units supplying parts, components, raw materials to the organised sector are in the purview of the unorganised sector of the manufacturing sector output. The contribution of the unorganised sector was 20 % of the total manufacturing sector output in 1991-92. Therefore, it would be incorrect to leave out the unorganised sector from the analysis.

Bulmer Thomas, while discussing the *theoretical implications* of including the informal sector in the input-output tables says "In conventional input-output studies, no distinction is made between formal and informal sector activities. Yet, the technological conditions governing production in an 'informal' establishment are sufficiently different from those in a formal establishment to suggest a case for disaggregation of the two activities within the same 'sector' which differs; the output is also non-homogenous and often performs different functions. There is therefore a theoretical case as well for treating the two activities differently". (Bulmer-thomas 1982,p. 180)

In case of the Capital Output Matrix, the above fact needs even more emphasis . The capital structure of the two - formal and informal sector is different. In fact many times the definition - whether a factory comes in a formal or informal sector - is based on the value of Capital asset.

*Empirical issues* of incorporating the informal sector in the Capital Matrix have received little attention in literature. In case of the work done in India, none of the earlier attempts of estimating the Capital-Output Matrix have addressed the issue of inclusion of the informal sector. Due to limitations of data availability, this was done away with and the Capital Matrix represented only the organised sector of the manufacturing activity. In this study we make an attempt to incorporate the informal sector in the Capital-Output matrix. Though, it may not be refined or theoretically exact, it is nevertheless a first approximation.

No theoretical guidelines are specifically given on how to incorporate this sector in the capital matrix. Although there is some discussion in Bulmer Thomas, he concentrates on incorporating the informal sector in the Input-Output Table. However, the issues involved in doing the same for a Capital Coefficient Matrix may be slightly different.

For the input-output table, Bulmer Thomas recommends, estimating 'K' new rows and 'K' new columns, if 'K' is the number of the informal sectors. (Bulmer-Thomas 1982,p. 180 ).

In case of the Capital Coefficient Matrix, we are primarily estimating it by estimating its columns. We are estimating the coefficients directly rather than estimating the cell entries in terms of value/amount and then deriving the coefficients. In such a case, we need to identify 'K' new columns to show the capital structure of the 'K' informal sectors. We assume the same number of rows - those showing total (all) sectors/industries without differentiating between the source of the (capital goods) output being from the formal or the informal sector. This means we do not identify 'K' new rows for the capital matrix.

The main advantage in estimating the capital columns of the informal sector separately would be that : If we give the columns of the registered or the formal sector alone, we may be misrepresenting the demand made by the manufacturing sector for capital goods. Secondly, including these columns will show us how the capital structure differs in case of the same good, when it is produced by the formal and the informal sector.

#### **4.8 THE CAPITAL ASSET STRUCTURE**

Each sector of the economy has its own composition of capital or fixed assets, like the services sectors would by and large have a larger proportion of their fixed capital in the form of buildings whereas heavy manufacturing industries like iron and steel would have a larger proportion of it's assets in the form of plant and machinery. To

estimate the capital structure of each sector we have to explore different sources relating to different industries and use data reported therein.

#### 4.9 THE INVENTORY COEFFICIENT MATRIX :

Stocks or inventories comprise of raw materials, semi-finished goods and finished goods. All production businesses hold inventories for a fixed time period. The inventories are held in a particular proportion which is determined by the business manager according to the requirements of the particular business and which is evolved by him by trial and error method. This proportion may be peculiar to each business and may be different for the different units in each industry.

When we add inventory columns to the fixed capital stock columns, the implication is that for a typical sector - investment comprises of investment in fixed assets and in inventories. When such a "B" matrix is used to plan out the investment requirements of various sectors, for a given growth plan, the implicit assumption is that for meeting a target growth in output, businesses require not only fixed capital but also a proportionate level of inventories. When a business unit makes an investment decision which creates the demands for the goods of the other sectors of the economy, these include demand for fixed assets as well as stock of raw materials as inventories to ensure smooth and undisturbed production.

*Finished goods*, though a part of the reported value of inventories of business units, must be deducted from the value of total inventories. The "B" matrix will be used to estimate the demand being made by the business units for capital goods and accompanying raw material. However, a business unit will not make demand for its own finished product to be held as capital asset or inventory. Hence we need to adjust the inventory data to remove the value of finished goods.

A generally made assumption in literature, regarding distribution of inventories is that inventories are held in the same proportions as the inputs required for production. This

proportion is shown by the respective column of the 'A' matrix. So, the practice is to distribute the total inventories held by a sector over the column, according to the proportion shown by the corresponding column of that sector in the 'A' matrix. This method has been used by Mathur and by Eckaus and Parikh.

Bulmer Thomas has pointed out that inventories is a thorny issue which has not been resolved, so it should be left out as exogenous to be included in the final bill of goods. (Bulmer-Thomas 1982, p. 177). But leaving them as exogenous would mean avoiding the issue rather than tackling it even in an approximate way. Therefore in this study, the value of inventories less finished goods of the  $i$ th sector will be distributed over the column of that sector in the "B" matrix to get a stock coefficient matrix. Thus, the fixed capital coefficient matrix and the stock coefficient matrix will together give a fair approximation of the capital or investment needed for a unit vector of output.

Having seen the theoretical issues of estimating the  $B$  matrix, we go on to estimate the  $B$  matrix for the Indian economy in the next chapter.

### 5.1 ICOR ESTIMATION

Having decided to compute ICORs by regression, we now discuss the data used, price adjustments made. Consider the equation.

$$C_{it} = a + b O_{it}$$

where  $C$  = Capital Stock in the  $i$ th sector in the  $t$ th year.

$O_{it}$  = Output in the  $i$ th sector in the  $t$ th year.

For running this regression, we need data on two variables - namely capital stock and output for every  $i$  for the defined time period of 1980 to 1994-95. The NAS provides Net Fixed Capital Stock (NFCS) and Depreciation figures at constant and current prices for the primary and services sectors and for the aggregate registered and unregistered manufacturing sector. The Annual Survey of Industries (ASI) provides data on NFCS, Net Fixed capital Formation (NFCF) and Gross Fixed Capital Formation (GFCF) and Depreciation for the registered manufacturing sector at 3 digit level. However we need a series of Gross Fixed Capital Stock (GFCS). This can be got either by

1. Adding the depreciation figures to the available NFCS figures to get value of the gross capital stock. However, reported depreciation figures may not reflect the true depreciation of the capital assets. It is known that depreciation figures are inflated by business managers for tax accounting.

Another way of generating the Gross Capital Stock series is by

2. Generating a time series of Gross Fixed Capital Stock by the Perpetual Inventory Method (PIM). This requires the yearly investment (Gross Fixed Capital Formation (GFCF) figures to be added to the available capital stock estimate of the nearest year. Many researchers have used this method to construct a time profile of the value of capital stock estimates. Chitale has used this method in his empirical work on estimation of Capital output ratios for the Indian economy. For the basic capital stock



estimates, he uses estimates made by Pratap Narain and R.P. Katyal. (Chitale 1986,p. 13)

Earlier period estimates of capital stock were not brought out by the NAS; individual scholars have done work estimating these - Uma Datt Ray Choudhary (1977) , Narain and Katyal (1980) etc. According to Venkatramaiah et al, it is not necessary to have a base period capital stock data. If that is unavailable, the Cumulative Investment regressed on output can be used to estimate ICORs. Dholkia, in his study uses a similar method. (Dholkia 1983) . Referring to it, he says "It is widely known as the perpetual inventory method of measuring the value of capital stock. This method was pioneered by Raymond Goldsmith while deriving the time series of Capital Stock in United States". (Dholkia Bakul ,1983 p 25)

Dholkia uses a modified version of Raymond Goldsmith's method for the Indian economy. Venkatramaiah et al too use the Cumulative Investment Method. Both will be reviewed here :

### 5.1.2 Dholkia's Method

The time series of gross capital stock at constant base period prices can be derived by using the following equation :

$$GK_{i,t} = GK_{i,T} + GCF_{i,t} - AD_{i,t} \dots\dots\dots \text{Variant I}$$

1.  $GCF_{i,t}$  time series of gross capital formation at constant base period prices for the entire period under consideration
2.  $AD_{i,t}$  time series of the aggregate value of capital assets discarded in each year , valued at the given base period prices
3.  $GK_{i,T}$  Independently derived estimates of gross capital stock relating to a specified bench-mark year valued at the base year period prices.
4.  $NFCF_{i,t}$  Time Series of Net Fixed Capital Formation.
5.  $D_{i,t}$  Time Series of Depreciation

i denotes the industry or sector  
t denotes the year  
T denotes a particular bench - mark year.

In the author's words, "Thus, using the bench-mark estimates of capital stock and the time series of capital formation at constant base period prices, we can derive through the perpetual inventory method, the time series of capital stock for the entire period under consideration. To get the gross capital at bench mark year, Dholkia has used the Net Capital Stock in that year as reported by ASI and the gross net ratio for 41 industries by RBI ( Dholkia 1983,p.40)

To get value of assets discarded every year, Dholkia has used the following method : "Some information pertaining to the aggregate value of different types of fixed assets discarded by the firms belonging to the census sector of ASI is available for the years 1963 to 1971. We have worked out the ratio of assets discarded to depreciation allowance, for each type of assets, for each year on the basis of this information. By applying these ratios to the estimated breakup of depreciation allowance by type of assets, for each industry group in the corresponding years, we have obtained the required estimates of the value of assets discarded in each year; for each industry group, by type of assets" ( Dholkia 1983,p.41,42,43)

Looking at the present data availability, the Net Fixed Capital Stock is available as reported in NAS for the 14 sectors of the India economy. Gross Capital Formation series is available. The assets discarded every year would however prove to be problematic. So though Dholkia's method is appropriate , it will be difficult to get this kind of ratio for other (Primary and Tertiary)Sectors of the economy.

We consider the other specification, of Venkatramaiah et al ; We give here the specification given by them - retaining the earlier terminology :

$$GK_{i,t} = GK_{i,T} + NCF_{i,t-1} + D_{i,t-1}$$

or we can write the above as

$$GK_{i,t} = GK_{i,T} + GFCF_{i,t-1} \dots\dots\dots \text{Variant II}$$

Calling this **Variant II** , we note that it uses the annual gross additions to fixed capital to generate the capital stock series. Nowhere, depreciation or assets discarded are deducted. This is therefore based on the assumption that the gross value of capital

stock is a more correct index of capital as a factor of production and that depreciation figures given are highly inflated compared to the actual depreciation taking place.

This kind of specification is at exactly the other end of the pendulum as the one in Variant I. Though it may be reasonable to assume that depreciation figures are grossly inflated as compared to the actual depreciation, deducting no depreciation from gross investments for a time period may lead to inflating the value of the capital stock and subsequently the ICOR.

Using the Gross Fixed Capital as computed by Variant I would imply an ICOR value which shows only the new investment necessary to increase output. For planning, we need the gross measure of investment. Hence, ICORs or capital stock series based on Variant II would be preferable. We have estimated ICORs by Variant II.

## 5.2 PRICES

While generating the series on capital stock, by the Perpetual Inventory Method or the Cumulative Investment Method, the yearly capital stock figures need correction on two counts - one is prices and the second is depreciation. The latter has been discussed already.

The bench mark estimate of Capital Stock is at current prices. It has to be deflated (or inflated) to constant prices before the next years investment figure can be added.

Consider,

$K_0$  = Gross Fixed Capital Stock as on 31st March 1980

$G_i$  = Time Series of Gross Fixed Capital Formation

$P_i$  = Time Series of Price Index for Investment

$K_i$  = Time Series of Capital Stock Series generated

$$K_1 = K_0 + G_1$$

So, at the end of the first year the capital stock =  $K_1$

For the second year

$$K_2 = K_1 \left( \frac{P_2}{P_1} \right) + G_2$$

Thus, carrying  $K_1$  to period 2 without adjusting for prices is meaningless. Since,  $K_1$  is valued at 1st year's prices; for  $K_2$  to be valued at 2nd year's prices,  $K_1$  first needs to be valued at 2nd year's prices to be added to  $G_2$ .

Thus,

$$K_n = K_{n-1} \left( \frac{P_n}{P_{n-1}} \right) + G_n$$

This price adjustment is only for the Capital Stock data to be carried over to the next year and to enable addition of the next year capital formation. This does not mean that the whole capital stock is at Constant Prices. For getting it at Constant Prices, the basic variables being added, i.e.  $K_i$ ,  $K_o$ ,  $D_i$ ,  $N_i$  have to be converted to Constant Prices.

### 5.3 DATA REQUIREMENT

Data series on 3 main variables was required.

1. Gross Fixed Capital Formation
2. Value of Output
3. Gross Capital Stock in year 1980-81

### 5.4 THE SECTOR SPECIFICATION FOR ESTIMATION OF ICOR

Since the purpose of the study is to see the implications of growth on "the trade sector", the sectorisation was done accordingly. However, the ICORs estimated are for a slightly more detailed sectorization than the 'B' matrix.

While estimating ICORs, care had to be taken that the sectoral decomposition remained consistent with the traded/non-traded goods differentiation; secondly that each sector is as far as possible, cohesive from the capital structure point of view, and thirdly that it had to be compatible with the 'A' matrix.

Sometimes the 2 digit ASI classified data had to be broken up for e.g. in case of Sector 28 which is "Paper and Paper Products and Printing and Publishing". The two activities of Paper and Paper Products and Printing and Publishing are different. So, they have been treated as separate sectors.

For estimating ICORs we have therefore considered 4 primary sectors, 11 services sectors, 30 registered manufacturing and 19 unregistered manufacturing. The sectors and their matching with the classification code of their source is tabled in Table No. A5.1 (a) for Primary and Services sectors; A5.1(b) for registered manufacturing and A5.1 (c) for unregistered manufacturing.

## **5.5 DATA SOURCES FOR ESTIMATING ICORs FOR VARIOUS SECTORS**

### **5.5.1 AGRICULTURE**

The whole of the agriculture sector is treated as one column for the 'B' matrix - therefore a single capital structure for the whole agriculture sector inclusive of animal husbandry has been computed. This is done based on data given in the NAS.

Ideally, the different crops (food, cash and plantation) ought to have been treated separately as they may have quite different capital-output ratios and structure. It would be indeed interesting to see this and make a comparative study of the three food crops, cash crops and plantation crops. However, time limitations and data non availability do not permit this in the present study. The NAS data on Capital Formation is not given cropwise; although output data is given cropwise. So, the ICOR is estimated for the agriculture sector as one.

**5.5.2 OTHER PRIMARY SECTORS** - namely forestry and logging, fishing and mining and quarrying are treated separately. Data on Gross Fixed Capital Formation, and Value of Output at current and constant prices is taken from NAS, various issues. Data on capital stock for the bench mark year 1980 is available from NAS, 1990.

### **5.5.3 TERTIARY - SERVICES SECTORS**

Data was collected for 11 services sector. The data was taken from NAS, various issues. The data on services sector is available in NAS is at 12 sector disaggregation, as shown in the accompanying table. However, the shown aggregation was done to match the sectors in the Input-Output 60 sector table of 1983-84 and 1991-92.

Data on GFCF at current and constant (1980-81 = 100) prices, value of output at constant and current Prices, was taken from Statement 20 of NAS. Capital Stock data was also taken from NAS 1990 for the Primary and Services Sector.

#### **5.5.4 MANUFACTURING SECTOR**

This aggregate sector has got the most detailed treatment because of data availability. The manufacturing sector comprises of the registered and unregistered. In this section we discuss the registered manufacturing sector.

Data on the variables of Capital Stock (1980), GFCF and value of output is available in Table 6 of ASI - Summary Report of the Factory Sector, annually.

In the annual ASI reports, data is available at 3 digit level of classification. The three digit level data is brought down to thirty sectors. Since the sectorisation undertaken in this study is to enable a matching with the Input-Output classification, some of the manufacturing sectors are at the three digit level of classification and some at two. The matching is shown in the Table No. A5.1 (b)

Data on GFCF and value of output was collected from 1980-81 to 1994-95. This was at current prices. The data on Gross Capital Stock for 1980 was taken from ASI, 1980-81. Data for the unregistered manufacturing sector was taken from the NSSO Report (1995).

#### **5.6 PRICE INDICES**

Since ICORs have to be computed at both Current and Constant Prices, the relevant Price Indices were needed. We discuss below the method used to deflate the GFCF series and value of output series for the primary and services sectors and the registered manufacturing sectors.

##### **5.6.1 BASE YEAR**

First of all, let it be stated that the base year chosen was 1991-92. It was felt that a base year nearest to the latter half of the time series and the current period would be more meaningful.

##### **5.6.2 INFLATING THE VALUE OF OUTPUT TO 1991-92 PRICES**

In the study, we have output series from 1980-81 to 1993-94 for 4 primary, 30 registered manufacturing, and 11 services sectors. These series has to be brought to constant prices of 1991-92. For the *primary and services sectors*, data was available

at current and constant prices; constant prices were based on 1980-81=100. From these two series, the implicit price index for output and the implicit price index for GFCF was derived. The base was changed to 1991-92 and using this derived index, the series of value of output and of GFCF was inflated. These derived price indices at 1991-92 base for the primary and the services sectors for the Value of Output are shown in **Table No. A5.2 (a)**.

For the *manufacturing sector* -the of data for Price Indices of manufacturing industries has been taken from the RBI Report on Currency and Finance<sup>1</sup> - The Wholesale Price Index Commodity wise annual average<sup>2</sup> - is used. This is given in Volume II, Statistical Statements of the various issues of the RBI's Report on Currency and Finance. This Wholesale Price Index is given by major groups, groups, sub-groups and commodities. This classification is matched to the classification used in this study. The matching is shown in **Table No. A5.3 (a)**.

The WPI is at the base period of 1981-82 = 100. The price index for the year 1980-81 is available at another base period = 1971-72. This means that first and foremost, we have to estimate / compute the price index for 1980-81 at the base of 1981-82 (= 100). This has been done in the following manner. Along with the annual average WPI, the same statement also gives the annual average percentage increase in the index. This data has been used to extrapolate the series to cover the data for the one year at the new base period prices.

In this manner, the WPI for the one year of 1980-81 is worked out for all the manufacturing sectors. Thus, we now have a complete series of WPI from 1980-81 to 1994-95 (base 1981-82) for all manufacturing sectors. From this series, we estimate the WPI with base 1991-92, by simply changing the base period. This final Price

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<sup>1</sup> The Original Source for the wholesale price Indices is the Office of the economic Advisor, Ministry of Industry, Government of India. However we have used the WPI as given in the RBI Currency and Finance Reports as could be easily matched with the sector scheme adopted in our study.

<sup>2</sup> The Annual Index is an average of Monthly indices.

Index at 1991-92 base is used to update the value of output series of the registered manufacturing sectors. This Price Index is shown in Table No. A5.3 (b)

### 5.6.3 INFLATING THE GROSS CAPITAL STOCK SERIES TO 1991-92 PRICES

Inflating the value of output series to the prices of 1991-92 was relatively easier as the Price Indices are readily available. However, to inflate the data series of capital stock is relatively difficult as no readily usable Price Index was available.

For the *Primary and Services Sectors*, this problem did not arise as the data on Gross Fixed Capital Formation (GFCF) is reported at both Current and Constant Prices, in National Account Statistics (NAS). The only thing required was to change the base of the index from 1980-81 to 1991-92. This Price Index to be used to inflate the Capital Stock Series of the primary and Services sectors, derived from the data given in the NAS is shown here in Table No. A5.2 (b)

In case of the *Registered Manufacturing Sectors*, there is no ready price index available to inflate capital stock series or even capital formation. Also, investment in different sector varies in its composition of asset. So for every sector the investment price index has to be unique.

An investment index was computed for every manufacturing sector. Though each sector must be having a composition of various different assets in its investment, three main types of assets were considered, namely.

- |    |                     |       |
|----|---------------------|-------|
| 1) | Construction        | $P_1$ |
| 2) | Machinery and Plant | $P_2$ |
| 3) | Transport Equipment | $P_3$ |

Now every year the prices of these three assets will be changing. Depending on the ratio in which each sector demands these three goods, they will be faced with a price rise (or fall) depending on the weightage of each of these goods in their total investment and the prices of these three.



So, the asset composition of every sector's capital formation was used as weights to compute a composite weighted investment price index for each sector. An example is given for illustration. Suppose, we consider Leather manufacturing; we are given that for this industry the asset composition as proportion of its total assets was as follows

Construction	=	$W_1$	=	0.228
Plant and Machinery	=	$W_2$	=	0.709
Transport Equipment	=	$W_3$	=	0.062
		$W_1 + W_2 + W_3$	=	0.999

Suppose the Price Indices for these goods are given as for say 1980-81 at base 1991-92

Construction	=	28.588	=	$P_1$
Plant and Machinery	=	42.918	=	$P_2$
Transport Equipment	=	43.586	=	$P_3$

Then the composite index for investment for the Leather Manufacturing Sector for 1980-81 will be

$$= 28.588 (0.228) + 42.918 (0.709) + 43.586 (0.062)$$

or  $P(W_1) + P(W_2) + P(W_3)$

$$= 41.509258$$

In this manner a whole series of weighted investment Index was estimated for all the registered manufacturing sectors from 1980-81 to 1994-95. These Price Indices were used to inflate the capital stock series of the various registered manufacturing sectors.

Let us state how the data for the above estimation has been collected. The NAS, gives price index of construction and machinery and equipment in Statement 3 : Price and Quantum indices. The current series of Price Indices is at base 1980-81. The Price Index for Construction and Machinery and Equipment are taken from here. The base is converted to 1991-92. The indices are taken from NAS, 1991 and 1995. The Price Index for Transport Equipment is taken from RBI Report on Currency and Finance. This index is given at base 1981-82 = 100. The index for 1980-81 is available at a

different base that of 1971-72. So, the percentage increase in price index of Transport Equipment from 1980-81 to 1981-82 has been used to extend the Price Index series (base 1981-82), to one year earlier. Then the whole series from 1980-81 to 1994-95 is converted to the new base of 1991-92. The weights are taken as follows :

### **Registered Manufacturing Sectors**

The ASI Detailed Report of the Factory Sector 1983-84, in 15 volumes, gives the assetwise composition of Gross Fixed Capital Formation at four digit level of classification. This is given for 5 different types of capital goods excluding land; they are

- |                                 |                              |
|---------------------------------|------------------------------|
| 1) Improvement to Land          | 2) Building and Construction |
| 3) Plant and Machinery          | 4) Transport Equipment       |
| 5) Tools and other Fixed Assets |                              |

These five have been brought down to three and the four digit level figures have been aggregated according to the sectorization scheme adopted in our study. Thus, the 3 categories are

- 1) Construction - including (1) and (2)
- 2) Plant and Machinery - including (3) + (4)
- 3) Transport Equipment - (5)

The Price indices of the three capital goods considered above are shown in **Table No. A5.4 (a)**. The break up of capital assets by type of capital goods used as weights is shown in **Table No. A5.7 (a)** The estimated Investment Price Index for Registered Manufacturing Sector from 1980-81 to 1993-94 is shown in **Table No. A5.4 (b)**. These are used to inflate the data on GFCF and depreciation to constant prices of 1991-92.

## **5.7 DATA ON CAPITAL STOCK FOR BENCHMARK YEAR :**

### **5.7.1 FOR PRIMARY & SECONDARY SECTOR**

Data on Net Fixed Capital Stock as on 31st March 1981; at 1980-81 prices was taken from statement 22 from NAS, 1990. Malhotra, referring to Venkatramaiah et al's computation, "For the first year of the time span i.e. 1973-74, the gross fixed capital is obtained as the book value plus depreciation in 1973-74. ( Malhotra, N 1990, p. 89).

Ideally the NCS should be adjusted to GCS and prices. The price adjustment has been made using the Investment Price Index derived earlier for each sector. However, the depreciation adjustment is not made. So the benchmark capital stock estimate that we use is actually a Net Value of Capital Stock. This will not affect the results as noted by Saluja, ( Saluja et al,1980) since it will go in the intercept i.e. the regression coefficient and therefore the ICOR will be unaffected by this.

### **5.7.2 REGISTERED MANUFACTURING**

For this, data on Fixed Capital Stock as on 31st March 1980 was taken from ASI, Summary Reports of Factory Sector. This figure too is the book value of the capital stock and therefore shows the depreciated value of the capital stock.

Thus, we have the following sets of ICORs

1) Gross Incremental Capital Output Ratios at Current Prices and at Constant (1991-92) Prices estimated by using the regression method for 4 primary, 30 registered manufacturing sectors and 11 services sectors for a period of 1980-81 to 1992-93. They are tabled in Table No. 5.1

### **5.8 CAPITAL OUTPUT RATIOS OF THE UNREGISTERED MANUFACTURING SECTOR**

The main source of data for the unorganised manufacturing activity is the survey carried out by the National Sample Survey Organisation (NSSO), in its 40th and 45th Round. The time period of the surveys is July 1984 to June 1985 (40th round) and July 1989 to June 1990 (45th Round).

Informal sectors are considered for the manufacturing activity alone. Though for registered manufacturing, we have considered 30 sectors (ASI), where 3 digit level of classification is available, for the unregistered sector the requisite data is available only at 2 digit level of classification.

The 45th Round NSSO Report gives data on assetwise breakup of Gross Fixed Capital Formation for the year of the survey for Own Account Manufacturing Enterprises (OAME) and Non-Directory Manufacturing Establishment (NDME). The types of capital assets and its classification of sectors is the same as of the registered manufacturing sector.

Data for the unregistered enterprises is given on value of output, value added and fixed capital (total) as well as fixed capital by type of assets. The data on these variables is not given for all the unregistered units of each sector. "Per enterprise" value of output, value added and fixed capital is given, for different types of unregistered enterprises: by rural and urban, by Own Account Manufacturing Enterprises (OAME) and Non Directory manufacturing Enterprises (NDME). Again fixed asset are given separately for all these categories under two heads - those owned by the enterprises and those not owned.

A lot of averaging had to be done to get per unit capital-output figures for every sector representative of the unregistered sector as a whole. Per enterprise assets owned and not owned were added to give per enterprise fixed assets for every category. OAME's and NDME's data for rural areas was averaged. A weighted average was used, the weights being the number of OAME's and NDME's in rural areas. A similar averaging was done for the per enterprise data of the OAME's and NDME's of the urban areas. Thus a representative figure was obtained for the urban and rural unregistered enterprises of all the manufacturing sectors. Again a weighted average was taken of the data of urban enterprises and rural enterprises, the weights being the number of unregistered units being in rural areas and urban areas. Per enterprise data on value of output, fixed capital was obtained for several manufacturing sectors which was representative of all the unorganised units in each sector.

From this data, capital output ratios were worked out for the year 1989-90. The estimated Capital-Output Ratios for the unregistered manufacturing sectors are given in Table No. 5.2. The data on unregistered sector is limited: hence the estimation may not be accurate; however, it is better to have a crude approximation of its contribution than to leave it out altogether. The capital output ratio represents data for a single year; however the year being not a very historical year makes the data acceptable.

**Table No. 5.1 RESULTS OF ICORs AT CURRENT AND CONSTANT (1991-92) PRICES**

SR No	NAME OF SECTOR	ICOR CURRENT	ICOR CONSTANT
1	Agriculture +Allied	1.77	2.20
2	Forestry & Logging	1.29	-6.83
3	Fishing	1.49	2.34
4	Mining &Quarry	5.83	6.94
5	Sugar	0.91	1.01
6	Edible Oil	0.14	0.17
7	Oth.Food .Products	0.31	0.37
8	Beverages & Tobacco	0.46	0.82
9	Cotton Textiles	0.97	1.50
10	Wool,Syn.Text	0.80	0.83
11	Jute, Hemp,Mesta Textiles	0.93	-2.65
12	Radymade Garments	0.21	0.23
13	Other Textiles Articles	0.38	0.45
14	Wood & Wood Products	1.01	2.02
15	Paper & Paper Products	1.21	1.51
16	Printing	2.12	9.74
17	Leather & Leather Products	0.36	0.40
18	Rubber & Its Products	0.99	1.10
19	Plastic Products	0.47	0.50
20	Petrol & Coal Tar Products	0.72	0.56
21	Organic & Inorganic Chemicals	1.67	1.58
22	Fertilisers & Pesticides	1.18	1.11
23	Pharmaceuticals	0.55	0.60
24	Other Chemical Products	0.85	0.96
25	Cement	1.55	1.22
26	Non Metallic Mineral Products	1.04	1.57
27	Iron & Steel	1.65	3.95
28	Non Ferrous Basic Metals	0.76	0.87
29	Machine Tools	0.57	0.88
30	Non Electrical Machinery	1.86	2.99
31	Electrical Machinery	0.61	0.66
32	Rail Transport Equipment	0.42	0.31
33	Other Transport Equipment	1.22	1.81
34	Other Manufacturing	0.60	0.54
35	Construction	0.33	0.50
36	Electricity Etc.	6.76	7.20
37	Railway Services	6.40	7.63
38	Other Transport Services	1.82	2.13
39	Communication	4.48	6.90
40	Trade	0.41	0.50

**Table No. 5.1 Concl.**

Sr No	NAME OF SECTOR	ICOR CURRENT	ICOR CONSTANT
41	Hotels & Restaurants	1.28	1.52
42	Banking & Insurance	0.84	0.93
43	Storage & Warehousing	3.70	5.05
44	Ownership Of Dwellings	21.82	20.79
45	Community Services	4.15	4.37
46	Registered Manufacturing	0.86	0.93
47	Unregistered Manufacturing	0.73	-----
48	Total Economy *	3.76	4.44

Note: \* is the Capital-Value Added Ratio.

Note: The ICORs are estimated by regression for the period 1980-81 to 1992-93.

The model used is  $Y = a + b K$ ; Y= Output K= Capital Stock.

**Table No. 5.2**

**CAPITAL-OUTPUT RATIO FOR THE  
UNORGANISED MANUFACTURING SECTOR  
1989-90**

INDUSTRY CODE	INDUSTRY	CAP-OUT RATIO EXL.LAND	CAP-OUT RATIO INC.LAND
20	Man.Of Food Products	0.47	0.61
21	Man. Of Food Products	0.35	0.47
22	Beverages, Tobacco Etc.	0.50	0.72
23	Man.Of Cotton Textiles	0.50	0.66
24	Wool,Silk,Synth.Text.Text	0.48	0.59
25	Jute,Hemp,Mesta	0.28	0.44
26	Textile Products	0.48	0.64
27	Wood,Wood Products	0.37	0.58
28	Paper,Paper Products	1.30	2.43
29	Leather And Products	0.26	0.36
30	Basic Chemicals	0.36	0.60
31	Rubber,Plastics,Petroluem	0.37	0.53
32	Non Metallic Min.Products	0.51	0.81
33	Basic Metals And Alloys	0.32	0.48
34	Metal Products & Parts	0.49	0.75
35	Machinery & Equipment	0.65	0.96
36	Machinery & Equipment	0.58	0.82
37	Transport Equipment	0.81	1.15
38	Other Manufacturing Indu.	0.55	0.72
	All Industries	0.50	0.73

## 5.9 DISCUSSING THE RESULTS

We have estimated ICORs for the primary, secondary and tertiary sectors by regression. The details of the regression results are given in the appendix to this chapter. The regression results at current prices are given in Table No. A5.5 (a) and those at constant prices are given in Table No. A5.5 (b). The  $R^2$ , Standard Error, T value and the F value are given. For ICOR's at current prices, all the sectors give a good fit with a T and F both significant at 1 % level. Most of the regressions at constant prices, also give satisfactory results with a good fit and T and F being significant at 1 % . Some sectors however give T and F which are significant only at 5 % like printing and publishing and construction. Jute gives a negative ICORs and T and F values which are not significant even at 5% . For this sector we use the ICOR at current prices. For forestry and logging ,although T is significant at 1.% and F at 5%, the ICOR turns out to be negative. For this sector too we use the ICOR at current prices. We now compare our results with those obtained by the Planning commission. The comparison has been Tabled below in table No. 5.3

**Table No. 5.3 ICORs Estimated In This Study Compared with Planning Commission Estimates**

Sectors	Planning Commission			This Study Estimates
	ICOR	Lags*	Current	Constant
Agriculture	0.7953	5	1.77	2.20
Forestry & Logg	0.0376	6	1.29	-6.83
Fishing	1.2134	1	1.49	2.34
Mining & Quarrying	1.9228	3	5.83	6.94
Manufacturing	0.7259	4	0.86	0.93
Construction	1.0230	2	0.33	1.19
Electricity	1.7318	6	6.76	7.20
Railways	2.2131	6	6.40	7.63
Other transports	0.5177	6	1.82	2.13
Communication	2.8813	3	4.48	6.80
Other services	0.7861	3	4.15	4.37

Note: \* Lags are in No. of years.

Source: Planning Commission:(1995) Technical Note to the Eighth Plan, Annexure 1.23 p.266.

This study ICOR estimates are by regression method using value of output as the numerator. The, Planning Commission estimates are based on a different time period

(1973-74 to 1989-90) and incorporate different lags for different sectors, so the two may not be strictly comparable. They use incremental output and Investment to get parameters of the investment function to fit data for 1973-74 to 1989-90. (GOI, Planning Commission 1995 pp 9.)

From the above table we see that the ICORs estimated by us compare fairly well with those of the Planning Commission for Agriculture, Fishing, manufacturing. For sectors like Railways, Electricity, Communication, Mining and Quarrying and other Services, Planning Commission ICORs are lower than those obtained in this study., for e.g. ICOR for electricity is 1.73 according to Planning Commission estimate and 6.76 according to our estimate. However it is to be noted that Planning Commission estimates incorporate time lags in their estimation ranging from 1 to 6 years. Only for the Construction sector is our ICOR (current prices) estimate lower than that of the Planning Commission. However the ICOR at constant prices is comparable.

Referring to Table No. 5.1, we see that the ICOR estimate for the economy is 3.76 at current prices and 4.44 at constant i.e. 1991-92 prices. The Eighth Plan assumes an ICOR of 4.1 and 4.23 for the economy.<sup>3</sup> The Ninth Plan (1997-2002) is based on the assumption of a slightly higher ICOR of 4.34.<sup>4</sup> Thus, the overall economy ICOR estimated by us compares fairly well with that of the Planning Commission. Having estimated ICORs and CORs (for the unregistered sector), we now turn to examining how the columns of the capital matrix were generated using these results.

#### 5.10 GENERATING THE "B" MATRIX

We now discuss how the columns of the "B" matrix were estimated. We have chosen the gross values of ICORs at constant prices of 1991-92 estimated by the regression method, for most of the sectors. Each of these sectoral ICORs or  $b_1, b_2, \dots, b_n$  are to be distributed over its column in such a way so that we get the estimate of the column. This implies that we are allocating the total ICOR into its constituents; we

---

<sup>3</sup> Source: GOI, Planning Commission, 1997 : Approach to the Ninth Plan., p.24

<sup>4</sup> Source: GOI, Planning Commission, 1997 : Approach to the Ninth Plan, p.25.



are allocating the total ICOR (demanded) of the investing sector into its constituting assets given by the supplying sectors. Here, we consider only fixed assets. Inventories are dealt with later.

The following main types of fixed assets or constituents of the Capital Output Ratio are considered.

1. Tools and Other Fixed Assets
2. Electrical and Non-Electrical Machinery
3. Rail Transport Equipment
4. Other Transport Equipment
5. Construction

These main categories are chosen keeping various constraints in mind. The main constraint in choosing the the type of capital goods was the availability of data on the break up of capital formation by type of goods tapped from various sources for different sectors. For e.g. ideally, electrical and non-electrical machinery should be in separate groups. However, this is not possible because data available on asset-wise breakup of capital goods for all sectors is not available with this distinction.

The ICOR estimates which we use as column sums are inclusive of land as a fixed asset. In estimating the "B" matrix however, we have removed the contribution of land as a fixed asset in the total ICOR. So the columns of the "B" matrix exclude land.

#### **5.10.1 TIME PERIOD**

The question of time period needs to be addressed before proceeding further. Since the "B" matrix is based on ICOR's computed on the basis of data for the past 13 years, it is difficult to allot the matrix any specific time period. It is an average estimate of the annual changes observed. The Constant Prices data is valued at 1991-92 prices. This should render it reliable to be used for the initial years of the nineties.

#### **5.10.2 COMMODITY BY INDUSTRY MATRIX**

The matrix that will be estimated will be essentially a commodity by industry or a commodity by sector matrix. This is because the ICORs (i.e. the column sums) estimated are essentially sectoral ICORs; and in the break up proportions used, the

break up of capital assets is given commodity-wise. Hence it is commodity by industry / sector matrix. This makes it compatible with the "A" matrix derived from the commodity by industry transaction table.

### **5.10.3 SECTOR SPECIFICATION FOR 'B' MATRIX**

The number of sectors for the B matrix were chosen mainly on the basis of the availability of data for them. For e.g. theoretically the sectors of electrical and non electrical machinery should have been retained as separate sectors. Indeed we have estimated ICORs for both these sectors. However the data on the asset composition of various sectors gives it under very broad heads of capital assets; in almost all cases no distinction is made between electrical and non electrical machinery held as capital assets by the various sectors under consideration. All data sources give capital assets under the heading of "machinery and plant and equipment". Therefore, though we have separate estimates of ICORs for electric and non electrical machinery we cannot have these as separate sectors in the matrix since we cannot identify the columns separately, although we have separate column sums. A total of 45 ICORs are brought down to thirty five sectors - 4 primary, 7 services and 24 manufacturing sectors- for constructing the B matrix; these are shown in Table No. A5.6.

### **5.11 DATA REQUIREMENTS**

We need the allocation proportion for each column to distribute each sector's ICOR. Different sources have been explored to procure data on this. As the data on the asset-wise breakup has been tapped from different sources, the time period varies from one source to another. This is a limitation, but in the absence of greater frequency of data collection and reporting in India, there is no option but to use data sources of different time periods.

#### **5.11.1 REGISTERED MANUFACTURING SECTORS**

The Annual Survey of Industries (ASI) Reports are the data source for the 30 sectors of registered manufacturing activity. The Annual Survey of Industries 1983-84., Factory Sector, in 15 volumes; the 1st Volume : Introduction Summary, Tables and Annexures gives the relevant data. Table 6 gives "Value of Additions to Fixed Capital and other Transactions (by) Industry Group - All India; at four digit level of

classification. This gives data on addition to fixed capital in 1983-84, in terms of types of assets. The assets considered are :

1. Land
2. Improvement to Land
3. Buildings
4. Plant and Machinery
5. Transport Equipment
6. Tools and other Fixed Assets
7. Assets under construction

These are the 7 main components of capital formation for which the breakup is given. These have been brought down to 5 assets. Land and Improvement to Land are clubbed together. Buildings and Assets under Construction are clubbed together. So the five categories read thus

1. Land & Improvement to Land
2. Tools and other Fixed Assets
3. Plant and Machinery
4. Transport Equipment
5. Building and other Construction

Now, Table 7 from the same source above, gives the asset-wise breakup at 3 digit level of "Invested Capital" and "Physical Capital". In deciding to use Table 6 data the following point was considered. Table 7 data gives the breakup of total fixed assets, whereas table 6 gives the breakup of fixed assets added during 1983-84. For planning purpose, Table 7 data would be misleading because the composition of new investment may not be in the same proportion as that of the existing invested capital. So we use Table 6 data. This does not mean that Table 6 data has no limitation. Its major limitation is that it is for a particular year 1983-84. Using this would mean that even a decade later, we expect investment composition to follow the 1983-84 pattern. If the 1989-90 ASI detailed report is procured in time, this data would be more current. However, since the publication of the 1989-90 ASI Factory Sector Report in 15 volumes has been delayed, we are forced to use the 1983-84 data.

Table 6 data is at 4 digit level. It is aggregated to match the classification of 30 registered manufacturing sectors adopted in this study. This breakup is converted from value (in Rs. lakhs) to proportion terms, as proportion of total Gross Fixed Capital Formation. This breakup is shown in Table No. A 5.7 (A). This asset-wise breakup is

applied to the ICORs of the respective registered manufacturing sector and the ICOR is distributed according to this proportion.

This way, the asset-wise breakup of capital formation is used as allocation proportion to allocate the ICORs across the supplying sectors. The ICORs allocated thus for the registered manufacturing sector are presented in **Table No. A 5.7 (B)**.

### **5.11.2 THE UNREGISTERED MANUFACTURING COLUMNS**

In this section, we explain the methodology of estimating the columns of the informal sector. The method is the same as that for the registered manufacturing sector only the data sources and the level of disaggregation is different. For this, the source of data is the National Sample Survey Organization Report of the 45th Round for the period of July 1989 - June 1990, which gives "Tables with Notes on Survey of the Unorganized Manufacture : Non Director Establishment and Own Account Enterprises. Table 3, in this, gives the " per enterprise estimated value of different items of fixed assets owned by industry division". The fixed assets considered are :

1. Land
2. Building and other Construction
3. Plant and Machinery
4. Transport Equipment
5. Tools and other Fixed Assets

The types of capital goods breakup matches that of the registered sector. This data is given at only 2 digit level of classification. The problem is that the data is not given for the unorganized sector as a whole. The per enterprise asset-wise breakup of all fixed assets is given separately for Own Account Manufacturing Enterprises (OAME) in rural areas, OAME in urban areas, Non-Directory manufacturing Enterprises (NDME) in rural areas and NDME in urban areas. Again for all these above categories, the per enterprise data is given separately for capital assets owned and now owned by industry division.

To get data representative of the unregistered manufacturing sector of each industry division, some kind of averaging needs to be done. A weighted average, the weights being the number of enterprises in each category, of the data of per enterprise capital

assets owned and not owned, OAME, NDME and of rural and urban areas is done to get the final per enterprise asset-wise breakup of capital assets used by the unregistered manufacturing sectors at 2 digit level industry division.

This final table of per enterprise use of capital assets by industry division is converted to proportions - each capital asset expressed as a proportion of total capital assets used in that industry. This proportion, as shown in **Table No. A 5.8 (A)**, of capital assets is used as the allocation proportion to distribute the ICORs for the unregistered manufacturing sector into its supplying industries. In this way the ICORs for the unregistered manufacturing sector are distributed according to the allocation proportions derived from the above source. Thus, the capital matrix columns for the unregistered manufacturing sector are presented in **Table No. A 5.8 (B)**

### **5.11.3 THE MANUFACTURING SECTOR AS A WHOLE**

Now, we have the fixed capital matrix columns for 30 registered manufacturing and 19 unregistered manufacturing sectors

We need to get a typical column for each sector representative of the average capital structure of that sector, an average of the registered and the unregistered manufacturing units. It would be more meaningful to take a weighted average, giving appropriate weights to the registered and unregistered units. Thus we have estimated the columns for the manufacturing sectors after getting a weighted average of the columns of the registered and the unregistered units. For weights, the value of output of registered and unregistered units of each sector in 1991-92 was taken. The weights expressed in percentage terms are shown in **Table No. A 5.9**. The columns for all the 30 manufacturing activities are derived in this manner and the results are presented in **Table No. A 5.10**. We now look at the other sectors and how the allocation proportions were estimated for these.

### **5.11.4 ESTIMATING CAPITAL MATRIX COLUMNS OF OTHER SECTORS**

#### ***AGRICULTURE & ALLIED ACTIVITIES :***

The source for data on the type of assets in agriculture is the RBI Bulletin, April 1995. The statement II gives the combined balance sheet industry group wise from 1990-91

to 192-93 on pp. 417. The type of capital assets considered are: Land, Building, Plant and Machinery, Capital Work in Progress, Furnitures, Fixtures and Office Equipment and Others Total Gross Fixed Assets.

The change in Gross Fixed Assets was considered between 1992-93 and 1991-92. This was converted to percentage (as percentage of total change in gross fixed assets). This percentage was used as the allocations proportion. The capital assets were matched to the sector in this study and aggregated accordingly.

#### ***FORESTRY & LOGGING :***

The source for this sector's capital breakup asset-wise is the same as above: RBI Bulletin. The capital asset breakup for this sector is not available. Therefore, the same breakup proportions, as that for the agricultural sector are repeated.

#### ***FISHING :***

The source used for this is a study sponsored by World Bank through the Planning Commission and Ministry of Food Processing Industries, Government of India. The study, "Fishery Sector of India" is authored by U.K. Srivastav et al, ( Srivastav, U.K. 1991) . Though the above study is recent, the table referred to, for obtaining an assetwise break up of capital assets in a mechanised fisheries project, pertains to a project in the late seventies and early eighties. Though this makes the data dated, in the absence of any other source, this should suffice, as it gives a fair idea of the investment items involved for a mechanized fishing industry.

#### ***MINING AND QUARRYING :***

The source of data for this sector is again RBI Bulletin, Statement II, Combined Balance Sheet Industry group-wise. The change in gross fixed assets from 1991-92 to 1992-93 is considered. The Plant and Machinery component has been broken further into Plant and Machinery and Transport Equipment. 1/3 of total Plant and Machinery is taken as transport equipment.

There is another data source which pertains to iron ore mining. This, though limited to mining of a particular ore is felt to be more realistic than the above. The source is the

information on the fixed assets. The value of fixed assets are given as on 1.4.91 and 31.3.92. The change between the two is considered.

Both the sources of data i.e. RBI Bulletin and the Kudremukh Company Report were compared. The allocation proportions of both were compared. In the "B" matrix the allocating proportions from the Kudremukh's Company Report were used as they seem to be more realistic. Though they represent only an iron ore mining company, it can be taken as representative of a mining company.

### **CONSTRUCTION**

The source used for getting the asset-wise breakup of fixed capital in the construction sector is ICICI: Portfolio 1992-93, Financial Performance of Companies, Table III-A on page number 129 gives the Balance Sheet based on a sample of companies in Group 18 which is Construction and Allied Activities. The data is based on a sample of only 4 companies.

### **RAILWAY SERVICES :**

The source used for this sector is the Government of India's, Ministry of Railways (Railway Board), Indian Railways Annual Report and Accounts, 1992-93. The table on page 156, gives the gross value of assets of the Indian Railways as on 31st March 1992 and as on 31st March 1993. The capital assets are given under the 6 major heads. The major heads are-Land, Structural Engineering Works, Track, Rolling Stock, Equipment (Machinery and Plant), Suspense (Floating Assets like Inventories)

The change in assets from 1992 to 1993 is worked out; then the percentage of each asset of the total gross fixed capital (not including suspense - as that consists of inventories), is worked out. This is used as the allocation proportion for distributing the ICOR into its constituting assets.

### **OTHER TRANSPORT SERVICES**

Other Transport Services comprises of Road Transport, Air Transport, Inland Water Transport etc. Here only the first two categories were considered. A capital column was estimated for Road Transport and another one for Aviation or Air Transport. A weighted average of the two columns will be used as representative of the capital

was estimated for Road Transport and another one for Aviation or Air Transport. A weighted average of the two columns will be used as representative of the capital demands of the sector "Other Transport Services". The weights used are 70% to road transport and 30% to air transport.

### ***Road Transport***

The Administration Report of the Maharashtra State Road Development Corporation for 192-93 has been used as the source of data. Annexure VII gives the "Statement of Fixed Capital Expenditure at Cost". It gives the Gross assets on 1/04/1992 and on 31/03/93. From these two, the change in capital asset is worked out. This change in capital stock of each asset is converted to percentage of each asset of total capital stock. This percentage distribution of change capital stock by type of asset is used to distribute the ICOR.

### ***Aviation***

The Annual Report 1992-93 of the Indian Airlines is the source of data on capital assets for this sector. The Schedule "A" on page 38 gives the data on "Gross Block and Depreciation as on 31.3.1993 and 31.4.1992". From this the change in the gross block is worked out. From here, the percentage of each asset in the total asset is worked out. The type of capital assets are matched with the sector classification of this study. Now, having got the allocation proportions of both Road Transport and Air Transport, a weighted average of the two is worked out.

### ***ELECTRICITY AND GAS & WATER SUPPLY:***

The assetwise break up data is taken from ASI, 1983-84 detailed report. From here, a weighted average column for the combined sector of Electricity and Water and Gas supply is worked out. The weights are 85.88% to Electricity and 14.12% to Gas and Water. These weights are worked out from the value of output data of these two sectors of 1989-90.

### ***STORAGE***

For storage, the data is taken from ASI, the same source as the registered manufacturing sector. For *TRADE*, there is no direct source of data. What has been attempted is as follows: The sector 96, of ASI "Repair Services" is used as proxy for



the Trade Sector. The data is again from ASI, 1983-84, Detailed (In 15 Volumes) Report of Factory Sector.

### **COMMUNICATIONS**

The source for data on this is the Government of India's Ministry of Communications, Department of Telecommunications Annual Report 1992-93. (page 41) Table 5 gives data on "Capital Outlay" during and upto end of 1991-92. The type of assets are matched with the asset classification in this study and the allocation proportions are thus generated.

### **OTHER SERVICES**

The sector "*other services*" in the Input-Output Transaction Table of 1991-92, comprises of the aggregation of the following services sectors: Storage, Hotels & Restaurants, Banking, Insurance, Ownership of Dwellings, Education & Research, Medical Health, Other Services, Public Administration & Defence.

To have a comparable sector of "Other Services" in the "B" matrix, we need to estimate the capital coefficient columns for all these above 9 sectors and then take a weighted average. However, in the absence of such detailed data even for estimating ICORs as well as the capital structures of each of these sectors separately, we consider only those sectors for which capital assets breakup data is available. So, a weighted average of the Capital Coefficient Columns of three sectors is considered, which covers 4 of the above 9 sectors comprising "Other Services". These 3 sectors are: Storage, Hotels & Restaurants and Banking & Insurance. The weights used are value of output of these three sectors at current prices for 1991-92. This is shown in Table No. A 5.11 (A). For, these sectors - namely - **Hotels and Restaurants, Banking and Insurance and Community Services**, the ICICI<sup>5</sup> source of data is used.

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<sup>5</sup> ICICI : Portfolio 1992-93 : Financial Performance of Companies; Table III-A; page 1

The allocation proportions thus derived for the primary and tertiary sectors are shown in **Table No. A 5.12 (A)** and the columns of the B matrix generated according to this proportion for these sectors are shown in the **Table No. A 5.12 (B)**

### **5.12 THE 'FIXED CAPITAL COEFFICIENT MATRIX 35 SECTORS**

Having got the fixed capital coefficients columns for all the sectors, we are now able to put forth a "B" matrix which will be of the order of 5 by 35 where in only fixed capital coefficients are seen. This is shown in **Table No. 5.4** To this we now add inventory coefficients to get the complete 'B' matrix. The changes in stocks or inventories are considered in the next section.

### **5.13 ESTIMATING THE INVENTORY COEFFICIENT MATRIX : DATA AND ADJUSTMENTS**

Inventories data is available from sources like NAS, ASI, as well as the Input-Output Transaction table. The NAS and ASI give the changes in stock data annually. A series of inventories for the different sectors can be obtained. But as stated in the earlier chapter, no averaging is being done for inventories; the data for the reference year will be used. The reference year being 1991-92; we use data on inventories for that year.

**5.13.1 Finished Goods** The inventories consists of raw materials, semi-finished goods and finished goods. We have deducted the value of finished goods held as stock from the value of the inventories. To get the relevant data for every sector we have tapped various sources, as follows:

For *agriculture and mining and quarrying* the source is the RBI Bulletin : Balance Sheet of Industries. In this table the data on fixed capital stock and inventories is given. From here the average (for the two years of 1991-92 and 1992-93) percentage of finished goods of total inventories is estimated. It is 52.125% for agriculture and allied activities and 45.85% for mining and quarrying.

For all the *services sectors*, the changes in stocks is zero and there is no question of finished goods being held as stock, by the very nature of the activity involved. In Fishing too, there is no question of holding finished goods as stock.

For the manufacturing sector, data on value of "Changes in Stocks" and its components - raw materials, semi-finished and finished goods, is taken from ASI, 1991-92 and 1992-93. Finished goods as percentage of total "changes in stocks" is worked out for both years. This percentage of finished goods of total changes in stocks is taken of 1991-92. In case of the sector "Wool, Silk and Synthetic Textiles", this figures comes out to be 160.62%. This is adjusted to 54.69, by considering the average percentage of inventories for two years - 1991-92 and 1992-93 (160.62 and 43.96). A similar adjustment is made for the jute sector and other transport equipment, because the former shows a high percentage for one year and the latter shows a negative value.

The **Table No. A5.13** shows the types of inventories as percentage of total "changes in stocks" for 1991-92 for all the sectors. These percentages are applied to the column of the inventories and the value of the finished goods is worked out. This value is deducted from the total "changes in stocks" to yield a value which shows "changes in stocks" adjusted for finished goods.

This column vector will now be transposed to a row vector, and these values will be treated as column totals, to be distributed over the columns according to the proportions of the columns of the "A" matrix. This generates a matrix of "changes in stock". Wherever, the changes in stocks is negative, it is adjusted to zero. This happens to be the case here only with the Mining and Quarrying Sector.

From the "Inventory Matrix", the inventory coefficients are worked out. This is the "Stock Coefficient Matrix". The Stock Coefficient Matrix is shown in **Table No.5.5**. This can now be added to fixed Capital Coefficient Matrix to get the "B" matrix.

## 5.14 UPDATING THE "A" AND "B" MATRICES

Having got the "B" matrix, we now discuss the adjustments required to enable one to use the matrix along with the "A" matrix for the relevant year.

### 5.14.1 Updating The "B" Matrix

Each cell of the "B" matrix shows how much of the  $i$ th goods is required as capital input in the  $j$ th sector. To update these coefficients for the relevant year, we need to use a ratio of two prices (1) The  $i$ th good prices and (2)  $j$ th good prices. If  $b_{ij}$  = capital coefficient, and  $P_{ij}$  = Price Index for the  $b_{ij}$  where,

$$P_{ij} = \frac{\text{Wholesale Price Index of } i\text{th good}}{\text{Wholesale Price Index of the } j\text{th good}}$$

Both the Price Indices are at 1991-92 base.

$$P_{ij} = \frac{\text{WPI}_i \text{ 1994-95 (base 1991-92 = 100)}}{\text{WPI}_j \text{ 1994-95 (base 1991-92 = 100)}}$$

The Price Indices for the primary and the services sector are taken from NAS, 1995; Statement 3; Price and Quantum Indices, pp 8. The base year in this source is 1980-81. This has been converted to base 1991-92.

For Services Sector, wherever the Price Index for 1994-95 is not available, the Index for 1993-94 is used and it is carried further by making an appropriate percentage increase. This increase is based on the consumer Price Index (for Industrial Workers) increase between 1993-94 to 1994-95 which is 9%.

This increase is chosen to reflect overall inflation. The CPI is taken because it includes a lot of services like housing and number of other services grouped as miscellaneous, whereas the WPI (overall), has only manufactured and primary goods in its basket of commodities. The source for obtaining the increase in CPI for 1994-95 is Table 4.5; on page 76; the Economic Survey 1994-95 : Annual Rate of Inflation in Essential Commodities.

The Price Indices for the Manufacturing Sector are taken from RBI: Report on Currency and Finance 1994-95, Volume II; Statistical Statements, Statement 27; Index Number of Wholesale Prices - Annual (pp 40).

#### 5.14.2 Updating The "A" Matrix:

The "A" matrix for 1991-92 is taken from the "Technical note to the Eighth Five year Plan". The A matrix given is of the order 60 by 60 sector ; commodity by industry input-output table. This matrix has been derived from the earlier "A" matrix for 1983-84 published by the CSO by making adjustments for price changes and adjusting for levels of output etc. In this study we use the "A" matrix for 1991-92 given in the "Technical Note" (GOI, Planning Commission 1995) and the A matrix of 1983-84 brought out by the CSO.<sup>6</sup> The 1991-92, 60 by 60 sector table is brought down to 35 by 35 sector. The sectoral aggregation and matching is shown in the appendix Table No A 5.14. The same matching for the 1983-84 table is shown in Table A5.15.

The "A" matrix for 1991-92 as available is updated to 1994-95 by using the sectoral price indices as described above for the "B" matrix. The adjustment made are purely price adjustments, so that they adjust each cell entry to reflect the change in the relative prices of it's input and output. It does not attempt to try and depict any change in the use of inputs or the capital structure.

With these parameters and the final demand vectors, in the next chapter we go on to estimate the maximal possible growth rate for the Indian economy, the necessary investment vectors for these and the trade vectors associated with these.

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<sup>6</sup> The CSO has recently brought out the A matrix for 1989-90 but it is a draft version not the final one. It has not been published yet.

TABLE NO. 5.4

THE FIXED CAPITAL COEFFICIENT MATRIX 1980-81 TO 1992-93

Sector No.	SECTOR NO.	1	2	3	4	5	6	7	8	9	10	11	12
	NAME OF SECTOR	AGRICUL	FOREST	FISHING	MIN&QUAR	SUGAR	ED.OIL	OT.FOOD PRO.	COT.TEXT	WOOL,SILK	JUTE,HEMP	OT.TE.ART.	WOOD.PRO
1	AGRICULTURE +ALLIED												
2	FORESTRY & LOGGING												
3	FISHING												
4	MINING & QUARRY												
12	WOOD & WOOD PRODUCTS												
22	IRON & STEEL												
23	NON FERROS BASI.METAL												
24	MACHINE TOOLS/MET.MAN	0.473	0.287			0.033	0.007	0.026	0.020	0.017	0.045	0.023	0.042
25	EL+NON EL.MACH.	0.515	0.298	0.120	3.987	0.648	0.118	0.258	1.142	0.349	0.730	0.268	0.477
26	RAIL TRANS. EQUIP	0.000	0.000	0.000	0.006								
27	OTHER TRANS EQP.	0.471	0.276	2.220	0.030	0.029	0.014	0.036	0.015	0.008	0.013	0.024	0.077
28	MISCELL. MANUFACTURING												
29	CONSTRUCTION	0.721	0.415	0.000	2.910	0.278	0.029	0.132	0.306	0.201	0.126	0.065	0.319
36	LAND	0.017	0.011	0.000	0.011	0.023	0.004	0.026	0.020	0.068	0.011	0.007	0.162
	TOTAL ICOR	2.197	1.287	2.340	6.944	1.013	0.172	0.478	1.503	0.682	0.925	0.387	1.077
	ICOR MINUS LAND	2.180	1.276	2.340	6.933	0.990	0.168	0.452	1.483	0.613	0.914	0.380	0.915

NOTE: The matrix is based on ICORs estimated by regression for the period of 1980-81 to 1992-93 at Constant Prices of 1991-92 =100

TABLE NO. 5.4

## THE FIXED CAPITAL COEFFICIENT MATRIX 1980-81 TO 1992-93

Sector No.	SECTOR NO.  NAME OF SECTOR	13 PAP&PRINT	14 LEATHER	15 RUBBER	16 PLASTICS	17 PETR.CI.PR	18 FERT+PEST	19 OTCHEMPRO	20 CEMENT	21 N.M.M.PRO	22 IR+STEEL	23 N.F.B.MET	24 MET.MAN
1	AGRICULTURE +ALLIED												
2	FORESTRY & LOGGING												
3	FISHING												
4	MINING & QUARRY												
12	WOOD & WOOD PRODUCTS												
22	IRON & STEEL												
23	NON FERROS BASI.METAL												
24	MACHINE TOOLS/MET.MAN	0.068	0.021	0.060	0.034	0.009	0.016	0.005	0.029	0.058	0.109	0.019	0.042
25	EL+NON EL.MACH.	2.747	0.169	0.841	0.364	0.112	0.986	0.072	0.770	0.961	2.583	0.631	0.409
26	RAIL TRANS. EQUIP												
27	OTHER TRANS EQP.	0.068	0.016	0.019	0.014	0.004	0.031	0.003	0.037	0.059	0.087	0.011	0.022
28	MISCELL. MANUFACTURING												
29	CONSTRUCTION	0.517	0.176	0.146	0.086	0.414	0.067	0.036	0.339	0.313	1.107	0.172	0.279
36	LAND	0.198	0.039	0.016	0.005	0.016	0.031	0.015	0.045	0.090	0.068	0.026	0.147
	TOTAL ICOR	4.033	0.380	1.082	0.503	0.556	1.131	0.129	1.221	1.466	3.954	0.859	0.810
	ICOR MINUS LAND	3.835	0.342	1.066	0.497	0.539	1.100	0.118	1.175	1.376	3.886	0.833	0.662

NOTE: The matrix is based on ICORs estimated by regression for the period of 1980-81 to 1992-93 at Constant Prices of 1991-92 =100

TABLE NO. 5.4

THE FIXED CAPITAL COEFFICIENT MATRIX 1980-81 TO 1992-93

Sector No.	SECTOR NO.  NAME OF SECTOR	25 MACHINERY	26 RAIL.T.EQP	27 OT.T.EQP	28 MISC.MAN	29 CONSTRU	30 ELECTRIC	31 RAILSERV	32 OTHTRAPTS	33 COMMUNIC	34 TRADE	35 OTH SERV
1	AGRICULTURE +ALLIED											
2	FORESTRY & LOGGING											
3	FISHING											
4	MINING & QUARRY											
12	WOOD & WOOD PRODUCTS								0.002			
22	IRON & STEEL											
23	NON FERROS BASI.METAL											
24	MACHINE TOOLS/MET.MAN	0.116	0.007	0.130	0.050	0.144	0.449	0.000	0.002	0.000	0.057	0.146
25	EL+NON EL.MACH.	1.022	0.205	1.117	0.236	0.927	3.789	4.395	0.115	6.410	0.103	0.696
26	RAIL TRANS. EQUIP							2.878				
27	OTHER TRANS EQP.	0.131	0.005	0.044	0.016	0.000	0.040	0.000	1.497	0.026	0.050	0.006
28	MISCELL. MANUFACTURING								0.005			
29	CONSTRUCTION	0.352	0.090	0.361	0.253	0.022	2.180	0.337	0.460	0.404	0.282	0.132
36	LAND	0.074	0.006	0.079	0.065	0.093	0.738	0.024	0.048	0.056	0.005	0.187
	TOTAL ICOR	1.590	0.313	1.716	0.600	1.186	7.196	7.634	2.129	6.897	0.497	1.167
	ICOR MINUS LAND	1.516	0.307	1.637	0.534	1.092	6.458	7.610	2.081	6.841	0.492	0.980

NOTE: The matrix is based on ICORs estimated by regression for the period of 1980-81 to 1992-93 at Constant Prices of 1991-92 =100



TABLE NO. 5.5 STOCK COEFFICIENT MATRIX 1991-92

SN	NAME OF SECTOR	1	2	3	4	5	6	7	8	9	10	11	12
1	AGRICULTURE +ALLIED	0.0170	0.0000	0.0000	0.0000	0.0367	0.0050	0.0305	0.0170	0.0025	0.0405	0.0003	0.0000
2	FORESTRY & LOGGING	0.0000	0.0004	0.0000	0.0000	0.0004	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0401
3	FISHING	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000
4	MINING & QUARRY	0.0000	0.0000	0.0000	0.0034	0.0014	0.0013	0.0003	0.0009	0.0003	0.0007	0.0002	0.0001
5	SUGAR	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000
6	EDIBLE OIL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
7	OTH.F.PR.&BEVRE	0.0009	0.0000	0.0000	0.0000	0.0000	0.0752	0.0065	0.0003	0.0000	0.0002	0.0000	0.0000
8	COTTON TEXTILES	0.0003	0.0000	0.0000	0.0000	0.0000	0.0042	0.0001	0.0331	0.0058	0.0002	0.0111	0.0001
9	WOOL,SYN.TEXT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0015	0.0291	0.0002	0.0037	0.0000
10	JUTE, HEMP,MESTA TEXTILES	0.0000	0.0000	0.0000	0.0000	0.0021	0.0002	0.0002	0.0017	0.0010	0.0216	0.0007	0.0000
11	OTHER TEXTILES ARTICLES	0.0000	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0003	0.0007	0.0034	0.0068	0.0001
12	WOOD & WOOD PRODUCTS	0.0000	0.0001	0.0000	0.0007	0.0000	0.0001	0.0003	0.0001	0.0002	0.0000	0.0007	0.0049
13	PAPER & PAPER PRODUCTS	0.0000	0.0005	0.0000	0.0013	0.0001	0.0004	0.0007	0.0005	0.0007	0.0003	0.0003	0.0001
14	LEATHER & LEATHER PRODUC	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
15	RUBBER & ITS PRODUCTS	0.0000	0.0006	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	PLASTIC PRODUCTS	0.0000	0.0000	0.0000	0.0000	0.0001	0.0015	0.0005	0.0003	0.0003	0.0005	0.0008	0.0003
17	PETROL.+CL.TAR.PRO.	0.0012	0.0021	0.0001	0.0197	0.0016	0.0009	0.0008	0.0025	0.0014	0.0030	0.0005	0.0003
18	FERT+PEST	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	OTHER CHEMICAL PRO.	0.0001	0.0000	0.0000	0.0098	0.0006	0.0349	0.0008	0.0050	0.0270	0.0028	0.0012	0.0004
20	CEMENT	0.0000	0.0000	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	NON METALLIC MINERAL PROD	0.0000	0.0000	0.0000	0.0042	0.0003	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000
22	IRON & STEEL	0.0000	0.0001	0.0000	0.0000	0.0000	0.0020	0.0000	0.0001	0.0000	0.0008	0.0000	0.0001
23	NON FERROS BASIC METALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0003	0.0000
24	MACHINE TOOLS	0.0000	0.0000	0.0000	0.0011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	EL+NON EL.MACH.	0.0006	0.0003	0.0000	0.0436	0.0005	0.0003	0.0004	0.0014	0.0004	0.0006	0.0004	0.0002
26	RAIL TRANSPORT EQUIPMENT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	OTHER TRANS EQP.	0.0001	0.0012	0.0000	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	OTHER MANUFACTURING	0.0000	0.0008	0.0000	0.0058	0.0007	0.0084	0.0014	0.0010	0.0007	0.0012	0.0005	0.0004
29	CONSTRUCTION	0.0015	0.0008	0.0000	0.0109	0.0005	0.0002	0.0003	0.0003	0.0001	0.0003	0.0003	0.0002
30	ELECTRICITY ETC	0.0009	0.0001	0.0000	0.0272	0.0008	0.0038	0.0009	0.0064	0.0081	0.0058	0.0010	0.0007
31	RAILWAY SERVICES	0.0004	0.0010	0.0000	0.0074	0.0004	0.0014	0.0003	0.0006	0.0002	0.0008	0.0001	0.0004
32	OTHER TRANSPORT SERVICES	0.0007	0.0093	0.0000	0.0043	0.0028	0.0032	0.0020	0.0041	0.0027	0.0066	0.0014	0.0019
33	COMMUNICATION	0.0000	0.0006	0.0000	0.0005	0.0002	0.0005	0.0001	0.0003	0.0002	0.0003	0.0001	0.0001
34	TRADE	0.0041	0.0007	0.0000	0.0096	0.0125	0.0227	0.0088	0.0160	0.0070	0.0164	0.0042	0.0077
35	OTHER SERVICES	0.0009	0.0049	0.0000	0.0314	0.0076	0.0041	0.0031	0.0080	0.0067	0.0068	0.0042	0.0018
	TOTAL CHANGES IN STOCKS	0.0339	0.0238	0.0002	0.1859	0.0703	0.1703	0.0632	0.1015	0.0954	0.1131	0.0389	0.0599
	GROSS OUTPUT COL.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE NO. 5.5 Contd.

## STOCKS COEFFICIENT MATRIX 1991-92

SN	NAME OF SECTOR	13	14	15	16	17	18	19	20	21	22	23	24
1	AGRICULTURE +ALLIED	0.0004	0.0071	0.0125	0.0000	0.0000	0.0000	0.0054	0.0000	0.0002	0.0000	0.0000	0.0000
2	FORESTRY & LOGGING	0.0066	0.0013	0.0001	0.0000	0.0001	0.0001	0.0015	0.0000	0.0015	0.0004	0.0002	0.0021
3	FISHING	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	MINING & QUARRY	0.0079	0.0001	0.0010	0.0000	0.1094	0.0336	0.0044	0.0796	0.0318	0.0180	0.0372	0.0005
5	SUGAR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
6	EDIBLE OIL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
7	OTH.F.PR.&BEVRE	0.0006	0.0006	0.0000	0.0000	0.0000	0.0001	0.0045	0.0000	0.0000	0.0000	0.0000	0.0000
8	COTTON TEXTILES	0.0008	0.0003	0.0011	0.0006	0.0001	0.0001	0.0047	0.0000	0.0003	0.0000	0.0000	0.0002
9	WOOL,SYN.TEXT	0.0001	0.0002	0.0051	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	JUTE, HEMP,MESTA TEXTILES	0.0012	0.0002	0.0002	0.0001	0.0001	0.0077	0.0009	0.0288	0.0005	0.0002	0.0003	0.0003
11	OTHER TEXTILES ARTICLES	0.0009	0.0013	0.0014	0.0002	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
12	WOOD & WOOD PRODUCTS	0.0003	0.0003	0.0001	0.0002	0.0001	0.0002	0.0010	0.0001	0.0005	0.0001	0.0002	0.0023
13	PAPER & PAPER PRODUCTS	0.0821	0.0004	0.0004	0.0006	0.0002	0.0006	0.0057	0.0000	0.0009	0.0000	0.0001	0.0012
14	LEATHER & LEATHER PRODUC	0.0001	0.0203	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
15	RUBBER & ITS PRODUCTS	0.0001	0.0060	0.0194	0.0004	0.0000	0.0000	0.0001	0.0000	0.0002	0.0000	0.0000	0.0001
16	PLASTIC PRODUCTS	0.0012	0.0004	0.0004	0.0083	0.0005	0.0027	0.0031	0.0002	0.0006	0.0001	0.0004	0.0012
17	PETROL.+CL.TAR.PRO.	0.0039	0.0005	0.0018	0.0015	0.0231	0.0431	0.0106	0.0055	0.0141	0.0134	0.0212	0.0088
18	FERT+PEST	0.0000	0.0000	0.0000	0.0000	0.0000	0.0310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	OTHER CHEMICAL PRO.	0.0153	0.0048	0.0260	0.0525	0.0049	0.0526	0.0668	0.0002	0.0042	0.0024	0.0102	0.0046
20	CEMENT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0109	0.0000	0.0000	0.0000
21	NON METALLIC MINERAL PROD	0.0003	0.0001	0.0004	0.0006	0.0000	0.0004	0.0023	0.0027	0.0125	0.0014	0.0001	0.0006
22	IRON & STEEL	0.0003	0.0000	0.0007	0.0004	0.0000	0.0000	0.0002	0.0065	0.0046	0.0900	0.0110	0.2300
23	NON FERROS BASIC METALS	0.0049	0.0000	0.0002	0.0007	0.0000	0.0003	0.0025	0.0003	0.0011	0.0113	0.0548	0.0230
24	MACHINE TOOLS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0296
25	EL.+NON EL.MACH.	0.0021	0.0002	0.0002	0.0003	0.0001	0.0013	0.0010	0.0032	0.0010	0.0015	0.0025	0.0465
26	RAIL TRANSPORT EQUIPMENT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	OTHER TRANS EQP.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	OTHER MANUFACTURING	0.0035	0.0006	0.0019	0.0011	0.0016	0.0066	0.0056	0.0055	0.0021	0.0206	0.0044	0.0435
29	CONSTRUCTION	0.0007	0.0003	0.0005	0.0004	0.0003	0.0009	0.0006	0.0016	0.0012	0.0022	0.0010	0.0043
30	ELECTRICITY ETC	0.0136	0.0008	0.0014	0.0038	0.0018	0.0258	0.0096	0.0302	0.0052	0.0149	0.0426	0.0201
31	RAILWAY SERVICES	0.0030	0.0002	0.0003	0.0001	0.0029	0.0054	0.0012	0.0123	0.0055	0.0081	0.0029	0.0070
32	OTHER TRANSPORT SERVICES	0.0055	0.0027	0.0028	0.0035	0.0028	0.0077	0.0058	0.0061	0.0073	0.0058	0.0070	0.0125
33	COMMUNICATION	0.0016	0.0003	0.0006	0.0006	0.0001	0.0007	0.0011	0.0006	0.0007	0.0007	0.0008	0.0065
34	TRADE	0.0191	0.0120	0.0164	0.0073	0.0139	0.0326	0.0196	0.0311	0.0197	0.0242	0.0189	0.0361
35	OTHER SERVICES	0.0203	0.0048	0.0051	0.0062	0.0045	0.0206	0.0115	0.0180	0.0073	0.0122	0.0178	0.0668
	TOTAL CHANGES IN STOCKS	0.1964	0.0658	0.1001	0.0899	0.1664	0.2741	0.1702	0.2325	0.1340	0.2276	0.2336	0.5480
	GROSS OUTPUT COL.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE NO. 5.5 conold.

## STOCKS COEFFICIENT MATRIX 1991-92

SR.	NAME OF SECTOR	25	26	27	28	29	30	31	32	33	34	35
1	AGRICULTURE +ALLIED	0.0000	0.0000	0.0000	0.0001	0.0008	0.0002	0.0000	0.0002	0.0000	0.0000	0.0030
2	FORESTRY & LOGGING	0.0006	0.0007	0.0006	0.0001	0.0027	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	FISHING	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
4	MINING & QUARRY	0.0003	0.0001	0.0003	0.0003	0.0087	0.0284	0.0010	0.0001	0.0000	0.0000	0.0002
5	SUGAR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
6	EDIBLE OIL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
7	OTH.F.PR.&BEVRE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0008
8	COTTON TEXTILES	0.0002	0.0000	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
9	WOOL.SYN.TEXT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	JUTE, HEMP, MESTA TEXTILES	0.0002	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0065	0.0000
11	OTHER TEXTILES ARTICLES	0.0000	0.0000	0.0003	0.0000	0.0000	0.0001	0.0000	0.0001	0.0002	0.0000	0.0001
12	WOOD & WOOD PRODUCTS	0.0014	0.0001	0.0007	0.0003	0.0050	0.0006	0.0001	0.0000	0.0001	0.0108	0.0002
13	PAPER & PAPER PRODUCTS	0.0015	0.0000	0.0019	0.0004	0.0001	0.0003	0.0001	0.0007	0.0122	0.0141	0.0014
14	LEATHER & LEATHER PRODUCT	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	RUBBER & ITS PRODUCTS	0.0017	0.0003	0.0220	0.0002	0.0001	0.0000	0.0000	0.0033	0.0002	0.0001	0.0000
16	PLASTIC PRODUCTS	0.0008	0.0001	0.0016	0.0001	0.0000	0.0000	0.0001	0.0001	0.0000	0.0067	0.0000
17	PETROL.+CL.TAR.PRO.	0.0036	0.0016	0.0065	0.0007	0.0015	0.0060	0.0040	0.0172	0.0021	0.0022	0.0001
18	FERT+PEST	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	OTHER CHEMICAL PRO.	0.0069	0.0031	0.0065	0.0015	0.0023	0.0004	0.0000	0.0001	0.0000	0.0000	0.0041
20	CEMENT	0.0000	0.0000	0.0000	0.0000	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	NON METALLIC MINERAL PROD	0.0011	0.0000	0.0013	0.0007	0.0070	0.0006	0.0002	0.0000	0.0000	0.0000	0.0001
22	IRON & STEEL	0.0539	0.0104	0.0894	0.0124	0.0183	0.0013	0.0009	0.0000	0.0000	0.0020	0.0000
23	NON FERROS BASIC METALS	0.0217	0.0036	0.0104	0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	MACHINE TOOLS	0.0000	0.0000	0.0016	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
25	EL+NON EL.MACH.	0.0774	0.0047	0.0142	0.0014	0.0050	0.0144	0.0015	0.0010	0.0221	0.0003	0.0002
26	RAIL TRANSPORT EQUIPMENT	0.0000	0.0356	0.0000	0.0017	0.0000	0.0000	0.0334	0.0000	0.0000	0.0000	0.0000
27	OTHER TRANS EQP.	0.0007	0.0001	0.0617	0.0003	0.0001	0.0001	0.0000	0.0062	0.0003	0.0001	0.0002
28	OTHER MANUFACTURING	0.0108	0.0016	0.0126	0.0040	0.0002	0.0036	0.0012	0.0007	0.0002	0.0113	0.0016
29	CONSTRUCTION	0.0014	0.0002	0.0022	0.0002	0.0000	0.0042	0.0038	0.0005	0.0144	0.0080	0.0027
30	ELECTRICITY ETC	0.0048	0.0017	0.0075	0.0016	0.0022	0.0864	0.0025	0.0010	0.0069	0.0278	0.0009
31	RAILWAY SERVICES	0.0022	0.0005	0.0030	0.0006	0.0019	0.0120	0.0007	0.0008	0.0052	0.0105	0.0002
32	OTHER TRANSPORT SERVICES	0.0050	0.0008	0.0061	0.0010	0.0028	0.0037	0.0008	0.0084	0.0094	0.2376	0.0010
33	COMMUNICATION	0.0020	0.0001	0.0018	0.0007	0.0003	0.0009	0.0001	0.0009	0.0000	0.0202	0.0010
34	TRAINE	0.0177	0.0030	0.0243	0.0030	0.0122	0.0145	0.0013	0.0033	0.0035	0.0530	0.0024
35	OTHER SERVICES	0.0259	0.0019	0.0303	0.0039	0.0033	0.0030	0.0034	0.0066	0.0097	0.2203	0.0041
	TOTAL CHANGES IN STOCKS	0.2419	0.0701	0.3074	0.0394	0.0824	0.1808	0.0557	0.0516	0.0864	0.6313	0.0249
	GROSS OUTPUT COL.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

***APPENDIX TO CHAPTER FIVE***

**Table No. A5.1(a) Sectors Considered For Estimaing ICORs and their Matching with Data Sources :**

**PRIMARY AND SERVICES SECTORS**

<b>SC NO.</b>	<b>NAME OF SECTOR</b>	<b>CORRESPONDING OF CLASSIFICATION</b>	<b>NO. NAS</b>
<b>A.</b>	<b>PRIMARY</b>		
1.	Agriculture and Allied Activities	1.1	
2.	Forestry and Logging	1.2	
3.	Fishing	1.3	
4.	Mining and Quarrying	2	
<b>B.</b>	<b>SERVICES</b>		
1.	Construction	5	
2.	Electricity Generation + Water & Gas Supply	4.1 and 4.2	
3.	Railway Services	7.1	
4.	Other Transport Services	7.2	
5.	Storage and Warehousing	7.3	
6.	Communication	7.4	
7.	Trade	6.1	
8.	Hotels and Restaurants	6.2	
9.	Banking and Insurance	8.1	
10.	Ownership of Dwelling	8.2	
11.	Community, Social & Personal Services	9	

**Table No. A5.1(b) Sectors Considered For Estimating ICORs and their Matching with Data Source REGISTERED MANUFACTURING**

Sr.N	Name of Sector	Three /Two digit Class. No. of ASI
1.	Sugar	206 - 207
2.	Edible Oil	210 - 211
3.	Other Food Products	20* - 21*
4.	Beverages and Tobacco	22
5.	Cotton Textiles	23
6.	Wool, Silk, Synthetic Textiles	24
7.	Jute, Hemp, Mesta Textiles	25
8.	Readymade Garments	264 - 265
9.	Other Textile Articles	26*
10.	Wood and Wood Products	27
11.	Paper and Paper Products	280 - 283
12.	Printing and Publishing	284 - 289
13.	Leather and Leather Products	29
14.	Rubber and Rubber Products	300 - 302
15.	Plastic Products	303
16.	Petroleum and Coal Tar Products	304 - 307
17.	Organic and Inorganic Chemicals	310
18.	Fertilizers and Pesticides	311
19.	Pharmaceuticals	313
20.	Other Chemical Products	312; 314 - 319
21.	Cement, Lime	324
22.	Non-Metallic Mineral Products	32*
23.	Iron and Steel	330 - 332
24.	Non-Ferrous Basic Metal	333 - 339
25.	Metal Manufacture	34
26.	Non-Electrical Machinery	35
27.	Electrical Machinery	36
28.	Rail Transport Equipment	371 - 373
29.	Other Transport Equipment	370; 37*
30.	Miscellaneous Manufacturing	38

**\* Note:** The asterisk indicates that the residual three digit level sectors are considered for estimating ICORs for throwing up the 'B' matrix.

**Table No. A 5.1 (c) SECTORS CONSIDERED FOR ESTIMATING ICORS**

**UNREGISTERED MANUFACTURING**

<b>Sr No.</b>	<b>INDUSTRY</b>	<b>NSSO 2 DIGIT INDCODE</b>
1	Man.Of Food Products	20
2	Man. Of Food Products	21
3	Beverages,Tobacco Etc.	22
4	Man.Of Cotton Textiles	23
5	Wool,Silk,Synthetic Textile	24
6	Jute,Hemp,Mesta	25
7	Textile Products	26
8	Wood,Wood Products	27
9	Paper,Paper Products	28
10	Leather And Products	29
11	Basic Chemicals	30
12	Rubber,Plastics,Petroluem	31
13	Non Metallic Min.Products	32
14	Basic Metals And Alloys	33
15	Metal Products & Parts	34
16	Machinery & Equipment	35
17	Machinery & Equipment	36
18	Transport Equipment	37
19	Other Manufacturing Indus.	38

Table No. A5.2 ( a)

Price Indices for Value Of output for the  
Primary and Services Sectors

Base 199-92 = 100

Year	Agric.	Forestry	Fishing	Mining et	Electri.et	Constru.	Trade	Hotels.
1980-81	40	37	32	35	41	29	38	40
1981-82	42	44	34	54	41	24	44	46
1982-83	44	50	40	61	41	20	46	47
1983-84	48	54	41	66	41	18	50	51
1984-85	52	58	47	72	58	51	56	56
1985-86	54	61	54	76	65	56	60	60
1986-87	59	68	60	76	111	60	63	63
1987-88	66	76	70	77	70	66	67	68
1988-89	69	85	75	88	74	72	73	75
1989-90	75	90	80	92	79	80	79	81
1990-91	84	98	93	95	89	89	88	88
1991-92	100	100	100	100	100	100	100	100
1992-93	107	103	118	112	111	109	108	109
1993-94	118	118	118	129	176	121	108	108

Year	Rail Serv	Oth.Tans	Storage	Commun	Bank, Ins	Real Esta	Oth.Serv
1980-81	29	30	37	31	46	50	38
1981-82	40	34	40	29	57	53	42
1982-83	45	39	43	33	58	57	45
1983-84	51	44	48	36	60	60	49
1984-85	54	48	51	38	64	65	53
1985-86	59	52	58	41	66	69	57
1986-87	63	56	60	43	67	73	59
1987-88	69	60	69	53	70	77	68
1988-89	76	67	75	67	72	82	74
1989-90	86	71	84	84	77	88	80
1990-91	93	85	92	90	87	94	88
1991-92	100	100	100	100	100	100	100
1992-93	117	113	104	106	106	107	110
1993-94	130	130	130	130	112	112	118

Source: The above Price indices are derived from the Value of Output given at Current and Constant prices In NAS, Various Issues



Table No. A5.2 (b)

**Price Indices for Gross Fixed Capital Formation  
for the Primary and Services Sectors  
Base 199-92 = 100**

YEAR	Agric.	Forestry	Fishing	Mining et	Electri.etc	Constru.	Trade	Hotels
1980-81	35	31	36	37	37	42	39	38
1981-82	40	34	44	41	40	46	44	43
1982-83	44	38	49	43	44	47	48	46
1983-84	48	42	56	47	47	52	52	51
1984-85	50	46	61	50	51	54	56	55
1985-86	57	54	67	57	57	61	62	57
1986-87	62	59	75	61	61	64	66	67
1987-88	67	66	81	65	66	65	67	67
1988-89	73	73	87	71	73	72	74	81
1989-90	81	81	90	80	79	80	81	81
1990-91	89	88	93	87	86	87	88	88
1991-92	100	100	100	100	100	100	100	100
1992-93	110	110	101	111	108	110	110	109
1993-94	117	121	111	116	112	112	114	114

YEAR	Rail Serv	Oth.Tans	Storage	Communi	Bank, Ins	Real Estat	Oth.Serv
1980-81	30	39	31	44	39	30	33
1981-82	36	48	36	30	44	36	37
1982-83	41	49	44	47	48	42	42
1983-84	43	62	48	47	53	48	46
1984-85	48	51	55	56	57	54	50
1985-86	56	73	58	60	63	60	58
1986-87	56	55	64	65	66	67	62
1987-88	66	81	71	59	66	73	66
1988-89	72	92	75	61	73	78	72
1989-90	82	86	80	83	81	83	79
1990-91	88	99	91	101	88	88	87
1991-92	100	100	100	100	100	100	100
1992-93	105	113	104	97	-	107	109
1993-94	110	-	115	106	-	116	117

Source: The above Price indices are derived from the Gross Fixed capital Formation given at Current and Constant prices In NAS, Various Issues

**TableNo.A5.3(a) MATCHING SECTOR SCHEME ADOPTED IN THIS STUDY WITH THE CLASSIFICATION OF THE WHOLESALE PRICE INDEX**

Sr. No	Name Of Sector For ICOR In This Study	WPI No.	WPI Group Name	ASI's Industry Code
1.	Sugar + Khandsari	III (A) f	Sugar, Khandsari, Gur	206-207
2.	Edible Oil	III (A) i	Edible Oils	210211
3.	Other Food Products	III (A)	Food Products	20* -21*
4.	Beverages& Tobacco	III (B)	Beverages, Tobacco, Products	22
5.	Cotton Textiles	III(C) a	Cotton Textiles	23
6.	Wool, Silk, Synthetic Textiles	III(C),b, c,	Manmade Textiles, Woolen Textiles	24
7.	Jute, Hemp, Mesta	III(C),d	Jute, Hemp, Mesta Textiles	25
8.	Readymade Garments	III(C),e	ManufactureTextiles, n.e.c.	264265
9.	OtherTextile Articles	III(C),e	Manufacture of Textiles, n.e.c.	26*
10.	Wood & Wood Products	III (D)	Wood&WoodProducts	27
11.	Paper and Paper Products	III (E), a, b,	Paper, Pulp, board manufacture	280 - 283
12.	Printing and Publishing	III(E),c	Printing& Publishing ofnewspaper, periodicals etc.	284 - 289
13.	Leather&LeatherPro ducts	III (F)	Leather & Leather Products	29
14.	Rubber & itsProducts	III(G),a	Tyers, Tubes	300-302
15.	Plastic Products	III(G),b	Plastic Products	203
16.	Petroleum & Coal Tar Products	I (C), c	Petroleum Crude and Natural Gas	304 - 307
17.	Organic & Inorganic Chemicals	III (H), a, b,	Basic heavy Organic Chemicals.	310
18.	Fertilizers&Pesticide	III(H),c	Fertilizers&Pesticid	311

**Table A5.3(a) Concl.**

Sr. No	Name Of Sector For ICOR In This Study	WPI No.	WPI Group Name	ASI's Industry Code
19.	Pharmaceuticals	III(H), f	Drugs and Medicines	
20.	Other Chemical Products	III (H)	Chemical & Chemical Products	312; 314-319
21.	Cement, Lime	III(I), c	Cement,Lime& Plaster	324
22.	Non-Metallic Mineral Products	III (I)	Non-Metallic Mineral Products	32*
23.	Iron & Steel	III(J), a	BasicMetals & Alloys	330 - 332
24.	Non-FerrousBasicMetals	III(J), a	Non-Ferrous Metals	333 - 339
25.	Metal Manufacture	III(J), c	Metal Products	34
26.	Non-Electrical Machinery	III(K),a	Non-Electrical Machinery & Parts	35
27.	Electrical Machinery	III(K),b	Electrical Machinery	36
28.	RailTransport Equipment	III(L), a	Locomotives, railway wagons and parts	371 - 373
29.	OtherTransport Equipment	III(L),b	MotorVehicles, MotorCycles, Scooters,Bicycles and parts	37*
30.	Miscellaneous Manufacturing	III (M)	OtherMisc. Manufacturing Inds.	38

- Note :**
1. \*The asterisk indicates the aggregation of residual three digit level industries, in ASI.
  2. The roman numerals stand for major groups, capital alphabets for groups, small case alphabets for sub-groups.

**Source :** RBI : Report on Currency and Finance Vol. II Statistical Statements; 26 : Index Numbers of Wholesale Prices - Annual (Base Period 1981-82 = 100) by Major Groups, Group and Sub-Groups, RBI, 1992-93.

**Table No. A5.3 (b) Index Number of Wholesale Prices (Average Annual)  
Base Converted From 1980-81 = 100 TO 1991-92 = 100**

Indus. Cod Year	Sugar 206-207	Ed. Oil 210-211	Food Pr 20,21	Bev & T 22	Cot. Tex 23	Jute Tex 25	Wool Te 24	Text. Ar 26	Wood P 27	Paper P 280-283
1980-81	70	33	50	36	47	40	57	50	55	36
1981-82	62	38	48	38	51	35	60	50	62	38
1982-83	52	39	47	38	53	40	64	51	70	41
1983-84	58	44	52	40	55	51	64	54	76	45
1984-85	62	48	55	42	57	83	67	61	77	50
1985-86	72	44	57	46	59	63	69	65	90	55
1986-87	74	54	63	50	59	50	68	65	92	59
1987-88	73	66	68	58	64	55	73	72	96	65
1988-89	79	64	72	68	71	70	75	80	97	69
1989-90	95	67	80	78	81	87	89	85	98	80
1990-91	95	84	88	91	87	100	94	96	98	86
1991-92	100	100	100	100	100	100	100	100	100	100
1992-93	112	100	108	111	109	96	111	102	197	119
1993-94	148	96	120	115	119	113	117	118	236	126

Indus. Cod Year	Print Pu 28	Leather 29	Rubber 300-302	Plas Pro 303	Petro. Pr 30	Chem. C 310	Chem. In 310	Fertiliser 311	Drugs & 313	O. Chem 31
1980-81	28	44	51	46	95	44	79	67	56	53
1981-82	30	43	59	53	99	46	83	76	63	55
1982-83	35	43	64	55	102	48	86	80	65	57
1983-84	38	46	64	53	99	51	85	75	67	62
1984-85	41	49	68	57	102	52	85	75	70	70
1985-86	48	55	74	62	102	59	90	78	74	74
1986-87	53	57	78	72	98	63	90	82	77	78
1987-88	62	61	84	86	93	65	88	84	80	85
1988-89	66	72	91	101	88	71	90	78	86	85
1989-90	75	79	93	98	91	79	91	79	88	85
1990-91	80	96	97	99	99	86	93	80	94	88
1991-92	100	100	100	100	100	100	100	100	100	100
1992-93	136	109	109	103	102	115	106	125	107	112
1993-94	146	111	111	103	120	124	107	141	117	118

Indus. Cod Year	Cement 324	N.M.M. 32*	Iron & S 330.33	N.F.B.M 33*	Metal M 34	N.El. M 35	El. Mach 36	Rail Eq 371-373	Tr. Eq 37*	Misc.M 38
1980-81	42	34	39	34	36	41	48	35	45	76
1981-82	49	37	47	37	40	45	51	39	51	78
1982-83	60	42	48	37	42	48	51	42	53	79
1983-84	69	49	50	40	44	50	53	49	54	79
1984-85	76	51	53	45	49	52	56	52	57	79
1985-86	74	54	67	47	52	57	60	53	63	77
1986-87	68	59	65	48	54	60	63	56	66	83
1987-88	68	62	67	57	56	61	66	58	69	86
1988-89	67	66	77	73	67	70	75	68	74	88
1989-90	74	74	89	89	83	79	81	76	83	91
1990-91	88	79	95	94	92	86	87	85	90	93
1991-92	100	100	100	100	100	100	100	100	100	100
1992-93	106	86	110	109	107	111	110	109	108	108
1993-94	105	94	119	114	118	112	117	116	110	116

Source : RBI Report On Currency and Finance, Vol. II Statement on Wholesale Prices, Various issues

**Table No. A5.4 (a) Price Indices For Construction,  
Machinery & Transport Equipment**

**Base 1991-92 = 100**

<b>Year</b>	<b>Construction</b>	<b>Machinery</b>	<b>Transport Eqp.</b>
1980-81	29	43	44
1981-82	34	45	49
1982-83	40	46	51
1983-84	45	51	52
1984-85	51	54	59
1985-86	56	61	61
1986-87	63	65	64
1987-88	66	64	67
1988-89	72	72	74
1989-90	80	80	82
1990-91	89	87	90
1991-92	100	100	100
1992-93	109	109	108
1993-94	119	112	111

**Source :** The Construction + Machinery Indices are from NAS, Price Index of Capital Formation. Transport Equipment is from RBI, Currency + Finance.

**Table No . A 5.4 (b) PRICE INDEX FOR INFLATING GFCF  
FOR REGISTERED MANUFACTURING SECTORS**

Indus.Code	206-207	210-211	20,21	22	23	24	25	264	26	27
Year										
1980-81	39	40	39	40	40	40	41	38	41	40
1981-82	42	44	43	43	43	43	44	42	44	43
1982-83	44	45	45	45	45	45	45	45	45	45
1983-84	49	50	50	50	50	50	50	49	50	50
1984-85	53	54	54	54	54	54	54	54	54	54
1985-86	59	60	59	60	60	60	60	59	60	60
1986-87	65	65	65	65	65	65	65	64	65	65
1987-88	65	65	65	65	65	65	65	65	65	65
1988-89	72	72	72	72	72	72	72	72	72	72
1989-90	80	80	80	80	80	80	80	80	80	80
1990-91	88	88	88	88	88	88	87	88	87	88
1991-92	100	100	100	100	100	100	100	100	100	100
1992-93	109	109	109	109	109	109	109	109	109	109
1993-94	114	113	114	113	113	113	113	114	113	113

Indus.Code	280-283	284-289	29	301-302	303	30	310	311	313	312-319
Year										
1980-81	40	42	40	41	40	32	42	43	39	39
1981-82	43	45	43	44	44	37	44	46	43	43
1982-83	45	46	43	45	45	42	46	47	45	45
1983-84	50	51	50	50	50	46	51	52	50	50
1984-85	54	54	54	54	54	52	54	55	54	54
1985-86	60	60	60	60	60	57	60	62	59	59
1986-87	65	65	65	65	65	63	65	67	65	65
1987-88	65	65	65	65	65	66	65	66	65	65
1988-89	72	72	72	72	72	72	72	74	72	72
1989-90	80	80	80	80	80	80	80	82	80	80
1990-91	88	88	88	87	88	89	87	89	88	88
1991-92	100	100	100	100	100	100	100	102	100	100
1992-93	109	110	109	109	109	109	109	112	109	109
1993-94	113	113	113	113	113	117	113	115	114	114

Table No. A5.4 (b) conclud.

Indus.Code	324	32 *	330	333-339	34	35	36	371-373	37 *	38
Year										
1980-81	51	40	39	40	41	40	39	39	40	39
1981-82	56	43	42	43	44	43	43	42	43	43
1982-83	59	45	44	45	45	45	45	44	45	45
1983-84	64	50	49	50	50	50	50	49	50	50
1984-85	71	54	53	54	54	54	54	53	54	54
1985-86	77	60	59	60	60	60	59	59	60	59
1986-87	83	65	65	65	65	65	65	65	65	65
1987-88	84	65	65	65	65	65	65	65	65	65
1988-89	93	72	72	72	72	72	72	72	72	72
1989-90	104	80	80	80	80	80	80	80	80	80
1990-91	114	88	88	88	87	88	88	88	88	88
1991-92	129	100	100	100	100	100	100	100	100	100
1992-93	140	109	109	109	109	109	190	109	109	109
1993-94	146	113	113	113	113	113	114	114	113	114

Indus.Code	40	41-42	74	91	95	96	97	AL.IND
Year								
1980-81	38	39	37	40	41	35	24	39
1981-82	41	43	41	43	44	39	27	42
1982-83	44	45	44	45	45	43	29	45
1983-84	49	50	48	50	51	48	32	49
1984-85	53	54	53	54	54	53	36	54
1985-86	59	59	59	60	60	58	39	59
1986-87	64	65	64	65	65	64	43	65
1987-88	65	65	65	65	65	66	44	65
1988-89	72	72	72	72	72	72	48	72
1989-90	80	80	80	80	80	80	54	80
1990-91	88	88	88	87	87	88	59	88
1991-92	100	100	100	100	100	100	67	100
1992-93	109	109	109	109	109	109	73	109
1993-94	114	114	115	113	113	116	77	114

Note: Weighted Price Indices Estimated For Gross Fixed Capital Formation (GFCF) For Each Industry From 1980-81 To 1993-94 Weighted By Asset Composition In Each Registered Manufacturing Industry.

**TABLE NO. A5.5 (a) REGRESSION RESULTS OF THE SECTORWISE ICOR ESTIMATES FOR THE INDIAN ECONOMY 1980-81 TO 1992-93 [AT CURRENT PRICES]**

NO	SECTOR	R <sup>2</sup>	F	b (T VALUE)	ICOR = 1/ b
1	Agriculture	0.992856	1582.753	0.565649** (39.09953)	1.767880
2	Forestry & Logging	0.937124	163.9475	0.777246** (12.80427)	1.286593
3	Fishing	0.988525	947.6056	0.671868** (30.78372)	1.488386
4	Mining & Quarrying	0.966552	317.8686	0.171385** (17.82911)	5.834789
5	Sugar	0.956494	241.8386	1.093317** (15.55133)	0.914647
6	Edible oil	0.948897	208.5477	7.025973** (14.44131)	0.142329
7	Other food products	0.996968	3616.968	3.184493** (60.15067)	0.314021
8	Beverages and Tobacco	0.992900	1538.295	2.173590** (39.22302)	0.460068
9	Cotton Textiles	0.982436	615.2810	1.034554** (24.80503)	0.966599
10	Wool, Silk, Synth. Textiles	0.979047	513.98	1.251993** (22.67156)	0.798726
11	Jute, Hemp, Mesta TExiles	0.748516	32.740	1.080769** (5.721928)	0.925266
12	Ready Garments	0.993186	1603.323	4.686206** (40.04361)	0.213392
13	Other Textile Articles	0.969012	343.9761	2.627697** (18.54678)	0.380561
14	Wood & Wood Products	0.964099	295.398	0.986172** (17.18738)	1.014021
15	Paper & Paper Products	0.969088	344.8488	0.825304** (18.57028)	1.214323
16	Printing & Publishing	0.957457	247.5619	0.472101** (15.73418)	2.118189
17	Leather Products	0.967281	325.1960	2.779459** (18.03344)	0.359782
18	Rubber Products	0.921323	128.8121	1.012902** (11.34960)	0.987262
19	Plastic Products	0.991482	1280.382	2.140613** (35.78406)	0.467155
20	Petroleum and Coal Tar Prods	0.836179	56.14645	1.396575** (7.493106)	0.716037
21	Chemicals	0.994615	2031.711	0.597946** (45.07675)	1.672389



**TABLE NO. A5.5 (a) (contd.)**

<b>NO</b>	<b>SECTOR</b>	<b>R<sup>2</sup></b>	<b>F</b>	<b>b (T VALUE)</b>	<b>ICOR = 1/ b</b>
22	Fertilizer	0.981269	576.2671	0.848713** (24.00578)	1.178253
23	Drugs & Med.	0.995344	2351.542	1.824320** (48.49306)	0.548149
24	Oth. Chem. Prods.	0.976187	450.9325	1.174517** (21.23531)	0.851413
25	Cement, Lime	0.972697	391.8861	0.643360** (19.79618)	1.554337
26	Non- Met. Min. Pro.	0.994461	1974.918	0.965035** (44.44212)	1.036231
27	Iron & Steel	0.974487	420.1527	0.604563** (20.49798)	1.654086
28	Non- Ferr. Mets.	0.964353	297.5813	1.316178** (17.25079)	0.759775
29	Metal. Manu.	0.966023	312.7484	1.747868** (17.68485)	0.572125
30	Non Elec. Mach.	0.907337	107.7097	0.536250** (10.37838)	1.864798
31	Elec. Mach.	0.974053	412.9411	1.631991** (20.32121)	0.612748
32	Rail Trans. Eqp.	0.910457	111.8460	2.373119** (10.57576)	0.421386
33	Oth. Trans. Eqp.	0.933675	154.8499	0.819732** (12.44391)	1.219909
34	Misc. Manuf.	0.983191	643.4113	1.671949** (25.36572)	0.598104
35	Construction	0.977922	487.2335	3.006873** (22.07376)	0.332571
36	Electricity	0.930319	146.8622	0.147947** (12.11868)	6.759171
37	Railway Services	0.993889	1789.032	0.156221** (42.29916)	6.401163
38	Oth. Trans. Service	0.979993	538.8075	0.549401** (23.21253)	1.820161
39	Banking Insurance	0.991994	1362.969	1.195038** (36.91873)	0.836792
40	Storage	0.993930	1801.191	0.270463** (42.44058)	3.697355
41	Hotel & Rest	0.996688	3310.256	0.783163** (57.54056)	1.27687
42	Trade	0.996624	3247.293	2.455477** (56.98771)	0.407252
43	Communication	0.986508	804.2979	0.223047** (29.62228)	4.483347

**TABLE NO. A5.5 (a) (concl.)**

NO	SECTOR	R <sup>2</sup>	F	b (T VALUE)	ICOR = 1/b
44	Real Estate	0.997498	4385.482	0.045833** (66.22313)	21.81812
45	Community Personal Services	0.995196	2278.758	0.240983** (47.73650)	4.149669

Note: Specification :  $Y = a + bx$   
Y = Output X = Capital ICOR = 1/b

F value at for d.f. N1 = 1 ; N2 = 11

(1%) = F > 9.65 \*\*

(2%) = F > 4.84 \*

T Value for d.f. = 11

(1%) = T > 2.718 \*\*

(2%) = T > 1.796 \*

**TABLE NO. A5.5 (b) REGRESSION RESULTS OF THE SECTORWISE  
ICOR ESTIMATES FOR THE INDIA ECONOMY  
1980-81 TO 1992-93**

[AT CONSTANT 1991-92 PRICES]

NO	SECTOR	R <sup>2</sup>	F	b (T VALUE)	ICOR = 1/b
1	Agriculture	0.923775	133.3096**	0.455117** (11.54601)	2.197234
2	Forestry & Logging	0.454770	9.17497270*	-0.14636** (-3.02902)	-6.83234
3	Fishing	0.981918	597.3397**	0.427296** (24.44080)	2.340292
4	Mining & Quarrying	0.996028	2758.385**	0.144006** (52.52587)	6.944146
5	Sugar	0.804298	45.20790**	0.987021** (6.723693)	1.013149
6	Edible oil	0.844750	59.85349**	5.822775** (7.736515)	0.171739
7	Other Food Prods.	0.979207	518.0241**	2.729558** (22.76047)	0.366359
8	Beverages Tob	0.859469	67.27454**	1.220741** (8.202124)	0.819174
9	Cotton Textiles	0.939278	170.1534**	0.665305** (13.04429)	1.503069
10	Wool, Silk, Synth.	0.967823	330.8590**	1.203147** (18.18968)	0.831153
11	Jute, Hemp	0.190491	2.588483	-0.37785 (-1.60887)	-2.64650
12	Ready Garm.	0.988987	987.8195**	4.429436** (31.43003)	0.225762
13	Oth. Text. Art.	0.895220	93.98186**	2.205491 (9.694445)	0.453413
14	Wood & w. Prods.	0.430953	8.3305**	0.495115** (2.886173)	2.019729
15	Paper & Prods.	0.742021	31.63912**	0.660123** (5.624873)	1.514868
16	Printing & Publi.	0.313865	5.013183*	0.102696* (2.243177)	9.737415
17	Leather Prods.	0.975165	431.9232**	2.544502** (20.78295)	0.393004
18	Rubber Prods.	0.94133	76.4350**	0.906122** (13.28299)	1.103604
19	Plastic Prods.	0.918505	123.9776**	1.989403** (11.13459)	0.502663
20	Petroleum	0.863560	69.62151**	1.799065** (8.343963)	0.555844

**TABLE NO. A5.5 (b) (contd.)**

NO	SECTOR	R <sup>2</sup>	F	b (T VALUE)	ICOR = 1/b
21	Chemicals	0.984098	680.7368**	0.634477** (26.09108)	
22	Fertilizer	0.956142	239.8094**	0.902419** (15.48590)	1.108132
23	Drugs & Med.	0.976560	458.2832**	1.667183** (21.40791)	0.599813
24	Oth. Chem. Prods.	0.956191	240.0899**	1.042997** (15.49487)	0.958774
25	Cement, Lime	0.980141	542.9050**	0.819195** (23.30045)	1.220710
26	Non- Met. Min. Pro.	0.957204	246.0333**	0.634891** (15.68557)	1.575073
27	Iron & Steel	0.840312	57.88432**	0.252926** (7.608190)	3.953714
28	Non- Ferr. Mets.	0.931533	149.6613**	1.142046** (12.23362)	0.875620
29	Metal Manufacture	0.892131	90.97554**	1.137252** (9.538152)	0.879312
30	Non Ele Machinery	0.788131	40.91887**	0.334757** (6.396789)	2.987240
31	Electrical Machinery	0.929336	144.6662**	1.514492** (12.02779)	0.660287
32	Rail Transpt Equipt	0.782718	39.6254**	3.195902** (6.294889)	0.312900
33	Oth.. Transt Equipt	0.713541	27.39991**	0.553162** (5.234502)	1.807788
34	Misc. Manuf.	0.958356	253.1436**	0.536431** (15.91067)	0.536431
35	Construction	0.327233	5.3504099*	0.843301** (2.313094)	1.185816
36	Electricity	0.997748	4873.547**	0.138962** (69.81578)	7.196180
37	Railway Services	0.952222	219.2314**	0.130993** (14.80661)	7.633984
38	Oth. Trans. Service	0.994910	2150.100**	0.469709** (4637174)	2.128973
39	Banking Insurance	0.967355	325.9622**	1.079576** (18.05442)	0.926289
40	Storage	0.875130	77.09161**	0.198124** (8.780186)	5.047320
41	Hotel & Rest	0.992358	1428.413**	0.656628** (37.79551)	1.522931

**TABLE NO. A5.5 (b) (concl.)**

NO	SECTOR	R <sup>2</sup>	F	b (T VALUE)	ICOR = 1/ b
42	Trade	0.990787	1182.965**	2.011373 (34.39612)	0.497172
43	Communication	0.988648	957.9922**	0.144994** (30.95168)	6.896823
44	Real Estate	0.998821	9318.940**	0.048107** (96.53654)	20.78668
45	Community Personal Services	0.983828	669.1879**	0.228684** (25.86906)	4.372832

Note : Specification  $Y = a + bx$ , where  
 $Y$  = Value of Output Constant Prices (1991-92)  
 $X$  = Capital Stock at 1991-92 Prices                      ICOR = 1/b.  
 F value at for d.f.  $N1 = 1$  ;  $N2 = 11$   
 (1%) =  $F > 9.65$  \*\*  
 (2%) =  $F > 4.84$  \*  
 T Value for d.f. = 11  
 (1%) =  $T > 2.718$  \*\*  
 (2%) =  $T > 1.796$  \*

**Table No. A 5.6 SECTOR SPECIFICATION FOR ESTIMATING THE B MATRIX**

<b>SEC.NO</b>	<b>SECTOR</b>
1	AGRICULTURE
2	FORESTRY & LOGGING
3	FISHING
4	MINING & QUARRYING
5	SUGAR
6	HYDROGENATED OIL
7	OTHER FOOD PRODUCTS & BEVERAGES
8	COTTON TEXTILES
9	WOOL, SILK, SYNTHETIC TEXTILES
10	JUTE, HEMP, MESTA TEXTILES
11	OTHER TEXTILE ARTICLES
12	WOOD & WOOD PRODUCTS
13	PAPER & PAPER PRODUCTS
14	LEATHER & LEATHER PRODUCTS
15	RUBBER PRODUCTS
16	PLASTIC PRODUCTS
17	PETROLEUM & COALTAR PRODUCTS
18	FERTILISERS & PESTICIDES
19	CHEMICALS
20	CEMENT
21	OTHER NON METALLIC MINERAL PRODUCTS
22	IRON & STEEL
23	NON FERROUS METALS
24	MACHINE TOOLS
25	ELECTRICAL & NON ELECTRICAL MACHINERY
26	RAIL EQUIPMENT
27	OTHER TRANSPORT EQUIPMENT
28	MISCELLANEOUS MANUFACTURING
29	CONSTRUCTION
30	ELECTRICITY ETC.
31	RAIL TRANSPORT SERVICE
32	OTHER TRANSPORT SERVICE
33	COMMUNICATION
34	TRADE
35	OTHER SERVICES

**Table No. A5.7 (a) Break Up Of Gross Fixed Capital Formation Into Its Constituting Assets. ( As Proportion of Total GFCF) : For Registered Manufacturing Sector.**

Sr. No.	INDUST RY CODE	LAND + IMPR TO LAND	BUILD + COSNTR	PLANT & MACH.	TRANS. EQUIP.	TOOLS & OTHER F. ASS.	TOTAL GFCF
1.	206-207	0.023	0.275	0.640	0.029	0.033	0.999
2.	210-211	0.021	0.170	0.687	0.079	0.043	1.000
3.	20,21	0.018	0.250	0.611	0.081	0.039	1.000
4.	22	0.024	0.211	0.585	0.092	0.089	1.000
5.	23	0.014	0.204	0.760	0.010	0.013	1.000
6.	24	0.005	0.196	0.760	0.016	0.023	1.000
7.	25	0.012	0.136	0.789	0.014	0.049	1.000
8.	264	0.031	0.348	0.365	0.124	0.133	1.000
9.	26	0.015	0.133	0.756	0.052	0.044	1.000
10.	27	0.033	0.203	0.631	0.104	0.028	1.000
11.	280-283	0.011	0.200	0.768	0.011	0.011	1.000
12.	284-289	0.004	0.094	0.719	0.020	0.163	1.000
13.	29	0.013	0.225	0.648	0.061	0.052	1.000
14.	301-302	0.010	0.131	0.786	0.018	0.056	1.000
15.	303	0.011	0.171	0.723	0.027	0.067	1.000
16.	30	0.030	0.746	0.202	0.006	0.016	1.000
17.	310	0.022	0.095	0.826	0.022	0.035	1.000
18.	311	0.028	0.060	0.889	0.028	0.015	1.020
19.	313	0.027	0.249	0.600	0.036	0.088	1.000
20.	312-319	0.011	0.249	0.678	0.024	0.038	1.000
21.	324	0.037	0.278	0.631	0.031	0.024	1.000
22.	32*	0.035	0.179	0.704	0.041	0.040	1.000
23.	330.332	0.017	0.280	0.653	0.022	0.027	1.000
24.	333-339	0.022	0.196	0.748	0.011	0.022	1.000
25.	34	0.012	0.135	0.768	0.042	0.043	1.000
26.	35	0.013	0.181	0.698	0.031	0.077	1.000
27.	36	0.016	0.236	0.654	0.022	0.072	1.000
28.	371-373	0.019	0.288	0.655	0.017	0.022	1.000
29.	37*	0.020	0.191	0.686	0.026	0.076	1.000
30.	38	0.016	0.257	0.604	0.028	0.094	1.000
31.	40	0.103	0.316	0.516	0.005	0.059	1.000
32.	41-42	0.103	0.221	0.589	0.007	0.080	1.000
33.	74	0.013	0.415	0.519	0.033	0.019	1.000
34.	91	0.000	0.171	0.827	0.000	0.001	1.000
35.	95	0.013	0.103	0.741	0.015	.127	1.000
36.	96	0.011	0.568	0.207	0.100	0.114	1.000
37.	97	0.063	0.278	0.234	0.071	0.042	0.688
	AL.IND.	0.047	0.260	0.630	0.018	0.045	1.000

**Note :** Components Of GFCF\* 1983-84 [ Rs. Thousands] Registered Manufacturing Sector Aggregated At Two Digit Level As Proportion Of Total GFCF  
\*GFCF = Gross Fixed Capital Formation

**Source:** ASI, 1983-84 (15 Volumes, Vol. 1)

Table No A 5.7 (b)

## ICORs Distributed into its Constituent Supplying Sectors for the Registered Manufacturing Sector

Sector Code	Sector	206-207 SUGAR	210-211 ED.OIL	20,21 OT.FOOD.F	22 BEV+TOB	23 COT.TEXT	24 WOOL,SILIJUTE,HEM	25 R.GAR.	264	26 OT.TE.ART	27 WOOD.PRO
1	Tools & Oth Fixed Assets	0.033	0.007	0.014	0.073	0.020	0.020	0.045	0.030	0.020	0.057
2	Plant & Machinery	0.648	0.118	0.224	0.479	1.142	0.632	0.730	0.082	0.343	1.275
3	Transport Equipment	0.029	0.014	0.030	0.075	0.015	0.013	0.013	0.028	0.023	0.209
4	Building & Construction	0.278	0.029	0.092	0.173	0.306	0.163	0.126	0.078	0.060	0.411
5	Land & Improv. to Land	0.023	0.004	0.007	0.019	0.020	0.004	0.011	0.007	0.007	0.067
	ICOR	1.013	0.172	0.366	0.819	1.503	0.831	0.925	0.226	0.453	2.020
	ICOR Minus Land	0.990	0.168	0.360	0.800	1.483	0.827	0.914	0.219	0.447	1.952

Sector Code	Sector	280-283 PAPER	284-289 PRINT	29 LEATHER	301-302 RUBBER	303 PLASTICS	30 PETR.CT.PI O+IN	310 CHEM	311 FERT+PES	313 PHARMA	312-319 OT.CHEM
1	Tools & Oth Fixed Assets	0.016	1.582	0.020	0.061	0.034	0.009	0.055	0.016	0.053	0.036
2	Plant & Machinery	1.163	6.998	0.255	0.867	0.364	0.112	1.302	0.986	0.360	0.650
3	Transport Equipment	0.016	0.196	0.024	0.020	0.014	0.004	0.034	0.031	0.022	0.023
4	Building & Construction	0.303	0.918	0.089	0.145	0.086	0.414	0.150	0.067	0.150	0.239
5	Land & Improv. to Land	0.017	0.043	0.005	0.011	0.005	0.016	0.034	0.031	0.016	0.010
	ICOR	1.515	9.737	0.393	1.104	0.503	0.556	1.576	1.131	0.600	0.959
	ICOR Minus Land	1.498	9.694	0.388	1.093	0.497	0.539	1.542	1.100	0.584	0.949



Table No A 5.7 (b) concld.

## ICORs Distributed into its Constituent Supplying Sectors for the Registered Manufacturing Sector

Sector Code	Sector	324 CEMENT	32* N.M.M.PRC	330-332 IR+STEEL	333-339 N.F.B.MET	34 MET.MAN	35 N.EL.MAC	36 I.E.L.MACH.	371-373 RAIL.T.EQ	37* I.O.T.T.EQP	38 MISC.MAN
1	Tools & Oth Fixed Ass	0.029	0.063	0.109	0.019	0.038	0.230	0.048	0.007	0.137	0.050
2	Plant & Machinery	0.770	1.110	2.583	0.655	0.676	2.084	0.432	0.205	1.240	0.324
3	Transport Equipment	0.037	0.065	0.087	0.010	0.037	0.092	0.014	0.005	0.048	0.015
4	Building & Constructic	0.339	0.282	1.107	0.172	0.119	0.541	0.156	0.090	0.346	0.138
5	Land & Improv. to Lar	0.045	0.055	0.068	0.020	0.010	0.039	0.011	0.006	0.037	0.009
	ICOR	1.221	1.575	3.954	0.876	0.879	2.987	0.660	0.313	1.808	0.536
	ICOR Minus Land	1.175	1.520	3.886	0.856	0.869	2.947	0.650	0.307	1.771	0.528

Sector Code	Sector	40 ELEC.	41-42 WATE.S+G STORAGE	74 AL.INDUS
1	Tools & Oth Fixed Ass	0.428	0.574	0.095
2	Plant & Machinery	3.718	4.239	2.622
3	Transport Equipment	0.039	0.050	0.169
4	Building & Constructic	2.277	1.594	2.097
5	Land & Improv. to Lar	0.738	0.742	0.067
	ICOR	7.200	7.200	5.050
	ICOR Minus Land	6.462	6.458	4.983

**Table No. A5.8 (A) Break Up Of Gross Fixed Capital Formation Into Its Constituting Assets. UNREGISTERED MANUFACTURING SECTOR**

Sr. No.	INDUS. CODE	LAND	BUILD+ OTH. COSNTR	PLANT & MACH.	TRANS. EQUIP.	TOOLS & OTHER F. ASS.	TOTAL ASSETS
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[9]
1.	20	0.254	0.429	0.268	0.010	0.039	1.001
2.	21	0.244	0.377	0.282	0.068	0.029	1.000
3.	22	0.233	0.537	0.116	0.046	0.068	0.999
4.	23	0.214	0.447	0.305	0.009	0.026	1.001
5.	24	0.135	0.571	0.271	0.006	0.017	1.002
6.	25	0.515	0.288	0.167	0.011	0.019	1.001
7.	26	0.314	0.520	0.120	0.023	0.023	0.991
8.	27	0.359	0.434	0.148	0.015	0.044	1.008
9.	28	0.362	0.352	0.216	0.008	0.063	1.212
10.	29	0.247	0.611	0.080	0.007	0.055	1.000
11.	30	0.419	0.397	0.123	0.022	0.040	1.000
12.	31	0.261	0.404	0.288	0.013	0.034	1.004
13.	32	0.385	0.385	0.156	0.024	0.051	1.000
14.	33	0.334	0.388	0.194	0.045	0.039	1.000
15.	34	0.326	0.375	0.248	0.012	0.040	1.001
16.	35	0.288	0.346	0.316	0.014	0.036	0.974
17.	36	0.284	0.443	0.201	0.036	0.037	1.001
18.	37	0.298	0.357	0.263	0.024	0.057	1.005
19.	38	0.235	0.572	0.109	0.022	0.062	1.001
20.	39	0.240	0.455	0.223	0.017	0.066	1.006
21.	97	0.257	0.579	0.085	0.011	0.067	1.000
22.	99	0.453	0.250	0.215	0.010	0.072	1.000
	Total	0.301	0.416	0.218	0.021	0.045	1.022

Source : NSSO Report (1995) : 45 th Round.

Table No. A 5.8 (b)

## THE FIXED CAPITAL OUTPUT MATRIX FOR 1989-90 FOR THE UNORGANISED SECTOR

Sr.N <sup>o</sup> Industry Code	20	21	22	23	24	25	26	27	28	29	30
1 Tools & Oth.Fixed Assets	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.03	0.14	0.02	0.02
2 Bldgs. & Construction	0.25	0.19	0.47	0.45	0.23	0.30	0.41	0.27	0.53	0.33	0.31
3 Plant & Machinery	0.19	0.11	0.03	0.16	0.17	0.03	0.08	0.06	0.52	0.02	0.06
4 Transport Equipment	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.00	0.01
5 Land	0.14	0.12	0.17	0.15	0.11	0.16	0.16	0.21	1.12	0.10	0.24
All Assets	0.61	0.47	0.72	0.66	0.59	0.44	0.64	0.58	2.43	0.36	0.60
All Assets Excl. land	0.47	0.35	0.50	0.50	0.48	0.28	0.48	0.37	1.30	0.26	0.36

Sr.N <sup>o</sup> Industry Code	31	32	33	34	35	36	37	38	39	97	99 ALLINDS	
1 Tools & Oth.Fixed Assets	0.02	0.03	0.03	0.05	0.05	0.03	0.09	0.05	0.10	0.09	0.06	0.04
2 Bldgs. & Construction	0.16	0.50	0.18	0.41	0.42	0.39	0.46	0.48	0.63	0.77	0.36	0.39
3 Plant & Machinery	0.16	0.06	0.10	0.19	0.29	0.20	0.36	0.06	0.27	0.09	0.16	0.13
4 Transport Equipment	0.01	0.02	0.03	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.01
5 Land	0.15	0.30	0.16	0.26	0.31	0.23	0.34	0.18	0.33	0.34	0.38	0.23
All Assets	0.53	0.81	0.48	0.75	0.96	0.82	1.15	0.72	1.21	1.21	1.01	0.73
All Assets Excl. land	0.37	0.51	0.32	0.49	0.65	0.58	0.81	0.55	0.89	0.87	0.63	0.50

**Table No. A 5.9 Weights of the Registered and Unregistered Sectors  
as percentage of Total Manufacturing 1991-92**

Industry Code	Industry	Registered Manufact. (%)	Unregistered Manufact. (%)	Total
20-21	Man.Food Products	89	11	100
22	Beverages & Tobacco	83	17	100
23	Cooton Textiles	100	0	100
24	Wool,Silk, Synth.Text	39	61	100
25	Jute,Hemp,Mesta Text	100	0	100
26	Textile Products	100	0	100
27	Wood roducts	34	66	100
28	Paper Products	84	16	100
29	Leather Products	64	36	100
30	Basic Chemicals	94	6	100
31	Rubber,Plas, Petrol.	96	4	100
32	N.Met.MIn.Prods.	86	14	100
33	Bas.Met & Alloys	96	4	100
34	Metal Products & Parts	45	55	100
35	Non-Electrical Machinery	80	20	100
36	Electrical Machinery	80	20	100
37	Transport Equipment	86	14	100
38	Other Manufacturing Indus	66	34	100
39	Repair of Capital Goods	17	83	100
97	Repair Services	18	82	100
	All Industries	80	20	100

Note: For jute Textiles, Cotton Textiles & Textiles Products, data for the unregistered Manufacturing is not available; hence the weight of the registered sector appears as 100

Table No A 5.10

**The Capital Coefficient Matrix For The Composite  
Manufacturing Sectors [ Registered and Unregistered Sectors]**

Sr.No.	Name of Asset Supplying Sectors	206-207 Sugar	210-211 Ed.Oil	20,21 Oth.FooD Pr	22 Bev,Tob.	23 Cot.Text	24 Wool,Silk	25 Jute,Hemp	26 Ot.Text.Art.	27 Wood Pr.	28 Paper,Print	29 Leather
1	Tools & Other Fixed As	0.033	0.007	0.015	0.064	0.020	0.017	0.045	0.023	0.042	0.068	0.021
2	Plant & Machinery	0.648	0.118	0.216	0.403	1.142	0.349	0.730	0.268	0.477	2.747	0.169
3	Transport Equipment	0.029	0.014	0.028	0.064	0.015	0.008	0.013	0.024	0.077	0.068	0.016
4	Building & Constructor	0.278	0.029	0.106	0.222	0.306	0.201	0.126	0.065	0.319	0.517	0.176
5	Land & Improvement to	0.023	0.004	0.020	0.045	0.020	0.068	0.011	0.007	0.162	0.198	0.039
	Estimated ICOR	1.013	0.172	0.384	0.802	1.503	0.682	0.925	0.387	1.077	4.033	0.380
	ICOR Minus Land	0.990	0.168	0.365	0.750	1.483	0.613	0.914	0.380	0.915	3.835	0.342

Sr.No.	Name of Asset Supplying Sectors	301-302 Rubber	303 Plastics	30 Petr.cl.T.Pr.	311 Fert.Pest.	31* Oth.ChePr	324 Cement	32* N.M.M.Pr.	330-332 IR+STL.	333-339 N.F.B.Met	34 Met.Man	35 N.El.Mach
1	Tools & Other Fixed As	0.060	0.034	0.009	0.016	0.005	0.029	0.058	0.109	0.019	0.042	0.194
2	Plant & Machinery	0.841	0.364	0.112	0.986	0.072	0.770	0.961	2.583	0.631	0.409	1.729
3	Transport Equipment	0.019	0.014	0.004	0.031	0.003	0.037	0.059	0.087	0.011	0.022	0.077
4	Building & Constructor	0.146	0.086	0.414	0.067	0.036	0.339	0.313	1.107	0.172	0.279	0.518
5	Land & Improvement to	0.016	0.005	0.016	0.031	0.015	0.045	0.090	0.068	0.026	0.147	0.093
	Estimated ICOR	1.082	0.503	0.556	1.131	0.129	1.221	1.466	3.954	0.859	0.810	2.584
	ICOR Minus Land	1.066	0.497	0.539	1.100	0.118	1.175	1.376	3.886	0.833	0.662	2.491

NOTE : The Table shows the Weighted Average Column for the Registered and Unregistered Sector Weighted by the Value of Output at current Prices in 1991-92

Table No. A 5. 10 conclud.

Sr.No.	Name of Asset Supplying Sectors	36	371-373	37*	38	40	41-42	74	Al.Indus
		El Mach	Rail Tr Eq	Ot.T.Eqp	Misc.Man	Electricity	Water S.Gas	Storage	
1	Tools & Other Fixed Asse	0.045	0.007	0.130	0.050	0.428	0.574	0.095	0.041
2	Plant & Machinery	0.384	0.205	1.117	0.236	3.718	4.239	2.622	0.496
3	Transport Equipment	0.018	0.005	0.044	0.016	0.039	0.050	0.169	0.016
4	Building & Construction	0.203	0.090	0.361	0.253	2.277	1.594	2.097	0.270
5	Land & Improvement to La	0.056	0.006	0.079	0.065	0.738	0.742	0.067	0.081
	Estimated ICOR	0.694	0.313	1.716	0.600	7.200	7.200	5.050	0.845
	ICOR Minus Land	0.636	0.307	1.637	0.534	6.462	6.458	4.983	0.856

**Table No.A 5.11 (a) Asset Wise Break up of Capital Stock for other Services.**  
[ As % of Total]

Sectors	Hotels & Rest...\$	Banking & Insur.\$	Storage *
Plant & Mach.	37.26	84.24	51.91
Trans. Eqp.			3.35
Oth. Fixed Assets	18.77	9.97	1.87
Cap. Work in Prog.	8.55	3.84	41.53
Land & Bldg.	35.42	1.96	1.33
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Table No.A 5.11 (b) Distribution of ICOR According to Above Proportions**

	Hotels & Rest...\$	Bank & Insur.\$	Storage *
Plant & Mach.	0.567	0.780	2.620
Trans. Eqp.	0.000	0.000	0.169
Oth. Fixed Assets.	0.286	0.092	0.094
Cap. Work in Prog.	0.130	0.036	2.096
Land & Bldgs.	0.539	0.018	0.067
<b>ICOR</b>	<b>1.523</b>	<b>0.926</b>	<b>5.047</b>

**Table No.A 5.11 (c) OTHER SERVICES**  
[Weighted Average of the Three Sectors]

	Hotels & Rest...\$	Banking & Insur.\$	Storage *	Other Services
Plant & Mach.	0.567	0.780	2.620	0.742
Trans. Eqp.	0.000	0.000	0.169	0.002
Oth. Fixed Assets	0.286	0.092	0.094	0.151
Cap. Work in Prog.	0.130	0.036	2.096	0.094
Land & Bldgs.	0.539	0.018	0.067	0.177
<b>ICOR</b>	<b>1.523</b>	<b>0.926</b>	<b>5.047</b>	<b>1.167</b>
<b>WEIGHTS @</b>	<b>15132</b>	<b>33939</b>	<b>723</b>	<b>49794</b>
<b>WGTS (%)</b>	<b>30</b>	<b>68</b>	<b>1</b>	

\$ Source: ICICI Portfolio 1992-93: Financial Performance of Companies; Table III - A, pp: 129

\* Storage: Source : Annual Survey of Industries, 1983-84 in Fifteen Volumes, Vol I.

@ Weights: The weights are value of output at current prices of 1991-92; Value in Rs Crores

**Table No.A 5.12 (a) Proportions for Distributing the ICORs of the Primary & Services Sectors**

Sec.	Name of Sector	1 Agricult	2 Forest	3 Fishing	4 * Mini Qu	29 Constr.	30 Electrici	31 Rail.Ser	32 Oth.tr.Se	33 Commua	34 Trade	35 Oth.Serv.
1	Agriculture & Allied											
2	Forestry & logging											
3	Fishing											
4	Mining & Quarrying											
12	Wood & Products								0.001			
22	Iron & Steel											
23	Non Ferr. Bas. Met.											
24	Metal Manufacture	0.215	0.223			0.121	0.062		0.001		0.114	0.125
25	Machinery	0.234	0.231	0.051	0.574	0.782	0.527	0.576	0.054	0.929	0.207	0.597
26	Rail Trans. Eqp.				0.001			0.377				
27	Other Trans.Eqp.	0.214	0.215	0.949	0.004	0.000	0.006	0.000	0.703	0.004	0.100	0.005
28	Miscell. Manuf.								0.002			
29	Construction	0.328	0.322	0.000	0.419	0.018	0.303	0.044	0.216	0.059	0.568	0.113
36	Land	0.008	0.008	0.000	0.002	0.079	0.103	0.003	0.023	0.008	0.011	0.160
	Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

**Table No.A 5.12 (b) Gross ICORs at constant Prices Allocated Among the Capital Goods Supplying Sectors for the Primary and Services Sector**

Sec.	Name of Sector	1 Agricult	2 Forest	3 Fishing	4 Mini Qu	29 Constr.	30 Electrici	31 Rail.Ser	32 Oth.tr.Se	33 Commua	34 Trade	35 Oth.Serv.
1	Agriculture & Allied											
2	Forestry & logging											
3	Fishing											
4	Mining & Quarrying											
12	Wood & Products								0.002			
22	Iron & Steel											
23	Non Fer Bas Metals											
24	Metal Manufacture	0.473	0.287			0.144	0.449	0.000	0.002	0.000	0.057	0.146
25	Machinery	0.515	0.298	0.120	3.987	0.927	3.789	4.395	0.115	6.410	0.103	0.696
26	Rail Trans. Eqp.	0.000	0.000	0.000	0.006			2.878				
27	Other Trans.Eqp.	0.471	0.276	2.220	0.030	0.000	0.040	0.000	1.497	0.026	0.050	0.006
28	Miscell. Manuf.								0.005			
29	Construction	0.721	0.415	0.000	2.910	0.022	2.180	0.337	0.460	0.404	0.282	0.132
36	Land	0.017	0.011	0.000	0.011	0.093	0.738	0.024	0.048	0.056	0.005	0.187
	Total	2.197	1.287	2.340	6.944	1.186	7.196	7.634	2.129	6.897	0.497	1.167
	ICOR minus Land	2.180	1.276	2.340	6.933	1.092	6.458	7.610	2.081	6.841	0.492	0.980

Note : For other Services ICOR is estimated as the Weighted Average of hotels, banking and storage sectors



**Table No. A 5.13 Finished Goods As Percentage Of Stocks 1991-92.**

Sector Code	Sector Name	F. G. % OF Stocks.
1	Agriculture #	52.13
4	Mining & Quarrying #	45.85
5	Sugar	90.21
6	Edible Oil	49.12
7	Oth Food Products	43.43
8	Cotton Textiles	40.87
9	Woolen Textiles Etc *	54.69
10	Jute Textiles Etc *	55.23
11	Ot.Text.Articles	33.32
12	W.Wood Products	38.70
13	Paper & Its Products	29.46
14	Leather & Its Products	38.33
15	Rubber & Its Porducts	50.57
16	Plastics & Products	31.62
17	Petroleum & Coal tar	41.54
18	Fertilisers& Pesticides	89.80
19	Chemicals	41.07
20	Cement	39.24
21	N.Met. Min.Products	46.41
22	Iron and Steel	61.81
23	N.F.B. Metals	29.78
24	Metal Manufacture	22.26
25	Machinery	31.67
26	Rail Trans Equipment	13.69
27	Oth. Trans Equiupment	n.a.
28	Misc. Manufacture	34.70

\* AVERAGE OF 1990-91 & 1992-93.

# These percentages are averages for the two years 1991-92 & 1992-93. They are taken from the .. data on capital in these sectors from RBI bulletin from the 'Balance Sheet of Industries'. For the remaining sectors, the data is from ASI, 1991-92 and 1992-93.

**Table No. A5.14 SECTOR CLASSIFICATION AND MATCHING WITH INPUT - OUTPUT TRANSACTION TABLE , 1991-92**

SR. NO	SECTORS IN THIS STUDY	INPUT-OUTPUT TABLE 1991- 92, 60 SECTOR	
		SECTOR NO	SECTOR NAME
1	Agriculture & Allied	1 to 12	Paddy, Wheat, Other Cereals, Pulses
			Sugarcane, Jute Cotton, Tea, Coffee,
			Rubber, Other Crops, Animal Husbandry
2	Forestry & Logging	13	Forestry & Logging
3	Fishing	14	Fishing
4	Mining + Quarrying	15 to 19	Coal + Lignite, Petro Crude, Iron Ore,
			Non.Metallic Minor Minerals
5	Sugar	20, 21	Sugar + Khandsari
6	Edible Oil	22	Hydrogenated oil
7	Food Products & Bev.	23	Other Food Products & Beverages
8	Cotton Textiles	24	Cotton Textiles
9	Wool, Silk, Synth.Text	25, 26	Wool, Silk, Synthetic Textile
10	Jute, Hemp Textiles	27	Jute, Hemp, Mesta Textiles
11	Other Textile Articles	28	Other Textile Articles
12	Wood + Wood Products	29	Wood + Wood Products
13	Paper + Paper Products	30	Paper + Paper Products
14	Leather + Products	31	Leather + Leather Products
15	Rubber & Rubber Prod.	32	Rubber & Rubber Products.
16	Plastics & PlastProducts	33	Plastics & Plastic Products
17	Petro + Coal Tar Prods.	34, 35	Petroleum Products, Coal Tar Products
18	Fertilisers & Pesticides	36, 37	Fertilisers, Pesticides
19	Other Chemical Prods.	38, 39	Synthetic, Fibre Resin, Other Chemicals
20	Cement	40	Cement
21	Non Metallic Min Prod	41	Non Metallic Mineral Products
22	Iron & Steel	42	Iron & Steel
23	Non.Ferro Basic Metals	43	Non.Ferros Basic Metals
24	Machine Tools	45	Machine Tools
25	El. + Non. El.Machinery	44, 46,	Tractors & Agri. Mach., Other N.Elec. Mach.

Table No. A5.14 conclud.

SR. NO	SECTORS IN THIS STUDY	INPUT-OUTPUT TABLE 1991-92, 60 SECTOR	
		SECTOR NO	SECTORS NAME
25	El. + Non. El.Machinery	47, 48,	Electrical Machinery, Communication Equip
		49	Electronic Equipment
26	Rail Transport Equip.	50	Rail Transport Equipment
27	Other Transport Equip.	51,52	Motor Vehicles, Other Transport Eqp
28	Other Manufacturing	53	Other Manufacturing
29	Construction	54	Construction
30	Electricity	55	Electricity
31	Rail Transport Services	56	Rail Transport Services
32	Other Transport Services	57	Other Transport Services
33	Communication	58	Communication
34	Trade	59	Trade
35	Other Services	60	Other Services

Note: The 1991-92 A matrix is from GOI, Planning Commission (1995): Technical Note to the Eighth Plan.

Table No. A5.15

**SECTOR CLASSIFICATION AND MATCHING WITH  
INPUT - OUTPUT TRANSACTIONS TABLE , 1983-84**

SR. NO	SECTORS IN THIS STUDY	INPUT-OUTPUT TABLE 1983-84 , 60 SECTOR	
		SECTOR NO	SECTORS NAME
1	Agriculture & Allied	1 to 5	Food Crops, Cash Crops, Plantation Crops
			Other Crops, Animal Husbandry
2	Forestry & Logging	6	Forestry & Logging
3	Fishing	7	Fishing
4	Mining + Quarrying	8 to 11	Coal + Lignite, Petro Crude, Iron Ore, Other Minerals
5	Sugar	12	Sugar + Khandsari
6	Edible Oil	13	Hydrogenated oil
7	Food Products & Bev.	13* to 15	Other Food Products & Beverages
8	Cotton Textiles	16	Cotton Textiles
9	Wool, Silk	17	Wool, Silk, Synthetic Textile
10	Jute, Hemp Textiles	18	Jute, Hemp, Mesta Textiles
11	Other Textile Articles	19	Textile Products incl. Wearing Apparel
12	Wood + Wood Products	20,21	Wood + Wood Products, Furniture & Fixtures
13	Paper + Paper Products	22,23	Paper + Paper Products, Printing & Publishing
14	Leather + Leather Prod.	24	Leather + Leather Products
15	Rubber & Plastic Prod.	25	Rubber & Plastic Products.
16	Plastic Products	n.a.	n.a.
17	Petro + Coal Tar Prod.	26,27	Petroleum Products, Coal Tar Products
18	Fertilisers & Pesticides	30,32	Fertilisers, Pesticides
19	Other Chemical Prod.	28,29,31	Organic & Inorganic Chemicals, Other Chem.
20	Cement	33	Cement
21	Non Metallic Minl Prod	34	Non Metallic Mineral Products
22	Iron & Steel	35	Iron & Steel
23	Non.Ferr Basic Metals	36	Non.Ferros Basic Metals
24	Machine Tools	37	Metal Prods. Except Mach. Transp Equipment
25	Electrical + Non Electri Machinery	38,39,	Agriculture Machinery., Machinery for food and text.industries;
			40,41

Table No. A5.15 conclud.

SR. NO	SECTORS IN THIS STUDY	INPUT-OUTPUT TABLE 1983-84, 60 SECTOR	
		SECTOR NO	SECTORS NAME
26	Rail Transport Equip.	42	Rail Transport Equipment
27	Other Transport Equip.	43	Motor Vehicles, Other Transport Equip
28	Other Manufacturing	44	Other Manufacturing
29	Construction	45	Construction
30	Electricity	46,47	Electricity, Gas and Water Supply
31	Rail Transport Services	48	Rail Transport Services
32	Other Transport Serv.	49	Other Transport Services
33	Communication	51	Communication
34	Trade	52	Trade
35	Other Services	50,53,	Storage & Warehousing, Hotels & Restaurants, Banking, Insurance.
		54 to 60	Ownership Of Dwellings; Educational, Medical & Health Services; Other Services, Public Administration and Defence.

Note : \* indicates the residual sectors..i.e. 13th sector comprises of edible oil and other food products. 13\* indicates other food products except edible oil. The A matrix for 1983-84 has been taken from GOI, CSO (1990) : Input-Output Transactions Table 1983-84.

**CHAPTER SIX**  
**THE MAXIMUM RATE OF BALANCED GROWTH**

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## 6.1 INTRODUCTION

Having estimated the 'B' matrix for India, we now try to see in this chapter, the technical capacity of the economy. The technical capacity can be seen by the current production relations as shown by the A matrix and the capital relationships as shown by the B matrix. Given these two technical limits we try to assess what is the maximum possible growth rate the economy can achieve. This maximum possible growth rate can change if these limits of the economy change e.g. the economy becomes more or less efficient.

In this chapter we examine the concept of this maximum possible growth rate based on the technical relationships existing in the economy; Section I gives a brief theoretical review on this. In section II we examine this growth rate as it emerges in the static and dynamic versions of the Input-Output model; Section III puts forth the available empirical estimations of this in literature and also gives the results of this study; a comparison of the two is done. Section IV looks at the Investment implications of following a high growth programme; we see the changes that have taken place in the requisite investment mix for a high growth programme over the years.

### 6.1.1 THE DYNAMIC INPUT-OUTPUT SYSTEM

The problems of dealing with a closed system in the dynamic set up have been addressed by Leontief (Leontief, 1954 p 58; Ch. 3; Static and Dynamic Theory). If the additional output capacity required is given by the vector  $\Delta X$ ; then the capital stock required to be able to produce this would be given by,

$$B \Delta X$$

Adding to the static equation: we get

$$X - Ax - B \Delta X = F$$

$\Delta X$  signifies a change/increase in X, if we want it grow at a rate of  $g$ ;

$$X - AX - BgX = F$$

$$X = [I - A - gB]^{-1} F$$

This is the dynamic input-output model as put forth by Leontief. This incorporates the economic growth rate 'g' and it makes investment an endogenous variable. Thus investment depends upon the capital structure of the economy as shown by the B matrix and the required growth of the final demand 'g'. Here we are talking of purely requirements of investment for a given growth programme.

### 6.1.2 BALANCED GROWTH IN THE DYNAMIC LEONTIEF SYSTEM

The Leontief Dynamic System can for every time period 't' be written

as

$$X_1 = a_{11} X_1 + a_{12} X_2 + \Delta S_1 + C_1$$

$$X_2 = a_{21} X_1 + a_{22} X_2 + \Delta S_2 + C_2$$

$$S_1 = b_{11} X_1 + b_{12} X_2$$

$$S_2 = b_{21} X_1 + b_{22} X_2$$

$$\Delta S_1, \Delta S_2, X_1, X_2 \text{ all } \geq 0$$

This can be written as

$$X = AX + \Delta S + C$$

$$S = BX$$

According to Dorfman, Solow, Samuelson: "In the interesting Malthus - von Neumann case in which all consumption is zero, we can prove that there will always exist one and only one relative configuration of initial stocks that will permit all capacities to grow at the same percentage rate with no excess capacity. Hence in the special Leontief technology there must be such a mode of balanced growth. We can go further and prove that this positive rate of balanced growth is the greatest rate of growth of which the system is capable. This means : Suppose there is an initial configuration of stocks such that the system can increase each stock at a relative rate at least equal to, say, and some stocks at a greater rate; then is smaller than the unique rate of balanced growth described above" (Dorfman et al 1958,p. 296)

### 6.1.3 THE VON NEUMANN GROWTH RATE

J. von Neumann put forth a Model of General Economic Equilibrium,<sup>1</sup> (J.von Neumann 1945) where he put forth a rigorous mathematical proof of the existence of an efficient, greatest technically feasible solution of an economic system, i.e. the existing of a "greatest (purely technically possible) factor of expansion of the whole economy." (Champernowne 1945,p. 10)

The assumptions on which his model is based (J. von Neumann 1945, p 1) are close to the I-O model. Thus, the proof that such a maximal growth rate of the economy exists was given. Of course this would operate if all real life transactions were based as shown by the purely technical relationships as shown in the model. However, even if we concede that reality may never be akin to that (like a friction less economy), the knowledge of this maximal growth rate would be interesting.

For empirical analysis what would be of interest is : What is the maximal or Von Neumann growth rate for the Indian economy and how does the economy reach it in the shortest possible time?

### 6.1.4 THE VON NEUMANN MODEL

Explaining the von Neumann General Equilibrium Model, Dorfman et al, say that it generalizes the Leontief production model in two ways - one it permits joint production and second - it relaxes the assumption of a fixed ratio of inputs to output. (Dorfman et al, 1958, p 300). They go on to explain the generalization by relaxing only the second assumption. Commenting on Balanced Growth Path, the authors say, "To summarize: Malthus-Cassel-Harrod balanced growth is always possible but always inefficient, with one important exception. Every composition of capital has its own possible rate of steady growth. One and only one configuration has the largest possible rate. Call this the von Neumann rate (since he was the first to study this problem, although not in these terms). The von Neumann path is always efficient, whenever initial stocks are in the right proportion. It is the only steady growth path

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<sup>1</sup> The Von Neumann model is explained in Champernowne (1946) 'A model of Economic Equilibrium' in Review of Economic Studies, Vol.13(1),pp 10-18; in Dorfman et al ( 1958)



that is ever efficient. Of course there are many other non balanced efficient paths emanating from the same initial conditions." (Dorfman et al 1958 p 329)

They further add, "But maximal steady growth, growth at the von Neumann rate and particular proportions is special. For one thing it is efficient. In fact, even more is true. In the very long run, maximal balanced growth is in a sense the best way for the economy to expand. Thus, in an unexpected way, we have found the normative significance for steady growth - not steady growth in general, but maximal von Neumann growth. It is in a sense, the single most effective way for the system to grow, so that if we are planning long run growth, no matter where we start and where we desire to end up, it will pay in the intermediate stages to get into a growth phase of this kind. It is exactly like a turnpike paralleled by network of minor roads. There is a fastest route between any two points; and if origin and destination are close together and far from the turnpike, the best route may not touch the turnpike. But if origin and destination are far enough apart, it will always pay to get on to the turnpike and cover distance at the best rate of travel, even if it means adding a little mileage at either end. The best intermediate capital configuration is one which will grow most rapidly; even if it is not the desired one, it is temporarily optimal". (Dorfman et al 1958 p 331). The next section gives the proof.

The authors (Dorfman et al) discussing the dynamic Leontief system; its closed version setting consumption as zero, work out the balanced efficient growth path. Commenting on this growth path emerging from the Leontief's dynamic model, they say "This special steady growth path has all the same distinguishing characteristics as the "von Neumann path," that we studied earlier. Indeed the correspondence is quite exact. The maximal steady growth path plays the same role in the Leontief technology as in the neo classical." (Dorfman et al 1958 p 344.) They contend that "in the special Leontief technology there must be such a mode of balanced growth. We can go further and prove that this particular positive rate of balanced growth is the greatest rate of growth of which the system is capable." (Dorfman et al 1958,p.296.) They further state," We have proved that every "normal" dynamic Leontief system

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Linear Programming and Economic Analysis, pp 300-305 and in Brody Andras (1970)

has one initial relative configuration that can continue to satisfy all the equalities of (11-29), and in fact does so by generating steady, balanced growth." (Dorfman 1958,p. 297) . However, having said this, the authors go ahead to prove in the next paragraph that the Leontief dynamic system is indeterminate. They say "Leontief systems are as often as not such that the slightest disturbance of initial conditions away from the razor's edge of balanced growth will necessarily result in a growth of capitals that will ultimately either (1) violate the requirement that  $\Delta S_i \geq 0$  or (2) require us to replace by inequalities one or more of the equalities ....." This means that the growth rate may not be a balanced one or steady state, because if a slight disturbance, will necessitate that  $\Delta S_i < 0$ , meaning that no investment or disinvestment will have to take place. And according to the authors, Leontief assumes that  $\Delta S_i$  should never be negative. (Dorfman et al 1958 p.297)

The authors, Dorfman et al , further contend, "The path so defined (as long as a path is defined) is just one among many possible and efficient paths. The point of our present discussion is that the dynamic Leontief system is causally ambiguous and hence there is no simple way of deducing the behaviour of the system. To repeat for emphasis: Recognition of the prominent role played by the inequalities in (11-27) and (11-29), reveals the Leontief dynamic system to be causally indeterminate and incomplete, even if we postulate complete technological non-substitutability. (Dorfman et al 1958 p.298) Leontief's own procedure, as we have remarked is to insist on equalities and determinance. Numerical examples like ours above indicate that sometimes these "Leontief trajectories" (defined by always moving to the vertex point) arrive at an impasse. They insist that some  $S_i < 0$  which is contrary to assumption. Even if we were to relax the assumption and permit decumulation, this would only postpone trouble, since eventually many Leontief's trajectories would lead to some  $S_i$  itself being negative and this is clearly nonsensical". ( Dorfman 1958,p.298)

Mathur (Mathur,1965) modified the basic Leontief dynamic I-O model and proved it to be stable. Mathur has cleared the doubt raised by Dorfman et al., about the

Leontief dynamic system being unstable. Mathur explains in his article that the doubts about the instability of the dynamic system arose because of a minor slip in the original presentation of the model by Leontief. He says that Leontief puts an assumption about not letting  $\Delta X_i < 0$  which according to him is not necessary at all. In his words, ".....the difficulties have arisen due to an oversight in the first presentation of the model in which the constraint imposed by the non negativity of output was not allowed to sully the mathematical grandeur of the whole conception". ( Mathur 1965, p.326)

According to Mathur, "In his original presentation (6), the Leontief dynamic model was designed to explain the working of the actual economy. The open trajectories were supposed to be exogenously given while the closed trajectories represented the working of the residual system in an endogenous fashion". ( Mathur 1965, p 330.) Further, he shows that out of 'n' closed Leontief trajectories (n-1) are non feasible. "Residuals cannot be taken care of by the closed trajectories in the Leontief Dynamic I-O System. It has to be taken care of by extra open trajectories. That is always possible, for the growth of residuals at zero rate of growth is one of the available solutions. ( Mathur 1965 p 330) This means that if due to a bottleneck in case of some commodity some other commodities remain unutilised by the model, they should be left out as residuals. Where as in his original scheme, Leontief said that there should be no excess capacity. This led to the model not giving a maximal growth rate which was steady. However, with Mathur's modified interpretation of the dynamic I-O system, a maximal growth which is stable can be found for a real life economy.

Dorfman et al have themselves pointed out why the Leontief system is indeterminate. They say "Leontief's own procedure, as we have remarked, is to insist on equalities and determinacy. But from all that has gone before, it is clear that there is no real economic reason to insist on equalities". (Dorfman et al 1958 p. 98). This is exactly what Mathur says and with relaxing this assumption of strict equalities(i.e. non-negativity of output) and permitting excess capacity where Leontief did not he has proved that Leontief system after these modifications is stable and has a maximal steady growth path in his article. (Mathur 1965 )

### 6.1.5 MATHUR'S MODIFIED VERSION OF THE LEONTIEF DYNAMIC I-O MODEL<sup>2</sup>

$$X = AX + F$$

$$X - AX = C + K; \quad K = gBX$$

$$X - AX = C + gBX$$

$g$  = growth rate

$B$  = Capital Coefficient Matrix

$F$  = all final demand

$X$  = gross output

$K$  = Investment

$C$  = final consumption

$$[I - gB(1-A)^{-1}]X = C \quad (I)$$

$$\text{OR } X = [I - gB(1-A)^{-1}]^{-1}C \quad (II)$$

Equation II means that for any pure consumption vector 'C' to grow at a rate of 'g', 'X' amount of output will be required. Now to try and see the maximum balanced growth in the model, we consider (I). Maximum growth in a system is defined when consumption is zero or in other words, all surplus generated is reinvested within the system.

$$[I - gB(1-A)^{-1}]X = C$$

Putting  $C = 0$

$$[I - gB(1-A)^{-1}]X = 0 \quad (III)$$

This is akin to the eigen equation. For e.g. the eigen equation for the A matrix would be written as

$$[\lambda I - A]X = 0$$

where  $\lambda$  is the eigen value of the equation and X is the eigen vector.

Consider III again :

$$[I - gB(1-A)^{-1}]X = 0$$

Putting  $g = 1/\lambda_i$

$$[I - \frac{1}{\lambda_i} B(1-A)^{-1}]X = 0$$

$$[\lambda_i I - B(1-A)^{-1}]X^* = 0$$

<sup>2</sup> This is given in Mathur 1967 p.110-112.

Here  $\lambda_i$  is the eigen value of the matrix  $B(1-A)^{-1}$  and  $X^*$  is the eigen vector. If the greatest eigen value  $\lambda^*$  of  $B(1-A)^{-1}$  is say '5' then the maximum possible balanced growth rate will  $1/5 = 20\%$ . What is the meaning of this? It means that the system will be convergent only if  $g_i \leq 1/\lambda^*$ . It means that if  $g_i \geq 1/\lambda$  then the system will become explosive and no solution will be found.

For e.g. If  $g > 1/5$ ;  $\lambda = 5$

$$g > 20\%$$

Suppose.  $g = 25\%$

$$\text{then } [I - g_i B(1-A)^{-1}] X^* = 0$$

the second term in the bracket on the LHS will not be convergent.

Thus, we see that there is a maximal balanced growth. What is the path to attain this growth? Here there are two aspects. One - the structure and second, the level of investment to be adopted in order to reach this growth rate. The structure or the proportions of the various goods is shown by the eigen vector  $X^*$ . This is the only proportion which will ensure the maximum possible  $g^*$ . About the level of investment - that depends on the availability of capital goods (whether domestic or imported) in the economy. What the planner can do is - given the eigen vector  $X^*$ , the level of this maximal growth generating vector must be increased as much as possible - so that the maximum growth can be achieved in the least time.

Suppose

$$CX^* \text{ where } C \text{ is a scalar.}$$

To increase  $C$  as much as possible so that

$$CX^* < Y^*$$

where  $Y^*$  is the surplus available for investment after meeting the minimum requirements of the economy like consumption, exports.

What role does trade play in this? Historically, the two gap models of development stress on two obstacles to development - savings and foreign trade. Thus, foreign trade can be used to fill the gap which will ensure that a high growth programme is not abandoned for want of resources domestically.

Consider,

$$Y^* - CX^* = Z^*$$

where  $Z^*$  is a vector showing the pure surplus of the economy. This is the surplus that remains after meeting consumption requirements and investment for high growth. Thus,  $Z^*$  can be exported. However, some elements in  $Z^*$  may be negative showing a greater demand by the economy than its available resources can satisfy. These will have to be imported. Thus, we get a trade vector as a residual from the model - showing the domestic resource gap.

This is the dynamic model of Leontief in its modified version as put forth by Mathur. We will attempt to test Indian data for the modified version as put forth by Mathur (1965). Mathur basically made Leontief's investment allocations in a more open setting. Where as Leontief put the condition that the maximal growth be defined based only on the (domestically) available resources, such that all resources are exhausted; Mathur on the other hand implicitly introduced the trade sector as the balancing item and defined maximum growth to be defined as that based on available resource of any one sector (the level) and the rest to be adjusted by means of foreign trade. Thus, a growth programme in Mathur's version is feasible with the help of some imports, where it would not be so in Leontief scheme.

Mathur also relaxed the restrictive assumption by Leontief that in a maximal growth programme, all the resources available were to be exhausted. Leontief did not allow for any residual. Mathur relaxed this assumption/restriction and allowed for a residual to exist which he termed as exportables. These goods if to be used in the maximum growth programme, would require too much of other goods- more than the domestic production and a permissible level of imports could allow. So, he said these goods were naturally surplus and should be used as exports.

In brief, Mathur took the Leontief dynamic I-O system one step further by : Relaxing two restrictive assumptions which are difficult to hold good in real economies and thereby also proved that the maximum growth emerging from this model was very much stable. Secondly, with the same relaxation, he introduced the trade sector in the framework. Because of this the model has come even closer to depicting real life

economy. No economy in contemporary times can remain a closed economy, even if it has the technology and resources to produce all that it requires. In today's complex world, all economies are becoming more and more interdependent. Thus Mathur's modified Leontief Dynamic Input-Output model is even more applicable presently.

## 6.2 G\* IN THE STATIC AND DYNAMIC MODELS

In the following section we explain the derivation of the relationship between the growth rate "g" and the highest eigen value in the static as well as the dynamic I-O model.

### 6.2.1 The Static Model:

Consider,

$$X - AX - gAX = C$$

$$X - (1+g)AX = C$$

$$[I - (1+g)A]X = C \quad \text{Putting } (1+g) = k$$

$$[I - kA]X = C$$

$$[1/kI - 1/k(kA)]X = C$$

Setting  $C = 0$ , to set all surplus equal to zero.

$$[1/kI - 1/k(kA)]X = 0 \quad \text{Putting } 1/k = \lambda$$

$$[\lambda I - A]X = 0$$

This is nothing but the eigen equation of the matrix A, with  $\lambda$  as the eigen value and X as the eigen vector. Now suppose  $\lambda^*$  is the highest eigen value of all  $\lambda_i$ 's; then

$$\lambda^* = 1/k \quad \text{and} \quad k = (1+g^*)$$

Hence,

$$g^* = 1/\lambda^* - 1.$$

### 6.2.2 The Dynamic Model

Here instead of the AX matrix growing by a growth rate of g, the investment is endogenised and the growth rate is attached to the capital coefficient matrix.

Thus,

$$X - AX - gBX = C$$

$$(I - A)X - gBX = C$$

$$[(I - A) - gB]X = C$$

$$[I - g(I - A)^{-1}B]X = C$$

$$[1/g I - (I-A)^{-1} B] X = C$$

Putting  $1/g = \lambda$

$$[\lambda I - (I-A)^{-1} B] X = C$$

Putting  $C = 0$  to render the system closed or to plough back all the surplus into the system,

$$[\lambda I - (I-A)^{-1} B] X = 0$$

Now this is the eigen equation for the matrix  $(I-A)^{-1} B$ , derived from the dynamic I-O system; where  $\lambda$  is the eigen value and  $X$  is the eigen vector.

Consider  $\lambda^*$  as the highest eigen value, then

$$\lambda^* = 1/g^*$$

$$\text{Therefore } g^* = 1/\lambda^*$$

Thus we see from the above that the static and the dynamic model would lead to different definitions of the maximal growth rate and hence different estimates. A numerical example of a simple 2 by 2 sector economy shows that the resulting eigen growth rate is bound to differ in the two cases. To illustrate the maximum possible steady growth rate concept in the dynamic Input-Output system, we give an example taken from Brody, Andras 1970 p 114.<sup>3</sup>

$$A = \begin{matrix} 0.2 & 0.3 \\ 0.2 & 0.3 \end{matrix}$$

$$B = \begin{matrix} 0.5 & 2.0 \\ 0.5 & 2.0 \end{matrix}$$

$$B = \begin{matrix} 0.5 & 2.0 \\ 0.5 & 2.0 \end{matrix}$$

$$B = \begin{matrix} 0.5 & 2.0 \\ 0.5 & 2.0 \end{matrix}$$

The eigen values of the matrix " $(I-A)^{-1} B$ " are 5 and 0. Hence the maximum possible growth rate for this system is  $1/5 = 0.2$  or 20 %. He does not find the eigen value of the "A" matrix alone. If we do that the eigen values come out to be : 0 and 0.5. Hence the maximum possible growth rate considering only the "A" matrix will be :

$$1/0.5 - 1 = 1 \text{ or } 100 \%$$

While estimating the maximum possible growth rate the practice is to

<sup>3</sup> Note: Another illustration is given in the Appendix to this chapter, Annexure 6.1 p.185.



augment the matrix for which the eigen value is being estimated, by the household sector. We see this in Brody's work (Brody, 1958 p153 ). He discusses the closed I-O model and the actual computations. Here he takes a 7 by 7 sector economy where the seventh sector is the household sector. This is done so that the eigen value and therefore the resultant growth rate obtained is a feasible concept. Without including some minimum consumption requirement in the matrix, the growth rate would tell us by how many times the economy can replicate itself. This is of little use because no economy will ever plough back all its output available for final use into the economy, to enable the economy to grow. Hence inclusion of the Household sector or some minimum level of consumption is essential.

### 6.3 AUGMENTATION IN THE STATIC AND DYNAMIC I-O MODELS

#### *THEORETICAL ISSUES*

When working in the static 1-0 model, i.e. using the 'A' matrix alone, the closed system is written as:  $(1-A)^{-1} X=0$  This is the equation for deriving the maximal balanced growth rate,  $g^*$ . Here, the matrix A used is the augmented A, Where,

$$\text{Augmented } A = A' = \begin{matrix} A & C \\ V & O \end{matrix}$$

where, A = input/output coefficient matrix,

C = consumption coefficient vector and

V = value added coefficient vector.

The augmented A is used in the closed system to enable the endogenising of the minimal requirements of the economy as shown by consumption and value added. A takes into account all possible current demands made by the economy on its output namely, intermediate consumption (shown by AX), final consumption (shown by C) and remuneration to labour (as shown by L).

In case of the A' matrix, the augmented 'A' matrix is used, where consumption is endogenised in the n+1th column, and the labour input in the n+1th row.

If A used is augmented A\*, then B has to also be augmented, otherwise they will not be compatible for multiplication. Since the matrix  $B(I-A)^{-1}$  is involved, the order of both 'A' and 'B' to be the same.

### 6.3.1 The Dynamic Model

In the dynamic model, the eigen equation for the maximal growth rate is given <sup>4</sup>

$$[\lambda I - (1-A)^{-1}B]^{-1} X = 0$$

So, the matrix for which the eigen value is to be computed is “ $(1-A)^{-1}B$ .” Here, investment which was left outside the model in the static framework is endogenised in the form of the “ $B$ ” matrix. In a closed model, it is necessary that consumption, value added be endogenised, because it is essential to endogenise the known and predictable demands made on the available output. Here, it is possible to make the augmentation only once, i. e. first estimate

$(1-A)^{-1}B = D$  and then augment  $D$  so that

$$\text{Aug. } D = \begin{bmatrix} D & C \\ V & O \end{bmatrix}$$

It is possible to consider augmenting of  $A$  and  $B$  separately and then computing  $(1-A)^{-1}B$ . According to Leontief<sup>5</sup> consumption expenditure on consumer durables can be used to augment the ‘ $B$ ’ matrix. Leontief has given a suggestion in his studies on Structure of Augmented Economic "Static and Dynamic p 58)...." "The components of final demand  $Y_1, Y_2$  .....for the purposes of dynamic analysis be described in terms of two sets of parameters - the flow coefficient  $a_{1n}-a_{2n}$  and the stock coefficients,  $b_{1n}$  ....the latter determine consumer's investments in housing, automobiles, household appliances and all other kinds of durables and "storables".

Using this argument we can say that if ‘ $C$ ’ is the total consumption vector and  $C_{ND}$  and  $C_D$  are the consumer non-durables vector and Consumer Durables Vector respectively, where,

$$C = C_D + C_{ND}$$

Then,

$$\text{Augmented } A = A' = \begin{bmatrix} A & C_{ND} \\ V & O \end{bmatrix}$$

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<sup>4</sup> Derivation has been explained earlier on pp 158

and augmented  $B = B' = [ B \quad C_D ]$

Thus, we see that the consumption vector can be separated and added to A and B. However, what about endogenising the row vector of value added? How is this to be augmented in the 'B' matrix? Available literature does not address this issue. The following suggestion can be made

If value added comprises the remuneration to factors of production like labour, capital, land and entrepreneurship, then we can segregate the factors which are in nature like a current input and those which are in nature like a capital asset. The remuneration to those whose nature is akin to a current input can be used to augment the A matrix and which are of a fixed capital asset can be used to augment the 'B' matrix. We can treat labour as a current input and the remaining as a fixed capital assets.

Thus, if  $V = \text{Total Value Added}$

Then

$V = W + R + I + P$  where

$V = \text{Value Added}$

$W = \text{Wages and Salaries}$

$R = \text{Rent}$

$I = \text{Interest}$

$P = \text{Profits}$

Then  $V_1 = W$

and  $V_2 = R + I + P$

We can thus bifurcate the total Value Added into  $V_1$  and  $V_2$ ;  $V_1$  can be used to augment A and  $V_2$  to augment B. Thus

$$A' = \text{Augmented A} = \begin{matrix} A & C_{ND} \\ V_1 & 0 \end{matrix}$$

and

$$B' = \text{Augmented B} = \begin{matrix} B & C_D \\ V_2 & 0 \end{matrix}$$

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<sup>5</sup>See Leontief (1953): "Dynamic Analysis in Leontief W. (Ed.): Studies in the Structure of the United States Economy New York OUP pp 58 ... Its structural prop..... the flow coefficients

## DATA

The data available in the Input-Output Transactions Table does not segregate C into  $C_{ND}$  and  $C_D$  nor does it segregate Value Added into W, R, I and P.

### 6.3.2 CONSUMPTION:

The NAS Sources and Methods 1989 gives classification of consumers goods into Durables and Non-durables. The classification gives 3 categories of goods- durable, semi-durable and non-durable and services. We need to classify all the goods into only 2 main categories- durables and non-durables. The problem is of placing the semi-durables like clothing, footwear, etc. From the list it is obvious that the goods that fall in the category of semi-durables, though of a semi-durable nature, will be clubbed together with the non-durables for our purposes.

For the present purpose, to augment the 'B' matrix, we need a column of consumption, which is capital in nature i. e. consumer goods which are like capital goods in nature. If we look at all the list, only the durable goods can be said to be of a fixed capital nature. Semi-durables are not of a capital nature even if they are not perishables. So, they will not be included in the capital consumption column =  $C_D$ . They will be clubbed with non-durables and will be used to augment the A matrix as items of Current Consumption =  $C_{ND}$ .

In the consumption vector, the consumption of the following sectors can be allotted to  $C_D$  : Wood and Wood Products, Machinery, Other Transport Manufacturing, Miscellaneous Manufacturing and Construction .

### 6.3.3 VALUE ADDED :

The data available gives gross value added for all the sectors for the years for which the 'A' matrix is available. This total value added has to be divided into  $V1 =$  Wages and Salaries and the rest =  $V2$ ; for all the sectors.

Statement 76.1 of the NAS gives: Factor Incomes by kind of Economic Activity. This gives data on Compensation to the Employees, Operating Surplus, and Mixed Income

and Net Domestic Product for all the major sectors of the economy. The proportions of the particular year will be used to divide the total Value Added into V1 & V2.

Thus

V1 = Compensation to Employees

V2 = Operating Surplus and Mixed Income

**Operating Surplus:** is defined as "Gross Output at producers' value less the sum of transformed intermediate consumption compensation of employees (including labour income of self employed) consumption of fixed capital and indirect taxes reduced by subsidies." Thus Operating Surplus is nothing but profits. ( NAS: Sources and Methods 1989; p 305)

**Mixed Income of Self Employed:** is defined as "This consists of wage income of own account workers and profits and dividends of unincorporated enterprises. This form of income has been specifically defined for India as the breakdown of the two components viz. the income of own account workers and profits etc., is not available separately." ( NAS: Sources and Methods 1989; p 305)

This means that MI includes all- wages, rent, profits and interest earnings of self employed people. So, if we allocate all of OS/Mi to the capital matrix, it would not be perfectly correct. However in the absence of any finer disaggregation available it is justifiable to segregate V into V1 and V2 such that

V1 = Compensation to Employees

V2 = Residual Value Added = Operating Surplus plus mixed Income.<sup>6</sup>

## 6.4 EMPIRICAL ESTIMATION IN THE STATIC AND DYNAMIC VERSIONS OF THE INPUT-OUTPUT MODEL

### 6.4.1 Empirical Evidence

In the available empirical exercises, Francis Seton (Seton, 1985) has computed these eigen growth rates for several economies like U.K, Japan, USA. The results are interesting but not strictly comparable because the years are different for different countries, the I-O tables used are at varying levels of sophistication. A point to note

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<sup>6</sup> Source: NAS: Sources and Methods 1989 pp: 305 Appendix 19.2 Items classified by Type of Goods.

however is that he does not mention whether the eigen values so computed are based on the "A" matrix alone or on the "(I-A)<sup>-1</sup> B". He defines the maximal growth rate  $\sigma^*$  as

$$\sigma^* = \frac{1}{\lambda^*} - 1 \quad \text{"where } \lambda^* \text{ is the highest eigen value of the cost norm matrix"} \quad (\text{Seton 1985,p.117})$$

From the definition, it appears that Francis Seton works with the "A" matrix alone. His results are given below.

**Table No. 6.1 The Maximum Rate of Balanced Growth Rate**

	Country	No.of Sectors	Year	Maximal Growth Rate (%)
1	Czechoslovakia	40	1973	50.47
3	Austria	54	1964	16.90
4	USA	76	1967	16.00
5	Sweden	35	1969	15.66
6	Yugoslavia	29	1972	11.05
7	Fed.Rep.Germany	44	1970	9.93
8	Japan	60	1970	9.60
9	USSR	56	1972	4.77
10	United Kingdom	60	1972	3.87
11	United Kingdom	73	1963	2.71

Source : Seton Francis (1985) PP 117.

An empirical exercise of this kind has been attempted for the Indian economy by Dhanmanjari Sathe (1996). She computes the eigen growth rates for the Indian economy for six years from 1950 to 1983-84. Her results are given below.

**Table No. 6.2 Maximum Rate of Balanced Growth Rate For India**

Year	Maximum Rate of Balanced Growth(percent p.a)
1951-52	9.04
1959	9.38
1968-69	10.91
1973-74	12.83
1978-79	13.95
1983-84	13.55

Source : Sathe Dhanmanjiri (1996) : Balanced Growth & Foreign Trade

#### 6.4.2 RESULTS OF THE PRESENT STUDY

Although it is possible to separate consumption and value added into current and capital, it is seen that augmenting A and B separately does not give a solution. Therefore we have done the following: Since we need to find the eigen value of the matrix  $(I-A)^{-1} B$ , we can estimate this matrix using the unaugmented "A" and "B". Once this matrix, let us call it 'E', is estimated, we can augment the matrix "E". Therefore in this case now the consumption is endogenised, investment is endogenised and value added is endogenised. Thus output minus this matrix would give the surplus present in the economy.  $E = (I-A)^{-1} B$

Augmented E =  $\begin{bmatrix} E & C \\ V & 0 \end{bmatrix}$

where C=Consumption V = Value added.

And we estimate the eigen value and eigen vector of this augmented matrix "E".<sup>7</sup>

**TABLE NO 6.3 The Maximum Rate Of Balanced Growth For India :  
Results Of The Present Study Using The Dynamic  
I-O Model (in % per annum)**

Sr no.	Year	Eigen Value	Growth Rate
1	1983-84	5.4760	18.26
2	1989-90	5.8106	17.21
3	1991-92	5.5093	18.15
4	1994-95	5.1841	19.29

Note: Growth Rate has been computed using the dynamic I-O model and using the matrix  $E = \begin{bmatrix} (I-A)^{-1} B & C \\ V & 0 \end{bmatrix}$

where C = Pvt. Consumption  
V = Total Value Added

The matrices have been adjusted for Prices of relevant years. The A matrix for 1989-90 is a draft version prepared by the CSO.

The results show that the maximal possible rate for all the years is around 18% to 19%. The rate shows marginal differences during the time period. It shows a decrease from 1983-84 to 1989-90, an increase from 1989-90 to 1991-92 and again an increase in 1994-95. It is possible that the year 1991-92 being a negative growth year, the growth rate shows a decline. It is possible that the growth rate actually has an overall increasing trend even if the increase is marginal. Due to unavailability of the "A" matrix at a greater frequency, we are unable to verify this empirically.

<sup>7</sup> This procedure is followed i.e. endogenising consumption, value added in the form of the household sector by Brody, A 1970 p.154-158.

Comparing this with Sathe's results., we see that she got the maximal growth rate in 1983-84 as 13.55%. She has used only the augmented A matrix. One would expect that a growth rate computed using only the A matrix would be much higher than that got by using  $B(I-A)^{-1}$ <sup>8</sup>. However, here we see that for the common year, 1983-84, Sathe gets a growth rate estimate of 13.55 % using the A matrix and we get the growth rate as 18.26 using the  $B(I-A)^{-1}$ . This is indeed a puzzling result. It could be due to the following reasons. First and foremost, the sectorization in both the studies is different. She uses a 18 sector model we have used a 35 sector model. It may be possible that the result is sensitive to the level of aggregation. Secondly, Sathe has left out the construction and services sector in her matrix..

This maximal balanced rate of growth for the Indian economy works out to approximately 18 % p.a. The Indian economy has never really experienced this high a growth rate. However, this does not mean that the growth rate obtained from the model serve no purpose. As is experienced for other countries, this eigen growth rate is always very much higher than the actual growth rate achieved by their economies. In a model, things happen automatically, as in a frictionless state; there are no institutional factors which impede the working. So a model's result are going to be to a certain extent just that : model . This growth rate estimation serves the purpose of indicating the possibilities with proper management of all the sectors of the economy.

The accuracy of the growth rate estimate would depend upon the accuracy of estimation of the coefficients of the 'A' and the 'B' matrices. If these coefficients are underestimations of the real coefficients operative in the economy, it would lead to an overestimation of the growth rate. However we see from Table No. 6.4, that these growth rates compare quite well to the nominal growth rate of GDP and NNP of India in the respective years.

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<sup>8</sup> See Appendix to this Chapter p.185

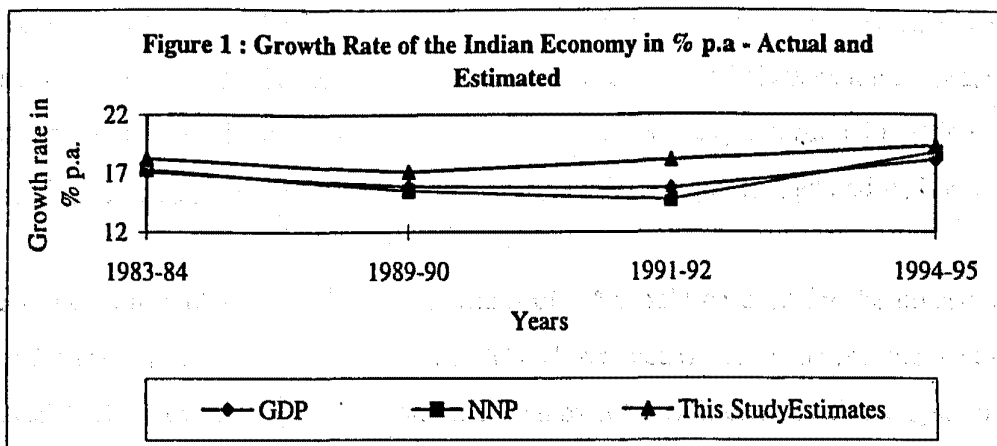


**Table No. 6.4 Growth Rate of the Indian Economy ( in % p.a.)**

**Actual and Estimated**

Sr No	Year	Growth Rate In Percent			
		NNP Const.	GDP	NNP	This Study Estimates
1	1980-81	7.30	7.30	19.70	
2	1981-82	5.80	16.70	16.06	
3	1982-83	2.10	11.18	10.02	
4	<b>1983-84</b>	<b>8.00</b>	<b>17.09</b>	<b>17.33</b>	<b>18.26</b>
5	1984-85	3.50	11.76	11.18	
6	1985-86	4.80	12.65	12.01	
7	1986-87	3.60	11.22	10.76	
8	1987-88	3.50	13.04	12.77	
9	1988-89	10.70	19.80	19.92	
10	<b>1989-90</b>	<b>7.00</b>	<b>15.86</b>	<b>15.52</b>	<b>17.12</b>
11	1990-91	5.10	16.92	17.01	
12	<b>1991-92</b>	<b>-0.1</b>	<b>15.69</b>	<b>14.72</b>	<b>18.15</b>
13	1992-93	4.90	14.00	13.72	
14	1993-94	4.20	14.75	14.95	
15	<b>1994-95</b>	<b>6.70</b>	<b>18.12</b>	<b>18.77</b>	<b>19.29</b>

Source: For NNP, GDP and NNP at Constant prices is NAS , 1996,Table 1,p.xlvii



## 6.5 INVESTMENT IMPLICATIONS

$$[ I - g(1-A)^{-1} B ] X = O$$

This is the closed dynamic I-O system. This means that when the surplus available after meeting all the minimum necessary requirements of the economy - namely consumption, inter-industry requirements and labour payment - can be invested back into the economy to enable it to grow at a higher rate. If X is the surplus available then  $[ I - g(1-A)^{-1} B ] X = O$  means that we are setting 'C' = 0 i.e. we are investing the surplus generated back into the system. If the capacity of the surplus bears a certain proportion to each other (the von Neumann proportion), then the corresponding g, g\* is the maximal possible balanced rate of growth, possible given technical constraints of "A", "B" and the minimum requirement of the household sector. Corresponding to g\* is the vector X\* called the eigen vector.

### 6.5.1 INTERPRETATION OF THE VECTOR X\*

Once, the minimal requirements of the economy are allotted for, the residual i.e. the output, which the planner can use to generate a high growth programme without impinging upon the minimum requirements, is available for investment. This residual, is to be invested in such a way (proportion) that it can exhaust itself and generate the highest possible growth rate. This proportion is given by the eigen vector X\* corresponding to the highest eigen value.

Now given "A" and "B" and consumption and value added, we can work out the above equation and solve it for 'g' and X. The g\* so obtained gives us the estimate of the highest possible balanced growth and X\* shows the proportion in which the available residual output should be in order to satisfy the equation, g\* and A, B etc.

From this, it is obvious that the proportions of X\* should be used for the investment or the residual available for investment. The above means that if the residual (output available) is available in the proportion shown by X\* then it can ensure the system g\* rate of growth. Here the x-axes cannot be used to dictate the proportions of total or gross output. Gross output can be in any proportion, so long as that available for investment is in the proportions dictated by X\*.

The eigen vectors obtained from the closed dynamic I-O model, show the "ideal" proportion of the investment vector for a high growth programme. By looking at their percentage composition, we can see the proportions in which the various goods will be required for an ideal investment or a maximum growth programme.

## 6.5.2 RESULTS

In the table below we see the eigen proportions for a maximal growth programme at broad sectoral aggregation for the Indian economy for some years.

**Table No. 6.5 Eigen Vectors At Four Sector Disaggregation**

Sector/Year	1967*	1983-84	1989-90	1991-92	1994-95
Primary	2.21	6.94	2.75	6.63	5.89
Manufacturin g	81.65	65.53	70.25	65.39	64.29
Construction	16.05	8.55	20.70	9.44	10.37
Services	0.00	18.98	6.30	18.53	19.45
Total	99.91	100.00	100.00	100.00	100.00

\* This is derived from Mathur's eigen vector.

Looking at the broad sectors in Table No. 6.5, we see that the importance of the primary and manufacturing sectors is declining and that of construction and service is increasing, as investment goods. This is borne out by the fact that the Indian economy

has so far been able to diversify its manufacturing sector quite well. It has also been able to produce adequately for its requirements of primary and secondary sector. The bottlenecks to growth that the economy is experiencing currently are of infrastructural services- electricity, communication, transport and other service. The proportion of investment of total investment required in the infrastructural sectors was 18.98% in 1983-84, where as the actual investment out of total investment by these sectors was 4.5 % ; the comparable figures were 6.30% and 3.86 % (1989-90); 18.53 % and 3.86% (in 1991-92) and 19.45% and 4.32 % (in 1994-95). A similar change is seen in case of construction. Thus, these two are the sector with potential for growth as also those that could become bottleneck for a high growth programme. The primary and secondary sectors-comprising agriculture, mining and manufacturing - mainly goods required as input in the production process - shows a decline in the proportion of total required investment. This could imply that the economy has developed to the extent that its growth impulse does not depend on raw materials available for investment; it is increasingly dependent on infrastructure.

Though the trend for the 4 sectors is clear - sectors within the four show different trends. The eigen vectors for the Indian economy for 1983-84, 1991-92 and 1994-95 are shown in **Table No. 6.6**. The disaggregation is at 35 sector level. These vector will show how the required investment mix has changed over the 10 year period. The **Table No 6.6** shows these vectors expressed in percentage terms; as percentage of total.

The results for the year 1989-90 appear to be out of line from the other years. This could be because of the following: For the year 1989-90, we have used the draft version of the A matrix brought out by the CSO. The CSO is currently engaged in finalising the same; an earlier version was available that was tried here. However we see that it gives results that are out of line with the other years. Whether this is a true reflection of the actual situation or is due to the approximate nature of the A matrix cannot be judged. Hence we do not undertake any more estimations with this version.

Table No 6.6

**COMPARING THE EIGEN VECTORS OF  
1983-84, 1991-92 and 1994-95  
( Eigen Vector As Percentage Of Total)**

SECTOR NAME/CODE	1983-84	1991-92	1994-95
1 Agric.	1.51	1.28	0.99
2 Forest	1.34	1.35	1.05
3 Fish	0.92	0.85	0.49
4 Min & Quar	3.18	3.14	3.36
5 Sugar	0.96	1.07	0.66
6 Ed.Oil	1.09	1.23	0.73
7 Ot.Food	1.19	1.10	0.70
8 Cot.Tex	0.89	0.85	0.60
9 Wool.Tex	0.83	0.88	0.59
10 Jute.Text	0.13	0.14	0.14
11 Ot.Tex.Ar	0.73	0.54	0.30
12 Wood	0.79	0.66	1.24
13 Paper	0.80	0.88	0.71
14 Leather	0.58	0.34	0.18
15+16 Rubb + Plas	0.74	0.60	0.48
16 Plastic	-	0.30	0.29
17 Petrol	2.50	2.35	2.39
18 Fertilisers	0.04	0.04	0.05
19 Chemicals	2.41	2.05	2.13
20 Cement	0.52	0.55	0.54
21 N.M.Min.P	1.13	1.05	1.00
22 Ir & St.	10.36	9.83	10.47
23 N.F.B.Met	2.66	2.74	2.83
24 Met.Man	3.53	1.95	1.98
25 Machinery	27.92	29.12	29.91
26 Rail Eqp.	1.26	1.39	1.28
27 Tr.Eqp.	3.41	3.29	2.72
28 Misc.Man	1.05	2.44	2.36
29 Construction	8.55	9.44	10.37
30 Electricity	2.97	2.90	4.35
31 Rail Service	1.67	1.41	1.30
32 Othr trans. Servi.	2.53	2.69	2.67
33 Communication	0.74	1.09	0.87
34 Trade	5.44	4.95	5.03
35 Oth. Services	5.64	5.49	5.24
Total	100.00	100.00	100.00

### 6.5.3 RESULTS AT 35 SECTOR

#### Primary Sectors :

Among the primary sectors, agriculture, forestry and fishing show a decline; Mining and Quarrying shows a steady increase in its contribution to the ideal investment. The economy needs almost 3.5% of it is total investment in the form of minerals.

#### Manufacturing Sectors

Sector No.s 5 to 14, like sugar, edible oil, textiles, wood, paper and leather are sectors which are mainly consumption sectors. Their importance in the production process or in an investment programme is limited to maintaining adequate stocks for the production, or to ensure that there is no shortfall in the consumption of these items. Each of these sectors except wood products shows a decline importance as an investment good. It is interesting that wood product has increased its percentage as an investment good.

The sectors 15 to 28 are intermediate and capital goods like rubbers, plastic, petrol, chemicals, cement, iron and steel, non-ferrous basic metals; and capital goods like metal manufacture, machinery, transport equipment and miscellaneous manufacturing. The percentage of machinery as an investment requirement is increasing. The same trend is seen for iron and steel, cement, petrol and rubbers and plastics. These goods continue to remain important; there is an increase in their importance in the "ideal investment basket". It follows that their production and imports should be encouraged.

The other sectors in this category - namely fertilizers, chemicals, rail and other transport equipment - show a decline in importance as investment goods. Except for railways all others show a continuous decline; railway equipment shows a marginal increase from 1983-84 to 1991-92. Two sectors - non metallic mineral products and non ferrous basic metals- show a fluctuating trend. The former shows a slight decline and then increase; the latter show a slight increase and then decline

**Construction** as an investment activity seems to be gaining importance over the period. The requirement in 1983-84 was 8.55% of total investment; this has increased to 10.37 %..

**Electricity** has almost doubled from 2.97% to 4.35%. Thus, investment requirement of electricity has gone up tremendously. *The changing percentage contribution of electricity to total investment could be an indication of our production process becoming power dependent; or increasingly mechanized.*

**Railway Services** as an investment input first declined in importance and then increased marginally. From 1983-84 to 1994-95, the percentage requirement has declined.

**Other Transport Services** has increased importance over the period as an investment sector. There is a need for increased output to go for investment. Thus, there is scope for increased production . It is an important infrastructural service today and this is borne out by the change in the eigen proportion.

**Communication** shows an increase initially and then a decrease. This is contrary to expectations as communication is a necessary infrastructural requirement, one would have thought that its percentage would have seen a continuous increase. Also investment requirement in communication are seen to be a merely 0.87 % of total Investment.

**Trade** show a decline and then a slight increase. It remains a hefty 5.03 % of total required investment. **Other Services** Comprise of Banking, Insurance, Hotels, Storage, Medical, Educational and Personal Services. The results show a continuous decline in the required percentage of total investment in these sectors. This could mean that either the economy is getting quite self sufficient in terms of growth of these services or that for growth, these are not the immediate requirements vis-à-vis other goods. However, despite the decline, the services still need to comprise a hefty 5.24 % of total investment.

### Summing Up

To sum up if we look at all the sector, the sectors which need to step up their growth rates of production to enable the economy to increase the share of these sectors in its growth programme are (1) Mining and Quarrying, (2) Petrol, (3) Cement, (4) Iron and Steel, (5) Machinery, (6) Miscellaneous Manufacturing, (7) Construction, (8) Electricity, (9) Other Transport Services and (10) Communication.

Of these 10 sectors, 4 are services or infrastructure sectors. The 4 sectors being non-tradable, it restricts the role that trade can play in a higher growth programme. The former 6 tradable sectors thus should get priority in terms of tariff concessions, imports or production. For the others, i.e. non-tradables sectors, the domestic production has to increase dramatically to enable the economy to undertake a high growth path.

#### 6.5.4 COMPARISON WITH MATHUR'S RESULT

Mathur estimated the eigen vector for India for 1960, using the dynamic I-O model. His eigen vector is for 19 sectors. We compare the eigen proportions for the 1960s to those obtained by us in this study. For this we collapse the eigen vector obtained for 35 sectors into 20 sector comparable to Mathur's study. The 20th sector is "Services" which is absent in Mathur's study. He considered only "Railways" and "Other Transport Services". He left out the agriculture sector. He estimated the demands of the agriculture sector separately. This comparison will enable us to see how the requirement of investment goods have changed; it will tell us something about the nature of the production and growth process then and now.

Referring to Table No. 6.7, we see that in the 1960s, the main goods required for a maximal investment programme were Minerals and Ores, Wood, Chemicals, Iron and Steel, Non Ferrous Basic Metal, Machinery, Transport equipment and Construction. In 1994-95, the main investment requirements were Minerals and Ores, Petrol, Wood, Chemicals, Cement, Iron and Steel, Non Ferrous Basic Metals, Machinery, Transport Equipment, Miscellaneous Manufacturing, Construction, Electricity, Railway Service and Other Services.



**Table No. 6.7 Comparing the Eigen Vectors With Those Of Mathur's Study Eigen Vectors As % Of Total**

SECTOR	MATHUR'S 1960	1983-84	1991-92	1994-95
Mining & Quarrying	2.21	3.18	3.14	3.36
Food ,Bever, Tobacco	0.24	3.24	3.40	2.09
Jute.Textiles	0.26	0.13	0.14	0.14
Cot,Wool,Oth.Textes	0.23	2.45	2.27	1.50
Wood	4.44	0.79	0.66	1.24
Paper	0.61	0.80	0.88	0.71
Leath,Rub,Plastic	0.18	1.32	1.23	0.95
Petrol	0.64	2.51	2.35	2.39
Fertilizers	0.00	0.04	0.04	0.05
Chemicals	2.94	2.41	2.05	2.13
Cement	0.56	1.66	1.60	1.54
Iron & Steel	8.07	10.36	9.83	10.47
NonFerros Bas.Metal	1.61	2.66	2.75	2.83
Machinery	54.01	31.45	31.07	31.89
Transport Equipment	7.74	4.67	4.68	4.00
Misc. Manufacturing	0.13	1.05	2.45	2.36
Construction	16.05	8.55	9.45	10.37
Electricity	0.00	2.97	2.90	4.35
Rail Services	0.00	1.67	1.41	1.30
Services	0.00	14.35	14.22	13.80
Total	99.91	96.23	96.51	97.47

Therefore, we see that the same goods which were important investment goods in 1960 are still important investment goods in 1994-95. Except for Iron and Steel, Mining and Quarrying and Non Ferrous Basic Metal, the percentage contribution to total investment of each of the important investment goods of 1960, has gone down in 1994-95. Iron and Steel which was 8.07% of total Investment in 1960 was 10.47% of total investment in 1994-95. Mining and Quarrying which was 2.21% in 1960 has increased to 3.36 % in 1994-95. This vouches for the importance of these two basic commodities as ingredients in the investment programme, over the years. The proportions of the other sectors has declined simply because the total investment mix basket has diversified to a great extent from 1960 to 1994-95.

The new sectors which have emerged as important from the point of an investment programme are Cement, Petrol, Miscellaneous Manufacturing (which comprises of medical, surgical instruments, optical and photographic equipment, film and film

processing material) and Electricity, and Other Services. Thus, we can say that over the period, our production structure has become more complex, requiring a host of new goods; it has become increasingly power driven and mechanized as shown by the increasing importance of Petrol and Electricity. Overall, traditional investment sectors have given way to new investment goods; the importance of the former has declined to accommodate the increase in the latter. The complexity of the production structure seem to have deepened as the required investment good basket has diversified. However, the major investment good still remain : Mineral and Ores, Iron and Steel, Non Ferrous Basic Metals, Machinery, Construction, Transport Equipment, Electricity and Other Services. A point to note is that in 1960s, services had little importance in the investment mix basket. This could be because Mathur did not consider services other than Railway and Other Transport. In 1994-95, we see that services are in fact the second largest (at 17.95% of Total Investment) input necessary in an investment programme.

Having seen the investment implications for a von Nuemann growth programme, we go on to see the trade implications in the next chapter.

## ANNEXURE 6.1

### Illustration of Growth Rate Estimation in the Static and Dynamic I-O Model for a 2 by 2 Sector Imaginary Economy.

Consider the following A and B matrices

$$A = \begin{bmatrix} 0.56 & 6 \\ 0.024 & 0.4 \end{bmatrix} \quad B = \begin{bmatrix} 0.22 & 0.21 \\ 0.26 & 0.40 \end{bmatrix}$$

$$\text{Consumption Vector} = \begin{bmatrix} 2 \\ 3 \end{bmatrix} \quad \text{Gross Output Vector} = \begin{bmatrix} 692.4 \\ 46.18 \end{bmatrix}$$

$$\text{Consumption Coefficient Vector} = \begin{bmatrix} 0.003 \\ 0.065 \end{bmatrix} \quad \text{Value Added Vector} = \begin{bmatrix} 0.04 \\ 0.08 \end{bmatrix}$$

From the above data, we estimate the maximal rate of balanced growth using the Static and the dynamic models

Sr.No	Matrix	Eigen Value 'e'	Def. of G*	Growth Rate G* in %
1	A	0.8678	$g^* = 1/e - 1$	15.23
2	A Augmented	0.8922	$g^* = 1/e - 1$	12.08
3	$(I-A)^{-1} * B$	15.5908	$g^* = 1/e$	6.41
4	$(I-A)^{-1} * B$ Augmented	15.5910	$g^* = 1/e$	6.41

Note: The above example of an imaginary economy is from Kundu, et al (1976) p.100. He gives the A and B matrices, the consumption vector and the gross output vectors. The value added vector has been assumed by us. Whether we use  $(I-A)^{-1} * B$  or  $B * (I-A)^{-1}$  the result is the same. This is proven in Kundu, et al (1976) p.99.

**CHAPTER SEVEN**  
**IMPLICATIONS FOR TRADE**

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**7.1 IMPLICATIONS FOR TRADE**

If the economy wants to aim to achieve the von Nuemann maximal balanced growth rate, there are two parameters to be examined. One, it has to alter its structure of investment, to ensure the required goods in the required amounts. This structure or proportion is shown by the eigen vector corresponding to the highest eigen value. This, we saw in the previous chapter. The second parameter is the level of investment. When planning for a maximal growth programme the level of investment can be decided, depending on the amount of resources available after meeting the minimum requirements of the economy which are deemed to have priority by the planner or the policy maker.

In this simulation, we assume that the actual total investment made by the economy is available to be invested in a von Neumann growth programme. Actual investment as percentage of total output was approximately 22.08% in 1983-84 , 25.08 % in 1989-90, 25.08% in 1991-92 and in 1994-95.<sup>1</sup> The actual investment made by the economy is shown by the investment vector (GFCF + C.I.S)<sup>2</sup>. To compare by how much the actual investment vector differs from the desired one, we have done the following,

If  $I$  = Actual Investment vector

$$I = \begin{pmatrix} i_1 \\ i_2 \\ \vdots \\ i_n \end{pmatrix}$$

$I = \sum_{n=1}^n i_n$

and  $I$  is the total amount invested

Then, this 'I' is distributed over the sectors of the economy according to the eigen proportion vector. This vector generated is labeled as 'Ideal Investment Vector' or  $I^*$

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<sup>1</sup> Source: CSO (1990) I-O TABLE 1983-84, Planning Commission (1990) Technical Note to the Eighth Plan.

where

$$\sum_{i=1}^n i_i = \sum_{I=1}^n i^*_i \quad \text{i.e.}$$

Then we compare the two vector of Actual Investment and Ideal Investment.

$$I - I^* = Z \quad \text{where } Z = \text{Surplus / Deficit Vector}$$

If  $Z > 0$  then that sector is a surplus sector whose exports can be increased without impeding the growth programme of the economy. If  $Z < 0$  then it means that that sector is a deficit sector for the maximal growth programme. If it is a tradable good, then imports need to be increased to make good the gap. If the sectors are non tradable, then production and/or productivity or both need to be increased.

We look at the results for the years 1983-84 and 1991-92 and 1994-95. The year 1989-90 is left out due to reasons explained earlier<sup>3</sup>. In case of the year 1994-95, since the actual I-O table is not available we have generated the final demand vectors assuming the same proportions as in 1991-92. However for the investment vector we were unable to get stock figures. So we have generated a column of C.I.S.<sup>4</sup>

The "B" matrix was adjusted to prices of 1983-84, the "A" matrix for 1983-84 was available from CSO (1990). The two matrices were brought down to the same level of aggregation. The only difference in the sector classification is that for 1983-84, rubbers and plastics are given as one sector (No. 15) where as we have them separately for 1991-92. So, these two sectors were combined into one. Therefore there are 34 sectors for 1983-84 and 35 for 1991-92. However we have retained the same numbering for 1983-84 as for 1991-92 to enable comparison. So in 1983-84, the fifteenth sector is numbered 15+16 and consists of rubber and plastic products.

<sup>2</sup> C.I.S is Changes in Stocks and GFCF = Gross Fixed Capital Formation

<sup>3</sup> See page no. 178, Chapter six of this study.

<sup>4</sup> We tried to get Stock estimates from other sources namely, ASI, NAS etc, but these showed great discrepancies. For e.g. CIS as % of GFCF was coming either as high as 26 % or as low as 3 to 4 %, where in the I-O tables of 1983-84 it is at 15 % and at 11 % in the I-O table of 1991-92. Therefore we have assumed 13 % of GFCF

### 7.1.1 RESULTS

The 'Z' vector as obtained for a von Nuemann growth programme and the actual net exports vector for 1983-84, 1991-92 and 1994-95 are shown in Table Nos. A7.1 (A), A7.1(B) and A7.1(C) respectively. Comparison of Surplus/Deficit Vector, Z, and Actual Trade Vector is presented in these tables. These are the comparison between the actual net exports and the net surpluses for maximal growth programme as shown by the model. Though surpluses and deficits are seen for the services sectors too; as also trade is seen in these sectors, for considering the impact of pursuing the maximal growth on programme trade, we leave out these sectors, as they are by nature non-tradables. Though entries in the actual export column are seen against services sectors like railway transport service, other transport services, electricity etc. these are negligible. They will, therefore be kept aside while analysing the trade sector. So, to consider the impact on the trade sector we confine ourselves to the sectors 1 to 28 which comprise mainly of agriculture and manufacturing activities.

The sectors emerging as surplus from the simulation for all three years are Woolen Textiles, Rubbers, Plastics, Chemicals, Railway Transport Equipment and Other Transport Equipment. In the actual trade vector apart from these, other sectors which are net exporter are : agriculture, fishing, sugar, other food products and beverages, jute textiles, cotton textiles other textile articles, leather, non-metallic mineral products, miscellaneous manufacturing, Railway services, trade and other services.

### 7.1.2 POSSIBILITIES FOR EXPORT GROWTH

To see the impact on sectoral export possibilities, we compare the eigen surplus ( $Z > 0$ ), to the actual total exports of that sector. This can give an indication of the potential that sectoral exports have for growth. The surplus sectors as shown by  $Z > 0$  are treated as extra possible exports and these are computed as percentage of actual exports. In Table No. 7.1, we show percentage increase possible.

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as CIS for 1994-95 to extend the simulation further than 1991-92. This total is distributed as a column in the same proportion as the CIS column of 1991-92.

**Table No. 7.1 Possible Increase In Sectoral Exports  
( As % of Actual Sectoral Exports)**

Sector No.	Sector Name	1983-84	1991-92	1994-95
1	Agriculture & Allied	192		9
7	Oth.Food prod and Bever.			4
9	Woolen Textiles	359	35	102
15	Rubbr&Plas Product	1317	102	122
16	Plastic & Plas. Products		243	296
18	Fertilisers & Pesticides	114		126
19	Chemicals & Products	74	22	29
26	RailTranspt Equipt	2075	5406	6304
27	OtherTranspt Equipmet	642	402	509
	<b>TOTAL *</b>	<b>40.51</b>	<b>23.04</b>	<b>30.88</b>

\*Note : These are as % of total commodity exports.

From the above table, it seems that we can increase our traditional exports like agriculture and woolen textiles to some extent. Although we are net importers of chemical products, the model shows a surplus. It means that we can definitely step up chemical exports in the sub-sectors / industries from which we are already exporting. Although for woolen textiles too, we appear to be net importers, there is scope for increasing exports to a large extent, almost 350 times the actual exports in 1983-84. This could also be reflecting the contribution of synthetic textiles which is incorporated in this sector, in which production and productivity may have improved. The remaining sectors namely, Rubber and Plastics, Rail Transport and Other Transport Equipment emerge as basically importables according to the actual trade figures. However, the model shows that these sectors can become exportable sectors as there is a scope to bring about a large increase in these exports. The suggested increase appear extremely high because the existing level of exports is low.

The suggested increase in total export as percentage of actual total commodity exports is seen in all the three years. This suggests that exports can be stepped up if the investment programme is adopted. Though the extra possible exports as percent of total exports shows a decline from 40 % to 30 %, it still shows that the adoption of a high growth programme, by altering the structure of investment, can release surplus for exports.

Over the three years, it is seen that exportable surplus declines from 1983-84 to 1991-92 (for total as well as sectoral exports); whereas it increases from 1991-92 to 1991-92 to 1994-95. This trend is in keeping with the growth rate  $g^*$  estimated in the previous chapter, where we saw that  $g^*$  decreases from 1983-84 to 1991-92 and increases from 1991-92 to 1994-95.

Sectors 5 and 6 which are sugar and edible oil respectively, show that they are neither major exports or imports according to the actual trade vectors. Sugar exports are 0.075% of total exports. Imports of sugar and edible oil are 0.0142% and 0.0212% of total imports. Edible oils show zero exports in 1991-92. However, for the growth model both these sectors show deficit as do fisheries. The deficits expressed as percentage of gross output of the respective sector is as follows : Fisheries = 22.52%, Sugar = 13.36% and Edible Oil = 49.90%

In case of sugar and edible oil - either imports have to be increased to make good the gap, or domestic production has to increase at the rate of 13.36% p.a. for sugar and 49.90% for edible oil. Fisheries sector showing a deficit shows the promise of a sector where domestic demand is still unsatisfied. Its production has scope for increase at the rate of 22.52% p.a. A high deficit is seen in this sector because unlike in other sectors this does not show any stocks in the actual investment vector; most of the output of this sector goes for consumption or exports. The eigen vector shows a contribution of around 1% of total required investment which is quite high for a predominantly consumption sector.

Leather is another puzzling result; showing a deficit in the model where as actually it is an export good. This could be because this simulation is for the von Neumann or the highest growth programme. Here, very high consumption and inventory needs could be wiping out the surplus one would naturally expect.

### 7.1.3 STRUCTURE OF EXPORTS

The commodity composition of exports is shown by the export vector. To see the structure, we work out the percentage composition of the export vector; i.e. each



sector's export as percentage of total commodity exports. We compare the structure of the actual export vector to the composition of the ideal export vector. The ideal export vector (IEx) is defined as the actual export vector (Ex) plus Extra Suggested exports; i.e.  $IEx = Ex + Z$  where  $Z > 0$ . These comparisons are shown in Tables A7.2 (A), A7.2(B) and A7.2 (C)

Table No A7.2 (A) shows how our exports need to be restructured for achieving the maximal growth plan for 198-84. On the whole, it calls for some diversification of our exports, so that the percentage composition is evenly spread among the exporting sector. The only exception to this are agriculture and allied activities, chemical exports, transport equipment, rubber and plastic products and woolen textiles; the share of agricultural exports alone needs to be increased from 9.39% to 17.09% in 1983-84. For all other major export like minerals, textile article, miscellaneous good, non-metallic mineral product, leather, machinery etc. share of exports in total export needs to be scaled down to make way for increasing the share of agriculture and allied activities, chemical exports, transport equipment, rubber and plastic products and woolen textiles.

Referring to Table A7.2 (B), we see that the ideal composition calls for lowering of the share of the major exports and diversification of export in 1991-92. As against 1983-84, when there was an indication for the increase in share of agricultural goods, in 1991-92, there appears a need to decrease its share from 11.87% to 9.65% of total commodity exports. Agriculture exports were 9.39% of total in 1983-84 and the model gave an indication to increase this to 17.51%; the same ratio is 11.867% in 1991-92 and the model asks it to scale it down to 9.65%. The results for 1994-95 show the same trend as 1991-92.; Share of almost all exports has to be decreased including agriculture from 11.87 % to 9.89 %. The exceptions are Rubber, plastics, fertilisers rail transport equipment and other transport equipment.

The eigen proportion of the agriculture sector has come down from 1.51 in 1983-84 to 1.28 in 1991-92 and further to 0.99 in 1994-95 (see Table No.6.6 page 179) which should have had a positive impact on exports. But this might have been compensated by the change in inter industrial linkages and in the consumption during the period.

Probably, the ideal share of agriculture in total exports lies somewhere around, 10 % of total commodity exports. *Rubber, Plastic, Rail Transport Equipment and Other Transport Equipment are sectors which show export potential i.e. new export sectors apart from the already existing ones. Their share in total export ought to be increased.*

#### 7.1.4 NECESSARY INCREASE IN IMPORTS

Referring to Table No A7.1 (A), we see that looking at actual trade vector, the following sectors emerge as (net) importables in 1983-84 : Agriculture, Minerals, Edible Oil, Woolen Textiles, Paper and Products, Petroleum, Fertilizers, Other Chemicals, Cement, Non-Metallic Minerals Products, Iron And Steel, Other Non-Ferrous Basic Metals, Metal Manufacture and Machinery. The sectors that emerge as importables from the Surplus/Deficit Vectors are: Forestry, Fishing, Mining And Quarrying, Sugar, Other Food Products, Jute, Other Textile Articles, Wood, Paper, Leather, Petroleum, Fertilizers, Cement, Non-Metallic Mineral Products, Iron And Steel, Non-Ferrous Basic Metals, Metal Manufacture, Machinery And Miscellaneous Manufacturing. Thus, if the ideal growth programme is to be followed, we have to not only increase the level of imports, but import a larger number of goods than we are actually importing. To examine this in greater detail, we look at the implied import and the actual imports : both at the aggregate and sectoral level.

The sectors which needs imports to correct the deficit for the maximal growth programme are as follows (See Table No. 7.2). The existing import sectors experience a shortfall, i.e. increase in import is called for to sustain a maximal growth programme. These are Minerals, Paper and Paper Products, Petroleum and Products, Fertilizers, Cement, Non-Metallic Mineral Product, Iron and Steel, Other Basic Metals, Metal Manufacture , Machinery , Miscellaneous Manufacturing .

Other sectors which show a deficit but are not major imports are : Forestry, Fishing, Sugar, Food Products, Jute, Other Textile Articles, Leather And Wood And Wood Products. The large deficits in these sectors could mean that for a maximal growth programme, we need to either import these in the amounts shown above or we need to

step up production and productivity in these sectors to ensure that these do not become bottlenecks in a high growth programme as well as to ensure that due to non availability, their domestic prices are not allowed to rise. These deficits could be due to high consumption and inventory requirements.

**Table No. 7.2 Necessary Increase in Sectoral Imports  
(As Percentage of Actual Sectoral Imports)**

Sec No	Sector Name	1983-84	1991-92	1994-95
1	Agriculture and Allied	-	3	-
2	Forestry & Logging	2285	276	301
3	Fishing	2665	-	22447
4	Mining & Quarrying	28	33	50
5	Sugar	-	12244	10031
6	Edible Oil	-	9444	7741
7	Food Prod.Bev. Tob	10041	-	-
8	Cotton Textiles	-	-	12
10	Jute Textile	507	1333	1767
11	Other Textile Articles	101	236	147
12	Wood	6572	1387	3929
13	Paper	39	71	71
14	Leather	1166	595	422
17	Petrol	61	50	79
18	Fertilizers	308	-	-
20	Cement	114	9705	11807
21	Non Met. Min. Prod.	34	395	500
22	Iron & Steel	319	439	669
23	NonFerrosBasic Metals	245	249	363
24	Machine Tools	348	46	84
25	Machinery	157	9	24
28	Misc. Manufacturing	18	39	51
	<b>Total</b>	<b>88</b>	<b>56</b>	<b>78</b>

\* Note : These are total commodity import; this is not the column sum.

From the above, Fishing, Sugar, Edible Oil, Jute Textile and Other Textile Articles, Leather are not major imports. In fact they are actually major exports. Among the major import sector, Mining and Quarrying, Paper, Petroleum, Cement, Non-Metallic Mineral Product, Iron and Steel, Non-ferrous Metals, Machinery, Miscellaneous Manufacturing, a high increase is called for in the imports of Wood Products, Iron And Steel, Other Basic Metal And Metal Manufacture. *Thus, the economy has deficit*

*in raw material rather than processed goods.* Machinery imports need to be increased only by 9.36% as against a 438.73% increase in Iron and Steel in 1991-92.

The change over the three year period shows that imports required (as % of actual imports) show a decline from 1983-84 to 1994-95 for consumer goods, like cotton textiles textile articles, leather etc. However for intermediate and capital goods, the requisite % shows an increase from 1991-92 to 1994-94 although actual imports of these have also increased in this period. This means that the increase in  $g^*$  from 1991-92 to 1994-95 is to be accompanied by necessitating lower extra imports (as % of actual imports) of consumer goods and higher imports for intermediate and capital goods imports. Thus liberalisation has made our production import dependent although it has enabled a higher level of exports with a higher growth rate.

### 7.1.5 STRUCTURE OF IMPORTS

Here we examine the composition of the import vector. We want to see the composition of the import vector as it exists and as is suggested by the model. How should the composition change to enable the economy to pursue a high growth programme?

If we look at Table A 7.3 (A), A and see the percentage composition of major imports; the major imports in 1983-84 are : agriculture (6.97%), Minerals (23.73%), Edible Oil (4.87%), Paper (2.66), Petrol (8.051%), Fertilizers (1.246%), Chemicals (9%), Non-metallic mineral products (7.087%), Iron and Steel (7.33%), Non-ferrous Basic Metals (2.66%), Metal Manufacture (1.386%), Machinery (16.36% and Miscellaneous Manufacturing (4.52%)

The model gives the ideal import structure which calls for reducing the proportion of agriculture (by half); Minerals (from 23.73 to 16.41%), Edible oils, Paper products, Petroleum, Fertilizers, Chemicals, Non-Metallic Mineral Products, Transport Equipment and Miscellaneous Manufacturing. The sectors for which imports share (as % of total imports) have to be increased are : Iron and Steel (from 7.3346 to 16.11%), Other Basic Metals (from 2.67 to 4.83%), Metal Manufacture (from 1.386% to 3.26%), Machinery (from 16.96 to 22.40%). So, these imports are crucial for the

growth programme and their share vis-à-vis the others have to be increased. These are mainly Capital and Basic Goods. The policy implication would be that if import duties have to be lowered, they should be lowered for these import goods first.

Referring to Table No. A7.3 (B) , we see that in 1991-92, a reduction is called for in the percentage share of total imports of all major imports like Mining and Quarrying, Machinery, Metal Manufacture Miscellaneous Manufacturing, Chemical, Transport Equipment. An increase in the share of total imports is indicated for Iron and Steel (a large increase - from 3.93% to 13.57%), Other Basic Metals, Paper Products and Cement. The share of petroleum stays almost the same at 7.93% and 7.88% and 7.96 %.

In 1994-95, we see that a reduction in import share is indicated for Mining And Quarrying, Paper, Fertilisers, Chemicals Machinery , Rail Transport Equipment, Other Transport Equipment And Miscellaneous Manufacturing . An increase in import share is called for in Forestry, Iron And Steel, Non Ferrous Basic Metals, Cement, Non Metallic Mineral Products, Wood Products, Petroleum And Metal Manufacture.

*Thus, the structural change indicated shows that imports should move from sophisticated value added finished goods (Machinery, Transport Equipment, Miscellaneous Manufacturing Metal Manufacturing etc.) to intermediate goods or raw materials like Iron and Steel, Non-ferrous Basic Metals, Cement, Non-Metallic Mineral Products etc.. More or less the same trends are indicated for 1983-84 and 1991 -92. Iron and Steel and Non-ferrous Basic Metals are foreseen to be the major bottleneck commodities in a maximal von Nuemann growth programme.*

#### **7.1.6 TOTAL TRADE**

Examining total exports, imports, total trade and Balance of Trade as percentage of GDP we see the following. ( See Table No. 7.3) For 1983-84, we see that a maximal growth programme calls for increase in trade from 14.19% of GDP to 24.13% of GDP. Imports as percentage of GDP are required to be almost doubled to 16.60%.

The BOT (which is negative) is required to stand at 9.07% of GDP. This shows that our economy is a deficit economy and its production base is such that it has to depend on trade (more on imports) to a large extent for a high growth programme.

In 1991-92, we see that the share of exports in GDP will have to be increased to 8.78%, that of Imports to 18.71% from 12.00%. The BOT will have to be increased from 4.86% of GDP to 9.93%. Thus, the growth will have to be fueled by foreign trade, putting a foreign exchange burden. Trade will have to increase from 19.13% of GDP to 27.49%. Comparing this to the results obtained for 1983-84, we see that in 1983-84, trade was at 14.19% of GDP and this was required to be increased to 24.77%. In 1991-92, the existing share of trade was higher at 19.13% than in 1983-84 and the increase necessitated was upto 27.49%.

Thus, we can say that the Indian economy has become trade dependent over the years. Though both - exports and imports were at higher % of GDP in 1991-92 as against 1983-84, the desired level of the two was still higher than the actual. So we can say that the economy has not been able to curtail its trade dependence. The liberalization has probably made our production and capital asset structure more trade dependent.

The change from 1991-92 to 1994-95 however shows that the actual imports ( % of GDP) are lower in 1994-95 than in 1991-92, actual exports are higher, deficit is lower so is the trade deficit. The extra possible exports (% of GDP) are higher in 1994-95, extra necessary imports are also higher. Therefore the total trade as % of GDP is also slightly higher in 1994-95. *This implies that after liberalisation though exports show some possibilities of increase, import requirements have not reduced and therefore an adverse trade deficit is seen in the near future.*

The deficit on the BOT cannot be wiped out in the near future, neither can it be reduced much. Since there is an inherent trade off between the growth rate and trade, especially imports, the BOT deficit will have to continue if a high growth programme is aimed at.

**Summing up the findings**, we can say that overall, a higher role of trade is called for, for the economy to pursue the von Nuemann growth path. Among the two, exports and imports, imports are more significant as our economy is still a deficit one in case of basic and capital goods. Increase in imports required is of a higher order. Thus the trade deficit cannot be eliminated. It will have to remain; albeit increase in order to finance the growth programme

**Table No 7.3 (A1) BALANCE OF TRADE 1983-84 (Rs. millions)**

		Actual	Extra Implied	Ideal	% increase
1	Exports	996174	40359	49976	40.51
2	Imports	1640140	144353	308394	88.01
3	Total Trade	2636314	184712	358370	70.06
4	BOT	-643966	-103994	-165256	16.15

**Table No. 7.3 (A2) TRADE AS % OF GDP, 1983-84**

		Actual	Extra Implied	Ideal
1	Exports	5.36	2.17	7.53
2	Imports	8.83	7.77	16.60
3	Total Trade	14.19	9.94	24.13
4	BOT	-3.47	-5.60	-9.07

Note : 1) These figures are from I-OTT, 1983-84, They refer only to Commodity Trade

2) Total Trade = Exports + Imports, BOT = Exports-Imports

3) GDP = Rs. 18581520 lakhs (Source: I-OTT, 1983-84)

**Table no 7.3 (B1) Balance of Trade 1991-92(in Million Rupees)**

	Actual	Extra Implied	Ideal	% increase
Exports	370806	85446	456252	23.04
Imports	623450	348929	972379	61.74
Total Trade	994256	434375	1428631	43.69
BOT	-252644	-263483	-516127	

**Table no 7.3 (B2) Trade as % of GDP, 1991-92**

	Actual	Extra Implied	Ideal
Exports	7.13	1.64	8.78
Imports	12.00	6.71	18.71
Total	19.13	8.36	27.49
BOT	4.86	5.07	9.93

(GDP = Rs. 5197160.0 millions)

**Table no 7.3 (C1) Balance of Trade 1994-95 ( In Million Rupees)**

	Actual	Extra Implied	Ideal	% increase
Exports	659060	203544	862604	30.88
Imports	835969	651033	1487002	77.88
Total Trade	1495029	854577	2349606	57.16
BOT	-176909	-447489	-624398	

**Table No 7.3 (C2) Trade as % of GDP, 1994-95**

	Actual	Extra Implied	Ideal
Exports	7.72	2.38	10.10
Imports	9.79	7.62	17.14
Total	17.50	10.01	27.51
BOT	-2.07	-5.24	-7.31

(GDP = Rs. 8541030 millions)



## 7.2 INFRASTRUCTURE

The Services Sector which were left out as non tradables are important sectors from the point of view of investment and growth. These seven sectors are : Construction, Electricity & Water Supply, Rail Transport Service, Other Transport Service, Trade, Communication and Other Services. Basically all these are infrastructural services. The success of a growth programme depends to a great extent on the level and quality of the infrastructural development. Though we cannot measure the qualitative aspect through this model, we can certainly see the level of these services required by the economy for a higher growth programme.

**Table No 7.4 (A) Surpluses /Deficits of the Services Sector  
1983-84 ( In Rupees Millions)**

Sect. No	Name	Surplus/Deficit	Net. Exp.
29	Construction	44088	0
30	Electricity/Water	-12196	29
31	Railway Services	-6278	1678
32	Other Transport Service	-8540	1257
33	Communication	-3035	53
34	Trade	-7331	13054
35	Other Services	-231471	8907

From the above, it is seen that some trade does take place in these industries, except for the construction industries. All services sector are net export sectors i.e. export are greater than import. The eigen vector however shows that for a von Nuemann growth programme, we need a lot more output from these sectors, if we consider the suggested increase as % of their gross output. Here we should be ideally looking at the composition of the actual investment in these sectors instead of output. However, the nature of these sectors is peculiar -Railway Services, Other Transport Service, Communication And Trade. How much of these services go for investment purposes is not known. If we look at the actual investment vector, the entries against Electricity, Communication and Other services is zero. About stocks it goes without saying that these will be zero. So, considering the peculiar nature of these services we consider proportion of these as % of actual output to compare with that of the desired eigen proportion to deduce the shortfall in the supply of these services for a high growth programme.

**Table No 7.4 (B) Deficits and Surpluses of the Services Sectors  
as % of Output 1983-84 (in Rs Millions)**

S. N	Sector Name	Deficit/Surplus Z	Actual Output	Sugg. increase in product as % of Output
29	Construction	44088	256077	+17.22
30	Electricity	-12196	88296	13.81
31	Railways	-6278	50571	12.41
32	Other Transport	-8540	144679	5.90
33	Communication	-3035	15498	19.58
34	Trade	-7331	303629	2.41
35	Other Services	-23147	526897	4.39

From the above, we see that the Construction Activity is a surplus activity. All the other sectors are deficit ranging from 2.41 % to 19% of their respective outputs. The last column suggests the percentage increase in output of all the sectors except construction, required to ensure that the economy can take up a von Nuemann growth plan. The larger increases are called for in Communication, Electricity, Railway Services. In the remaining services sector, the increases called for are around 5%. Thus, the former three are crucial infrastructure sectors in 1983-84.

Considering the model, i.e.  $I - I^* = Z$ , the surplus in the construction means that the actual output of construction going for investment purposes is much more than required. It could be due to the following reasons: While constructing the B matrix, we had left out the sector "ownership of dwellings" as it was difficult to map. It's ICOR was around 20. Most of this 20 would have been allotted to the construction sector. Hence the demand for the construction sector for investment and hence growth has been underestimated. However it may be noted that leaving out "ownership of dwellings" will not affect other results as, "ownership of dwellings" sector categorised by type of assets would lead to allotting the ICOR to only two types of assets namely land and construction

The other reason why construction sector shows a great surplus is that, if we consider the output of the construction sector going for various final demand, we note that a

large part of it goes for investment<sup>5</sup>. For e.g. 91.61 % of the total final output available for final use of the construction sector in 1983-84 went for investment, only 8.39 went for public consumption and 0 for private consumption. This means that household demand for construction is understated and is therefore not captured by the model adequately, even though household consumption is included as a sector making demands on the available output, while estimating the eigen value and eigen vector.

It is due to these two reasons - underestimation of demand (due to non incorporation of the sector ownership of dwellings in the B matrix) and overestimation of supply (amount of final use going for investment as shown in the actual final demand vectors of the I-O transaction tables - that the construction sector shows a high surplus. Hence, we have adjusted the surplus in this sector to account for demand made by the household sector for dwellings and its growth at the von Nuemann growth rate.<sup>6</sup> Even after this adjustment construction shows a surplus, which implies that the housing demand is underestimated. Now, let us see the shortfall in the supply of these sectors by comparing it with the required composition, as a % of actual output.

**Table No. 7.4 (C) Actual and Desired Composition of Output of Services Sector**  
(As % of Total) 1983-84

S.N	Sector	Actual Output Vector % of Total	Eigen Vector %
29	Construction	7.23	8.55
30	Electricity	2.49	2.97
31	Railway Service	1.43	1.67
32	Other Transport	4.08	2.53

<sup>5</sup> The percentage of total final use of the construction sector going for investment was 91.61 % in 1983-84, 89.87 % in 1989-90, 94.14 % in 1991-92 and 95.24 % in 1994-95.

<sup>6</sup> This has been done as follows: From the I-O table 1983-84, the output of the ownership of dwellings is taken as demand by the household sector for the construction. This demand, plus its growth in % (Von Nuemann growth rate) is deducted from the surplus to obtain a Z which takes care of household demand and its growth for the construction activity. The growth rate applied is that particular year's Von Nuemann growth rate. The column of the Ownership of Dwellings in the I-O table shows that it takes inputs only from the Construction activity. For 1991-92, the ownership of dwellings was not shown as a separate sector in the Planning Commission I-O table; hence we have used the proportion of 1983-84 to reduce the surplus of the Construction sector to account for household demand. The same treatment is made for 1994-95.

**Table No. 74 (C) conclud.**

33	Communication	0.44	0.74
34	Trade	8.57	5.44
35	Other Services	14.87	5.64
	<b>Total Services</b>	<b>39.11</b>	<b>27.54</b>

From the above, it is seen that the model shows a need to scale down the percentage contribution of the services sector from 39.106 to 27.54% . Construction sector output needs to be decreased: that of trade and services sector need to brought down.

### 7.2.1 INFRASTRUCTURE 1991-92

The non-tradable sectors which are deficit sectors for a growth programme, in 1991-92, are Electricity, Railway Services, Other Transport Services, Communication, Trade and other services. Basically all these are infrastructural services. Since they are not importables, the implication is that production of these has to be increased to retain a high growth programme.

**Table No. 7.5 (A) Surpluses and Deficits as % of Actual Output for Services 1991-92 (in Rs Millions)**

S.C ode	Sector Name	Deficit	Actual Gross Output	Suggested Increase as % of Actual Output
29	Construction	120722	706010	+17.10
30	Electricity	-37775.3	272912.8	13.84
31	Railway Services	-16737.3	122890	13.62
32	OtherTraspt Serce	-28949.9	463164.8	6.25
33	Communication	-14080.3	71681	19.64
34	Trade	-22024.7	924010.7	2.39
35	Other Services	-71404.0	1554679	4.60

Note : Only the Construction sector shows a surplus; all others show a deficit for the maximal growth programme.

**Table 7.5 (B) The Actual and Desired Levels of the Infrastructural Services 1991-92 (As % of Total Output)**

	Sector	Actual Output as % of Total	Eigen Percentage Level
29	Construction	7.08	9.44
30	Electricity	2.74	2.90
31	Railway Services	1.23	1.41
32	OtherTraspt Service	4.65	2.69
33	Communication	0.72	1.09
34	Trade	9.27	4.95

**Table No. 7.5 (B) conclud.**

35	Other Services	15.59	5.49
	Total	41.27	27.97

**Table No 7.6 (A) Surpluses /Deficits as % of Actual Output of Services  
1994-95 (in Rs Millions)**

S.C ode	Sector Name	Deficit	Actual Gross Output	Suggested Increase as % of Actual Output
29	Construction	+216428	1160259	+18.65
30	Electricity	-107610	448506	23.99
31	Railway Services	-29015	201958	14.37
32	OtherTraspt Serv	-54595	761167	7.17
33	Communication	-21522	117801	18.27
34	Trade	-44424	1518522	2.93
35	Other Services	-129627	2554966	5.07

**Table No 7.6 (B) The Actual and Desired Levels of the Infrastructural Services  
1994-95 (As % of Total Output)**

	Sector	ActualOutput as % of Total	Eigen Percent Level
29	Construction	7.08	10.37
30	Electricity	2.74	4.35
31	Railway Services	1.23	1.30
32	OtherTraspt Service	4.65	2.67
33	Communication	0.72	0.87
34	Trade	9.27	5.03
35	Other Services	15.59	5.24
	Total	41.28	29.83

From the above, it is clear that the maximal growth programme requires scaling down the proportion of the services sector from 41.27 to 27.97% in 1991-92 and from 41.28 to 29.83 % in 1994-95. In case of industries, it calls for increasing the proportion of Construction<sup>7</sup>, alone although at absolute levels, the output of construction needs to be scaled down. For the remaining sectors, the proportion is required to be reduced with

<sup>7</sup> Construction shows a surplus when seen against the total actual output of that sector; however, comparison of the eigen vector with the proportion of the actual output vector, shows that its % contribution needs to be increased. This apparently contradictory results are not really so. The surplus is seen mainly due to the underestimation of demand of construction for investment in our model. If the model had been able to capture the demand of construction for investment adequately probably the surplus would not be seen.

the greatest reduction in "Other services" and "Trade". Communication sector's output is required to be increase for all the three years.

### 7.3 SEPARATING THE TRADABLES AND NON-TRADABLES

When the surpluses and deficits are worked out for a maximal growth programme, the surpluses can be used as exports and the deficits can be made good by imports. This is possible in case in of goods and services. Trade is seen to take place in services too, however that is marginal. Some sectors are by nature non-tradables; sectors like Construction, Electricity, Road Transport Service, Railway Service etc. are non-tradables. Therefore some different treatment is called for while dealing with the surpluses/deficits of the tradable sectors and non-tradable sectors. Sectors 1 to 28 comprising of primary agriculture, forestry, fishing and mining and quarrying and manufacturing (of consumer and capital goods) are treated as tradables. Sectors 29 to 35 namely construction, electricity, rail services, other transport services communication, trade and other services are treated as non-tradables. We try to separate the tradables and non tradable sectors giving them different treatment in this simulation.

The surpluses /deficits vector  $(Z) = Z$  is divided into  $(Z)_{NT}$  and  $(Z)_T$ .

where  $T = \text{Tradables i.e. sectors 1 to 28}$

and  $NT = \text{Non Tradables i.e. sectors 29 to 35.}$

Consider  $(Z)_{NT}$  The surpluses in this vector if any are made zero and the deficits are treated as requirements to be met before any other; as domestic production is the only way of meeting these (by assumption).

$B^*(Z)_{NT} = X$ ; where  $X$  is the direct investment required to meet the deficits of the non tradable sectors.

Then Actual Investment vector  $I - X = Y$ ; where  $Y$  is the Investment goods available for requirements of the tradables for a maximal growth programme.

$\Sigma Y = \text{Total output available for meeting deficits of the tradable sectors. Distribute } \Sigma Y \text{ according to the eigen proportions of the tradables alone. Let us call this vector } Y_{eig}$

Therefore,  $\Sigma Y = \Sigma Yeig$

Then  $\Sigma Y - \Sigma Yeig =$  Pure Surplus/Deficit Vector  $Z^*$  after providing for the requirements of the non tradable sectors..

In Table No. 7.7 (A), we see the results at the aggregate level for 1983-84 , 1991-92 and 1994-95. The sectoral level surpluses and deficits are shown in Table No 7.7 (B) and 7.7 (C) respectively.

**Table No 7.7(A) Increases Required in Total Exports and Imports as % of Actual Commodity Exports and Imports (Simulation II)**

Sr no.	Year	Exports	Imports
1	1983-84	74.71	45.38
2	1991-92	35.62	21.18
3	1994-95	26.89	27.26

**Table No. 7.7 (B) Increases in Sectoral Exports Required as % of Existing Exports (Simulation II)**

Sr. no	Sector	1983-84	1991-92	1994-95
1	Agriculture	224.27	29.05	31.51
5	Sugar	11.84	-	-
6	Edible Oil	46.21	-	-
7	Oth.Food.	50.38	38.94	48.37
8	Cotton Text	94.77	18.92	22.54
9	Wool Text	693.79	152.00	179.02
10	Jute Text	-	1.01	-
11	Oth.Text Ar	10.89	-	0.60
12	Wood	232.77	-	-
13	Paper	69.39	148.63	169.56
14	Leather	15.49	-	-
15	Rubber	1767.47	158.14	165.96
16	Plastic	-	368.69	417.35
18	Fertiliser	-	149.58	166.90
19	Chemicals	279.13	96.72	104.41
20	Cement	17383.74	-	-
21	N.MetMin Pro	6.10	33.41	21.05
22	Iron & Steel	268.58	-	-
27	Oth. Tran Eqp.	382.29	271.40	368.25
28	Misc.Manufac	32.75	20.00	17.43
	<b>Total</b>	<b>74.71</b>	<b>35.62</b>	<b>26.89</b>

We note that in this simulation, more exports are released at the total level as well as the sectoral level, except for total exports in 1994-95. This is to be expected, as we are meeting the growth needs of the non-tradable sector from the available investible

resources and the remaining we are allocating to meet the growth or capital needs of the tradables sectors. Cement, Non Metallic Mineral Products and Miscellaneous Manufacturing show exportable surplus in this simulation which is not seen in the previous simulation.

**Table No. 7.7 (C) Increases in Imports Required as % of Existing Imports  
(Simulation II)**

Sr. no	Sector	1983-84	1991-92	1994-95
2	Forestry &Log	51.83	47.55	72.96
4	Mini&Quarry	0.29	8.60	16.46
5	Sugar		1465.16	1450.02
6	Edible oil		1495.9	1614.45
10	Jute Text	56.82		85.28
12	Wood		129.74	961.45
14	Leather		78.27	65.84
19	Petrol	1.03	16.86	15.83
22	Iron &Steel		16.76	92.49
23	NonFerBasMet	5.31	27.53	68.84
24	Metal Man.	109.24	213.10	328.19
25	Machinery	196.34	41.76	53.16
26	Rail Egiupmt.	2593.97	570.31	379.92
	<b>TOTAL</b>	<b>45.38</b>	<b>21.18</b>	<b>27.26</b>

The import requirements of this simulation at the total and the sectoral level are lower than the previous simulation. The number of sectors emerging as importables here is less than in the previous simulation. However, it is to be noted that import requirements of Machinery, Metal Manufacture is higher in this simulation. This implies that breaking up a growth programme like this for the tradables and the non-tradables leads to a higher deficits of these two sectors but lower deficits of other sectors like Iron And Steel, Non Ferrous Basic Metals, Petroleum Products as well as the traditional consumption goods sectors like leather, Jute.

Note: Some sectors which are export sectors like fishing show deficits for the von Nuemann maximal growth programme; However we have not treated these as extra necessary imports here because existing imports being very low, the required percentage increase will be ridiculously high. Also a high deficit is seen in this sector because unlike in other sectors this does not show any stocks in the actual investment vector; most of the output of this sector goes for consumption or exports. The eigen



vector shows a contribution of around 1% of total required investment which is quite high for a predominantly consumption sector. It is puzzling that predominantly export sectors like sugar, edible oil, leather and jute comes out as a deficit sector in both the above simulations. This could be because these simulation are for the highest possible growth programme, the von Neumann growth programme, which may not be feasible. This implies that the comparative advantage that we have in leather manufacturing may not be as strong as that in agriculture and textiles; hence this sector needs to be developed with a view to improving production and productivity.

From the above it emerges that for a high growth programme, the economy will have to take recourse to more foreign trade (almost double). It appears that our growth programme would be dependent on trade, given our existing technology, domestic production and productivity. It also emerges that the increased production and trade requirements appear very large; hence this maximal growth programme may not be feasible. Probably a growth programme that calls for a much lower level of investment being made in the eigen proportion may be required. In the next section, we examine the trade implications of a particular target growth programme.

#### **7.4 A PROGRAMME FOR 5% , 6 % AND 7% RATE OF GROWTH**

In the following simulation, we consider a particular, rather than the von Neumann growth programme for the Indian economy and try to see what it entails for the trade sector. Since the current pre-occupation of policy makers, economists and other experts is with a 6 to 7 % growth rate, we examine the scenario with this assumption in our model. The Eighth plan ( 1992-1997) had a target rate of growth for GDP fc, at 5.6 per annum. The actual achievement was almost 6%.(Planning Commission ,1997,p.5). The Ninth plan (1997-2002) projects a growth rate of 6.2 % p.a. ( Planning Commission 1997,p.25) and a current account deficit of 1.7 % of GDP. Exports are targeted to grow at 12 %. (Planning Commission 1997,p.26). The Common Minimum Programme envisages a 7 % growth during the Ninth Plan. Private consumption in this scenario is expected to grow at 6.7 % p.a..

We consider 3 growth programmes for the Indian economy- a 7 %, growth programme and scaled down programmes of 6 % and 5% rate of growth.

We try to use the latest data for the exercise. We see that 1994-95 is the year for which data of most of the variables is available: so we use A and B matrices which have been updated to 1994-95 prices. The final demand vectors are generated from the macro-economic aggregates available from the NAS and by distributing these in the proportions of the 1991-92 final demand vectors. Exports and imports figures are available only upto 1993-94, so we use these, inflated by the percentage increase in these two variables recorded over the year. The inter-industry requirement vector is estimated by multiplying the gross output vector by the A matrices. Gross output (total) is estimated from GDP figure by applying the output/value added ratio for 1991-92.

From gross output vector X, we deduct inter-industry requirement AX.

$X - AX = F$  where F is the output available for final use.

$$R1 = [ I - gB(I-A)^{-1} ]^{-1} TC$$

$$R2 = [ I - gB(I-A)^{-1} ]^{-1} Ex$$

R1 shows output required for consumption and its growth at  $g = 5\%, 6\%, 7\%$  and

R2 shows output required for the export vector and its growth at  $g = 5\%, 6\%, 7\%$ .

$R1 - TC = IC$  which is investment required for  $g\%$  growth of consumption.

$R2 - EX = IE$  which is investment required for  $g\%$  growth of exports.

$I = IC + IE =$  total investment required for  $g\%$  growth of consumption and export.

Therefore  $F - TC - EX - I = Z$  which is the surplus or deficit.

We note here that in the above model we are planning for a growth rate of the two final demand vectors of Total Consumption (public and private) and Exports. Usually, when referring to the growth rate of the economy it is output growth which is implied. Thus when the Ninth Plan projects a 6.2 % growth rate it implies growth of the output. Where as here we are trying to see the implications of achieving a particular growth rate of the consumption and export vector.

We now examine the results. The detailed results are presented in the Tables No. A7.4 ,A7.5 and A7.6. The surpluses and the deficits of these three growth programmes are also presented graphically in Figures 2, 3 and 4 on pp. 210,211 and 212. Here we discuss the main results.

**Table No. 7.8 (A) Possible Increase in Exports for the Growth Programmes  
(As % of Actual Exports)**

Sec.No	Sector	7 %	6 %	5%
1	Agriculture	211	240	244
3	Fishing	13	14	14
5	Sugar	562	596	609
7	Oth.Food Products	111	144	146
8	Cotton Textiles	53	56	58
9	Woolen Textiles	228	270	272
10	Jute Textiles	-	-	15
15	Rubber & Products	102	122	135
16	Plastic & Products	394	447	463
25	Machinery	-	-	248
27	Oth.TransportEquipment	-	22	169
	<b>Total</b>	<b>40</b>	<b>46</b>	<b>67</b>

Note : Rail Transport Equipment also shows surplus for all three years but actual exports being low the % increase required appears very high so we have not given it in the table

Figure 2 : Surpluses/Deficits of a 7% Growth Programme

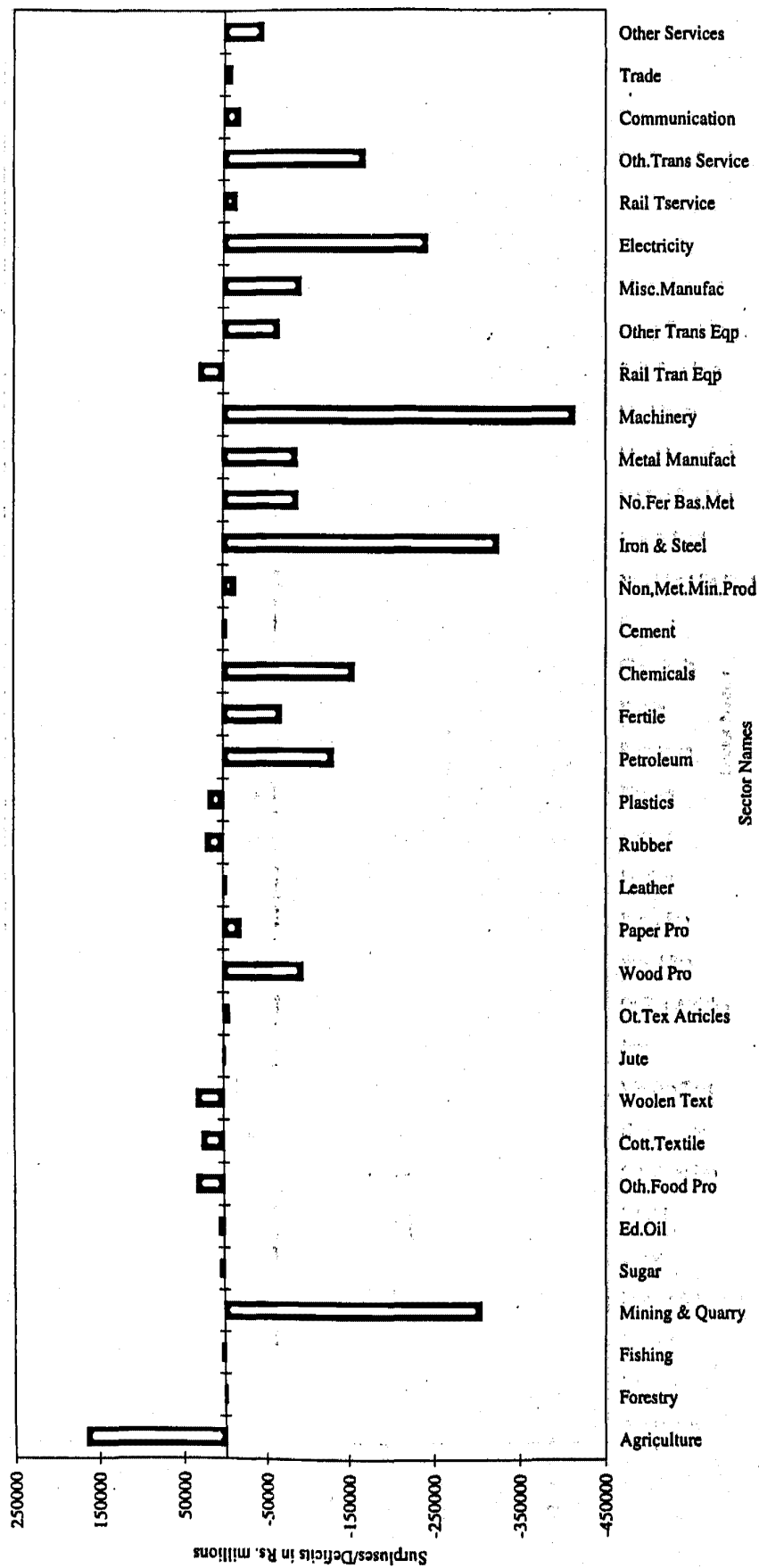
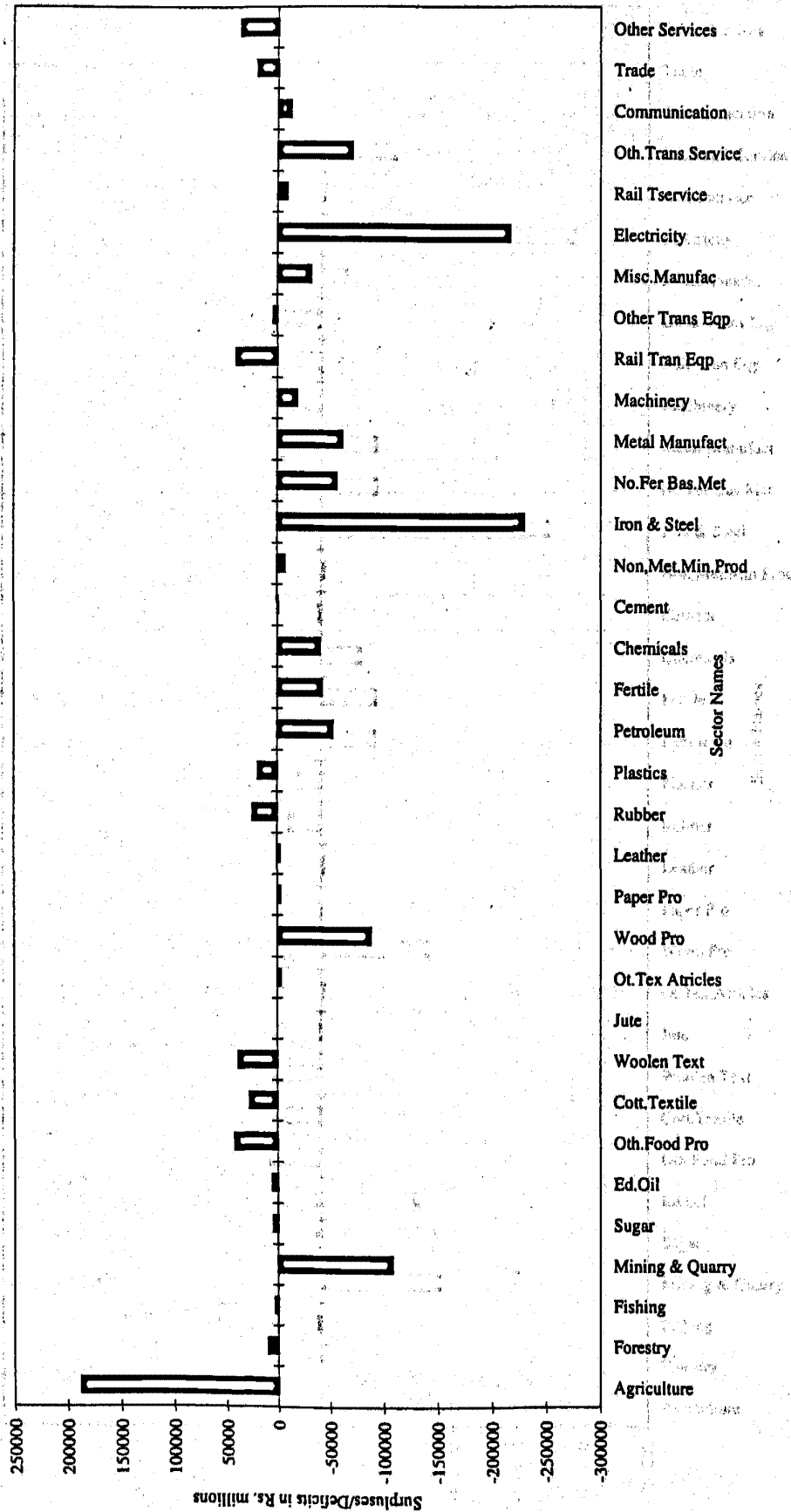
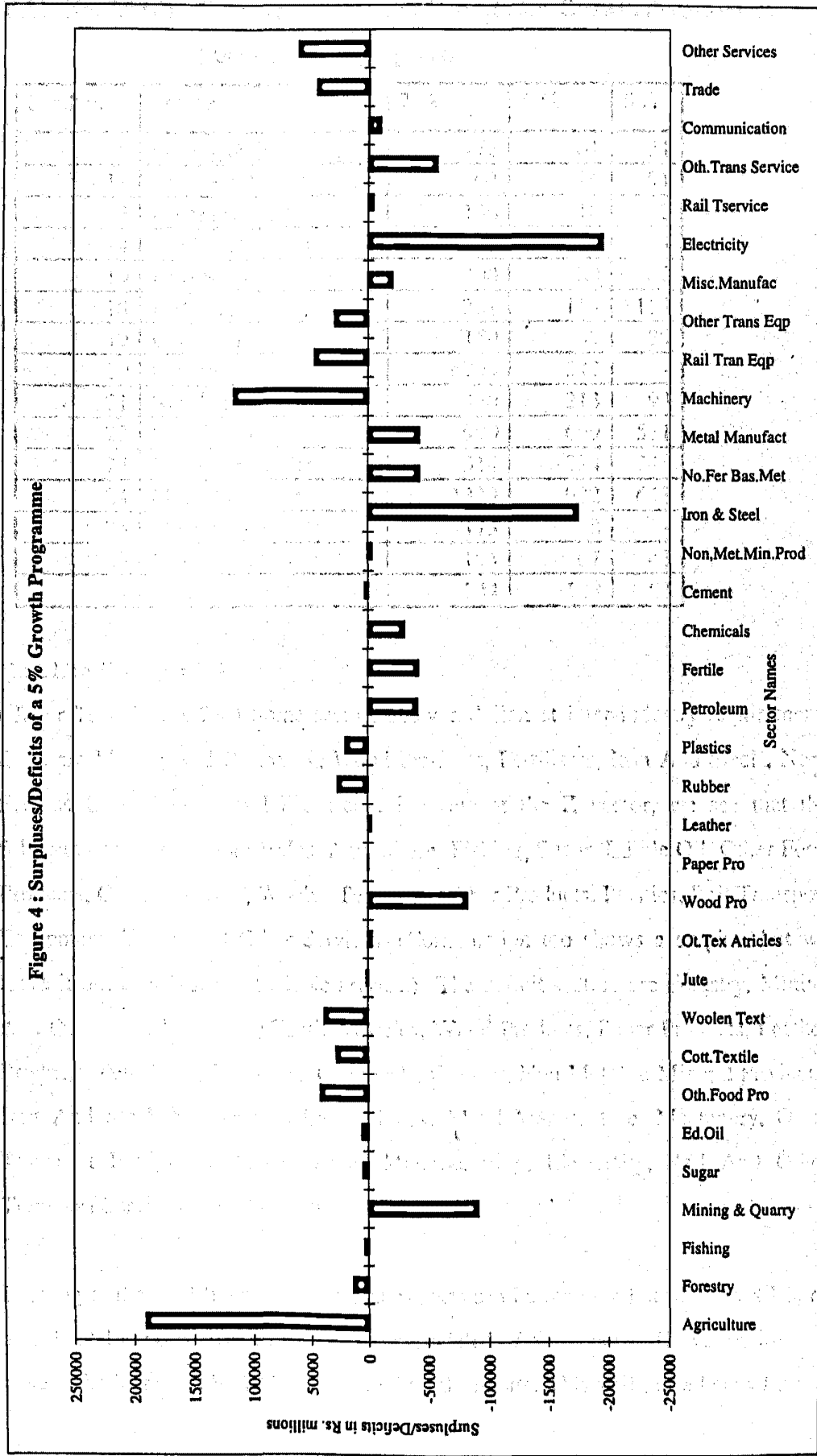


Figure 3 : Surpluses/Deficits of a 6% Growth Programme





**Table No. 7.8 (B) Necessary Increase in Imports for Growth Programmes**  
(As % of Actual Imports)

Sec.No.	Sector	7 %	6 %	5%
4	Mining & Quarrying	172	61	51
11	Oth.Text Article	202	96	91
13	Paper Products	136	18	2
14	Leather Products	376	270	264
19	Petroleum	200	80	62
18	Fertilisers	261	159	158
19	Chemicals	150	39	29
20	Cement	6794	542	-
21	Non Met Min Prod.	450	213	93
22	Iron & Steel	990	699	531
23	Non Fer Bas Met	514	324	248
24	Metal Manufact.	1339	932	648
25	Machinery	173	8	-
28	Misc.Manufact	194	67	43
	<b>Total</b>	<b>244</b>	<b>108</b>	<b>83</b>

#### 7.4.1 RESULTS FOR $g = 7\%$

(Refer Table No. A 7.4 ) Some sectors show a deficit at inter-industry requirement: these are Mining And Quarrying, Wood Products, Fertilisers, Iron And Steel , Non-Ferrous Basic Metals And Electricity. Looking at the Z vector, we see that the following sectors show a surplus: Agriculture, Fishing, Sugar, Edible Oil, Other Food Products, Cotton Textiles, Woolen Textiles, Rubber Products, Plastics, Rail Transport Equipment, Trade And Other Services. (Construction too shows a surplus, but we leave it out as it is a non tradable service.) The deficit sectors are Forestry, Mining And Quarrying, Jute, Other Textile Articles, Wood Products, Paper Products, Leather Products, Petroleum, Fertilisers, Chemicals, Cement, Non-Metallic Mineral Products, Iron And Steel, Non-Ferrous Basic Metals, Metal Manufacture, Machinery, Other Transport Equipment, Miscellaneous Manufacturing, Electricity, Rail And Other Transport Services, Communication.

Looking at the total figures, we see that exports can be increased at most by 40 % of actual total exports over and above their modeled 7 % increase. However, imports have to be increased by 244 % of actual total imports. This will put a heavy burden

on the BOT. Instead of an actual marginal trade surplus of 0.16 % of GDP, the economy will have to bear a 22 % trade deficit to finance this growth programme.

We see that the extra exportables generated are all in the traditional export sectors of the Indian economy which are primary products. These would be difficult to market in the international market in times of recession. The import requirements are seen in a large number of sectors, either of intermediate goods, raw materials and basic and capital goods and infrastructure services.

#### **7.4.2 RESULTS FOR $g = 6\%$**

(Refer Table No. A 7.5) Some sectors show a deficit at inter-industry requirement: these are Mining And Quarrying, Wood Products, Fertilisers, Iron And Steel Non-Ferrous Basic Metals And Electricity. Looking at the Z vector, we see that the following sectors show a surplus: Agriculture, Forestry, Fishing, Sugar, Edible Oil, Other Food Products, Cotton Textiles, Woolen Textiles, Rubber Products, Plastics, Rail Transport Equipment, Other Transport Equipment And Trade. (Construction too shows a surplus, but we leave it out as it is a non tradable service.) The deficit sectors are Mining And Quarrying, Jute, Other Textile Articles, Wood Products, Paper Products, Leather Products, Petroleum, Fertilisers, Chemicals, Cement, Non-Metallic Mineral Products, Iron And Steel, Non-Ferrous Basic Metals, Metal Manufacture, Machinery, Miscellaneous Manufacturing, Electricity, Rail And Other Transport Services, Communication And Other Services.

Looking at then total figures, we see that exports can be increased at most by 46 % of actual total exports over and above their modeled 6 % increase. However, imports have to be increased by 108 % of actual total imports. Thus, instead of an actual marginal trade surplus of 0.16 % of GDP, the economy will have to bear a 6.03 % trade deficit to finance this growth programme.

We see that the extra exportables generated are all in the traditional export sectors of the Indian economy which are primary products. These would be difficult to market in the international market in times of recession. The import requirements are seen



in a large number of sectors, either of intermediate goods, raw materials and basic and capital goods and infrastructure services.

#### 7.4.3 RESULTS FOR $g = 5\%$

(Refer Table No. A 7.6) We now see what a scaled down programme would entail. We set a target growth rate of 5%. In this simulation, looking at the surplus sectors, we see that all the sectors which emerged as exportables in the 6% growth programme, emerge as exportables here too. There are three additions: Jute, Cement and other Services which emerged as deficits sectors for a 6% growth programme, emerge as surpluses here. The deficit sectors remain the same as for a six% growth programme except for the above three, however the order of the deficit is much less.

Looking at the totals, we see that a 5% growth programme, would allow for a maximum 67% increase in exports over and above their modeled 5% increase. It necessitates a 83% in imports as against 108% for a 6% programme. Hence we get a much less adverse BOT of the order of -0.0097% of the GDP.

#### 7.5 CONCLUDING REMARKS

We see that compared to the von Neumann growth programme requirements, the programmes of 6 and 5 percent growth is much more feasible. The exportable surpluses is seen in case of Fishing, Sugar and Edible oil in the 7, 6 and 5% growth programmes, whereas it was absent in the von Neumann growth programme. However, Leather Products still remain the puzzling sector<sup>1</sup>; it shows a deficit even for a 7, 6 and 5% growth programmes. Among the non-traditional exportables, Machinery And Other Transport Equipment show potential for exports in 1994-95. Chemicals and Fertilisers which showed potential as exports in the von Neumann growth programme do not show the export potential in the above target growth programme. Cement seems to be on the borderline, not figuring as an exportable or as an importable in the 6% growth programme for 1994-95.

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<sup>1</sup> Note: Actual exports of leather goods in 1994-95 are 60% of total domestic output; another 21% goes for interindustry requirements and another 22% goes for domestic consumption and its growth.

Regarding the importables there are no surprising results. The same sectors show a deficit for the target growth programme in 1994-95 as in the von Neumann growth programme.

Having seen the trade implications of the growth programmes, we note that though the economy has some strong export sectors, it has an even stronger and more essential import dependence for a large number of commodities. This is either because of the production techniques adopted by the economy (being capital, fuel and power intensive) or because of low production and productivity in key sectors. Thus we can say that *Indian exports can really take off in a big way only in some traditional sectors like agriculture, fishing, cotton textiles, woollen textiles (includes synthetic textiles) and some non traditional sectors like rubbers, plastics, machinery (at low domestic absorption rates) and transport equipment.* So what needs to be done is to concentrate export promotion efforts in these sectors and for the remaining sectors - increase production, or productivity or both.

In case of imports we see that all the intermediate goods and capital goods are required as imports to fuel the growth programmes. *The deficits sectors are mining and quarrying, wood products, petroleum, chemicals, non metallic mineral products, iron and steel, non ferrous basic metals, metal manufacture, machinery miscellaneous manufacturing, other transport services, communications and electricity.*

The deficit of the electricity sector as percentage of its output for the 5, 6, 7 % programme is 43 %, 48 % and 54 % respectively. Thus a large investment in electricity is required. Even the inter-industry production demand cannot be met from the available supply. The only surprising result is leather goods which emerges as an importable in all the three growth programmes. This implies that leather goods sector needs to improve in production and productivity.

The trade deficit in Rupees Millions for the three growth programmes is -82543, -525051 and -1909664 for 5, 6 and 7 % growth programmes respectively. The actual trade balance in 1994-95 was Rs + 13490 million. The Net Invisibles for 1994-95 are

Rs. 66800 millions<sup>2</sup>. Thus we see that the growth programmes would entail a current account deficit of Rs 15743 million for 5 % programme ( 0.18 % of GDP); a deficit of Rs 458251 million for 6 % ( 5.37 % of GDP ) and a deficit of Rs 1842864 million for 7 % growth programme (21.58 % of GDP ). Converted to dollars at the current exchange rate of Rs 40 to a \$, the same figures would be a deficit of \$ 0.40 billion for the 5 % programme, a deficit of \$ 11.46 billion for the 6 % growth programme and a deficit of \$ 46.07 billion for the 7 percent growth programme. This implies that the 5 % programme can be very easily taken up, but the 6 % one would be the most feasible. (C. R. Rao, *India's Economic Growth 1950-1980*, p.240). Applying the Hecksher-Ohlin theorem of trade theory to the Indian economy, countries will export commodities which are

If we consider the exchange rate prevalent during 1994-95, which was Rs 31.39<sup>3</sup> to a dollar or Rs 31 to a dollar, we get current account deficit of \$ 0.51 billion for 5 %, a current account deficit of \$ 14.78 billion for 6 % and current account deficit of \$ 59.4 billion for 7 % growth programme. *From this it emerges that a growth programme between 5% and 6 % is feasible and a six percent programme would require a capital inflow of \$14.5 billion at exchange rate of Rs 31 to \$ or \$ 11.21 billion at the exchange rate of Rs 40 to \$.*

That there is an inherent trade off between growth and trade balance is known and is an obvious fact; however, when planning for a particular target growth rate, these tools can help the policy maker make a more informed choice of the growth rate to be set as a target and the cost to be incurred for a particular growth programme and hence its utility and feasibility.

## 7.6 CAPITAL REQUIREMENTS OF INDIA'S FOREIGN TRADE

One way of knowing whether a country's trade pattern is appropriate or not, is to see whether it is in tune with the country's resource endowment; whether the country is exporting goods which are intensive in the use of her relatively abundant factor and whether it is importing goods which are intensive in the use of the relatively scarce factor of production. The Hecksher-Ohlin theorem has been used to check the

<sup>2</sup> From RBI Currency and Finance 994-95, p.X32, Table No.X-4 A.

<sup>3</sup> This is from RBI Currency and Finance, 1994-95, p. This is the market exchange rate not the official one.

rationality of a country's trade. It would be interesting to see whether trade liberalisation of the early 1990s has helped India to move towards its assumed resource endowments<sup>4</sup>. As Bulmer-Thomas notes "the analysis of the factor content of imports and exports can serve as a useful check on the rationality of the pattern of international trade. Thus, confirmation of the Hecksher-Ohlin hypothesis by the factor content of trade provides prima facie evidence that a country has chosen to specialize in products which reflect her comparative advantage; where as the opposite results would prove either that trade policies need drastic revision or that the assumption of the model do not hold". (Bulmer-thomas 1982 p 242) Explaining the Hecksher-Ohlin model of trade Bulmer Thomas writes "Countries will export commodities which are intensive in the use of that country's relatively abundant factor of production and will import commodities which are intensive in the use of the scarce factor". (Bulmer-Thomas 1982 p 242). " It is then possible to test the model's hypothesis against the trade data of a given country. In the case of exports there is no great problems, because what is required is an examination of their factor content as given by the country's existing economic structure and destination of sales; in the case of imports, however, there is a serious difficulty because their factor content may differ according to the country of origin". Suggesting a way of overcoming this difficulty he writes further," It follows that the factor content of imports should be determined in relation to that same country or group of countries ". Here the author means that country or group of countries against whom our relative factor abundance has been established i.e. some major trading partner. "This means we cannot determine the factor content of imports by reference to imports replacing industries, as is done in some studies (Leontief,1966); instead, we must examine the factor content of exports in the country or group of countries from which the first country is importing." ( Bulmer -Thomas 1982,p. 242 )

The above implies that for the capital content of India's imports, we have to test data of the countries exporting these goods. Since this study does not have such a scheme, we will not be attempting this. This does not make so much of a difference; as Bulmer Thomas notes, "If the assumptions of the Hecksher-Ohlin model are correct, it would

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<sup>4</sup> Though it is normally assumed that India is a labour surplus and capital scarce

not make any difference, which procedure was adopted; when testing the model, however one is really it's assumptions and so it is more appropriate to consider the factor content of actual imports". Therefore the procedure adopted in this study if not more appropriate, is not totally incorrect either.

Prasad's thesis ( K.N. Prasad 1969 )<sup>5</sup> is on estimation of the factor content of India's trade in which is included examining the capital content of India's trade. His work follows that of Bhagwati ( Bhagwati, J 1964) and Bharadwaj (Bharadwaj 1962 a, b). Hazari ( Hazari 1968) has also examined the capital intensity of luxury consumption in India.

Bharadwaj uses the Input-Output coefficient table and the sectoral capital output and the labour output ratios to find out the factor intensity of India's trade vector ( a crore rupee worth of commodity imports and a crore rupee of competitive imports) in 1953-54 (Bharadwaj 1962 a ,p.54) . His findings show that India's trade pattern is in conformity with her assumed resource endowments. He finds that total capital requirements of a crore rupee worth of imports shows a continuous increase from 1950-51, to 1953-54 and to 1958-59 and the total capital requirements of a crore rupees worth of exports also increasing over the three years ( Bharadwaj, 1962 a, p.88-89) . In all the three years, the total capital requirements of imports are greater than those of exports. Thus he finds that the Indian trade confirms to the Hecksher-Ohlin theorem because of its exports being less capital intensive than its imports.<sup>6</sup>

However, Bharadwaj in the same year finds a paradoxical result for India when he examines the Indo-USA trade of 1953-54. he finds that " ...US exports relatively capital intensive goods and imports relatively labour intensive goods....(where as)...India exports to the United States relatively more capital intensive goods and

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country, this cannot be stated with any proof ( See Bharadwaj 1962,p.58-59)

<sup>5</sup> Prasad's work (Prasad 1967) summarises the available literature on this till then

<sup>6</sup> His findings are as follows: Capital Requirements of a crore rupees of exports are 0.98 crores in 1950-51, 0.99crore rupees in 1953-54 and 1.015 crores in 1958-59. Capital Requirements of a crore Rupees worth of Imports for the same years are 1.357, 1.457 and 1.446 rupees crores ( See Bharadwaj, 1962 a pp 88- 89.)

imports those goods whose production at home would involve relatively more labour .....(Bharadwaj 1962, b p.109).

Prasad finds that .. “ India has been exporting commodities having both, in absolute and relative terms, more of natural resources and capital ( but for year group one in case of capital ) till Second World War. It is only after that with the end of the period of dependence, the situation has changed with respect to capital as there is an import surplus of capital and there is a relative change with respect to natural resources. ( Prasad 1967, Chapter 4,p.162)

Bulmer-Thomas notes ( Bulmer-Thomas 1982, p 243) “ If  $\Omega > 1$ ; then exports are more labour intensive than our imports; this is the result one expects to find when analysing the trade pattern of a typical LDC with a typical DC. When imports are not broken down by region, interpretation of the Leontief statistic is made more difficult because LDCs also trade with other LDCs who may be even more “capital poor” than the country in question”. This, Bulmer-Thomas says is observed in case of the Japanese economy, where “when the trade is considered irrespective of geographical division, exports appear more capital intensive than imports.....when Japan’s exports to the USA only are considered in isolation, they appear much more capital -intensive than when all exports are considered irrespective of destination(p. 245)..... The pattern of Japanese trade appears rational; according to the Hecksher-Ohlin test. The opposite has been found for other countries such as India, however (Bhagwati, 1964)....., and a good deal of work still remains to be done in this area” (Bulmer-Thomas, 1982 p 245).

### 7.6.1 METHOD

In the method suggested to check the rationality of the trade pattern , Bulmer-Thomas says that “the indirect requirements of any factor may be sufficiently important to reverse the ranking of the sectors according to direct requirements and they must be therefore taken into account. He suggests using the model  $B*(I-A)^{-1}$ ”.

Method Suggested by Bulmer-Thomas: ( Bulmer-Thomas 1982, p.243)

$r_{ij}$  = ij th element of the matrix  $(I-A)^{-1}$

$b_i$  = capital output ratio of the ith sector

$\sum_i b_i r_{ij}$  = capital content per unit of the jth sector's output (direct + indirect)

This i.e.  $\sum_i b_i r_{ij}$  gives the capital content per unit of output of the jth sector. Exports of these may have different weights in total exports. So, he suggests weighting to get a correct estimate of the capital content of exports. If weights are given as  $w_j$ , then  $\sum_j w_j \sum_i b_i r_{ij}$  gives the capital content of exports. The relative factor content of exports is given as:

$$N(e) = \frac{\sum_j w_j \sum_i b_i r_{ij}}{\sum_j w_j \sum_i l_i r_{ij}}$$

Similarly the relative factor content for imports is given as:

$$N(m) = \frac{\sum_j w_j \sum_i b_i r_{ij}}{\sum_j w_j \sum_i l_i r_{ij}}$$

The Leontief statistic is defined as

$$\Omega = N(m) / N(e)$$

If  $\Omega > 1$ ; then exports are more labour intensive than imports.

In the present study, the analysis attempted is somewhat different than that suggested by Bulmer-Thomas. The labour requirement has not been considered. We are taking into account only one factor i.e. capital. We are estimating only the capital intensity of India's exports and imports.

(1) We have not included labour content in our study since that is not the focus of the study. We have no ready estimates of  $l_i$ ; therefore we have concentrated on finding out the relative capital content only.

(2) Instead of using  $b_i$  s i.e. sectoral capital output ratios, we shall be using the complete capital matrix or the  $b_{ij}$ s

(3) Instead of using weights to determine the importance of each sector's exports in total exports, we shall be using the actual export vector.

### 7.6.2 DIRECT CAPITAL REQUIREMENTS OF INDIA'S FOREIGN TRADE

In the following section, we have confined ourselves to finding out only the direct capital requirements of trade, for the years of 1983-84 1991-92 and 1994-95. In the next sub-section we take into account both direct and indirect requirements. Now

given that  $B$  = The Incremental Capital Coefficient Matrix

$B\Delta X$  = Incremental Capital Stock needed to produce  $\Delta X$ .

Then  $BX = C$  Here 'C' will show the investment embodied in X

Consider  $B * E = K^E$  where  $B$  = Capital Coefficient Matrix

$E$  = Export Vector

$K^E$  = Vector showing capital directly used in 'E'

Here the vector  $K^E$  will give the incremental capital stock required for producing the level of exports as shown by the export vector 'E'.

If  $K^E = K_i^e$  and  $E =$

$K_2^e$   $E_2$

$K_7^e$   $E_{35}$

Total K

Total E

Then dividing each  $K_i^e$  by total Exports 'E' we get,

$$K_i^e = \Omega_i^e$$

$$\frac{\quad}{E}$$

Now  $\Omega_i^e = i^{\text{th}}$  type of capital good required per unit of exports and

$$O^E = \frac{K^E}{E} = \text{All fixed Capital Required per unit of Exports}$$

E

Imports : Imported goods are not actually produced in the economy under study. They are produced in other economies and consumed here. Therefore, they may embody different type of capital goods, labour etc. For the sake of comparison however, we can put forth the following hypothesis : If all the imports were to be produced domestically, what amount of domestic goods (both current and capital) would they require? So

$B * I = K^M$  where, B is the Incremental Capital Coefficient Matrix, I = Import Vector



Now  $K^M$  here will show the amount of different type of capital goods that would be required if the imports shown by the import vector were to be produced domestically. According to the theory of comparative advantage, a country exports those goods in which it has a greater comparative advantage and that a country uses its more abundant factor more intensely. If we, by common sense and by a proxy reasoning, hypothesize that India is relatively a labour abundant rather than a capital rich country, then we would expect that its exports are more labour intensive than its imports or we would expect that its imports are more capital intensive than its exports i.e.

$$K^E < K^I$$

i.e. capital needed per unit of exports is less than the capital needed per unit of imports.

We define  $O^M = \frac{K^M}{I}$                        $O^E = \frac{K^E}{E}$

We need to now compare  $O^E$  and  $O^M$  and according to the hypothesis stated above, we expect that

$$O^E < O^M$$

**RESULTS** The detailed results are presented in Table Nos. A7.7 (a), A7.7 (b) and A7.7(c). Here we discuss some of the results

**Table No. 7.9 Direct Capital Intensity Of Total Indian Exports And Imports**

YEAR	$O^E$	$O^M$
1983-84	1.711762	2.399336
1991-92	1.297226	2.544690
1994-95	1.265390	2.468790

From the above it is clear that  $O^E < O^M$  for all three year; In 1983-84, our imports needed more capital per unit than our exports. This gap increased in 1991-92, when our imports needed almost double the capital per unit than our exports. So we can say that the capital intensity of our imports had increased and that of our exports has decreased to widen the gap. However, for 1994-95 though  $O^E < O^M$  the gap between

the two has narrowed. Thus, we cannot say that with liberalization, our exports and imports have moved towards being in tandem with our factor endowments.

The above results show that for total directly used capital, the relationship is in conformity with theory. However, what about the use of different types of fixed assets in our exports and imports? Does each type of capital asset used in production also confirm this relationship? To test this we compute  $\Omega^e_i$  and  $\Omega^m_i$  where  $\Omega^e_i = i^{\text{th}}$  type of capital used per unit of exports and  $\Omega^m_i = i^{\text{th}}$  type of capital used per unit of Imports. If India has a relative capital scarcity for all types of capital goods, then we expect  $\Omega^e_i < \Omega^m_i$  for all i's.

However, if the economy has a relative abundance of some type of capital asset than for this we may expect

$$\Omega^e_i > \Omega^m_i$$

**Table No. 7.10 (A) Direct Capital Intensity of Indian Exports and Imports by type of Capital goods 1983 - 84**

No	Capital Asset	$\Omega^e_i$	$\Omega^m_i$	If $\Omega^e_i > \Omega^m_i$
12	Wood Product	0.00233575	0.000954	$\Omega^e_i > \Omega^m_i$
24	Metal Manufacture	0.066711127	0.064070	$\Omega^e_i > \Omega^m_i$
25	Machinery	0.817455248	1.345675	
26	RailTranspt Eqp.	0.034790016	0.001092	$\Omega^e_i > \Omega^m_i$
27	OtherTransptEqp	0.242250	0.158417	$\Omega^e_i > \Omega^m_i$
28	Misc.Manfturing	0.007311	0.010265	
29	Construction	0.416358	0.691509	
	Total	1.711762	2.399336	

From the above we see that though overall, imports are more capital intensive than exports, when we look at types of assets, the results are different for different assets. In case of 4 out of 7 types of capital goods, our exports are more intensive in the use of these, than are our imports. These goods are Wood Products, Metal Manufacture, Rail Transport Equipment and Other Transport Equipment. If we go by established trade theory it would lead us to conclude that the Indian economy is relatively better endowed with these types of capital goods than the remaining two namely machinery and construction. Now we look at the results of 1991-92 so that we can compare the two.

**Table No. 7.10 (B) Direct Capital Intensity of Indian Exports and Imports by type of Capital goods 1991-92**

No	Capital Good	$\Omega_i^e$	$\Omega_i^m$	If $\Omega_i^e > \Omega_i^m$
12	Wood Products	0.001638	0.000885	$\Omega_i^e > \Omega_i^m$
24	Metal Manufacture	0.088436	0.064969	$\Omega_i^e > \Omega_i^m$
25	Machinery	0.552702	1.346448	
26	Rail Equipment	0.035797	0.001267	$\Omega_i^e > \Omega_i^m$
27	OthrTranspt Eqp.	0.194673	0.191691	$\Omega_i^e > \Omega_i^m$
28	Misc.Manufacturing	0.003996	0.007089	
29	Construction	0.294373	0.801805	
	Total	1.297226	2.544690	

In the above we see that out of 7, the same 4 capital assets show a more intensive use in exports as compared to imports. These are Wood products Metal Manufacture, Rail Transport Equipment and Other Transport Equipment.

#### Exports

The overall capital intensity of exports has declined during 1983-84 to 1991-92 from 1.711762 to 1.297226. The intensity of the different types of capital goods - the per unit use of Metal Manufacture, Rail Equipment and Other Transport Equipment in exports has increased from 1983-84 to 1991-92. This means that our exports have become more intensive in the use of this type of capital goods during the period. In case of all other types of capital goods, the intensity of use has decreased. Thus our exports have become less capital intensive and less intensive in use of the remaining 4 types of capital goods.

**Table No. 7.10 (C) Direct Capital Intensity of Indian Exports and Imports by Type of Capital Goods 1994-95**

No	Capital Good	$\Omega_i^e$	$\Omega_i^m$	$\Omega_i^e > \Omega_i^m$
12	Wood Products	0.003267	0.001741	$\Omega_i^e > \Omega_i^m$
24	Metal Manufacture	0.085378	0.063543	$\Omega_i^e > \Omega_i^m$
25	Machinery	0.534713	1.290934	
26	Rail Equipment	0.032605	0.001136	$\Omega_i^e > \Omega_i^m$
27	OthrTranspt Eqp.	0.173827	0.163873	$\Omega_i^e > \Omega_i^m$
28	Misc.Manufacturing	0.003992	0.007060	
29	Construction	0.300054	0.805162	
	Total	1.26539	2.468790	

For 1994-95 too we see that exports make more intensive use of Wood Products, Metal Manufacture, Rail Transport Equipment and other Transport Equipment. **Exports:** From 1991-92 to 1994-95, exports have been more intensive in the use of Construction; in case of all other capital goods the intensity per unit has declined. **Imports:** The capital intensity of imports has increased slightly from 2.39936 to 2.544690 from 1983-84 to 1991-92 and then declined to 2.468790 in 1994-95. Coming to the different types of capital goods, we see that except for wood products and miscellaneous manufacturing, our imports show increased intensity of use of other capital assets during the first period. This implies that our imports have become more intensive in the use of all the remaining 5 types of capital assets. Thus, our indirect imports of these 5 categories has increased through our imports. However from 1991-92 to 1994-95 the picture is different. The intensity of use of all capital goods in our imports has declined except for Wood products and Construction. Overall these results corroborate the theory that nations export goods in which they have a comparative advantage and those that use their more abundant factor more intensively. The change in the capital intensity from 1983-84 to 1991-92 also implies that our trade pattern is changing according to tandem with our endowments; however the findings for the the period 1991-92 to 1994-95 do not corroborate the above trend.

In the current exercise, we see that India's trade pattern confirms quite well to the assumed comparative advantage and to the assumption that India is a labour abundant and capital scarce economy. In all three years India's exports show a lower capital intensity per unit than do the imports; the gap between the two increasing in the first period (1983-84 to 1991-92) albeit narrowing in the later period (1991-92 to 1994-95).

### **7.6.3 DIRECT AND INDIRECT CAPITAL REQUIREMENTS OF INDIA'S FOREIGN TRADE**

In the above section we have seen the results of estimating the **direct capital contents** of exports and imports . Here the results corroborate the expected trade pattern. However as Bulmer -Thomas has noted, "the indirect requirements of any factor may be sufficiently important to reverse the ranking of the sectors according to direct requirements and they must be therefore taken into account".( Bulmer-Thomas,

1982,p 243). Therefore to see whether the same result holds when we consider the **direct and the indirect capital requirements**, we run the below described model for the same years i.e. 1983-84 and 1991-92 and 1994-95.

The model used is :  $B(I-A)^{-1} * E = Ke$  and

$$B(I-A)^{-1} * M = Km$$

$\sum Kei$  = Total direct and indirect capital required for producing the vector of exports E.

$\sum Kmi$  = Total direct and indirect capital required for producing the vector of imports M.

Then  $\sum Kei / \sum Ei = N(e)$ = Direct +Indirect Capital intensity per unit of exports.

Then  $\sum Kmi / \sum Ei = N(m)$ = Direct +Indirect Capital intensity per unit of imports

Defining  $\Omega = N(m)/N(e)$  ; If  $\Omega > 1$  then our exports are less capital intensive than our imports. The detailed results are presented in Tables Nos. A7.8 (a) , A7.8 (b) and A7.8 (c). The main results are discussed below:

**Table No 7.11 Direct and indirect (Total) Capital Intensity Of Indian Exports And Imports For The Actual Trade Vectors**

YEAR	DIRECTN(E)	D+IND N(E)	DIRECTN(M)	D+IND N(M)
1983-84	1.711762	3.728685	2.399336	5.246798
1991-92	1.297226	2.764580	2.544690	5.519249
1994-95	1.265390	2.777706	2.468790	5.503799

YEAR	$\Omega = N(M)/N(E)$ DIRECT	$\Omega = N(M)/N(E)$ DIRECT+INDIRECT
1983-84	1.402	1.407
1991-92	1.961	2.000
1994-95	1.951	1.981

From the above tables we see that the import vectors of all three years is more capital intensive than the export vector. The per unit capital required is more for the import basket than the export basket even when we consider both direct and indirect requirements. Therefore our trade pattern appears to be in conformity with assumed factor abundance.

Looking at the direct and indirect requirements of different types of capital goods as shown in Table Nos. 7.11 (a) , 7.11 (b) and 7.11 (c) , for exports and imports it can be noted that as against considering only the direct capital needs, here exports are more

intensive than imports in the use of only 2 or at most 3 capital goods namely Metal Manufactures, Rail Transport Equipment and Other Transport Equipment. The major difference is that exports in the earlier section, where only the direct capital requirements were considered, came out to be more intensive in the use of wood products than imports for all three years; where as in case of direct and indirect capital requirement, it imports which are seen to be more intensive in the use of wood products for all three years.

**Exports:** The use of Metal Manufacture, Machinery and Other Transport Equipment for the export vector has decline over the three years. The other capital goods show mixed trends. This implies that since our exports are becoming less intensive in the use of 3 capital goods over the years, their composition is changing according to our assumed resource endowments from capital intensive to less capital intensive exports. This is in accordance with the Hecksher- Ohlin theory.

**Imports:** For imports, the intensity of use of the following goods shows a decline over the period: Metal Manufacture and Construction. The use of the remaining capital goods shows an increase in the first period and then a decline. Hence we see that the changing import structure does not corroborate the implications shown by the export vector. In case of imports one would expect increasing intensity of use of at least heavy capital goods like Machinery, Transport Equipment etc. This could indicate that our imports may not necessarily embody the real complex capital goods like Machinery, Miscellaneous Manufactures; instead they may embody only the relatively less complex capital goods like Machine Tools and Construction in which India may not be really suffering a Comparative disadvantage.

**Table No.7.12(A) Direct And Indirect Capital Requirements Of Indian Exports And Imports By Type Of Capital Goods 1983-84**

No	Capital Good	$\Omega_i^c$	$\Omega_i^m$	$\Omega_i^c > \Omega_i^m$
12	Wood Products	0.035316	0.053226	
24	Metal Mnuufacture	0.130541	0.152371	
25	Machinery	0.990098	1.615164	
26	Rail Equipment	0.051364	0.017243	$\Omega_i^c > \Omega_i^m$
27	OthrTranspt Eqp.	0.280657	0.188638	$\Omega_i^c > \Omega_i^m$
28	Misc.Manufacturing	0.030321	0.043800	
29	Construction	0.443629	0.729095	
	<b>Total</b>	<b>3.728685</b>	<b>5.246798</b>	

**Table No.7.12 (B) Direct And Indirect Capital Requirements Of Indian Exports And Imports By Type Of Capital Goods 1991-92**

No	Capital Good	$\Omega_i^c$	$\Omega_i^m$	$\Omega_i^c > \Omega_i^m$
12	Wood Products	0.018431	0.042518	
24	Metal Mnuufacture	0.092278	0.068352	$\Omega_i^c > \Omega_i^m$
25	Machinery	0.725801	1.741533	
26	Rail Equipment	0.057451	0.035465	$\Omega_i^c > \Omega_i^m$
27	OthrTranspt Eqp.	0.228692	0.230618	
28	Misc.Manufacturing	0.065118	0.125235	
29	Construction	0.309712	0.830987	
	<b>Total</b>	<b>2.764580</b>	<b>5.519249</b>	

**Table No.7.12(C) Direct And Indirect Capital Requirements Of Indian Exports And Imports By Type Of Capital Goods 1994-95**

No	Capital Good	$\Omega_i^c$	$\Omega_i^m$	$\Omega_i^c > \Omega_i^m$
12	Wood Products	0.036705	0.083457	
24	Metal Manufacture	0.089067	0.066775	$\Omega_i^c > \Omega_i^m$
25	Machinery	0.702090	1.668975	
26	Rail Equipment	0.052299	0.031803	$\Omega_i^c > \Omega_i^m$
27	OthrTranspt Eqp.	0.204287	0.197616	$\Omega_i^c > \Omega_i^m$
28	Misc.Manufacturing	0.064594	0.122779	
29	Construction	0.31755	0.834634	
	<b>Total</b>	<b>2.777706</b>	<b>5.503799</b>	

#### 7.6.4 ESTIMATING THE CAPITAL INTENSITY OF THE IDEAL TRADE VECTOR

If the recommendations about the changes in the trade vector given in this chapter have some semblance of being fairly good estimates, then they should adhere to the resource endowment of the economy. To check this we estimated the same parameters as above i.e. direct and direct and indirect capital requirements for the ideal (recommended) trade vectors. We find the Hechsher- Ohlin assumptions being satisfied. The results are:

**Table No. 7.13 Direct And Indirect Capital Requirements Of The Ideal Trade Vectors**

YEAR	DIRECT N(E)	D+IND N(E)	DIRECT N(M)	D+IND N(M)
1983-84	1.69	3.67	2.61	5.70
1989-90	1.34	3.99	2.34	5.55
1991-92	1.24	2.68	2.74	5.92
1994-95	1.21	5.93	2.69	5.97

Looking at the above table and comparing it with the results of the actual trade vector (p. 224), we note that the ideal export vector needs less capital per unit than the actual export vector, in case of both direct and direct and indirect requirements, except in the case of direct and indirect requirements of 1994-95. In case of imports, the ideal import vector needs more capital per unit than the actual import vector both for direct and direct and indirect trade requirements.

To sum up this section on testing India's trade pattern we conclude that during the first period i.e. from 1983-84 to 1991-92, the changes in most of the estimated statistics show that India's trade pattern was moving in the direction of her assumed resource endowments. However, in the next period i.e. from 1991-92 to 1994-95, it was seen that though all the estimated statistics confirmed that India's trade pattern is still in tandem with her resource endowment the change from the year 1991-92 to 1994-95 was against the expected trend.

Though the per unit total capital requirements for imports is higher than that for exports, the gap between the two i.e. between total capital requirements for unit



exports and imports has narrowed considerably from what it was in 1991-92. *Therefore it may seem that our policies during early nineties have not helped our trade sector to go nearer to our assumed comparative advantage.*

#### **7.6.5 LIMITATIONS**

The limitation of this exercise is that while estimating the capital content of imports, we should have ideally estimated capital required in the economies where these imports are actually produced or if that was not possible, we should at least compare the per unit capital content of exports with that of only competitive imports. In LDCs however it is assumed that almost all imports are complementary, so the second limitation is not such a serious limitation. To separate imports into competitive and complementary would raise the issue of what criteria to base this distinction on, hence we have left it for the time being. Also if the labour ratio could have incorporated into the analysis it would have made the section more comprehensive.

***APPENDIX TO CHAPTER SEVEN***

**TABLE No A7.1(a) Comparison of Surplus/Deficit Vector, Z, and Actual Trade Vector 1983-84 (In Rs. millions)**

S.No	Sector	Z= I -I*	Act Exp-
1	Agriculture allied	15163	-20804
2	Forest	-5314	5941
3	Fishing	-3760	26101
4	Mining & Quarrying	-11919	-252021
5	Sugar	-3470	23640
6	Edible oil	-777	- 4886
7	Other Food. Bevers	-4505	1804
8	Cotton Textiles	-632	29342
9	Woolen Textiles	3455	- 3479
10	Jute	-531	12845
11	OtherTextile Articles	-1713	97586
12	Wood	-2140	2897
13	Paper	-2284	-33947
14	Leather	-1620	40428
15+16	Rubber and Plastics	8084	777
17	Petroleum	-9277	-98027
18	Fertilizers	-6321	-20395
19	Other Chemicals	3332	-103200
20	Cement	-695	-10380
21	N. Met. Min. Prod.	-3704	-1297
22	Iron & Steel	-37885	-111382
23	N.F.Basic Metals	-10577	-41634
24	Metal Manufacture	-7121	-8219
25	Machinery	-31475	-205590
26	Rail Transport Eqp.	1226	-3793
27	Other Transprt Eqp.	9098	-3823
28	Miscellaneous	-45	37550
29	Construction *	44088*	0
30	Electricity	-12196	289
31	Railway Service	-6278	16784
32	Transport Service	-8540	12568
33	Communication	-3035	529
34	Trade	-7331	130538
35	Other Services	-23148	81704
	Total	0	-402184

Note : \* This figure has been modified to take into account demand for dwellings which is not captured by the model. See the footnote no.6 note on p.201.

**Table No. A7.1(b) Comparison of Surplus/Deficit Vector, Z, and Actual Trade Vector 1991-92 (In Rs. million)**

	Sector	Surplus/Deficit	ActualNet Export
1	Agriculture allied	-420	29439
2	Forest	-17153	-6214
3	Fishing	-11027	12169
4	Mining & Quarrying	-43464	-124742
5	Sugar	-12734	314
6	Edible oil	-15204	-161
7	Other Food.Bevers	-5208	9533
8	Cotton Textiles	-3836	26062
9	Woolen Textiles	2725	3595
10	Jute	-1333	3060
11	OtherTextile Arties	-5664	58377
12	Wood	-7377	-307
13	Paper	-7957	-10831
14	Leather	-4024	33027
15	Rubber	11003	9873
16	Plastic	5664	1279
17	Petroleum	-27231	-38460
18	Fertilizers	1391	-18769
19	Other Chemicals	6282	-49677
20	Cement	-3882	-40
21	N. Met. Min. Prod.	-9802	1449
22	Iron & Steel	-107490	-21150
23	N.F.Basic Metals	-32342	-11531
24	Metal Manufacture	-2284	-1464
25	Machinery	-16713	-152569
26	Rail Transport Eqp.	19894	-2133
27	Other Transprt Eqp.	38486	-22879
28	Miscellaneous	-13783	+20115
29	Construction *	120722	0
30	Electricity	-37775	90
31	Railway Service	-16737	6799
32	Transport Service	-28950	-31126
33	Communication	-14080	-1401
34	Trade	-22025	66703
35	Other Services	-71404	46265
	Total	0	-171314

Note : \* This figure has been modified to take into account demand for dwellings which is not captured by the model. See the footnote no.6 note on p.201

**Table No. A7.1(C) Comparison of Surplus/Deficit Vector, Z, and Actual Trade Vector 1994-95 (In Rs. million)**

Sr.	Name Of Sector	I-I*	Exp-Imp
1	Agriculture + Allied	7108	58682
2	Forestry & Logging	-25082	-8332
3	Fishing	-12122	21646
4	Mining & Quarry	-87958	-163928
5	Sugar	-13943	604
6	Edible Oil	-16721	-216
7	Oth.F.Pr.&Bevre	1231	19781
8	Cotton Textiles	-113	46627
9	Wool, Syn. Text	14135	8223
10	Jute, Hemp, Mesta Textiles	-2367	5482
11	Other Textiles Articles	-4741	104805
12	Wood & Wood Products	-28014	-313
13	Paper & Paper Products	-10622	-14350
14	Leather & Leather Products	-3828	58997
15	Rubber & Its Products	23399	17963
16	Plastic Products	12269	2734
17	Petrol.+Cl.Tar.Pro.	-52180	-46789
18	Fert+Pest	2733	-24632
19	Other Chemical Pro.	14778	-54203
20	Cement	-6376	-54
21	NonMetallic Mineral Products	-16624	3658
22	Iron & Steel	-219922	-26897
23	Non Ferros Basic Metals	-63266	-14830
24	Machine Tools	-5560	-448
25	El+Non El.Mach.	-57334	-193215
26	Rail Transport Equipment	41225	-2700
27	Other Trans Eqp.	86666	-26494
28	Other Manufacturing	-24261	51290
29	Construction *	216428	0
30	Electricity Etc	-107610	160
31	Railway Services	-29015	12084
32	Other Transport Services	-54595	-27991
33	Communication	-21522	-1383
34	Trade	-44424	107892
35	Other Services	-129627	99637
	Total	-3	13490

Note : \* This figure has been modified to take into account demand for dwellings which is not captured by the model. See the footnote no. 6 on p.201.

**Table No. A7.2 (a) : Structure and Composition of Exports 1983-84**

Sector		Act.Exps.	Act. Exps % of Total	Ideal % Comp	Ideal Exp (Act + Extra)
1	Agriculture.	93500	9.39	17.51	245133
2	Forest	7917	0.79	0.57	7917
3	Fishing	27052	2.72	1.93	27052
4	Mining	137203	13.77	9.80	137203
5	Sugar	23640	2.37	1.69	23640
6	Edible Oil	74994	7.53	5.36	74994
7	Other F.Beve.	2052	0.21	0.15	2052
8	Cotton Textiles	29843	3.00	2.13	29843
9	Woolen Textiles	9624	0.97	3.16	44169
10	Jute	13940	1.40	1.00	13940
11	Other. Textil Art.	102894	10.33	7.35	102894
12	Wood	3277	0.33	0.23	3277
13	Paper	9633	0.97	0.69	9633
14	Leather	40988	4.11	2.93	40988
15,16	Rubber & Plastics	6140	0.62	6.21	86980
17	Petroleum	34031	3.42	2.43	34031
18	Fertilizers	53	0.01	0.00	53
19	Chemicals	45051	4.52	5.60	78371
20	Cement	76	0.01	0.01	76
21	N.Met.Min. Prod.	114949	11.54	8.21	114949
22	Iron & Steel	8916	0.90	0.64	8916
23	N.Ferr.Basc Meta	2100	0.21	0.15	2100
24	Metal Manufacture	14522	1.46	1.04	14522
25	Machinery	67314	6.76	4.81	67314
26	Rail Transport	591	0.06	0.92	12855
27	Transport Equipt	14168	1.42	7.51	105148
28	Misc. Manufact.	111706	11.21	7.98	111706
	Total	996174	100	100	1399756

**Table No A7.2 (b) Structure and Composition of Exports 1991-92**

Sec No	Sector Name	Actual Exports	Act.Exps As%of Total	%of Ideal Exports	Ideal Export
1.	Agriculture.	44006	11.87	9.65	44006
2.	Forest	0	0.00	0.00	0
3.	Fishing	12209	3.29	2.68	12209
4.	Mining	7670	2.07	1.68	7670
5.	Sugar	418	0.11	0.09	418
6.	Edible Oil	0	0.00	0.00	0
7.	Other F.Beve.	16033	4.32	3.51	16033
8.	Cotton Textiles	26762	7.22	5.87	26762
9.	Woolen Textiles	7795	2.10	2.31	10520
10.	Jute	3160	0.85	0.69	3160
11.	Other. Textil Art.	60777	16.39	13.32	60777
12.	Wood	225	0.06	0.05	225
13.	Paper	396	0.11	0.09	396
14.	Leather	33703	9.09	7.39	33703
15.	Rubber	10825	2.92	4.78	21828
16.	Plastics	2333	0.63	1.75	7997
17.	Petroleum	10952	2.95	2.40	10952
18.	Fertilizers	1225	0.33	0.57	2616
19.	Chemicals	28425	7.67	7.61	34707
20.	Cement	0	0.00	0.00	0
21.	N.Met.Min. Prod.	3930	1.06	0.86	3930
22.	Iron & Steel	3350	0.90	0.73	3350
23.	N.Ferr.Basc Metal	1449	0.39	0.32	1449
24.	Metal Manufacture	3472	0.94	0.76	3472
25.	Machinery	26026	7.02	5.70	26026
26.	Rail Transport	368	0.10	4.44	20261
27.	Transport Equipt	9583	2.58	10.54	48069
28.	Misc. Manufact	55714	15.03	12.21	55714
	Total	370806	100.00	100.00	456252

**Table No A7.2 (C) Structure and Composition of Exports 1994-95**

Sec tr. N	Sector Name	Actual Exports	Act.Exps As %of Total Exps	%of Ideal Exports	Ideal Export
1	Agriculture.	78215	11.87	9.89	85323
2	Forest	0	0.00	0.00	0
3	Fishing	21700	3.29	2.52	21700
4	Mining	13632	2.07	1.58	13632
5	Sugar	743	0.11	0.09	743
6	Edible Oil	0	0.00	0.00	0
7	Other F.Beve.	28497	4.32	3.45	29728
8	Cotton Textiles	47566	7.22	5.51	47566
9	Woolen Textiles	13855	2.10	3.24	27990
10	Jute	5616	0.85	0.65	5616
11	Other. Textil Art.	108023	16.39	12.52	108023
12	Wood	400	0.06	0.05	400
13	Paper	704	0.11	0.08	704
14	Leather	59903	9.09	6.94	59903
15	Rubber	19240	2.92	4.94	42639
16	Plastics	4147	0.63	1.90	16416
17	Petroleum	19466	2.95	2.26	19466
18	Fertilizers	2177	0.33	0.57	4910
19	Chemicals	50522	7.67	7.57	65300
20	Cement	0	0.00	0.00	0
21	N.Met.Min. Prod.	6985	1.06	0.81	6985
22	Iron & Steel	5954	0.90	0.69	5954
23	N.Ferr.Basc Metal	2575	0.39	0.30	2575
24	Metal Manufacture	6171	0.94	0.72	6171
25	Machinery	46258	7.02	5.36	46258
26	Rail Transport	654	0.10	4.85	41879
27	Transport Equip	17033	2.58	12.02	103699
28	Misc. Manufact.	99024	15.03	11.48	99024
	<b>Total</b>	<b>990290</b>	<b>100</b>	<b>100</b>	<b>2028113</b>



**Table No.A 7.3 (a): Structure And Composition Of Imports, 1983-84**

In Rs. Millions

Sect No.	Sector	Act.Imps	Act.I mps As % of Total	Ideal % Comp	Ideal Imp Vec
1	Agriculture.	114304	6.97	3.69	114304
2	Forest	1976	0.12	1.78	55113
3	Fishing	951	0.06	1.24	38550
4	Mining	389224	23.73	16.41	508409
5	Sugar	0	0.00	1.12	34696
6	Edible Oil	79880	4.87	2.83	87646
7	Other F.Beve.	248	0.02	1.46	45296
8	Cotton Textiles	501	0.03	0.22	6817
9	Woolen Textiles	13103	0.80	0.42	13103
10	Jute	1095	0.07	0.21	6403
11	Other. Textil Art.	5308	0.32	0.72	22438
12	Wood	380	0.02	0.70	21784
13	Paper	43580	2.66	2.14	66418
14	Leather	560	0.03	0.54	16758
15 + 16	Rubber	5363	0.33	0.17	5363
17	Petroleum	132058	8.05	7.26	224825
18	Fertilizers	20448	1.25	2.70	83655.2
19	Chemicals	148251	9.04	4.79	148251
20	Cement	10456	0.64	0.56	17404
21	N.Met.Min. Prod.	116246	7.09	4.95	153283
22	Iron & Steel	120298	7.33	16.11	499144
23	N.Ferr.Basc Meta	43734	2.67	4.83	149501
24	Metal Manufacture	22741	1.39	3.03	93954
25	Machinery	272904	16.64	18.97	587649
26	Rail Transport	4384	0.27	0.14	4384
27	Transport Equip	17991	1.10	0.58	17991
28	Misc. Manufact.	74156	4.52	2.41	74606
<b>TOTAL</b>	<b>Total</b>	<b>1640140</b>	<b>100</b>	<b>100</b>	<b>3127635</b>

**Table No.A 7.3 (b) Composition Of Actual And Ideal Imports, 1991-92**  
In Rs. Millions

SR	Sector	Actual Imports	Act Imports As%of Tot	%of Tot Ideal Imports	Ideal Imports
1.	Agricult.	14567	2.34	1.54	14987
2.	Forest	6214	1.00	2.40	23367
3.	Fishing	40	0.01	1.14	11067
4.	Mining	132421	21.24	18.09	175885
5.	Sugar	104	0.02	1.32	12838
6.	Edible Oil	161	0.03	1.58	15365
7.	Oth.F.Prod.	6500	1.04	1.20	11708
8.	CottonText.	700	0.11	0.47	4536
9.	WolenText.	4200	0.67	0.43	4200
10.	Jute Text.	100	0.02	0.15	1433
11.	Oth.Text.Ar	2400	0.38	0.83	8064
12.	Wood	532	0.09	0.81	7909
13.	Paper	14237	1.80	1.97	19184
14.	Leather	676	0.11	0.48	4700
15.	Rubber	952	0.15	0.10	952
16.	Plastics	1054	0.17	0.11	1054
17.	Petroleum	49412	7.93	7.88	76643
18.	Fertilisers	19994	3.21	2.06	19994
19.	Chemical	78102	12.53	8.03	78102
20.	Cement	40	0.01	0.40	3922
21.	N.Met.Prod	2481	0.04	1.26	12283
22.	Iron& Steel	24500	3.93	13.57	131990
23.	N.F.BMet.	12980	2.08	4.66	45322
24.	Metal.Man.	4936	0.79	0.74	7220
25.	Machinery	178595	28.65	20.09	195308
26.	RailTransp	2501	0.40	0.26	2501
27.	Transp. Eqp.	32462	5.21	3.34	32462
28.	Misc. Man.	35599	5.71	5.08	49382
	<b>Total</b>	<b>623450</b>	<b>100.00</b>	<b>100.00</b>	<b>972379</b>

**Table No.A 7.3 (C) Composition Of Actual And Ideal Imports, 1994-95**  
In Rs. Millions

SR	Sector	Actual Imports	%of Tot Act Imports	%of Tot Ideal Imports	Ideal Imports
1	Agricult.	19533	2.34	1.31	19533
2	Forest	8332	1.00	2.25	33414
3	Fishing	54	0.01	0.82	12176
4	Mining	177560	21.24	17.86	265518
5	Sugar	139	0.02	0.95	14082
6	Edible Oil	216	0.03	1.14	16937
7	Oth.F.Prod.	8716	1.04	0.59	8716
8	CottonText.	939	0.11	0.07	1052
9	WoolenText.	5632	0.67	0.38	5632
10	Jute Text.	134	0.02	0.17	2501
11	Oth.Text.Ar	3218	0.38	0.54	7959
12	Wood	713	0.09	1.93	28727
13	Paper	15054	1.80	1.73	25676
14	Leather	906	0.11	0.32	4734
15	Rubber	1277	0.15	0.09	1277
16	Plastics	1413	0.17	0.10	1413
17	Petroleum	66255	7.93	7.96	118435
18	Fertilisers	26809	3.21	1.80	26809
19	Chemical	104725	12.53	7.04	104725
20	Cement	54	0.01	0.43	6430
21	N.Met.Prod	3327	0.4	1.34	19951
22	Iron& Steel	32851	3.93	17.00	252773
23	N.F.BMet.	17405	2.08	5.43	80671
24	Metal.Man.	6619	0.79	0.82	12179
25	Machinery	239473	28.65	19.96	296807
26	RailTransp	3354	0.40	0.23	3354
27	TranspEqp.	43527	5.21	2.93	43527
28	Misc. Man.	47734	5.71	4.84	71995
	<b>Total</b>	<b>976800</b>	<b>100</b>	<b>100</b>	<b>2014626</b>

Table No. A7.4 A Programme for Seven percent Growth of Exports and Consumption 1994-95 In Rupees Million

Sect.No	Gross Output X	Imports Im	In.Ind. Use AX	Final Use X+Im-AX	Total Cons. TC	Exports Ex	Investment I	Surplus/ Deficit Z	Sector Name	Sec.No	Surplus Z+	Deficits Z-	Surpluses % act ex	Deficits as % act im
1	3245061	19533	1040672	2223922	1943160	78215	18299	164715	Agriculture	1	164715			211
2	152388	8332	52492	108228	84535	0	17201	-1839	Forestry	2	9953	1839		
5	80477	54	9234	71297	46337	21700	318	2889	Fishing	3	2889		13	
4	236953	177560	411823	2690	19271	13632	97214	-304987	Mining & Quarry.	4		304987		172
5	156590	139	37522	119207	113554	743	593	4178	Sugar	5	4178		562	
6	50066	216	3202	47081	41667	0	134	5064	Edible Oil	6	5064			
7	635550	8716	135229	509036	436896	28497	3232	31696	Oth.Food. Prod.	7	31696		111	
8	561127	939	193964	368101	290315	47566	4252	25030	Cotton Text.	8	25030		53	
9	315101	5632	86822	233911	181488	13855	1409	31527	Woolen Text.	9	31527		228	
10	49213	134	40092	9255	20	5616	4456	-972	Jute Text.	10		972		
11	214185	3218	35472	181931	76170	108023	1018	-6498	Oth.tex. Art.	11		6498		202
12	76482	713	130694	-53498	5606	400	35853	-96071	Wood Prods.	12		96071		13468
13	140421	15054	104800	50674	41525	704	13852	-20460	Paper Prod.	13		20460		136
14	99845	906	20670	80082	22339	59903	345	-3411	Leather	14		3411		376
15	126228	1277	54893	72611	18391	19240	14016	19688	Rubber	15	19688		102	
16	53434	1413	23736	31111	5355	4147	3859	16337	Plastics	16	16337		394	
17	429738	66255	357145	138848	119963	19466	65420	-132256	Petroleum	17		132256		200
18	155446	26809	219865	-37610	613	2177	2732	-69941	Fertilisers	18		69941		261
19	495215	104725	454732	145208	88112	50522	59199	-157350	Chemicals	19		157350		150
20	72468	54	59671	12850	0	0	16440	-3644	Cement	20		3644		6794
21	124846	3327	81935	46238	28243	6985	22656	-14973	Non Met Min Pro.	21		14973		450
22	512009	32851	518328	26532	0	5954	313097	-325371	iron & Steel	22		325371		990
23	91146	17405	103626	4925	0	2575	74331	-89386	Non Fer.Bas Met	23		89386		514
24	38313	6619	2823	42109	0	6171	117959	-88640	met. Manufact.	24		88640		1339
25	747957	239473	277247	710184	105897	46258	732904	-414349	Machinery	25		414349		173
26	179644	3354	112040	70957	0	654	38498	28452	Rail eqp.	26	28452		4350	
27	260782	43527	77461	226848	72720	17033	160214	-66646	Oth.trans.Eqp.	27		66646		
28	322749	47734	172118	198365	79444	99024	64816	-92653	Misc. MAnufact.	28		92653		194
29	1160259	0	150232	1010027	54570	0	321621	633836	Construction	29				
30	448506	0	496726	-48220	69933	160	123034	-241347	Electricity	30		241347		
31	201958	0	106411	95546	69412	12084	28716	-14666	Rail servives	31		14666		
32	761167	83959	421055	424071	378105	55968	75348	-169308	Oth.trans Services	32		169308		202
33	117801	3399	63584	57616	57001	2016	13624	-18424	Communication	33		18424		542
34	1518522	0	761003	757519	517279	107892	140582	-8234	Trade	34	19999	8234		
35	2554966	53474	586238	2022203	1719991	153111	141835	-46210	Other Services	35	35632	-46210		86
				0			0		Actual Total		990290	976800		
TOTAL	16386613	976800	7403558	9959855	6687910	990290	2729078	-1424223	Modelled		69320		13489.85	
									Extra Possible		395161	2387635		
	Gross Output		16386613						Total		1454771	3364435		
	Gross Value Added		8541030						Deficit/Surplus			1909664 act.def		0.16
											40	244 est.def		22.36

Table No. A7.5 A Programme for Six Percent Growth of Consumption and Exports, 1994-95 In Rs millions

Sect.No	Gross Output X	Imports Im	In.Ind. Use AX	Final Use X+Im-AX	Total Cons. TC	Exports Ex	Investment I	Surplus/Deficit Z	Sector Name	Sec.No	Surplus Z+	Deficits Z-	Surpluses as % of act exp	Deficits as % of act imp
1	3245061	19533	1040672	2223922	1943160	78215	15005	187542	Agriculture	1	187542			240
2	152388	8332	52492	108228	84535	0	13741	9953	Forestry	2	9953			
5	80477	54	9234	71297	46337	21700	257	3003	Fishing	3	3003		14	
4	236953	177560	411823	2690	19271	13632	77515	-107728	Mining & Quarryi	4		107728		61
5	156590	139	37522	119207	113554	743	486	4424	Sugar	5	4424		596	
6	50066	216	3202	47081	41667	0	108	5305	Edible Oil	6	5305			
7	635550	8716	135229	509036	436896	28497	2636	41008	Oth.Food. Prod.	7	41008		144	
8	561127	939	193964	368101	290315	47566	3482	26739	Cotton Text.	8	26739		56	
9	315101	5632	86822	233911	181488	13855	1171	37397	Woolen Text.	9	37397		270	
10	49213	134	40092	9255	20	5616	3572	46	Jute Text.	10	46			
11	214185	3218	35472	181931	76170	108023	830	-3092	Oth.tex. Art.	11		3092		96
12	76482	713	130694	-53498	5606	400	28647	-88152	Wood Prods.	12		88152		12358
13	140421	15054	104800	50674	41525	704	11103	-2657	Paper Prod.	13		2657		18
14	99845	906	20670	80082	22339	59903	287	-2447	Leather	14		2447		270
15	126228	1277	54893	72611	18391	19240	11412	23568	Rubber	15	23568		122	
16	53434	1413	23736	31111	5355	4147	3093	18516	Plastics	16	18516		447	
17	429738	66255	357145	138848	119963	19466	52270	-52850	Petroleum	17		52850		80
18	155446	26809	219865	-37610	613	2177	2263	-42663	Fertilisers	18		42663		159
19	495215	104725	454732	145208	88112	50522	47303	-40729	Chemicals	19		40729		39
20	72468	54	59671	12850	0	0	13140	-291	Cement	20		291		542
21	124846	3327	81935	46238	28243	6985	18088	-7078	Non Met Min Pro.	21		7078		213
22	512009	32851	518328	26532	0	5954	250066	-229488	iron & Steel	22		229488		699
23	91146	17405	103626	4925	0	2575	58821	-56471	Non Fer. Bas Met	23		56471		324
24	38313	6619	2823	42109	0	6171	97646	-61709	met. Manufact.	24		61709		932
25	747957	239473	277247	710184	105897	46258	576696	-18668	Machinery	25		18668		8
26	179644	3354	112040	70957	0	654	31038	39265	Rail eqp.	26	39265		6003	
27	260782	43527	77461	226848	72720	17033	133419	3676	Oth.trans.Eqp.	27	3676		22	
28	322749	47734	172118	198365	79444	99024	51728	-31831	Misc. MANufact.	28		31831		67
29	1160259	0	150232	1010027	54570	0	257479	697978	Construction	29				
30	448506	0	496726	-48220	69933	160	98099	-216412	Electricity	30		216412		
31	201958	0	106411	95546	69412	12084	22921	-8871	Rail servives	31		8871		
32	761167	83959	421055	424071	378105	55968	60587	-70589	Oth.trans Services	32		70589		84
33	117801	3399	63584	57616	57001	2016	10909	-12310	Communication	33		12310		362
34	1518522	0	761003	757519	517279	107892	112349	19999	Trade	34	19999		19	
35	2554966	53474	586238	2022203	1719991	153111	113468	35632	Other Services	35	35632		23	
TOTAL	16386613	976800	7403558	9959855	6687910	990290	2181635						46	108
									Actual Total		990290	976800		
									Modelled		69320			
									Extra Possible		456076	1054034		
									Total		1515686	2030834	act.def as % of GDP	0.16
									Deficit/Surplus		13490	-515148	est.def as % of GDP	-6.03
	Gross Output		16386613											
	Gross Value Added		8541030											

Table No. A7.6

A Programme for Five Percent Growth of Consumption and Exports, 1994-95

In Rupees Millions

Sect.No	Gross Output X	Imports Im	In.Ind. Use AX	Final Use X+Im-AX	Total Cons. TC	Exports Ex	Investment Surplus/Deficit I Z	Sector Name	Sect.No	Surplus Z+	Deficits Z-	Surpluses as % ofact exp	Deficits as % ofact imps
1	3245061	19533	1040672	2223922	1943160	78215	12009	190538 Agriculture	1	190538		244	
2	152388	8332	52492	108228	84535	0	10721	12973 Forestry	2	12973			
5	80477	54	9234	71297	46337	21700	203	3057 Fishing	5	3057		14	
4	236953	177560	411823	2690	19271	13632	60368	-90581 Mining & Quarryi	4		90581		51
5	156590	139	37522	119207	113554	743	389	4522 Sugar	5	4522		609	
6	50066	216	3202	47081	41667	0	85	5328 aEdible Oil	6	5328			
7	635550	8716	135229	509036	436896	28497	2099	41545 Oth.Food. Prod.	7	41545		146	
8	561127	939	193964	368101	290315	47566	2783	27437 Cotton Text.	8	27437		58	
9	315101	5632	86822	233911	181488	13855	949	37619 Woolen Text.	9	37619		272	
10	49213	134	40092	9255	20	5616	2797	822 Jute Text.	10	822		15	
11	214185	3218	35472	181931	76170	108023	660	-2922 Oth.tex. Art.	11		2922		91
12	76482	713	130694	-53498	5606	400	22358	-81862 Wood Prods.	12		81862		11476
13	140421	15054	104800	50674	41525	704	8692	-246 Paper Prod.	13		246		2
14	99845	906	20670	80082	22339	59903	233	-2393 Leather	14		2393		264
15	126228	1277	54893	72611	18391	19240	9070	25910 Rubber	15	25910		135	
16	53434	1413	23736	31111	5355	4147	2421	19188 Plastics	16	19188		463	
17	429738	66255	357145	138848	119963	19466	40790	-41371 Petroleum	17		41371		62
18	155446	26809	219865	-37610	613	2177	1828	-42228 Fertilisers	18		42228		158
19	495215	104725	454732	145208	88112	50522	36918	-30344 Chemicals	19				
20	72468	54	59671	12850	0	0	10259	2591 Cement	20	2591			
21	124846	3327	81935	46238	28243	6985	14105	-3095 Non Met Min Pro.	21		3095		93
22	512009	32851	518328	26532	0	5954	195062	-174484 iron &Steel	22		174484		531
23	91146	17405	103626	4925	0	2575	45462	-43113 Non Fer.Bas Met	23		43113		248
24	38313	6619	2823	42109	0	6171	78851	-42914 met. Manufact.	24		42914		648
25	747957	239473	277247	710184	105897	46258	443150	114878 Machinery	25	114878		248	
26	179644	3354	112040	70957	0	654	24439	45864 Rail eqp.	26	45864		7012	
27	260782	43527	77461	226848	72720	17033	108337	28758 Oth.trans.Eqp.	27	28758		169	
28	322749	47734	172118	198365	79444	99024	40319	-20422 Misc. MAnufact.	28		20422		43
29	1160259	0	150232	1010027	54570	0	201336	754121 Construction	29				
30	448506	0	496726	-48220	69933	160	76395	-194708 Electricity	30		194708		
31	201958	0	106411	95546	69412	12084	17869	-3819 Rail services	31		3819		
32	761167	83959	421055	424071	378105	55968	47581	-57583 Oth.trans Services	32		57583		69
33	117801	3399	63584	57616	57001	2016	8532	-9932 Communication	33		9932		292
34	1518522	0	761003	757519	517279	107892	87695	44653 Trade	34	44653		41	
35	2554966	53474	586238	2022203	1719991	153111	88659	60440 Other Services	35	60440		39	
TOTAL	16386613	976800	7403558	9959855	6687910	990290	1703426	578230 Actual Total		990290	976800	67	83
								Modelled		69320			
	Gross Output			16386613				Extra Possible		666125	811672		
	Gross Value Added			8541030				Total		1725735	1788472 ef as % of GDP		0.16
								Deficit/Surplus		13490	-62738 ef as % of GDP		-0.73

Table No. A7.7 (a) Per Unit Capital Requirement Of the Trade Vectors, 1983-84  
B\* Trade Vectors, 1983-84

Sr.No.	Sector	IE	AE	IM	AM
1	Agriculture	0.0046942	0.0034929	0.0017944	0.0018615
2	Forestry etc.	0.0004191	0.0004598	0.0006927	0.0006239
3	Fishing	0.0000159	0.0000206	0.0000219	0.0000058
4	Mining etc	0.0052323	0.0065676	0.0148857	0.0137710
5	Sugar	0.0000422	0.0000494	0.0000753	0.0000270
6	Edible Oil	0.0000107	0.0000117	0.0000127	0.0000107
7	Oth.Food Prod.	0.0040019	0.0049942	0.0022720	0.0042485
8	Cot.Text	0.0019126	0.0021295	0.0005092	0.0007570
9	Wool Text.	0.0012928	0.0006174	0.0001462	0.0002575
10	Jute etc.	0.0009090	0.0011131	0.0005713	0.0004214
11	Text. Articl	0.0005921	0.0006507	0.0001052	0.0000816
12	Wood Prods	0.0018975	0.0023336	0.0012437	0.0009542
13	Paper Prods	0.0019809	0.0023300	0.0024422	0.0029016
14	Leather Prods	0.0004900	0.0006203	0.0001009	0.0000170
15+16	Rubber, Plas.	0.0047559	0.0025018	0.0015354	0.0017000
17	Petroluem etc	0.0100929	0.0112381	0.0181478	0.0188895
18	Fertiliser	0.0010641	0.0005273	0.0009060	0.0008545
19	Chemicals	0.0131523	0.0092370	0.0104331	0.0148988
20	Cement	0.0012492	0.0016170	0.0010307	0.0017006
21	N M M in Prod	0.0013296	0.0015600	0.0014159	0.0019689
22	Iron & Steel.	0.0108760	0.0083265	0.0278531	0.0197670
23	N F B Metals	0.0017290	0.0016250	0.0066867	0.0053318
24	Metal Man.	0.0971927	0.0667111	0.0782102	0.0640707
25	Machinery	0.7852608	0.8174561	1.5060731	1.3456754
26	Rail Equip.	0.0271010	0.0347900	0.0463072	0.0010926
27	O.Trans Equip.	0.2386168	0.2422508	0.1745022	0.1584174
28	Misc. Man	0.0069416	0.0073113	0.0125001	0.0102652
29	Construction	0.4052245	0.4163588	0.6431596	0.6915094
30	Electricity etc	0.0053669	0.0060024	0.0112989	0.0084017
31	Rail Services	0.0023754	0.0027883	0.0039620	0.0033338
32	O.Trans Serv	0.0182322	0.0228238	0.0079820	0.0037576
33	Communication	0.0015349	0.0018444	0.0009911	0.0006373
34	Trade	0.0134927	0.0138854	0.0146611	0.0131546
35	Oth. Services	0.0257163	0.0303629	0.0191672	0.0154113
<b>TOTAL</b>		<b>1.6947957</b>	<b>1.7246090</b>	<b>2.6116969</b>	<b>2.4067767</b>

**KEY**

IE = IDEAL/SUGGESTED EXPORT VECTOR,83-84

AE = ACTUAL EXPORT VECTOR,83-84

IM = IDEAL/SUGGESTED IMPORT VECTOR,83-84

AM = ACTUAL IMPORT VECTOR 83-84

B = CAPITAL COEFFICIENT MATRIX

**Table No. A7.7 (b) Per Unit Direct Capital Requirements of the Trade Vectors  
1991-92**

SEC NO	SEC NAME	IDEAL	ACTUAL	IDEAL	ACTUAL
		EXPORTS	EXPORTS	IMPORTS	IMPORTS
		IE	AE	IM	AM
1	Agricultue	0.0029231	0.0047875	0.0016888	0.0014423
2	Forestry etc	0.0013067	0.0002747	0.0006636	0.0005253
3	Fishing	0.0000305	0.0000600	0.0000291	0.0000204
4	Mining etc	0.0053112	0.0031531	0.0127600	0.0110768
5	Sugar	0.0000678	0.0001306	0.0000686	0.0000647
6	Edible Oil	0.0000158	0.0000295	0.0000206	0.0000238
7	Oth Food Prod	0.0003728	0.0006804	0.0013612	0.0006525
8	Cotton Text	0.0016951	0.0032210	0.0006228	0.0006995
9	Wool etc	0.0006351	0.0010026	0.0001386	0.0002008
10	Jute	0.0006891	0.0011341	0.0005481	0.0004270
11	Oth Text Art	0.0005003	0.0009271	0.0001103	0.0000865
12	Wood Prods	0.0029491	0.0016386	0.0008845	0.0008856
13	Paper Prod	0.0014248	0.0024671	0.0027310	0.0028279
14	Leather Prod	0.0006396	0.0012445	0.0000875	0.0000366
15	Rubber Pods	0.0017280	0.0014315	0.0011500	0.0017623
16	Plastic Prods	0.0007371	0.0012046	0.0006614	0.0007947
17	Petrol	0.0029017	0.0036922	0.0102962	0.0112429
18	Fertilisers etc	0.0003431	0.0004595	0.0005475	0.0009495
19	Oth.Chem prod	0.0057869	0.0068995	0.0098212	0.0138521
20	Cement	0.0031631	0.0001200	0.0005126	0.0005717
21	N Met Min Pro	0.0032206	0.0004699	0.0012888	0.0014971
22	Iron & Steel	0.0147712	0.0076086	0.0223564	0.0226693
23	Non F Metal	0.0015295	0.0021247	0.0072851	0.0078605
24	Met.Manufact	0.1100658	0.0884362	0.0781304	0.0649696
25	Machinery	0.7231284	0.5527027	1.5033239	1.3464487
26	Rail Equip.	0.0188272	0.0357979	0.0393627	0.0012677
27	Oth Trans Equip.	0.1030707	0.1946737	0.1833078	0.1916912
28	Misc.Manu	0.0026422	0.0039966	0.0071547	0.0070900
29	Construction	0.1755332	0.2943735	0.7932188	0.8018054
30	Electricity etc	0.0043137	0.0058841	0.0128983	0.0102822
31	Rail Services	0.0019070	0.0019364	0.0036664	0.0030783
32	Oth Trans Serv	0.0158737	0.0283528	0.0086905	0.0048162
33	Communication	0.0016110	0.0027828	0.0012732	0.0011001
34	Trade	0.0129526	0.0130264	0.0139831	0.0137494
35	Oth.Services	0.0181522	0.0305020	0.0185968	0.0182215
<b>Total</b>		<b>1.2408198</b>	<b>1.2972265</b>	<b>2.7392410</b>	<b>2.5446901</b>

**KEY**

IE = IDEAL/SUGGESTED EXPORT VECTOE 1991-92

AE = ACTUAL EXPORT VECTOR 1991-92

IM = IDEAL/SUGGESTED IMPORT VECTOR 1991-92

AM = ACTUAL IMPORT VECTOE 1991-92

B = CAPITAL COEFFICVIENT MATRIX



Table No. A7.7 (c)

**The Per Unit Direct Capital  
Requirements of Trade Vectors For 1994-95  
B\* Trade Vectors**

Secto	Sector name	Actual Export: Ideal Export: Actual Import: Ideal Imports			
		Actual Export	Ideal Export	Actual Import	Ideal Imports
1	Agricultue	0.004805	0.002958	0.001411	0.001220
2	Forestry etc	0.000278	0.001277	0.000511	0.000670
3	Fishing	0.000055	0.000027	0.000019	0.000025
4	Mining etc	0.003108	0.005235	0.010821	0.013162
5	Sugar	0.000161	0.000083	0.000078	0.000057
6	Edible Oil	0.000024	0.000013	0.000019	0.000015
7	Oth Food Prod	0.000677	0.000371	0.000632	0.001149
8	Cotton Text	0.003224	0.001682	0.000730	0.000455
9	Wool etc	0.000943	0.000730	0.000199	0.000106
10	Jute	0.001073	0.000636	0.000367	0.000504
11	Oth Text Art	0.000968	0.000519	0.000096	0.000095
12	Wood Prods	0.003267	0.005722	0.001742	0.001795
13	Paper Prod	0.002397	0.001370	0.002750	0.002438
14	Leather Prod	0.001243	0.000615	0.000035	0.000058
15	Rubber Pods	0.001400	0.001875	0.001668	0.000958
16	Plastic Prods	0.000956	0.000603	0.000616	0.000498
17	Petrol	0.003752	0.003015	0.011339	0.010450
18	Fertilisers etc	0.000546	0.000413	0.000971	0.000472
19	Oth.Chem prod	0.007276	0.006465	0.014052	0.009097
20	Cement	0.000109	0.002791	0.000507	0.000442
21	N Met Min Pro	0.000462	0.003082	0.001447	0.001220
22	Iron & Steel	0.007939	0.015683	0.023614	0.024221
23	Non F Metal	0.002110	0.001608	0.007842	0.007483
24	Met.Manufact	0.085379	0.105464	0.063543	0.077822
25	Machinery	0.534713	0.698645	1.290935	1.465424
26	Rail Equip.	0.032606	0.016645	0.001137	0.038983
27	Oth Trans Equip.	0.173828	0.091487	0.163873	0.147936
28	Misc.Manu	0.003992	0.002733	0.007061	0.007368
29	Construction	0.300054	0.182187	0.805162	0.806339
30	Electricity etc	0.008715	0.006421	0.014927	0.020051
31	Rail Services	0.001941	0.001889	0.003023	0.003815
32	Oth Trans Serv	0.031361	0.017020	0.005191	0.010647
33	Communication	0.003086	0.001751	0.001220	0.001494
34	Trade	0.013005	0.012914	0.013519	0.013943
35	Oth.Services	0.029937	0.017609	0.017733	0.018683
<b>TOTAL</b>		<b>1.265391</b>	<b>1.210000</b>	<b>2.468791</b>	<b>2.690000</b>

**KEY**

AEx = Actual Export Vector

AIm = Actual Import Vector

IEx = IDEAL Export Vector

IIm = IDEAL Import Vector

B = Capital Coefficient Matrix

Table No. A7.8 (a) Per Unit Direct and Indirect Capital Requirements of the Trade Vectors Q\* Trade Vectors, 1983-84

Sr.No.	Sector	IE	AE	IM	AM
1	Agriculture	0.0377451	0.0368995	0.0464944	0.0452030
2	Forestry etc.	0.0294402	0.0304254	0.0461664	0.0460750
3	Fishing	0.0005189	0.0005422	0.0007577	0.0006765
4	Mining etc	0.1308357	0.1341629	0.2127064	0.1978232
5	Sugar	0.0007633	0.0007890	0.0010982	0.0010005
6	Edible Oil	0.0050506	0.0050768	0.0071034	0.0066755
7	Oth.Food Prod.	0.0045105	0.0055830	0.0027267	0.0048435
8	Cot.Text	0.0061470	0.0062832	0.0058523	0.0058186
9	Wool Text.	0.0026958	0.0017921	0.0013125	0.0013654
10	Jute etc.	0.0065520	0.0068894	0.0091607	0.0090294
11	Text. Articl	0.0018278	0.0019014	0.0015606	0.0014438
12	Wood Prods	0.0340883	0.0353164	0.0526850	0.0532264
13	Paper Prods	0.0232002	0.0239864	0.0343571	0.0325779
14	Leather Prods	0.0008851	0.0010500	0.0004283	0.0002919
15+16	Rubber, Plas.	0.0301712	0.0283093	0.0317991	0.0289995
17	Petroluem etc	0.0932405	0.0958664	0.1445211	0.1347962
18	Fertiliser	0.0032721	0.0026516	0.0037515	0.0036809
19	Chemicals	0.1014808	0.0976834	0.1437562	0.1375778
20	Cement	0.0260617	0.0270984	0.0403159	0.0434102
21	N M M in Prod	0.0411515	0.0423536	0.0645783	0.0670748
22	Iron & Steel.	0.4123608	0.4101063	0.6520797	0.5859775
23	N F B Metals	0.0965116	0.0968926	0.1649349	0.1449341
24	Metal Man.	0.1611290	0.1305417	0.1770942	0.1523711
25	Machinery	0.9515979	0.9900983	1.8054706	1.6151643
26	Rail Equip.	0.0422970	0.0513649	0.0707837	0.0172437
27	O.Trans Eqp.	0.2761372	0.2806571	0.2078012	0.1886382
28	Misc. Man	0.0292617	0.0303218	0.0497420	0.0438008
29	Construction	0.4320213	0.4436296	0.6844707	0.7290952
30	Electricity etc	0.1149643	0.1161652	0.1835108	0.1653688
31	Rail Services	0.0523280	0.0531412	0.0821074	0.0761982
32	O.Trans Serv	0.0902417	0.0961521	0.1184334	0.1067769
33	Communication	0.0112737	0.0117870	0.0164555	0.0147607
34	Trade	0.2121220	0.2151576	0.3240492	0.3035540
35	Oth. Services	0.2098902	0.2180099	0.3102794	0.2813246
<b>TOTAL</b>		<b>3.6717743</b>	<b>3.7286856</b>	<b>5.6983445</b>	<b>5.2467981</b>

**KEY**

IE = IDEAL/SUGGESTED EXPORT VECTOR,83-84

AE = ACTUAL EXPORT VECTOR,83-84

IM = IDEAL/SUGGESTED IMPORT VECTOR,83-84

AM = ACTUAL IMPORT VECTOR 83-84

Q = [INV(I-A)] \* B

Table No.A7.8 (b)

Per Unit Direct and Indirect Capital Requirements of  
the Trade Vectors 1991-92

SEC NC	SEC NAME	IE	AE	IM	AM
1	Agricultue	0.0152303	0.0200839	0.0282583	0.0267682
2	Forestry etc	0.0151894	0.0174574	0.0418932	0.0410107
3	Fishing	0.0003251	0.0003771	0.0006138	0.0005608
4	Mining etc	0.0884067	0.0954754	0.2227640	0.2127726
5	Sugar	0.0003975	0.0004984	0.0007598	0.0006925
6	Edible Oil	0.0001605	0.0001852	0.0003123	0.0002971
7	Oth Food Prod	0.0027812	0.0033556	0.0062620	0.0052815
8	Cotton Text	0.0048670	0.0070342	0.0060952	0.0059677
9	Wool etc	0.0016313	0.0023413	0.0015725	0.0016201
10	Jute	0.0043830	0.0054368	0.0103025	0.0099551
11	Oth Text Art	0.0012628	0.0019184	0.0015278	0.0014494
12	Wood Prods	0.0159010	0.0184319	0.0432282	0.0425182
13	Paper Prod	0.0144374	0.0160434	0.0299024	0.0283541
14	Leather Prod	0.0009989	0.0017935	0.0004455	0.0003653
15	Rubber Pods	0.0148746	0.0192770	0.0261111	0.0258696
16	Plastic Prods	0.0052407	0.0057403	0.0098153	0.0093655
17	Petrol	0.0613396	0.0656589	0.1359004	0.1290153
18	Fertilisers etc	0.0014943	0.0020505	0.0032907	0.0036516
19	Oth.Chem prod	0.0593298	0.0626262	0.1265767	0.1244763
20	Cement	0.0143258	0.0176895	0.0470432	0.0473849
21	N Met Min Pro	0.0198999	0.0229350	0.0580983	0.0576790
22	Iron & Steel	0.3126165	0.3053694	0.6554682	0.6136715
23	Non F Metal	0.0849016	0.0748227	0.1768585	0.1619572
24	Met.Manufact	0.1142783	0.0922787	0.0819488	0.0683527
25	Machinery	0.9268257	0.7258014	1.9379731	1.7415337
26	Rail Equip.	0.0374104	0.0574513	0.0811176	0.0354657
27	Oth Trans Eqp.	0.1240252	0.2286926	0.2222580	0.2306186
28	Misc.Manu	0.0672718	0.0651185	0.1352223	0.1252355
29	Construction	0.1905990	0.3097123	0.8245296	0.8309878
30	Electricity etc	0.0817475	0.0843504	0.1831878	0.1695292
31	Rail Services	0.0276739	0.0290825	0.0636617	0.0598414
32	Oth Trans Serv	0.0682420	0.0840815	0.1259254	0.1154422
33	Communication	0.0127747	0.0137110	0.0242328	0.0223989
34	Trade	0.1394462	0.1477786	0.3105599	0.2948050
35	Oth.Services	0.1500955	0.1599194	0.2942283	0.2743547
<b>Total</b>		<b>2.6803852</b>	<b>2.7645803</b>	<b>5.9179449</b>	<b>5.5192497</b>

## KEY

IE = IDEAL/SUGGESTED EXPORT VECTOE 1991-92

AE = ACTUAL EXPORT VECTOR 1991-92

IM = IDEAL/SUGGESTED IMPORT VECTOR 1991-92

AE = ACTUAL IMPORT VECTOE 1991-92

Q = [INV(I-A)] \* B

Table No. A7. 8 (c)

The Per Unit Direct and Indirect Capital  
Requirements of Trade Vectors For 1994-95

## Q \* Trade Vectors

Secto	Sector name	Actual Expor	Ideal Export	Actual Impor	Ideal Imports
1	Agricultue	0.020028	0.027032	0.026221	0.027213
2	Forestry etc	0.017336	0.041233	0.040115	0.041509
3	Fishing	0.000343	0.000549	0.000502	0.000552
4	Mining etc	0.097998	0.227253	0.215268	0.228775
5	Sugar	0.000617	0.000892	0.000845	0.000897
6	Edible Oil	0.000149	0.000247	0.000236	0.000249
7	Oth Food Prod	0.003366	0.005968	0.005210	0.006007
8	Cotton Text	0.007292	0.006258	0.006389	0.006300
9	Wool etc	0.002218	0.001420	0.001536	0.001430
10	Jute	0.005139	0.009626	0.009242	0.009690
11	Oth Text Art	0.002075	0.001641	0.001596	0.001652
12	Wood Prods	0.036705	0.085390	0.083458	0.085961
13	Paper Prod	0.015532	0.028373	0.027120	0.028563
14	Leather Prod	0.001757	0.000351	0.000312	0.000353
15	Rubber Pods	0.017337	0.022317	0.022664	0.022466
16	Plastic Prods	0.004536	0.007626	0.007287	0.007677
17	Petrol	0.069183	0.141987	0.133963	0.142938
18	Fertilisers etc	0.002480	0.003694	0.004187	0.003718
19	Oth.Chem prod	0.066218	0.130993	0.129367	0.131870
20	Cement	0.016029	0.042207	0.042295	0.042489
21	N Met Min Pro	0.022400	0.056178	0.055516	0.056554
22	Iron & Steel	0.305093	0.650590	0.605827	0.654946
23	Non F Metal	0.072289	0.170598	0.155041	0.171740
24	Met.Manufact	0.089068	0.080961	0.066776	0.081503
25	Machinery	0.702090	1.875212	1.668976	1.887765
26	Rail Equip.	0.052300	0.076920	0.031804	0.077435
27	Oth Trans Eqp.	0.204288	0.179592	0.197617	0.180794
28	Misc.Manu	0.064594	0.133413	0.122779	0.134306
29	Construction	0.315756	0.832776	0.834635	0.838350
30	Electricity etc	0.125014	0.270751	0.247968	0.272563
31	Rail Services	0.029025	0.063199	0.058902	0.063622
32	Oth Trans Serv	0.092457	0.138024	0.124796	0.138948
33	Communication	0.015076	0.026496	0.024289	0.026673
34	Trade	0.146206	0.304344	0.287577	0.306381
35	Oth.Services	0.155712	0.284353	0.263486	0.286256
<b>TOTAL</b>		<b>2.777707</b>	<b>5.930000</b>	<b>5.503800</b>	<b>5.970000</b>

## KEY

AEx = Actual Export Vector

AIm = Actual Import Vector

IEx = IDEAL Export Vector

IIm = IDEAL Import Vector

B = Capital Coefficient Matrix

Q = (I-A)-1 \* B

**CHAPTER EIGHT**  
**SUMMARY AND CONCLUSIONS**

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**The Problem:**

Trade Sector liberalization in developing countries has been an issue of intense debate in current academic literature as well as in policy formulation exercises ; liberal trade is advocated as leading to efficiency. The debate was generated in India too, as in 1991, the country went in for a liberal trade policy. This policy was adopted after years of following the import substitution policy through the decades of 1950s, 60s and 70s. During these years, except twice, there was always an unfavourable Balance of Trade [BOT]. The country was not able to cover it's import bill even after explicitly following the import substitution policy. The new economic policy of which the liberal trade regime, with it's focus on export promotion through import liberalization, was a part; was adopted for the trade sector with the hope that the foreign exchange earned through increase in exports would help to lessen the trade deficit. This was seen to be successful in the neighbouring South-East Asian countries and was therefore deemed to be a solution for India's trade deficit problems. It also promised higher growth rates for the economy, as academics claimed that export growth inevitably leads to overall growth. The South-East Asian successes was used to substantiate this argument.

Taking the cue from this problem ,this study decided to look at the trade sector of the Indian economy and it's role in the growth of the economy. A review of literature on trade and growth was undertaken. This is discussed in Chapter II of the thesis. The review was done keeping the following points in mind: 1) To see the evidence put forth for export growth causing income growth, and to see whether it can be applied to India's case and 2) What are the factors affecting Indian exports and imports ?

For the first, cross country studies, where a sample of countries divided into groups by various criteria, were looked at. We reviewed the works of Michealy (1976), Anne Krueger (1978), Balassa (1978), Bokil (1981), Bhagwati and Srinivasan (1978), Kavoussi (1982) and Ram ( 1985 ).

Many of these authors found that export growth does cause income growth (Anne Krueger, Balassa, Bhagwati and Srinivasan). Balassa tried to see the role of trade in growth, vis-à-vis the other variables like investment and labour. He found the  $R^2$  increasing with the inclusion of the export variable but its coefficient was insignificant.

The review lead us to conclude, that though co-relation was seen between export growth and income growth by most authors, this can not prove the link conclusively; because exports, being part of Gross National Product (GNP), the two series are bound to show co-relation. We also concluded that existence of co-relation could not prove causation from one to another. Thirdly, generalization about such a result from the sample for all the countries or for a specific country may not be appropriate.

The specific case of India was therefore studied (Bhagwati and Srinivasan, Bokil et al, Sunanda Sen, Patra and Ranjan, Da-Costa, Kelkar and Sharma and Smriti Mukherji). From this, it was seen, that the trade sector is not a large sector of the Indian economy, and hence can not become the dynamic sector for it as it has been for smaller countries. The dis-aggregated studies brought to light the fact that a blanket policy of liberalization or otherwise across the whole trade sector may not be right. Different commodities may have to be dealt with separately. Patra and Ranjan's study brought to light the "errors arising out of estimating the aggregate import function without taking into account the differential response of individual categories of imports". This lead us to conclude that an aggregate view of the trade sector may not be appropriate.

The other dis-sggregated studies indicated that Indian exports could be supply driven i.e. they are more dependent on domestic conditions of supply and demand, rather than on international factors of good prices, world income etc. This was found to be as true for its traditional exports like tea, jute, textiles as well as for its non-traditional exports like chemicals and engineering goods.

Lastly, studies on the direction of causation between export growth and income growth were reviewed. There was no conclusive evidence for India, that export

growth causes income growth. In fact these studies brought out for the first time that the assumed direction of causation from export growth to income growth need not always operate. The stimulus to income growth may come from exports, or the stimulus to export could come from income growth.

Since the review clearly showed that for the Indian trade sector the domestic factors are important, we have tried to analyze what trade would be, based on the domestic demand and supply situation. The question was posed as follows: If enhancing income growth is the objective of choosing an appropriate trade policy, why not study the implications of following a target growth programme or of maximising the growth rate of the economy, on its trade sector. The study decided to look at what the trade sector would be, if the country pursued a von Nuemann growth programme.<sup>1</sup> For working out the von Nuemann growth rate, we have used the Input-Output framework. In different simulations, we tried different growth rates ( $g = 5\%, 6\%$ , ) to see what extra imports would be needed to meet these targets and what extra exports could be generated. These results can give the policy maker a choice when planning for particular target growth rate.

### **The Input-Output System**

The Input-Output framework proved useful, as it can measure the demand for the output of each sector accurately. Within the Input-Output framework, we have used the Dynamic Input-Output model as it can measure not only the current production requirements, but the capital requirements as well. In the Static Input-Output model, growth rate can not be modeled adequately as it takes into account only the direct and indirect current production requirements. Investment in the Static Input-Output model remains exogenous and therefore would have to be determined outside the model. Therefore, the Dynamic Input-Output model was felt to be more suitable to study the question.

Some studies using the dynamic Input-Output to model the trade sector, were reviewed, namely Eckaus-Parikh (1968 ), Cambridge growth model (Stone and Brown

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<sup>1</sup> von Nuemann growth rate is the highest possible factor of expansion for all sectors of the economy at which the economy can remain in equilibrium.

(1962), Bhagwati and Srinivasan (1978 ) and Mathur (1967). It was seen that the Dynamic Input-Output model could become a very useful tool to plan for different growth rates or different trade scenarios.

### **The Capital Coefficient Matrix**

For working out the maximal growth rate or the von Neumann growth rate in the dynamic model, we needed a Capital Coefficient Matrix. One of the major contributions of this study is the estimation of the Capital Coefficient Matrix 'B', for the Indian economy for the nineties taking explicitly into consideration the role of the unorganised manufacturing sector. Chapter IV and V deal with the theoretical and empirical aspects of the estimation of the 'B' matrix.

The 'B' matrix is not based on the capital-output relationship of a single year. An attempt was made to find the average capital-output relationships based on the data for some past years, so that predictions for future investment requirements based on this would be fairly robust. The year to year fluctuations could be eliminated.

The 'B' matrix was based on Incremental Capital Output Ratios (ICORs) of 4 primary sectors, 30 registered manufacturing sectors, 19 unregistered manufacturing sectors and 11 services sectors. ICORs were computed by the regression method using time series data of gross capital stock and value of output for each sector. The data was for a period of 13 years from 1980-81 to 1992-93. The regressions were validated by using the 't', 'F' and 'R<sup>2</sup>' tests. Most of the results were all right, only a few sectors proved to be problematic. These were jute and forestry and logging.

This study estimates the ICOR for the Indian economy to be 3.76 at current prices and 4.44 at constant prices (1991-92) . The Planning Commission ICOR for the Eighth Plan was 4.1 and 4.23 for the Ninth Plan. ( GOI, Planning Commission 1997).

ICORs were computed at current and constant prices. Constant price ICORs were used to build the 'B' matrix except for the two sectors of jute products and forestry and logging. To bring the capital stock series to constant prices no ready price indices were available. Hence, we estimated price indices to deflate the capital stock of each



sector by using the weighted average technique. Price Indices of the major capital assets used by every sector were weighed by the percentage composition of these assets in the capital structure of each sector.

### **The Capital Structure By Type Of Assets**

The composition of the capital structure of each sector was estimated by tapping different data sources for different sectors. Here, since the sources were different, we were not able to maintain the same year for all sectors. Also, we found that this type of data on capital stock by type of assets, is difficult to come by and is not published frequently. It would indeed be beneficial to have such data published regularly for a uniform sector scheme for the economy by one single publishing agency. This would help when the planning agencies are drawing up investment plans, as one can observe the investment behaviour in the different sectors in a time series.

We also recommend that the data on the breakdown of capital assets, which is given under very broad heads, be given under more specific items of capital stock. This needs to be pointed out especially with regard to machinery. Capital expenses on all types of machinery are clubbed together; it would be useful to have them separately, at least under the heads of electrical and non-electrical machinery. This would help in forecasting separately, the demand for not only power driven machinery but would help to project the demand for electricity from the industrial sector. It would also help to know, how power intensive our manufacturing sectors are amongst themselves and as between the organised and unorganised sectors.

Another contribution of this study is the inclusion of the unorganised sector in the 'B' matrix. Separate capital-output ratios for the unorganised sector were estimated for 19 manufacturing sectors for a single year for which data was available i.e. 1989-90. This was broken down into the types of assets used by each sector. Thus we generated the fixed capital matrix columns for the unorganised manufacturing sectors. These were then added to the registered manufacturing sector columns by the weighted average method to reflect the composite capital structure of the each manufacturing sector.

From here, a 35 sector commodity by industry capital coefficient matrix was estimated of which 4 were primary sectors, 24 were manufacturing sectors and the 7 services sector. This aggregation was done keeping various constraints in mind like data availability on the break up of capital stock into type of assets, to match with the trade sector classification and to differentiate sectors where production processes and capital structure would be different. An inventory coefficient matrix was estimated for one reference year alone, for 1991-92.

### **The Maximum Rate Of Balanced Growth**

CHAPTER V begins by looking at the theoretical aspect of the maximum rate of balanced growth for India or the von Neumann growth rate. Some literature is studied to see the maximal growth rate concept and the similar von Neumann growth rate. Empirical estimates are presented of this maximal possible rate of balanced growth for the Indian economy for 4 years of 1983-84, 1989-90 and 1991-92 and 1994-95. The maximum possible growth rate for the Indian economy using the Dynamic Input-Output model for India was estimated to be 18.26% in 1983-84, 17.21% in 1989-90, 18.55% in 1991-92 and 19.29% in 1994-95. Though these rates seem higher than the actual growth rates ever achieved by the economy, they serve the purpose of knowing the capacity of the economy and its existing technology. Also, in a model, institutional factors cannot be included and therefore these rates seem utopian. These rates are dependent on the accurate specification of the 'A' and 'B' matrices. If there is some sort of underestimation in these two parameters, it is bound to overestimate the maximal growth rate. Secondly, the gap between these maximal growth rate and the actual rates achieved by the economy could also point to the underutilisation of the capacity. We see however that these estimated growth rates compare fairly well with the nominal growth rates recorded by the Indian economy.

The maximum rate of balanced growth was compared to results obtained from earlier studies of Sathe (1990,1996) and Seton (1985). These cannot be strict comparisons as they ( Sathe's and Seton's) were estimated using the Static Input-Output model and the sector classification was different. However it helped to bring forth an area of further possible research. The comparisons showed differences. Sathe's results for the Indian economy are at an 18 sector classification, which leaves out all the services

sectors of the economy. So, we have to conclude that the results of this exercise could be sensitive to 1) the size of the matrix, 2) to the level of aggregation, 3) to the definition of the growth rate  $g$  in the Static and Dynamic input-Output models. These need to be examined further before anything can be said conclusively.

## RESULTS

In the VIth chapter, we examine the **investment proportions** required for pursuing a maximal (von Nuemann) growth programme and the changes in this requisite proportion over the years. The proportions for an maximal growth programme seen at a broad four sector level show that the primary sector declines in importance from 6.94% in 1983-84 to 5.89% in 1994-95. The manufacturing sector also shows a gradual decline from 65.53% in 1983-84 to 64.29% in 1994-95. Construction and services show an increase in percentage of total required investment; construction increases from 8.55% in 1983-84 to 10.37 in 1994-95 and services from 10.98 in 1983-84 to 19.45 in 1994-95. This clearly shows that for a high (von Nuemann) growth programme a higher percentage of investment (of total investment) is called for in the construction and services (infrastructure) sectors and that the importance of the primary and manufacturing sectors are declining. These are results seen at very broad sectors of the economy. We further look at the required investment composition required in the economy by 35 sectors for the Indian economy over the years. The comparison is also done with the requisite investment proportions obtained by Mathur for the sixties.

### Simulation I : Trade Implications Of The Maximal Growth Programme

The shortfalls and the surpluses of the this maximal growth programme are worked out and are termed as extra importables and extra exportables respectively. The increases required in trade are worked out at the sectoral levels. In the first simulation we work out the surpluses and deficits of a maximal growth programme keeping the level of investment equal to actual total investment. Total trade as percentage of GDP will have to be increased from 14.2 to 24.8 in 1983-84; imports as percentage of GDP have to be doubled from 8.8 to 16.8 whereas exports

can be increased from 5.36 to 7.9 percent of GDP. In 1991-92 too same trends are seen. Imports appear more significant for a high growth programme.

**Exportable Surplus** is seen for Agriculture and Allied activities, Woolen Textiles, Rubbers and Plastic Products, Chemical Products, Rail Transport Equipment and Other Transport Equipment. **Importables** are seen for a large number of sectors, namely, Forestry & Logging, Fishing, Mining & Quarrying, Sugar, Other Food Products, Jute Textiles, Other Textile Articles, Wood, Paper, Leather, Petrol, Fertilizers, Cement, Non-Met Mineral Products, Iron & Steel, Non Ferrous Basic Metals, Machine Tools, Machinery and Miscellaneous Manufacturing. These are seen as importables for both years of 1983-84 and 1991-92 with the exception of Agriculture. Agriculture emerges as a exportable in 1983-84 and as an importable for 1991-92 for a high growth programme. This could be because 1991-92 was a low growth year.

#### *Exports*

Over the three years, it is seen that exportable surplus declines from 1983-84 to 1991-92 (for total as well as sectoral exports); whereas it increases from 1991-92 to 1994-95. This trend is in keeping with the growth rate  $g^*$  estimated in the previous chapter, where we saw that  $g^*$  decreases from 1983-84 to 1991-92 and increases from 1991-92 to 1994-95.

Leather and fishing not showing a surplus is a puzzling result; showing a deficit in the model where as actually it is an export good. This could be because this simulation is for the von Neumann or the highest growth programme. Here, very high consumption and inventory needs could be wiping out the surplus one would naturally expect.

On the whole, the maximal growth plan calls for some diversification of our exports, so that the percentage composition is evenly spread among the exporting sector. The only exception to this are agriculture and allied activities, chemical exports, transport equipment, rubber and plastic products and woolen textiles. For all other major export like minerals, textile article, miscellaneous good, non-metallic mineral product,

leather, machinery etc. share of exports in total export needs to be scaled down to make way for increasing the share of agriculture and allied activities, chemical exports, transport equipment, rubber and plastic products and woollen textiles. **Rubber, Plastic, Rail Transport Equipment and Other Transport Equipment are sectors which show export potential i.e. new export sectors apart from the already existing ones. Their share in total export ought to be increased.**

#### **Imports**

The sectors which need imports to be increased to sustain a maximal growth programme are Minerals, Paper and Paper Products, Petroleum and Products, Fertilizers, Cement, Non-Metallic Mineral Product, Iron and Steel, Other Basic Metals, Metal Manufacture, Machinery, Miscellaneous Manufacturing.

Other sectors which show a deficit but are not major imports are: forestry, fishing, sugar, food products, jute, other textile articles, leather and wood and wood products. The large deficits in these sectors could mean that for a maximal growth programme, we need to either import these in the amounts shown above or we need to step up production and productivity in these sectors to ensure that these do not become bottlenecks in a high growth programme as well as to ensure that due to non-availability, their domestic prices are not allowed to rise. These deficits could be due to high consumption and inventory requirements.

The change over the period shows that imports required (as % of actual imports) show a decline from 1983-84 to 1994-95 for consumer goods, like cotton textiles, textile articles, leather etc. However for intermediate and capital goods, the requisite % shows an increase from 1991-92 to 1994-95. This means that the increase in  $g^*$  from 1991-92 to 1994-95 is to be accompanied by necessitating lower extra imports (as % of actual imports) of consumer goods and higher imports for intermediate and capital goods imports. Thus liberalisation has made our production import dependent although it has enabled a higher level of exports with a higher growth rate.

The sectors for which imports share (as % of total imports) have to be increased are: Iron and Steel, Other Basic Metals, Metal Manufacture, Machinery. So, these

imports are crucial for the growth programme and their share vis-à-vis the others have to be increased. These are mainly Capital and Basic Goods. The policy implication would be that if import duties have to be lowered, they should be lowered for these import goods first.

*Thus, the structural change indicated shows that imports should move from sophisticated value added finished goods (Machinery, Transport Equipment, Miscellaneous Manufacturing Metal Manufacturing etc.) to intermediate goods or raw materials like Iron and Steel, Non-ferrous Basic Metals, Cement and Non-Metallic Mineral Products. Iron and Steel and Non-ferrous Basic Metals are foreseen to be the major bottleneck commodities in a growth programme.*

Thus, we can say that the Indian economy has become trade dependent over the years. Though both - exports and imports were at higher % of GDP in 1991-92 as against 1983-84, the desired level of the two was still higher than the actual. So we can say that the economy has not been able to curtail its trade dependence. The liberalization has probably made our production and capital asset structure more trade dependent.

The change from 1991-92 to 1994-95 however shows that the actual imports (% of GDP) are lower in 1994-95 than in 1991-92, actual exports are higher, deficit is lower so is the trade deficit. The extra possible exports (% of GDP) are higher in 1994-95, extra necessary imports are also higher. Therefore the total trade as % of GDP is also slightly higher in 1994-95. *This implies that after liberalisation though exports show some possibilities of increase, import requirements have not reduced and therefore an adverse trade deficit is seen in the near future.*

Summing up the findings, we can say that overall, a higher role of trade is called for, for the economy to pursue the von Nuemann growth path. Among the two, exports and imports, imports are more significant as our economy is still a deficit one in case of basic and capital goods. Increase in imports required is of a higher order. Thus the

trade deficit cannot be eliminated. It will have to remain; albeit increase in order to finance the growth programme

### **Simulation II : Separating Tradables And Non Tradables**

In the next section we undertake another simulation. Here we separate the tradable sectors from the non tradables and see the impact on the emerging exports and imports of the tradable sectors. The investment requirements of the non-tradable sectors for a high growth programme are allotted for from domestic output. The results show that, in this simulation exports can be increased much more and increase required in imports is much less than in the earlier simulation. Exports as percentage of existing exports can be increased by 75 % in 1983-84 and by 35 % in 1991-92 AND 27 % IN 1994-95. Imports as percentage of existing imports need to be increased by 45 % in 1983-84 and by 21 % in 1991-92 and 27 % in 1994-95. In this simulation the export surplus sectors turn out to be Agriculture, Other Food Products, Cotton Textiles, Woolen Textiles, Paper products, Rubbers Plastics, Chemicals , Non-metallic Mineral Products, Other Transport Equipment and Miscellaneous Manufacturing for both years of 1983-84 and 1991-92.

Imports are required to be increased in the following sectors in both the years of 1983-84 and 1991-92 -Forestry, Mining and Quarrying , Petrol, Non Ferrous Basic Metals, Metal Manufacturing, Machinery, Rail Equipment. Sugar and Edible Oil, Wood Products, Leather, Iron and Steel need to increase imports in 1991-92 where as Jute Textile Imports need to be increased in 1983-84.

Trade policies aimed at getting a surplus on the BOT will work only if attention is paid to increasing production and productivity in the areas where the *Indian economy has a comparative advantage namely in agriculture, food products, woolen textiles, chemicals, rubbers ,plastics and other transport equipment.*

### **Simulation III : A Programme For 5% , 6 % And 7% Growth**

In the following simulation, we consider a particular, rather than the von Neumann growth programme for the economy and try to see what it entails for the trade sector.

We consider 3 growth programmes for the Indian economy- a 7 %, growth programme and scaled down programmes of 6 % and 5% rate of growth for the year 1994-95. We note here that in the above model we are planning for a growth rate of the two final demand vectors of Total consumption (public and private) and exports. Usually, when referring to the growth rate of the economy it is output growth which is implied.

#### ***Results For The 7 % And 6 % Growth Programme***

For a 7 % some sectors show a deficit at inter-industry requirement: these are mining and quarrying, wood products, fertilisers, iron and steel, non-ferrous basic metals and electricity. For a 6 % growth programme, the same sectors show a deficit at inter-industry requirement as for a 7 % programme. For the 7 % growth programme, the following sectors show a surplus: agriculture, fishing, sugar, edible oil, other food products, cotton textiles, woolen textiles, rubber products, plastics, rail transport equipment, trade and other services. For the 6 % growth programme, apart from the surplus sectors for the 7 % growth programme, forestry and other transport equipment also emerge as surplus. The deficit sectors for the 7 % growth programme are forestry, mining and quarrying, jute, other textile articles, wood products, paper products, leather products, petroleum, fertilisers, chemicals, cement, non-metallic mineral products, iron and steel, non-ferrous basic metals, metal manufacture, machinery, other transport equipment, miscellaneous manufacturing, electricity, rail and other transport services, communication. For the 6 % growth programme, the deficit sectors are the same except the two sectors of forestry and other transport equipment.

Looking at the total figures for a 7 % growth programme, we see that exports can be increased at most by 40 % of actual total exports over and above their modeled 7 % increase. However, imports have to be increased by 244 % of actual total imports. This will put a heavy burden on the BOT. Instead of an actual marginal trade surplus of 0.16 % of GDP, the economy will have to bear a 22 % trade deficit to finance this growth programme.

The total figures for the 6 % growth programme shows that exports can be increased at most by 46 % of actual total exports over and above their modeled 6 % increase.



However, imports have to be increased by 108 % of actual total imports. Thus, instead of an actual marginal trade surplus of 0.16 % of GDP, the economy will have to bear a 6.03 % trade deficit to finance this growth programme.

For both the programmes, we see that the extra exportables generated are all in the traditional export sectors of the Indian economy which are primary products. These would be difficult to market in the international market in times of recession. The import requirements are seen in a large number of sectors, either of intermediate goods, raw materials and basic and capital goods and infrastructure services.

#### **Results For The 5 % Growth Programme**

For a target growth rate of 5% we see that all the sectors which emerged as exportables in the 6 % growth programme, emerge as exportables here too. There are four additions: Jute, Cement, Machinery and other Services which emerged as deficit sectors for a 6 % growth programme, emerge as surpluses here. The deficit sectors remain the same as for a 6 % growth programme except for the above four; however the order of the deficit is much less. Looking at the totals, we see that a 5 % growth programme, would allow for a maximum 67 % increase in exports over and above their modeled 5 % increase. It necessitates a 83 % in imports as against 108 % for a 6 % programme. Hence we get a much less adverse BOT of the order of 0.0097 % of the GDP.

Having seen the trade implications of the target growth programmes, we note that though the economy has some strong export sectors, it has an even stronger and more essential import dependence for a large number of commodities. This is either because of the production techniques adopted by the economy (being capital, fuel and power intensive) or because of low production and productivity in key sectors. Thus we can say that *Indian exports can really take off in a big way only in some traditional sectors like agriculture, fishing, cotton textiles, woolen textiles (includes synthetic textiles) and some non traditional sectors like rubbers, plastics, machinery (at low domestic absorption rates) and transport equipment.* So what needs to be done is to concentrate export promotion efforts in these sectors and for the remaining sectors - increase production, or productivity or both.

In case of imports we see that all the intermediate goods and capital goods are required as imports to fuel the growth programmes. *The deficits sectors are mining and quarrying, wood products, petroleum, chemicals, non metallic mineral products, iron and steel, non ferrous basic metals, metal manufacture, machinery miscellaneous manufacturing, other transport services, communications and electricity.*

The deficit of the electricity sector as percentage of its output for the 5, 6, 7 % programme is 43 %, 48 % and 54 % respectively. Thus a large investment in electricity is required to overcome the demand supply gap for these three growth programmes. The only surprising result is leather goods which emerges as an importable in all the three growth programmes. This implies that leather goods sector needs to improve in production and productivity.

The trade deficit in Rupees Millions for the three growth programmes is -82543, -525051 and -1909664 for 5, 6 and 7 % growth programmes respectively. The actual trade balance in 1994-95 was Rs + 13490 million. The Net Invisibles for 1994-95 are Rs. 66800 millions<sup>2</sup>. Thus we see that the growth programmes would entail a current account deficit of Rs 15743 million for 5 % programme ( 0.18 % of GDP); a deficit of Rs 458251 million for 6 % ( 5.37 % of GDP ) and a deficit of Rs 1842864 million for 7 % growth programme (21.58 % of GDP ). Converted to dollars at the current exchange rate of Rs 40 to a \$, the same figures would be a deficit of \$ 0.40 billion for the 5 % programme, a deficit of \$ 11.46 billion for the 6 % growth programme and a deficit of \$ 46.07 billion for the 7 percent growth programme. This implies that the 5 % programme can be very easily taken up, but the 6 % one would also be feasible.

If we consider the exchange rate prevalent during 1994-95 ,which was Rs 31.39<sup>3</sup> to a dollar or Rs 31 to a dollar, we get current account deficit of \$ 0.51 billion for 5 %, a current account deficit of \$ 14.78 billion for 6 % and current account deficit of \$ 59.4 billion for 7 % growth programme. *From this it emerges that a growth*

<sup>2</sup> From RBI Currency and Finance 994-95,p.X32, Table No.X-4 A

*programme between five and six percent growth rate is feasible and a six percent growth programme would require a capital inflow of \$14.5 billion at exchange rate of Rs 31 to \$ or \$ 11.21 billion at the exchange rate of Rs 40 to \$.*

That there is an inherent trade off between growth and trade balance is known and is an obvious fact; however, when planning for a particular target growth rate, these tools can help the policy maker make a more informed choice of the growth rate to be set as a target and the cost to be incurred for a particular growth programme and hence its utility and feasibility.

### **Capital Intensity Of India's Trade**

In the next section we look at the **capital intensity of the existing trade vectors** to see whether India's trade pattern confirms to its assumed relative factor endowment (of the Indian economy being labour abundant and capital scarce). Here we consider the capital intensity by direct capital requirements as well as by direct and indirect capital requirements. In case of Direct Capital Requirements Per Unit Capital Intensity of Exports is 1.7 (1983-84), 1.297 (1991-92) and 1.265 (1994-95). Capital Intensity of Imports is 2.4 (1983-84), 2.545 (1991-92) and 2.469 (1994-95). When both, direct and indirect Capital Requirements are considered, the Per Unit Capital Intensity of Exports is 3.7 (1983-84), 2.765 (1991-92) and 2.778 (1994-95); Per Unit Capital Intensity of Imports is 5.2 (1983-84), 5.519 (1991-92) and 5.504 (1994-95). The results shows that India's exports are less capital intensive than its imports or all three years i.e. the assumed factor endowments are vindicated.

The capital intensity is estimated for the ideal or recommended trade vectors also. The results show that the capital intensity of the ideal export vector is lower than the capital intensity of the actual export vector except for total capital intensity for 1994-95, thus confirming that the suggested export vector is in keeping with the assumed relative labour abundance of the economy. In case of imports, the results show that capital intensity of the suggested /ideal import vector is higher than the import intensity of the actual import vector.

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<sup>3</sup> This is from RBI Currency and Finance, 1994-95,p. This is the market exchange rate not the official one.

The results on the capital intensity of the trade vectors show that our trade pattern is in conformity with our resource endowment i.e. India's imports are more capital intensive than her exports. We further see that the change in the capital intensity of the trade vectors from 1983-84 to 1991-92 has moved nearer to our assumed resources endowment but the change in the capital intensities of the export and import vectors from 1991-92 to 1994-95 is not in line with our resource endowment. This implies that though our trade structure is in line with our resource endowment, it has not moved to be more in tune with it in the latter period of 1991-92 to 1994-95. This could be because the liberalisation resulted in increasing imports of all kinds. Although the export vector from 1983-84 to 1991-92 to 1994-95 became increasingly less capital intensive (except for total capital requirement of exports in 1994-95), the import vector became more capital intensive in the first period i.e. 1983-84 to 1991-92 in the second period i.e. 1991-92 to 1994-95 the import vector showed decline in capital intensity.

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