

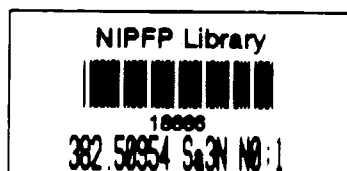
A NOTE ON THE MEASUREMENT
OF IMPORT SUBSTITUTION

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This paper has drawn on my M.Phil dissertation, Saleem, Hasheem N. on "Import Substitution in the Indian Manufacturing Sector (1970-85)", submitted to Centre for Economic and Social Studies, Hyderabad. I am grateful to Prof. R.Radhakrishna for guidance and help. I am also indebted to Dr. B.N.Goldar and Dr. A.Dasgupta for useful comments.

A Note on the Measurement of Import Substitution

Many studies¹ have presented estimates of import substitution in the Indian manufacturing sector. However, the measures adopted in these studies suffer from the defect that when they are applied at sectoral and aggregate levels, there is inconsistency in the estimates. In this paper an attempt is made to modify the Chenery measure so as to bring about consistency at the micro and the macro levels. Section 1 points to the inconsistencies in the conventional measures and Section 2 proposes a method for obtaining consistent results. In Section 3 this method is applied to measure import substitution in the Indian manufacturing sector between 1973-74 and 1979-80.

1. Inconsistency in the Currently Used Measures of Import Substitution

Studies that have estimated the extent of import substitution (IS) in the Indian manufacturing sector have been based on the Absolute measure, Relative measure, Chenery measure or variations of the Chenery measure².

The Absolute measure computes the difference between the ratios of import availability during the different periods of time. A positive change indicates that IS is taking place. Thus if M^1 and M^0 are the imports during the current and base year, Z^1 and Z^0 are total availability, and X^1 and X^0 are domestic output, $Z^1 = M^1 + X^1$, then if

$$R^1 = M^0/Z^0 - M^1/Z^1 > 0 \quad (1)$$

IS is present to the extent of the change in the value of the ratio. If the absolute measure is related to a base period, it gives the relative measure.

$$R_2 = R_1 / (M^0 / Z^0) \quad (2)$$

It must be pointed out that these ratios may not estimate IS accurately if imports are subject to controls and restrictions.

Chenery's (1960) measure defines IS as "the difference between the growth in output with no change in the Import ratio and the actual growth." Chenery apportions the growth in domestic output (a) to growth in demand, on the assumption that a constant proportion of total supply is imported and (b) to the change in the ratio of imports to total supply, which he calls IS.

Beginning from the basic identity, we get

$$Z = X + M \quad (3)$$

where Z = Availability, X = Domestic production, and
M = Imports

$$Z = X + M, \quad (4)$$

$$\text{and } \Delta Z = Z^1 - Z^0 \quad (5)$$

$$\text{Let } U^0 = X^0 / Z^0 \text{ and } U^1 = X^1 / Z^1 \quad (6)$$

$$\text{Then } \Delta X = Z^1 U^1 - Z^0 U^0 \quad (7)$$

Substituting Z^0 by $Z^1 - \Delta Z$ (equation (5) in equation (7)) we get

$$\Delta X = Z^1 U^1 - (Z^1 - \Delta Z) U^0 \quad (8)$$

$$\Delta X = Z^1 (U^1 - U^0) + U^0 \Delta Z \quad (9)$$

The change in domestic output ascribed to import substitution is measured by the change in the proportion of total supply imported, when total demand is held constant. $(U^1 - U^0)Z^1$ is taken as the measure of IS, $U^0 \Delta Z$ is the change in output caused by the change in the demand.

$(U^1 - U^0)Z^1$, as has already pointed out, is the measure of IS, but this term includes the interaction element. This has been indicated by Eysenbach (1969) to Lewis and Soligo (1965), who have used the measure to study growth and structural change in Pakistan's Manufacturing Industry.

He points out that

$$\begin{aligned}(U^1 - U^0)Z^1 &= (U^1 - U^0) (Z^0 + \Delta Z) \\ &= \Delta U(Z^0) + \Delta U(\Delta Z)\end{aligned}$$

It is only the first part of the term that is, $\Delta U (Z^0)$ that is attributed to IS. The second term is the interaction term, the product of two finite changes, which results from the co-existence of both IS and demand growth. So the use of $(U^1 - U^0)Z^1$ to measure IS could result in over estimation.

Desai³ has pointed out that there are two ways to estimate IS at the aggregate level. In a group consisting of several industries, one could either compute IS by taking into account aggregated imports, domestic production and supply or obtain IS for each industry and then aggregate for the whole group. The results differ according to the measure adopted. In Desai's study⁴ the results show that if aggregated data are used then there is no IS in the Indian economy for the period 1951-63, but the use of disaggregated data points to the presence of IS. In the following section, we outline the method to be adopted to determine the extent of IS for the year 1979-80.

2. Consistent Measures of IS for Aggregation Across Industries

IS refers to a policy that reduces or eliminates entirely the importation of a commodity, and conduces for production in the domestic market. Thus IS would imply a decline in the ratio of imports to total supply of its product. In order to estimate IS we employ the Chenery measure with modifications. In this measure we propose to incorporate indirect imports⁵ and changes in the structure of final demand. The break-up of change in imports (a) due to change in IS (b) due to growth

in final demand and (c) due to change in the composition of final demand would be estimated.

The measure to be adopted would be as follows:

X_i^d = Domestic production of the i^{th} item

M_i = Import of the i^{th} item

S_i = Supply = $X_i + M_i$

X_i = Demand of the i^{th} item

A = Technical coefficient matrix

m_i = Proportion of imports i.e., M_i/S_i

F = Final demand

The balance equation for the i^{th} sector would be

$$X_i^d + M_i = X_i, \quad (10)$$

and
$$X_i^d + M_i = AX_i^d + F. \quad (11)$$

If we assume a constant import coefficient, m , then

$$M_i = m_i X_i, \quad (12)$$

so that, using (12) we get

$$M_i = m_i (X_i^d + M_i) \quad (13)$$

or
$$M_i - M_i m_i = m_i X_i^d,$$

or
$$M_i (1 - m_i) = m_i X_i^d,$$

or finally,

$$M_i = (m_i / 1 - m_i) X_i^d \quad (14)$$

Let us define \hat{M} as a diagonal matrix, with the i^{th} element in the diagonal equal to $(m_i / 1 - m_i)$, then

$$M = \hat{M} X^d$$

Restating it as follows,

$$\begin{aligned} X^d + \hat{M} X^d &= AX^d + F \\ \text{or } X^d &= (1 - A + \hat{M})^{-1} F \end{aligned} \quad (15)$$

Equation (15) would give us the value of total domestic output required to meet the final demand F (in value terms). The import requirement for this output would be $i \hat{M} X^d$ where i is a unit row vector. Import requirement per unit of final demand would be $i \hat{M} X^d / F$.

In measuring IS between two points of time, we concentrate on the case of an unchanged technology matrix, given the data restriction. Extension to the case of different technology matrices is straightforward. In our estimates of IS, we consider only the changes in import coefficients and the final demand. If the import requirements are obtained by taking into account the changes in the import coefficients between the terminal year and base year, holding the final demand constant, then this part of change in imports could be attributed to IS. If the import requirements are obtained by taking into account the changes in the final demand between the terminal year and base year, holding the import coefficients constant, then this could be attributed to changes in final demand. For the aggregate measure the change in imports, attributed to final demand, is split into two parts that due (i) to growth in final demand, and (ii) to the composition of final demand. This could be symbolically expressed as follows :

$$\text{Let } i[(I - A)^0 + \hat{M}^0]^{-1} = T$$

$$\begin{aligned}
& \text{and } i[(I-A)^0 + \hat{M}^1]^{-1} = Q \\
& \text{then } M^1(QF^1) - M^0(TF^0) = [M^1(QF^1) - M^0(TF^1)] \\
& \{\text{changes in imports}\} = \{\text{changes due to IS}\} \\
& \quad + \\
& \quad [M^0(TF^1) - M^0(TF^0)] \quad (16) \\
& \quad \{\text{changes due to final demand}\}
\end{aligned}$$

The aggregate measure is obtained by the summation of estimates of IS for each industry. For the manufacturing sector as a whole, the change in final demand is split into (i) growth due to final demand on the assumption that a uniform growth rate (δ) obtained from the terminal year final demand over base year final demand) is applicable to all industries, and (ii) changes due to composition of final demand. This could be symbolically expressed as follows :

$$\begin{aligned}
\sum M^1(QF^1) - M^0(TF^0) &= \sum M^1(QF^1) - M^0(TF^1) \\
\{\text{changes in imports}\} & \quad \{\text{changes due to IS}\} \\
& \quad + \\
& \quad \sum M^0(TF^1) - M^0(T\delta F^0) \\
& \quad \{\text{changes due to composition effect}\} \\
& \quad + \\
& \quad \sum M^0(T F^0) - M^0(TF^0) \quad (17) \\
& \quad \{\text{changes due to growth effect}\}
\end{aligned}$$

Thus from equation (17) we could estimate the extent of IS in the manufacturing sector and the extent of change in final demand.

3. Estimation of IS using the Input-Output Framework(1973-74 to 1979-80)

To estimate direct and indirect imports for the years 1973-74 and 1979-80, the 66X66 input-output matrix of the Fifth Plan and 89 X 89 input-output matrix of the Sixth Plan have been used. We have made a correspondence between the sectors of the Fifth and Sixth Plans in accordance with ASI classification (Appendix 1). Sectors in the manufacturing category of the input-output table have been aggregated into 14 groups similar to that of the ASI classification, and agriculture and service sector have been clubbed together. Imports and production data

TABLE 1.
EFFECT OF IMPORT SUBSTITUTION IN THE MANUFACTURING
SECTOR AT 71-72 PRICES. (1973-74 TO 1979-80)

Sl. No.	SECTOR	Direct and Indirect requirement of imports for per unit final demand				Effect of Import-Substitution 1979-80 over 1973-74
		1973-74	Rank	1979-80	Rank	
1.	Agriculture and Service	0.0293	14	0.0199	15	-0.0094
2.	Food Products	0.0384	12	0.0425	10	0.0041
3.	Textiles	0.0333	13	0.0235	13	-0.0098
4.	Wood & Wood Products	0.0177	15	0.0129	14	0.0048
5.	Paper and Paper Products	0.2832	2	0.1751	4	-0.1081
6.	Leather & Leather Products	0.0702	10	0.0415	11	-0.0287
7.	Rubber Plastic Petroleum & Coal Products	0.2266	5	0.1127	7	-0.1139
8.	Chemical & Chemical Products	0.2729	3	0.1638	5	-0.1091
9.	Non-metallic mineral Products	0.0598	11	0.0257	12	-0.0341
10.	Basic Metal & Alloy Industries	0.2283	4	0.2794	1	0.0511
11.	Metal Products & Parts Except Machinery	0.0835	9	0.0961	8	0.0126
12.	Machinery, Machine Tools & Parts except electrical machinery	0.7528	1	0.1774	3	-0.5754
13.	Electrical Machinery	0.1262	6	0.1784	2	0.0522
14.	Transport Equipment and parts	0.1066	7	0.1238	6	0.0172
15.	Miscellaneous Industries	0.1001	8	0.0917	9	-0.0084

for 1973-74, given in the technical note of the Fifth Plan, are at 1971-72 prices, and data on imports and production in 1979-80, given in the Technical Document of the Sixth Plan are at 1979-80 prices. In order to express imports and production of 1979-80 at 1971-72 prices, we have deflated imports and production of the various sectors by the appropriate unit value indices of imports and wholesale price respectively.

To arrive at constant prices of imports with 1971-72 as the base year, 1979-80 with base 1970-71, has been changed to 1971-72=100. Similarly, for the wholesale price indices the base has been changed to 1971-72=100 from base 1970-71. The general index has been used to deflate the agro-based and services sector. For the food products group, which includes manufactures of food and beverages, tobacco and tobacco products, a weighted average has been used. The indices that have been used as deflators for the other sectors are shown in Appendix-2. In estimating the extent of IS for the manufacturing sector at a disaggregated level for the year 1979-80 as compared to 1973-74, we take into account the change in the import coefficients and assume the final demand to remain constant. The import requirements per unit of final demand are shown in Table 1. In the year 1979-80 as compared to 1973-74, IS occurred in eight industries, the highest being in machinery and machine tools (58 per cent). The effect of oil price hike in 1973 has resulted in IS in the case of rubber, petroleum and coal products industry (11 per cent). Other industries where IS took place during the abovementioned period are paper and paper products (11 per cent) and chemicals and chemical products (11 per cent). Import dependence occurred in Six Industries. In basic metal and alloy industries and in electrical machinery import dependence was to the extent of 5 per cent. To estimate the import requirements of the economy, we take into account the changes in final demand between 1973-74 and 1979-80. The estimates are shown in Table 2.

TABLE 2
Direct and Indirect Requirements of Imports

(Rs million at 1971-72 prices)

Imports required for fulfilling final demand in 1973-74	23,409.7
Imports required for fulfilling final demand in 1979-80	16,830.0
Change in import requirements	(-)6,579.7

From Table 2 we notice that for the Indian economy there has been a decline in import requirements in 1979-80 as compared to 1973-74 in real terms. The dependency in imports in 1979-80 has declined substantially as compared to 1973-74. In order to verify whether the extent of IS (Rs.-10523.4)(refer Table 3) has been overestimated, the data of the RBI and Planning Commission were compared. At constant prices (1971-72=100), there was considerable difference between the two sources of data (refer Appendix 3). In the group Machinery and Transport Equipment the difference is substantial. When we examine the import matrix of the Fifth Plan, we notice that in the group Machinery and Machine Tools Iron and Steel is an important item of imports, whereas the RBI data show notice that Non-electrical machinery constitutes a major item of imports; however further break-up of this industry group is not available. In the case of Mineral Oil and Lubricants, according to RBI data there has been an increase, the Planning Commission data reveal a decline. This could be due to the fact that crude oil is the major item in the petroleum group, which gets included in crude materials, according to the RBI classification. The import price of this item was very high. The reason for the decline in imports in real terms could be due to the enormous increase in import price of petroleum products in 1979, the year of the second oil price hike

The break-up of changes in imports due to changes in final demand as well as in IS is presented in Table 2. The growth rate is estimated on the basis of final demand in the current year vis-a-vis the base year, keeping the composition of final demand constant. The increase in domestic production due to IS is estimated from the changes in the import coefficients, as shown in section 2. The estimates so derived are given in Table 3.

TABLE 3
Factors Contributing to Changes in Imports in the
Manufacturing Sector
 (Rs.million, 1971-72prices)

Change due to growth effect	=1338.2
Change due to composition effect	=2605.5
Total change in final demand	=3943.7
Changes due to Import substitution	=(-)10523.4

In this paper, we have taken into account the intermediate demand for imports to estimate IS. The break-up of changes in imports due to changes in final demand and in IS has been incorporated. In the measure that we have adopted there is consistency between the sectoral and global estimate of IS, as IS for the aggregate of all industries is equal to the sum of contributions of IS in each individual industry. Rather than attempt to provide a detailed explanation of the impact of IS⁶, our aim was to estimate the extent of IS in the manufacturing sector. From our estimates for the manufacturing sector for 1973-74 to 1979-80 it is evident that IS strategy played a major role in reducing imports. Machinery and Machine Tools; Rubber, Petroleum and Coal Products, and Chemicals and Chemical Products were the important industries in which IS has taken place.

NOTES

1. Bokil et al, Desai, P.Nambiar.R.G, Ahluwalia, I.J, Sastry, D.U. have estimated IS using the Chenery measure or its variants.
2. Sastry .D.U. has used a composite measure, in which the average of change in imports weighted by the terminal year supply and imports weighted by the base year supply is taken to estimate IS.
3. Cf. Desai, P. (1969) Alternative measures of IS.
4. Desai (1970) has grouped the industries into 3 categories namely Consumer goods Industries, Raw materials and Intermediates, and Investment goods. She has estimated IS using different measures.
5. Chenery, Shisido and Watanabe (1962) were the first to incorporate intermediate imports. Morley and Smith(1972) incorporated indirect imports to estimate IS for Brazil. Guillamont attempted to derive an estimate of IS which was globally consistent.
6. For details, see Saleem, N.Hasheem (1988)

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APPENDIX 1

CORRESPONDENCE BETWEEN THE SECTORS OF THE FIFTH PLAN AND SIXTH PLAN

Sl. No.	ASI Code	Industry Group	Sectors Fifth Plan (66x66)	Sectors Sixth Plan (89x89)
1.	-	Agro-based and service sector	1-10, 62-66	1-19, 79-89
2.	20-21-22	Manufacture of food products	11-14	20-27
3.	23-26	Manufacture of Textiles	15-18, 28	28-35
4.	27	Manufacture of wood and wood products, furniture & fixtures	19	36
5.	28	Manufacture of paper & paper products, printing publishing and allied industries	20, 61	37, 38
6.	29	Manufacture of Leather and leather fur products	21	39, 40
7.	30	Manufacture of Rubber, Petroleum and coal	22, 26, 30	41-44
8.	31	Manufacture of chemical & chemical products (except products of petroleum and coal)	23-25, 27, 29	45-53
9.	32	Manufacture of non-metallic mineral products	31-33	54-56
10.	33	Basic metal and alloy industries	34-35	57-60
11.	34	Manufacture of metal products and parts except machinery.	36-39	61
12.	35	Manf. of machinery, machine tools and parts except electrical machinery	40, 42, 43	62-65
13.	36	Manufacture of electrical machinery, apparatus, appliances and supplies and parts	41, 42, 51	66-71
14.	37	Manufacture of transport equipment and parts	52-57	72-76
15.	38	Miscellaneous manufacturing industries	58-60	77-78

Sources : (i) A Technical note of the Fifth Plan 1974-79.
(ii) A Technical note on the Sixth Plan 1980-85.

APPENDIX 2

INDEX NUMBERS OF WHOLESALE PRICES & IMPORTS

FOR 1979-80

(Base 1971-72 = 100)

S.NO.	Code	Industry group	Wholesale price index	Unit-value index of imports
1.	1-19,	Agriculture and service 79-89	206.1	387.6
2.	20-27	Food products	180.6	392.8
3.	28-35	Textiles	185.4	187.9
4.	36	Wood and wood products	211.9	88.0
5.	37, 38	Paper and paper products	215.0	238.1
6.	39, 40	Leather and fur products	298.2	258.0
7.	41-44	Rubber, plastic, petroleum and coal	447.4	1433.0
8.	45-53	Chemical & chemical products	195.8	257.5
9.	54-56	Non-metallic mineral products	228.3	595.0
10.	57-60	Basic metal and alloy Ind.	246.4	264.8
11.	61	Metal products and parts except m/c.	220.7	357.2
12.	62-65	Machinery, machinery tools and parts	208.0	444.6
13.	66-71	Electrical machinery	193.2	233.7
14.	72-76	Transport equipment	213.9	296.1
15.	77,78	Miscellaneous industries	202.3	437.9

Source: Chandhok, Whole Sale Prices Statistics, India, Vol-I, Indian Trade Journal.

APPENDIX 3

INDIA'S IMPORTS OF PRINCIPAL COMMODITIES

(Rs. Million at 71-72 Prices)

Sl. No.	Commodity	R B I		Planning Commission	
		1973-74	1979-80	1973-74	1979-80
1.	Food	2920	710	-	-
2.	Mineral Oils & Lubricant	2740	3470	1405	785
3.	Chemicals	2680	3720	4035	4687
4.	Iron & Steel	1890	3220	2712	3900
5.	Machinery & Transport equipment	5090	3830	4975	1492
	TOTAL IMPORTS	19960	23010	25337	23944

(At Current Prices)

Sl No.	Commodity	R B I		Planning Commission	
1.	Food	5470	2810	-	-
2.	Mineral Oils & lubricant	5610	33320	-	11244
3.	Chemicals	3570	9560	-	12070
4.	Iron & Steel	2490	8340	-	10328
5.	Machinery & Transport equipment	6520	13680	-	6633
	TOTAL IMPORTS	29550	89080	-	87900

Source : RBI and Planning Commission


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