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MEASURING FACTOR CONTENT OF INDIAN TRADE IN THE PRE AND POST LIBERALISATION PERIODS

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ABSTRACT

A large number of empirical studies related to the measurement of factor content of Indian trade are found in the literature. We observe quite a few exercises of the above kind for India also. This paper tries to improve the robustness of the results related to the above by using domestic Input-Output matrix for projection on the one hand and using 'Value Added per Employee' as a measure of relative capital intensity on the other. The advantage of using 'Value Added per Employee' as a measure of relative capital intensity is that we indirectly are able to incorporate the contribution of human capital (in addition to physical capital) in the value added per employee figures. The results obtained suggest that India exports relatively more labour intensive commodities and imports capital intensive commodities, both in the pre liberalization and post liberalization periods and Heckscher Ohlin theorem holds for the Indian economy.

KEYWORDS

Domestic Input Output Matrix, Factor Intensity, Value Added per Employee.

INTRODUCTION

Since July 1991, the Indian economy has witnessed a series of economic reforms encompassing all major sectors of the economy. It has marked a steady break from the past policy regime. The import substituting development strategy of the past has been given up in favour of an export linked open economy strategy. As a measure of import liberalization, all types of quantitative restrictions on imports were being gradually withdrawn. Import duty has been reduced to a significant number of commodities. Non-tariff barriers on imports have been withdrawn to a large extent. Exports and imports have now been freed from almost all restrictions. Naturally our concern has been very much to understand the impact of the above on the factor endowment position and trade pattern of the Indian economy. Resorting to Input-Output model, in this paper we have made an intertemporal study to look into the process of changes of trade pattern in relation to factor endowment position over a range of periods. More specifically our study period relates to the period 1989-90 – 2006-07. The year 1989-90 belongs to pre-liberalization phase for the Indian Economy. The years 1993-94, 1998-99, 2003-04 and 2006-07 relate to the post liberalization phase. We take 1993-94 as the year in which liberalization process already started, but was yet to make perceptible impact on the economy. By the years 1998-99 and 2003-04 the impact was already recognizable, and by 2006-07 the liberalization progressed sufficiently so as to make substantial impact on the economy.

REVIEW OF LITERATURE

The basic Heckscher-Ohlin Theorem asserts that varying factor endowments in different countries is the most important single factor in determining comparative cost differences leading to International Trade. This coupled with the fact of different commodities using different factor proportions will lead to a pattern of trade where 'each country tends to export commodities which use relatively large amounts of abundant factors'.

Based on certain assumptions, the Heckscher-Ohlin theorem has been put to empirical verification by quite a few researchers including Leontief himself in various countries in fifties, sixties and also a few in recent decades. So far, the most controversial of such attempts is that of Leontief (1953) himself who aimed to analyze the structural basis of American Foreign Trade. Leontief put to test with the help of Input-Output model the commonly held notion that U.S possesses a comparative advantage in the production of commodities which require large quantities of capital and relatively small amount of labour for their manufacture as suggested by Heckscher Ohlin Model.

The factual finding of Leontief caused a great deal of puzzle as it implied some notion contrary to general expectation that the U.S exports goods which require relatively more labour than those required by her competitive import replacements. The later studies of Leontief (1953, 1956) related to the pattern of trade between the Rest of the World and Japan, U.S, West Germany and Canada also did not support the theorem.

But the studies by Totemoto and Ichumura (1959) related to Japan, Stolper, Roskamp (1961) related to East Germany and Bhavadwaj (1962), Sengupta (1989) related to India supported the theorem. These observations, certainly, stimulated some more studies incorporating some new approaches towards measuring capital intensity in determining the precise factor content of a country's trade.

Leontief's results apparently contradicting with that of Heckscher-Ohlin theorem induced quite a few researchers to examine the above conflict from various angles. Leontief himself suggested that though there is some scope of substitutability of capital for labour in America, the productivity of American labour is still higher than that of other countries due to the fact that American labour is possibly endowed with richer human capital. Leontief (1956) observed and later Bhavadwaj & Bhagabati (1968) subscribed to the same observation that U.S seemed labour abundant because the U.S labour was on the average three times as efficient as foreign labour and so Heckscher-Ohlin theorem seems valid for U.S also.

In the noted exercise of Bhavadwaj and Bhagwati (1968), we see a very stimulating attempt to split capital intensity of various Indian industries into physical and human capital components and the apparent contradiction between the Heckscher-Ohlin Theorem and Leontief's original empirical studies can be resolved if these results are adjusted by accommodating human capital in the capital intensity calculation and the Heckscher-Ohlin Theorem seems to survive comfortably. The first exercise of Bhavadwaj (1962) on factor content of Indian trade was carried out on unadjusted data (human capital was not taken into consideration). The actual pattern of Indian trade observed in this study seemed to support the Heckscher-Ohlin theorem. The second exercise of Bhavadwaj jointly with Bhagwati (1968) was carried out with an intention to test the validity of Heckscher-Ohlin Theorem in the context of Indian economy incorporating revised notion of capital (adjusted for human capital). It was suggested that the skilled labour be separated from unskilled labour and the differential wage rates are to be treated as returns to human capital. Their results despite the adjustment for human capital did support the Heckscher-Ohlin theorem.

The analytically interesting explanation for this contradictions perhaps is the one that runs in terms of the concept of Factor Intensity Reversal introduced by Minhas (1963) and suitably linked with Heckscher-Ohlin theorem. Minhas in his outstanding exercise (1963) tried to show that the strong factor intensity assumption implicit in the Heckscher-Ohlin theorem does not hold if factor intensities are reversible empirically within the observable price range. The CES production function fitted by him to international data showed elasticities of substitution both significantly different from unity and zero and also from one another. This implies that factor intensity reversals took place within observable price ratios. However, serious doubts have been raised on the validity of these observations on both statistical and analytical grounds.

Now, let us look at the history of empirical studies on validity of Heckscher-Ohlin Theorem for Indian trade pattern. As far as the main data base for these kinds of studies are concerned, undoubtedly a sufficiently elaborated Input-Output tables would provide the main input data.

In this connection it should be mentioned that the earlier works for India, by and large, are based on the Input-Output tables prepared by the planning commission. Unfortunately Planning Commission's tables are mostly derived from projection from previous tables (not based on actual survey). In the empirical work of Bhavadwaj and Bhagwati (1968), in the absence of any availability of imported input matrix, factor requirements have been calculated on the basis of total input matrix only (Domestic + Import). So, to this extent, imported inputs are proxied by domestic inputs. Hence, factor requirement calculation is to some extent erroneous because calculation of domestic factor requirement needs to be based on domestic input-output matrix only. It needs to be noted that no

exercise published till date relating to testify the Hechsher-Ohlin theorem based on domestic matrix. Most probably it is the first attempt to study the trade pattern of India in relation to its factor endowment pattern by using domestic Input-Output matrix for projection on the one hand and using 'Value Added per Employee' as a measure of relative capital intensity on the other.

OBJECTIVES

First, to utilize the domestic input output matrices for India for the years 1989-90, 1993-94, 1998-99, 2003-04 and 2006-07 made available by CSO for getting a more correct projection of domestic output requirement and hence the capital and labour requirement for a certain export and import vector as a component of final demand. So by the above we may expect some improvement in the quality of projection of the consequences of liberalisation of import compared to projection obtained in the exercises done by others.

Second, as the data base of our study incorporates information related to more recent periods, it has been possible to capture the impact of liberalization in the truer sense as it is expected that as more and more time passes consequences of relaxation of controls will be manifested in greater and greater degrees. In this respect, results of our study possibly appear more robust.

Third, 'Value Added Per Employee' as a measure of capital intensity proposed by Lary (1968) is used here to calculate the factor content of Indian Trade. The concept of 'Value Added Per Employee' as a measure of capital intensity has some unique advantages which would be discussed later on.

Fourth, to carry out the comparison of indirect factor content implicit in the composite export and that in the composite import replacements in somewhat unconventional fashion, the total factor content of Indian export in a hypothetical pre trade situation would be compared with the total factor content of the same bill of goods in the actual post trade situation. The indirect factor content of an average unit of export in the actual post trade situation will have to accommodate for intermediate imported inputs. Here the hypothetical pre trade situation is considered as proxy for a situation of import substitution and the post trade situation is generally considered as a situation of import leakage. Then the comparison of factor content of an average unit of export in the pre trade and the post trade situation can be taken as equivalent to the comparison of factor content of export and import replacements.

THE METHODOLOGICAL FRAMEWORK

Leontief open static input-output model appears undoubtedly the most useful basic tool for analyzing the factor content of Indian trade. Total output from each industry equals total inter-industrial demand plus the final demand. So, we have the balance relations as follows:

$$X_i = \sum_{j=1}^m X_{ij} + D_i \dots\dots\dots(1) \text{ where } X_i = \text{Output of the } i^{\text{th}} \text{ sector (in value terms)}, D_i = \text{Final Demand in the } i^{\text{th}} \text{ sector (in value terms) and } X_{ij} = \text{input flow from } i^{\text{th}} \text{ sector to } j^{\text{th}} \text{ sector.}$$

Assuming a production function with fixed coefficients, we can write

$$X_{ij} = a_{ij} \cdot X_j \dots\dots\dots(2) \text{ where } a_{ij} = X_{ij}/X_j$$

By substituting (2) in (1), gross output or sales of sector i can be expressed as :

$$X_i = \sum_{j=1}^m a_{ij} \cdot X_j + D_i \dots\dots\dots(3)$$

Therefore, $X = AX + D$ where $X = (X_i)$, $A = (a_{ij})$ and $D = (D_i)$

Or, $D = X - AX = IX - AX = (I - A)X$

Or, $X = (I - A)^{-1}D \dots\dots\dots(4)$

In the equation (4) if D is prescribed from outside, the required gross output levels X's get determined. For our present purpose it is not the entire Final Demand but the export and import part of the final demand that are relevant

Now, if $X_{ij}(m)$ = Imported input of i^{th} sector to j^{th} sector and if $X_{ij}(t)$ = total supply of input of i^{th} sector to j^{th} sector and $X_{ij}(d)$ = domestically produced input of i^{th} sector to j^{th} sector, we may obtain the total (direct and indirect) domestic output requirement X_E to meet the export basket, E which can be expressed as $X_E = (I - A_d)^{-1}E$ where $A_d = (a_{ij}(d))$. Similarly, $X_M = (I - A_d)^{-1}M$ where X_M = Gross output requirement (direct plus induced) to meet the import replacement (domestically) vector M.

We, now, discuss the methodology related to the determination of factor content of export.

a) Using the criterion of 'Value Added Per Employee', as proposed by Lary (1968) and as already referred to, direct factor content of export is given by the scalar $V^E = V \cdot E \dots\dots\dots(5)$ where E is a column vector of sectoral export proportions representing an average unit of export and V is a row vector of value added per employee. V^E is then simply a weighted mean of value added per employee, the weights being the sectoral export proportions. Similarly, the factor content of competitive imports is given by $V^M = V \cdot M \dots\dots\dots(6)$ Where M is a vector of import proportions. Here we can consider two possible situations.

SITUATION-1 : $V^E > V^M$

The above situation may be characterized as a situation when an average unit of a country's export is relatively more capital intensive than an average unit of import replacements.

SITUATION-2 : $V^E < V^M$

This situation can be interpreted as a situation where an average unit of a country's export is relatively less capital intensive than an average unit of import replacements.

Now, the procedure for calculation of total factor content is as follows:

Considering 'A' as the current Technical Matrix (combining the domestic and the imported input) in case of no trade and consequent absence of any intermediate imports, it may be taken to approximate to the domestic 'pre-trade' technical matrix as it is assumed that domestic inputs are substitutes for imported inputs. So vector $X = (I - A)^{-1}E$ indicates the direct and indirect output requirement induced by a unitary increase in export in sector i. Hence total capital content of an average unit of exports as suggested by Lary can be calculated by pre-multiplying the normalized X by the vector of value added per employee as follows:

$$T_k = V^* \cdot \bar{X} \dots\dots\dots(7)$$

Where T_k = Total capital content of an average unit of exports

V^* = Row vector of value added per employee

\bar{X} = Normalised X (The elements of this vector \bar{X} is obtained by dividing corresponding element of X by the sum of the elements of the vector X).

Similarly, we define $X^* = (I - A_d)^{-1}E$ as the vector of sectoral outputs to satisfy an average unit of exports in the situation when opening up of trade allows import leakage in the intermediate inputs. E = Column vector of Sectoral export proportions.

So, $T_k^* = V^* \cdot \bar{X}^* \dots\dots\dots(8)$ will indicate total capital content of an average unit of export when opening up of trade allows import leakage in the intermediate inputs. Here, \bar{X}^* = Vector of normalized X^* .

Now, we are in a position to compare the relative capital intensity of exports vis-à-vis capital intensity of imports substituted for the intermediate inputs and in this context we make the crucial assumption that the country concerned is relatively labour abundant and capital scarce.

We may have the two possible situations as follows:

SITUATION 1

If it happens that $T_k > T_k^*$, then it would mean that an average unit of the concerned country's export is relatively less capital intensive. In this case, the country concerned imports capital intensive goods and skilled labour from Rest of the World and exports labour intensive goods and the Hecksher-Ohlin proposition holds good.

SITUATION 2

But if the result shows that $T_k < T_k^*$, it will mean that an average unit of the concerned country's export is relatively more capital intensive. In this case, the country concerned imports labour intensive goods and exports capital intensive goods and the Hecksher-Ohlin proposition seems not valid.

DATA BASE OF THE EMPIRICAL STUDY

For our empirical study of relative factor content of Indian trade (capital and labour requirements of exports and import replacements), Input-Output tables (Total inter-industry Transaction matrix) prepared and circulated by CSO for the years 1989-90, 1993-94, 1998-99, 2003-04 and 2006-07 provide major part of the information required for our purpose. The import matrices for the said years are also prepared by CSO but these are not circulated by them. We have collected the import matrices (not published or circulated) from C.S.O's desk informally. The matrices (Transaction and Import) as obtained from CSO for the years 1989-90, 1993-94 and 1998-99 are of order 115*115 where as the Transaction and Import matrix for the year 2003-04 and 2006-07 are of order 130*130. All the matrices (115*115 and 130*130) are aggregated into 18*18 matrices by clubbing the sectors by adopting a suitable aggregation scheme.

The employment data and capital stock data for the Non-manufacturing sectors have been taken from the Economic Survey-2006-07 published by Govt. of India and National Accounts Statistics of India-(1950-51 to 2002-03), Linked series with 1993-94 as the base year, published by EPW Research Foundation respectively. It is to be mentioned here that as far as capital data are concerned, net fixed capital stock have been used here. Annual Survey of Industries (ASI) Reports published by C.S.O, Govt. of India, gives information in respect of number of employees and fixed capital for the manufacturing sector. The Manufacturing groups covered in our study are as per the two digit commodity classification of NIC (National Industrial Classification) of the year 1987 and 1988.

RESULTS OF THE STUDY**THE FACTOR CONTENT OF INDIAN EXPORTS AND IMPORTS**

On the assumption that 'Value Added per Employee' may be taken as a reasonably reliable index of relative capital intensity, estimates of the factor content of Indian exports and imports replacements are obtained as shown in Table-1.

TABLE-1: DIRECT FACTOR CONTENT OF INDIAN EXPORTS AND IMPORTS REPLACEMENTS

	Value Added per Employee (Rs. Lakhs)				
	1989-90	1993-94	1998-99	2003-04	2006-07
Export(V^E)	.6809	.1880	.3083	2.1230	2.1430
Import Replacements(V^M)	1.3260	.6428	1.5221	7.0501	6.5432

Source: Author's own calculation based on the equation no - 5 and 6

On the basis of the results shown in table-1, we may conclude that an average unit of Indian exports is relatively less capital intensive than a unit of import replacement. Not only for the pre-liberalization period, 1989-90, the result is confirmed by repetition of the exercise of the calculation for the post liberalization years -1993-94, 1998-99, 2003-04 and 2006-07. It has been found that relative capital intensity of export further decrease in the years 1993-94, 1998-99, 2003-04 and 2006-07.

Now, we incorporate the implication of induced factor requirement in the calculation of capital intensity through Value Added per Employee.

TABLE-2: DIRECT AND INDIRECT CAPITAL CONTENT OF AN AVERAGE UNIT OF EXPORT (RS. LAKHS)

	1989-90	1993-94	1998-99	2003-04	2006-07
Without import leakage(T_k)	0.7955	0.3095	0.5892	0.7259	0.7843
With import leakage(T_k^*)	0.7869	0.3012	0.5727	0.6435	0.6523

Source: Author's own calculation based on the equation no - 7 and 8

Table-2 shows that the estimated values of T_k and T_k^* for the year 1989-90 are 0.7955 and 0.7869 respectively. The corresponding values for the years 1993-94, 1998-99, 2003-04 and 2006-07 are 0.3095 and .3012, .5892 and .5727, .7259 and .6435 and .7843 and .6523 respectively. The results for the years suggest that opportunity of trade reduces the domestic capital intensity of an average unit of exports. This is in agreement with the hypothesis that India imports capital intensive inputs from the rest of the world and exports relatively labour intensive commodities. When the measurement of factor inputs based on direct plus induced input requirement is considered, an average unit of exports is found less capital intensive than what is suggested by a measure based on direct factor inputs only.

The results of 2003-04 and 2006-07 (table-1), in respect of value added per employee, seem little bit large as compared to those of previous years like 1989-90, 1993-94 and 1998-99. So, one may question the sensibility of the above results. But we feel that the observations of value added per employee themselves do not seem to suggest any direct implication. Rather, we should be more concerned with the comparative values of value added per employee for export and import replacements to obtain any conclusion relevant for testing Hecksher-Ohlin theorem. Though we have taken value added per employee as our guideline for determining relative capital intensity, we should note that the increase in the absolute value added per employee may result from various other factors like technological changes etc. So, too high value of value added per employee in 2003-04 and 2006-07 may be partly result of significantly improved technology and so on.

CONCLUSION

India is a labour abundant and capital scarce country and our results show that India exports relatively more labour intensive commodities and imports capital intensive commodities, both in the pre liberalization and post liberalization periods. So, Hecksher Ohlin theorem holds for the Indian economy.

Three important points need be noted here.

One is that the orthodox measure of total factor intensity developed by Leontief assumes that all intermediate inputs are domestically produced. No distinction has been made between the imported input and the domestic inputs as regards the direct factor requirement calculation for the inputs. As a result, the applicability of the total factor intensity so computed is required to be dependent on the validity of the implicit assumption that in respect of direct factor intensity imported intermediate inputs are equivalent to domestic inputs. This assumption seems, to some extent, unrealistic.

Another point is that the labour has been used here in its unadjusted form. Human capital component requires to be properly accounted for. This requires that while calculating labour requirement, we should separate out the skilled labour component (ie differentiation between skilled and unskilled) from the total labour requirements and be clubbed with the physical capital requirement while calculating capital intensity. In this connection, it should be mentioned that when value added per employee method is used to calculate capital intensity, one may expect that along with physical capital 'human capital' component is automatically captured in the estimation process.

The third point is that we should be careful to note that in the calculation of total factor requirement when we consider the post trade situation by incorporating the possibility of imported inputs our procedure of calculation does not take into consideration import in final demands. So when we talk of import replacement we restrict the meaning of 'import' to import in intermediate inputs only. Further our method of analysis does not have any room for considering the factor

content in non competitive imports. Though for US it may be true that large changes in domestic factor prices would not lead to goods classified as non competitive imports being substituted by domestic production, it is doubtful whether the same borderline in the classification of non competitive and competing imports can be applicable for India.

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ANNEXURE

ADVANTAGES OF USING 'VALUE ADDED PER EMPLOYEE' AS A MEASURE OF RELATIVE CAPITAL INTENSITY

According to 'Value Added per Employee' as a measure of relative capital intensity, industries with a high value added per employee are regarded as relatively capital intensive and industries with a low value added per employee are regarded as relatively labour intensive. While this measure of capital intensity has its own limitations, Lary's tests on US data suggest that value added per employee is a reasonably good measure of relative capital intensity.

If we assume that wage value is highly correlated with labour skills, value added per employee may be taken to reflect inputs of human as well as physical capital. The usual reliance on more infrequent and sometimes unreliable statistics of stocks of physical capital not of good quality as a measure of capital intensity may be avoided by using this alternative notion of factor intensity. It is worthy of mention that Lary has tested the validity of this approach by breaking down the value added per employee into its wage component and the rest and significant correlations have been found across industries between the first component and measures of skill and between the second and stocks of physical capital. Value added per employee being a flow concept rather than a stock figure, it fits better with the notion of factor inputs into production. Apart from this, the problems associated with the conventional measurement of physical capital are due to the fact that the available data on capital assets include equipments and buildings acquired at various times in the past and evaluated at different price levels, varying depreciation practices and changing tax laws.

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