Chapter VI

FACTOR STRUCTURE OF INDIA'S FOREIGN TRADE

In this chapter we propose to retest the celebrated Heckscher-Ohlin theory using the 1963 trade figures, capital, labour and intermediate input data. The previous tests by Bharadwaj[1] and Prasad[2] have established that the theory survives comfortably when capital, labour and natural resources were taken into account. But no attempt was made to study the skill requirements and Research and Development (R and D) activities in Exports versus Competitive Import Replacements. An attempt is made in this chapter to study their role along with other factor requirements.

Methodology:

The conventional input-output system is written as

$$X = (I - A)^{-1}y \quad .. \quad .. \quad .. \quad .. \quad (1)$$

Where X is a column vector of output, $(I - A)^{-1}$ is the inverted matrix, and Y is a column vector of final demand.

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[1] Bharadwaj, Ranganath. Op.Cit.

[2] Prasad, K.N.: "Structure of India's Trade: Further explorations on the theme with natural resources as an additional factor." Artha Vijnana. Vol. 9, 1967.

By multiplying equation (1) by the row vectors of capital and labour coefficients, the following equations are obtained:

$$CX = C(I - A)^{-1} Y$$
$$LX = L(I - A)^{-1} Y \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where C and L are row vectors of direct capital and labour coefficients respectively.

$C(I - A)^{-1} = (C_1, C_2 \ldots\ldots C_n)$ may be interpreted as the amounts of capital directly and indirectly required to produce one unit of final output. Similarly $L(I - A)^{-1} = (L_1, L_2 \ldots . L_n)$ is the direct and indirect labour required per unit of final output.

Then the direct and indirect requirements of capital and labour for a erore rupees worth of exports and competitive import replacements are derived as follows:

$$[C_1, C_2 \ldots . C_n] \begin{bmatrix} E_1 \\ E_2 \\ \vdots \\ E_n \end{bmatrix} = CE \qquad [C_1, C_2 \ldots . C_n] \begin{bmatrix} M_1 \\ M_2 \\ \vdots \\ M_n \end{bmatrix} = CM$$

$$[L_1, L_2 \ldots . L_n] \begin{bmatrix} E_1 \\ E_2 \\ \vdots \\ E_n \end{bmatrix} = LE \qquad [L_1, L_2 \ldots . L_n] \begin{bmatrix} M_1 \\ M_2 \\ \vdots \\ M_n \end{bmatrix} = LM$$

Where E represents a column vector of exports and M represents a column vector of competitive import replacements, each proportionately reduced to a crore rupees.

Statistical Sources:

The trade data for 1963-64 were collected from the Monthly Statistics of Foreign Trade of India. The two vectors of exports and competitive import replacements[3] of a crore rupees worth each were derived by dividing the sectorwise exports/imports by total exports/imports and then multiplying them by one crore.

The capital coefficients of all the sixty five sectors except agriculture sector are those directly taken from the calculations made by the input-output division, Gokhale Institute of Politics and Economics. The capital coefficient of agriculture could not be computed directly for the year 1963-64 due to lack of data regarding the capital stock in agriculture. However, information on reproducible tangible wealth in Indian agriculture was available for the year 1960-61 from a study made by the Reserve Bank of India on Estimates of Tangible Wealth in India (1960-61).[4] The gross output figures of this sector for the corresponding year was

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[3]Reexports are not deducted from gross imports.

[4]See Reserve Bank of India Bulletin, January 1963.

1960-61 to 1964-65.

The land factor could not be computed directly because of the statistical difficulties. A proxy to this is arrived by computing the value of natural resource requirements[7] of one crore rupees worth of exports and competitive import replacements.[7]

For getting the skill-wise composition of the labour, the two sources of reference were occupational pattern of manufacturing industries[8] and Fact Book on Manpower Research.[9] The first publication gives occupational pattern in manufacturing industries according to nine broad occupational classifications (each one with further two digit classification):

0. Professional, Technical and Related workers.
1. Administrative, Executive and Managerial workers.
2. Clerical and Related workers.
3. Sales workers.
4. Farmers, Fishermen, Hunters, Loggers and related workers.

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[7]The details of this calculation are given in Chapter V. However it must be stated that non-correspondence of import prices with the price structure of the flow matrix (which is at purchaser prices) would result to some extent on under estimate of natural resource, capital and labour requirements of competitive import replacements.

[8]Planning Commission, Government of India: Occupational Pattern in Manufacturing Industries, 1956.

[9]Institute of Applied Manpower Research: Fact Book on Manpower Research, Part I. 1969.

abridged[10] into the following five classifications:

1. Professional, Technical and Related Workers.

6. Workers in Transport and Communication.

7-8. Craftsmen and Production Process workers and Labourers not elsewhere classified.

9. Service, sport and recreation workers.

The Fact Book on Manpower Research gives information regarding employment in certain public sector undertakings and agriculture (including animal husbandry and mining) according to the following ten occupational categories:

0. Professional, Technical and Related workers.

1. Administrative, Executive and Managerial workers.

2. Clerical and Related workers.

3. Sales workers.

4. Farmers, Fishermen, Hunters, Loggers and Related workers.

5. Mining, Quarymen, and Related workers.

6. Workers in Transport and Communication.

7-8. Craftsmen and Production Process workers.

9. Service, Sport and Recreation workers.

290. Unskilled office workers.

414,415, 8990,899, 903,and 931. Other Unskilled workers.

For convenience, these occupational classifications were

skill composition of some closely similar industry was applied. When the same sector carried two or more representative industries, a weighted skill ratio on the basis of employment was used.

For evaluating the Research and Development factor, we have used the ratio of engineers and natural scientists (skill category I) engaged in import competing versus export production.[11]

Findings:

The final results of our computation are presented in Table 17. The results show that one crore rupees worth of exports require Rs.173 lakhs of capital and 7892 labourers while import replacements need Rs.200 lakhs of capital and 5566 labourers. In other words, if one crore rupees worth of imports are produced domestically, they require 16 per cent additional capital as compared to that of exports, whereas labour required is 40 per cent less than that of exports. The

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[11] The Engineer-Scientists variable is used here both as a skill measure and a proxy for Research and Development activities that result in new and improved products. A better indicator of Research and Development activities is the expenditure undertaken by each industry on this account. In fact, Keesing, Gruber, Vernon and Mehta employed both these measures: the ratio of engineers and natural scientists and the ratio of Research and Development cost involved in import competing versus export production. (See Donald B. Keesing. Op.Cit., pp. 175-190. Gruber, Vernon and Mehta. Op.Cit., pp.20-37.) We could not employ the second measure because of lack of data regarding expenditure undertaken by each industry on Research and Development.

relative capital/labour ratio of imports to exports[12] works out to be 1.64. This means that the substitution rate of exports to import replacements in terms of their comparative capital requirements is larger than the corresponding substitution rate based on comparative labour requirements. Under the assumption of similar production functions everywhere, the above results prove the Heckscher-Ohlin hypothesis that India pays in terms of her abundant factor labour, in order to save her scarce factor, capital.

The hypothesis that our exports production involves less skill requirements compared to import replacements also receives support from Table 17. The occupations that stand out relatively significant in import replacements are professional, technical and related workers, administrative executive and managerial persons and the clerical and sales workers. The import-export ratio in the case of these three skill categories is more than one. On the other hand the occupational classes - craftsmen, production process workers and other skilled workers - (Category IV) and unskilled workers (Category V) appear relatively significant in exports.

The Research and Development activities also stand out as more important in import replacements than in exports. The ratio of the number of engineers and scientists engaged in

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[12]Professor Leontief calls this as the index of comparative capital-labour intensity. (See Leontief. Second Report. Op.Cit., p.392.)

import replacements versus exports is 2.45.

Taking the natural resources as an additional factor, it is observed that the resource content of one crore rupees worth of exports is almost double that of imports. While ordering the export/import ratios of natural resources (R), capital (C) and labour (L) requirements from the highest to the lowest, they compare as follows:

$$R : L : C = 2.03 : 1.42 : 0.86$$

However, no complimentarity between capital and natural resources can be established in the Indian trade structure just as suggested by Vanek in the American trade structure.[13] For if R and C are complimentary, then the relative requirements of C for India's exports should be larger than her import replacements (because of high R content in exports) which is not the case in our study. This is further established by plotting the natural resource requirements and the corresponding capital requirements on a scatter diagram shown in Graph 5. Along the horizontal axis we measure the natural resource product requirements per rupee of final demand and along the vertical axis, the capital requirements (Direct and Indirect) per rupee of final demand.[14] The

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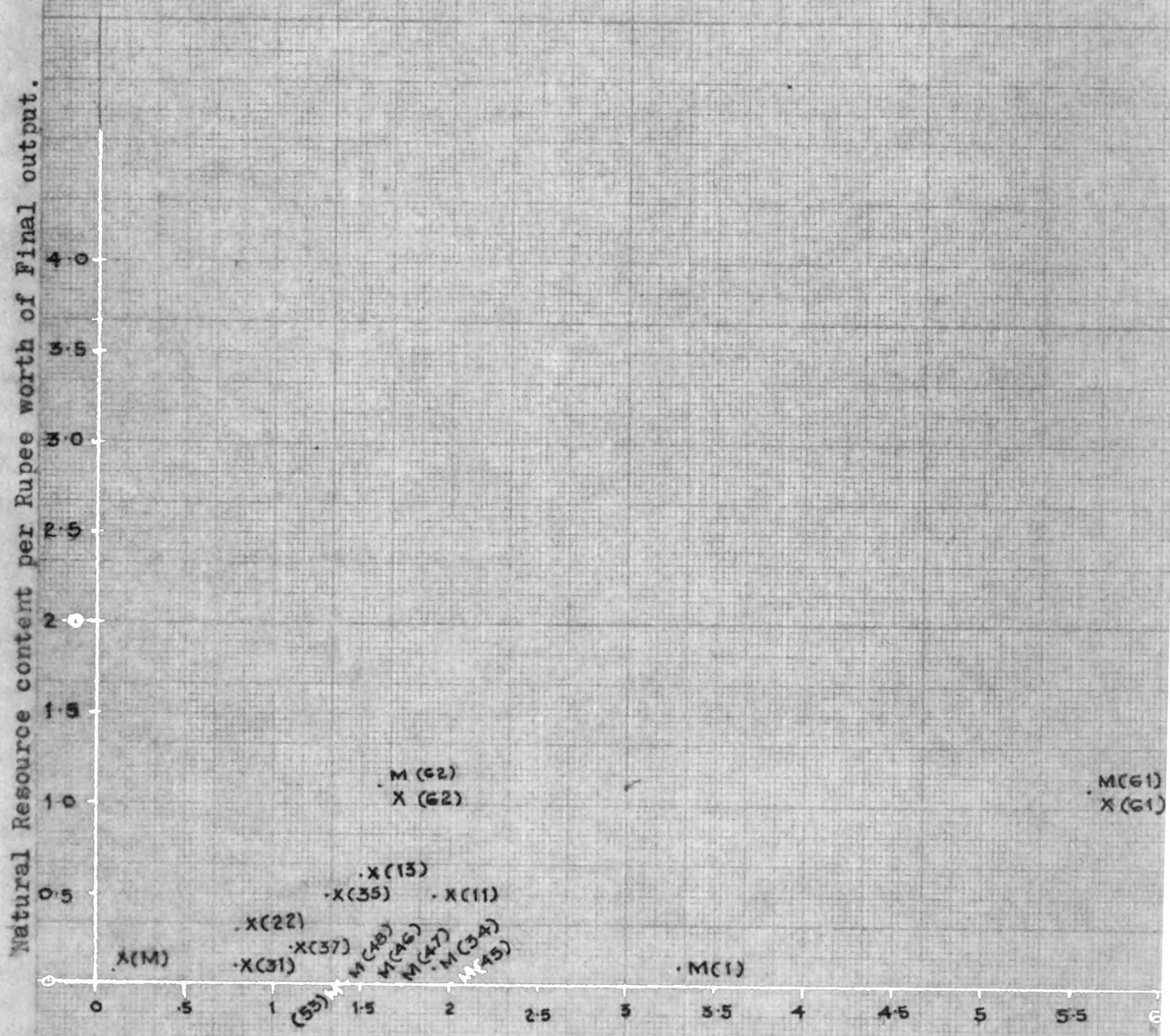
[13] See Jaroslav Vanek. Op.Cit., Vanek uses a complimentarity relationship between capital and natural resources in order to resolve the Leontief Paradox. pp.133-135.

[14] For data see Appendix V - 1 and VI - 1.



Graph 5 : Direct and Indirect Capital and Resource Product Requirements of selected Products Entering India's Foreign Trade (1963).

points (X) and (M) plotted in the graph refer to the Natural Resource-Capital relationship of certain sectors selected according to their relative importance in India's Exports and Imports respectively. It is noticed from the graph that the variations in capital in many of these sectors are independent of the variations in natural resources.

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APPENDIX VI - 2

Natural Resource Requirements (Direct & Indirect) Per Crore Rupees Worth of India's Foreign Trade (1963-64)

Sector Name	Exports	Competetive Import Replacement
1. Fertiliser	72.66861000	24780.70300000
2. Iron and Steel, Basic	7564.62120000	86.57314700
3. Internal combustion, Engine	205,86598000	2056.53090000
4. Machine Tools	11.78006100	5188.46250000
5. Meat and other foods	884.04875000	4.34713300
6. Dairy products	62.67293100	29869.91800000
7. Preservation of fruits and vegetables	2311.79980000	34.28516700
8. Preservation of fishes and sea foods	3711.93840000	20.69085000
9. Grain Mill products	2781.95030000	168671.91000000
10. Bakery products	150.21450000	0.00000000
11. Sugar	165464.98000000	0.00000000
12. Confectionary	221.70866000	227.97161000
13. Miscelleneous food products	436721.18000000	2013.22390000
14. Distilling and spirits	0.00000000	470.96827000
15. Wine industries	0.00000000	34.26117700
16. Breweries and malt	0.00000000	20.62552800
17. Soft drinks	24.77039700	0.00000000
18. Tobacco manufactures	3323.71000000	22.94851500
19. Textiles	282033.23000000	413.64568000

APPENDIX VI - 3a

Requirements of Labour, Occupationwise, Per Crore Rupees Worth of Exports (1963-64)

Sector	Professional Technical & Related workers	Administrative Executive and Managerial workers	Clerical and sales workers	Workers in Transport & Communication Craftsmen, Production Process workers and service, sport & Recreation workers	Farmers, Fishermen, Hunters and Related workers and Labourers N.E.C.
1	0.00003029	0.00000331	0.00019602	0.00973165	0.01884503
2	0.63780541	0.02941586	1.29472130	7.77608850	7.58356330
3	0.10057183	0.00000030	0.10058877	0.20202181	0.10155565
4	0.00640098	0.00000058	0.00648022	0.02667330	0.00718238
5	0.04991551	0.01657561	0.11999614	0.95114991	2.00482600
6	0.00000245	0.00000056	0.00000587	0.00010611	0.00176808
7	0.00003118	0.00001032	0.00007493	0.18991841	0.28571329
8	0.00000000	0.00000000	0.00000000	0.00000807	0.26913229
9	0.00008501	0.00002108	0.00020990	0.00752359	0.08700667
10	0.00000000	0.00000000	0.00000000	0.00810072	0.01620291
11	0.00539578	0.00145700	0.49108166	5.90206160	19.39718000
12	0.00000000	0.00000000	0.00000000	0.01771751	0.05458219
13	0.16073641	0.03055797	0.41018388	14.36151300	40.10722000
14	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

APPENDIX VI - 4

Matrix Sectors and the Corresponding Representative Industries whose occupational pattern is used

Sector Name	Representative Industry	Source of Reference
1. Fertilisers	Manufacture of Fertilisers (Public Sector)	Fact Book on Manpower Research
2. Iron and Steel, Basic.	Iron and Steel, Primary.	Occupational pattern in manufacturing industries.
3. Internal combustion, Engines.	Manufacturing and assembling of machinery, other than electrical.	Fact Book on Manpower Research.
4. Machine Tools	Machine Tools	Fact Book on Manpower Research.
5. Meat and other Foods. 6. Dairy products. 8. Preservation of Seafishes and Seafoods.	Since no occupational pattern for these sectors were available, a combined average of Sectors 7,9,10,11,12, and 13 - which are all food industries - was used.	
7. Preservation of Fruits and vegetables.	Fruits and vegetable processing.	Occupational pattern.
9. Grain Mill products.	Wheat flour. Rice milling.	Occupational pattern.
10. Bakery products.	Biscuit making.	Occupational pattern.
11. Sugar	Sugar	Occupational pattern.
12. Confectionary	Sugar	Occupational pattern.
13. Miscellaneous foods.	Starch Tea manufacturing Ground nut decortising.	Occupational pattern.

Appendix VI - 4 (contd.)

Sector Name	Representative Industry	Source of Reference
14. Distilling and Spirits. 15. Wine industries. 16. Breweries and manufacturing of Malt. 17. Soft drink.	Distilleries and Breweries	Occupational pattern in manufacturing industries.
18. Tobacco manufactures.	Tobacco products	Occupational pattern.
19. Textiles.	Cotton textiles. Wollen textiles. Jute textiles. Webbing and narrow fabrics. Thread and thread ball making. Textiles, dying and bleaching. Silk and artificial silk.	Occupational pattern.
20. Knitting mills.	Hosiery and other knitted goods.	Occupational pattern.
21. Cordage and Rope.	Rope making.	Occupational pattern.
22. Textiles N.E.C.	Cotton pressing Ginning Jute pressing.	Occupational pattern.
23. Footwear	Footwear and leather manufacturing.	Occupational pattern.
24. Weaving Apparel.	Clothing & Tailoring	Occupational pattern.

Appendix VI - 4 (contd.)

Sector Name	Representative Industry	Source of Reference
25. Saw Milling 26. Wooden and Cane containers.	Plywood and Tea chests Saw milling.	Occupational pattern.
27. Cork and wood products. 28. Furniture.	Woodware including furniture.	Occupational pattern.
29. Paper	Paper and Paper products.	Occupational pattern
30. Printing	Printing and Book binding.	Occupational pattern.
31. Tanneries	Tanning.	Occupational pattern.
32. Leather products.	Footwear and leather manufacturing.	Occupational pattern.
33. Rubber products	Rubber and Rubber products.	Occupational pattern.
34. Chemicals	Soap Matches Lac Chemicals including drugs. Turpentine.	Occupational pattern.
35. Vegetable oils	Vegetable oils	Occupational pattern.
36. Paints	Paints and varnishes.	Occupational pattern.
37. Pharmaceuticals	Turpentine Soap Matches Lac Chemicals including drugs.	Occupational pattern.

Sector Name	Representative Industry	Source of Reference
38. Petroleum Refineries.	Petroleum Refining	Occupational pattern.
39. Products of petroleum.	Petroleum Refining	Occupational pattern.
40. Structural clay products	Bricks Tiles Lime and Surki.	Occupational pattern.
41. Glass	Glass	Occupational pattern.
42. Pottery and Chinaware.	Enamelware	Occupational pattern.
43. Cement	Cement	Occupational pattern.
44. Non-metallic Mineral products.	Ceramics Hum pipes and other cement and concrete works. Asbestos and Asbestos cement products.	Occupational pattern
45. Iron and Steel, structural.	Iron and steel, primary.	Occupational pattern.
46. Non-ferrous metal products	Aluminium. Copper Brass:Primary.	Occupational pattern.
47. Metal products	Aluminium, Copper Brass: Secondary. Iron & steel:Secondary.	Occupational pattern.
48. Non-electrical machinery.	Manufacturing and assembling of machinery other than electrical.	Fact Book on Man-power Research.

Appendix VI - 4 (contd.)

Sector Name	Representative Industry	Source of Reference
49. Electrical machinery	Manufacture of heavy electricals machinery and equipment (Public sector)	Fact Book on Manpower Research.
50. Shipbuilding	Shipbuilding	Occupational pattern.
51. Railway Rolling stock.	Railway wagon manufacturing.	Occupational pattern.
52. Automobiles	Automobiles and Coach building.	Occupational pattern.
53. Automobiles N.E.C.	Bicycles Air craft assembling	Occupational pattern.
54. Scientific instruments. 55. Photographic instruments.	General engineering	Occupational pattern.
56. Watches and Clock.	Machine tools.	Fact Book on Manpower Research.
57. Jwellery 58. Musical instruments. 59. Manufacturing N.E.S.	Plastics (including Gramophone Records) Unspecified industries.	Occupational pattern.
60. Electricity generation.	Electric generation.	Occupational pattern.

Appendix VI - 4 (contd.)

Sector Name	Representative Industry	Source of Reference
61. Mining	Mining of coal Mining of crude petroleum.	Fact Book of Manpower Research
62. Agriculture*	Agriculture. Forestry, Fishing, Hunting, Planatations, orehards and Allied activities.	Fact Book of Manpower Research
63. Railways	Railways	Fact Book on Manpower Research
64. Road transport	Tramways and Bus services.	Fact Book on Manpower Research.
65. Construction	Construction	Fact Book on Manpower Research.

*Since the information regarding occupational pattern in Agriculture was not given seperately but along with mining, the skillwise labour composition of this sector was derived after deducting that part of labour employed in the Mining sector.