Mohammad, Sharif

Working Paper

An Empirical Verification of Keesings' Hypothesis-Skill Intensity of Exports and Import Replacement in India

Center Discussion Paper, No. 329

Provided in Cooperation with:
Yale University, Economic Growth Center (EGC)

Suggested Citation: Mohammad, Sharif (1979) : An Empirical Verification of Keesings' Hypothesis-Skill Intensity of Exports and Import Replacement in India, Center Discussion Paper, No. 329, Yale University, Economic Growth Center, New Haven, CT

This Version is available at:
https://hdl.handle.net/10419/160256

ECONOMIC GROWTH CENTER

YALE UNIVERSITY

Box 1987, Yale Station
New Haven, Connecticut

CENTER DISCUSSION PAPER NO. 329

AN EMPIRICAL VERIFICATION OF KEESING'S HYPOTHESIS - SKILL INTENSITY OF EXPORTS AND IMPORT REPLACEMENT IN INDIA

Sharif Mohammad

November 1979

Portions of this research were financed by the Ford Foundation.

An Empirical Verification of Keesing's Hypothesis - Skill Intensity of Exports and Import Replacement in India

Sharif Mohammad*

(Abstract)..

Keesing has shown that since U.S.A. has an abundant supply of skilled manpower it is not surprising that the exports originating from this country are highly skill-intensive and that imports much less skill-intensive. Does this explanation have a general validity? Does it follow from this that a country such as India, with an abundant supply of unskilled labour, would find it advantageous to export goods whose production is not highly skill-intensive and import skill-intensive commodities? In the framework of an open static input-output model we have attempted to answer these questions with reference to Indian economy.

* Institute of Economic Growth, Delhi. Presently, Visiting Fellow, Economic Growth Center, Yale University.

An Empirical Verification of Keesing's Hypothesis - Skill Intensity of Exports and Import Replacements in India*

Sharif Mohammad

That the Leontief paradox is not really a paradox is clearly demonstrated by Keesing (1966). In some recent papers he has shown that since U.S.A. has an abundant supply of skilled manpower it is not surprising that the exports originating from this country are highly skill-intensive and that imports much less skill-intensive. Does this explanation have a general validity? Does it follow from this that a country such as India, with an abundant supply of unskilled labour, would find it advantageous to export goods whose production is not highly skill-intensive and to import skill-intensive commodities? These are the questions which we have attempted to answer in the present exercise.

The Methodology

Following Keesing (1965), an input-output model has been employed to determine the skill-intensity of exports from and imports into the country. Before describing the details of the model, a word about the determination of skill-intensity of imports is necessary. Given the difficulties of compiling data on skill-intensities of imports from several countries Keesing treats the skill-intensities of import competing industries as a close approximation to these. This assumption

---

* I am grateful to Prof. Ajit K. Dasgupta, and Dr. R. Gaiha for their useful comments on an earlier draft of this paper.

is based on the observation that skill-intensities of manufacturing industries do not vary significantly between different countries.

The model which we have used is an open static input-output model. In this model, imports are determined partly endogenously and partly exogenously. Exports are exogenously determined. The composition of exports is decided on the basis of the past trends. The steps used in deriving the skill-intensity of export and import-competing industries are shown below using matrix notations. Taking the domestic input coefficient matrix and exports, direct and indirect output required for exports is estimated which has been converted into employment and then skill requirements.

$$X = (I - A + M)^{-1}. (E) \qquad ....(1)$$

$$L = (L/O). (X) \qquad ....(2)$$

$$S = (L). (SR) \qquad ....(3)$$

where,

A = Total input-output coefficient matrix of size (62x62)

I = Identity matrix (62x62)

M = Import coefficient matrix (62x62)

E = Diagonal matrix of exports (62x62)

L/O = Diagonal matrix of labour-output ratios (62x62)

SR = Skill-coefficient matrix (62x9)

L = Total sectoral labour requirements - estimates (62x1)

S = Skill composition of the labour requirements (62x9).

The Data

The input-output table used in the Fifth Plan divides the economy into 66 sectors. Since it was not easy to compute the labour-output ratios for the five agricultural sectors separately we have combined these sectors into a single agricultural sector. In all other respects the classification given in the Technical Note was used.

The sectoral labour-output ratios are taken from an earlier study, [Gaiha & Mohammad (1975)]. Since these estimates were obtained from different sources a complete uniformity in the definition of employment could not be attained. Also except for the sectors for which data was taken from the Census Reports, the coverage of the unorganised components of most other sectors is quite patchy.

The definition of skill used here is somewhat arbitrary.[1] We have worked with two alternative definitions: one includes occupational categories (0) and (1), and the second (0), (1), (2) and (3).[2]

The arbitrariness of this measure lies in the identification of skill in terms of educational attainment. This neglects the skills acquired on the job. While accepting this deficiency in our measurement of skill we would like to mention that in most cases a highly skilled person would be one with a high level of educational attainment.

---

1. These two alternative definitions of skill-intensity have been used by Delehanty (1968).

2. For occupational titles, see Appendix A.

The construction of skill ratios for the 62-sector classification could not be done with the published data (D.G.E. & T). Since the reports published by the D.G.E. & T. present occupational data for a few selected industries, we had to make use of unpublished data supplied by this organisation. As unpublished data for a more recent year was not accessible, we relied on data for the year 1965-66.

The Results

Our results are presented in Table 1 through 4. It can be seen from the tables that the skill-intensity in the import-competing industries is considerably higher than the skill-intensity of exporting industries. For example, the skill-intensity in Iron-ore, Other Minerals, Sugar and gur, Textiles, Other Electricals, Rail equipment, etc., is low, ranging between .02 to .06. On the other hand, in the import-competing sectors, Crude Oil, Paper and Paper products, Chemicals, Metal Products, etc. the skill coefficients are quite high, ranging between .05 to .27. The mean skill intensity in export industries is .035 and in the import competing industries .105. Since the mean is influenced by extreme values in the sample the coefficient of variation of skill intensities in two groups of industries are also computed. The coefficients turn out to be 54.63 and 67.25 for the export and import competing industries, respectively.

Another way of approaching this problem is to look at the wage rate differentials between the two groups of activities.[3] We find that there is a strong positive correlation between skill-intensity and wage rate in a sample of 28 manufacturing industries. This leads to the inference that the average wage rate would be higher in import competing industries than in the export industries. This is in fact the case. However, there is no inverse relationship between exports and wages. Mean wages in the export and import competing industries are Rs. 1965 and Rs.2624 per annum respectively, and the coefficients of variation turn out to be 33.01 and 22.09 for the two groups, respectively. The Keesing hypothesis, therefore, survives comfortably in the Indian context.

A question which is being given considerable importance in the literature on employment planning concerns the effectiveness of employment as a redistributive measure. Since (a) import replacing industries are found to be more skill intensive than export industries, (b) there is a positive association between wages and skill intensity, and (c) the most highly skilled workers are drawn from relatively affluent families, a given increase of employment in export industries might benefit the weaker sections much more than the same increase in employment in import competing industries. Also, since a given increase in output in export industries would generate more employment than import competing industries the case for promotion of the former with a view to alleviating income inequalities is further reinforced.

---

3. Keesing (1966).

Conclusions

(1) Our analysis has shown that the availability of skills does influence the trade pattern. More specifically, other things being equal, the trade between two countries would reflect the relative abundance of skills. If a country possesses more of a certain type of skilled manpower it would be advantageous for the country to export commodities whose production requires this skill. The significance of this result lies in a generalisation of Keesing's finding that the exports from the U.S.A. are more skill-intensive than its imports. It focusses attention on an input into production which has not been emphasised sufficiently in the literature.

(2) Another inference which is suggested by our analysis is that the strategy of export promotion is likely to have a larger income-equalising effect than import substitution. If it could also be shown that the cost of achieving a unit increase in exports is lower than or equal to the unit cost of import substitution, a strong case for export promotion can be built up.

Table 1: Sector-wise Skill Ratios

Sector (No. and title)		Skill Ratio (Definition 1)	Skill Ratio (Definition 2)
1-5	Agriculture	.0391	.1028
6	Coal	.060	.0908
7	Misc. Coal and Petroleum Products	.0359	.0908
8	Iron Ore	.0359	.0907
9	Crude Oil	.0359	.0906
10	Other Minerals	.0359	.0907
11	Sugar and Gur	.0847	.3127
12	Vegetable Oil	.0678	.2772
13	Tea and Coffee	.0105	.0792
14	Other Food Products	.0214	.0967
15	Cotton Textiles	.0217	.0836
16	Jute Textiles	.0226	.0735
17	Other Textiles	.0398	.1202
18	Misc. Textile Products	.0320	.1250
19	Wood Products	.0332	.1167
20	Paper and Paper Products	.0604	.2323
21	Leather Products	.0361	.1169
22	Rubber Products	.0985	.2574
23	Fertilizers	.2476	.4886
24	Inorganic Heavy Chemicals	.1085	.3260
25	Organic Heavy Chemicals	.2727	.5555

Contd...

Table 1 Contd...

Sector (No. and title)		Skill Ratio (Definition 1)	Skill Ratio (Definition 2)
26	Plastics	.0807	.2369
27	Cosmetcs and Drugs	.1384	.5928
28	Manmade Fibres	.0693	.1974
29	Other Chemicals	.0693	.1965
30	Petroleum Products	.1129	.3642
31	Cement	.0776	.2397
32	Refractory	.0237	.0814
33	Other Non-met. Min. Products	.0315	.1109
34	Iron and Steel	.0747	.2071
35	Non Ferrous Metals	.0496	.1471
36	Bolts and Nuts	.0560	.1696
37	Metal Containers	.0405	.1617
38	Other Metal Products	.0515	.2682
39	Ball-Bearings	.1020	.2857
40	Office & Domestic Equipment	.0913	.2670
41	Agricultural Implements	.0912	.2670
42	Machine Tools	.1136	.2564
43	Other Machinery	.0911	.2673
44	Electric Motors	.1381	.3933
45	Electric Wires	.0915	.2863
46	Electronics	.1250	.3846
47	Batteries	.0606	1.6923
48	Electric Household Goods	.1250	.2857
49	Radio	.1304	.3926
50	Telephone, Telegr. Equipment	.1666	.4000

Contd...

Table 1 Contd...

Sector (No. and Title)		Skill Ratio (Definition 1)	Skill Ratio (Definition 2)
51	Other Electricals	.1385	.3921
52	Motor Cycles	.0500	.1859
53	Motor Vehicles	.1230	.2939
54	Ships and Boats	.0425	.1951
55	Aircrafts	.1228	.4222
56	Rail Equipment	.0266	.2129
57	Other Transport Equipment	.0569	.3972
58	Watches and Clocks	.0288	.1322
59	Misc. Sc. Instruments	.0788	.2907
60	Other Industries	.0512	.1998
61	Printing	.0781	.3343
62	Electricity	.1082	.5030
63	Construction	.1440	.4336
64	Railways	.0344	.2043
65	Other Transport	.0319	.2122
66	Other Services	.7443	2.2535

Note: Skill Ratio = Number of Skilled Workers divided by the number of unskilled workers.

Table 2: Skill Intensity Per Crore Rupees of Exports - 1973-74

Sector	Exports (Rs. Million)	Total Labour Required	Definition 1		Definition 2	
			No. of Skilled Workers	No. of Unskilled Workers	No. of Skilled Workers	No. of Unskilled Workers
1	2	3	4	5	6	7
1-5	1.175	1580.00	60.00	1520.00	147.00	1432.00
6	.024	7.37	0.26	7.11	0.61	6.75
7	.011	14.91	0.52	14.39	1.24	13.67
8	.119	15.60	0.54	15.05	1.30	14.30
9	.0	1.95	0.06	1.89	0.16	1.79
10	.120	47.91	1.66	46.25	3.99	43.92
11	.161	2.30	0.18	2.12	0.55	1.75
12	.400	2.62	0.17	2.45	0.57	2.05
13	.883	78.40	0.82	77.58	5.76	72.64
14	.217	7.47	0.16	7.31	0.66	6.81
15	.970	41.96	0.89	41.07	3.24	38.72
16	1.072	55.31	1.22	54.09	3.79	51.52
17	.153	3.27	0.13	3.14	0.35	2.92
18	.327	10.71	0.33	10.38	1.19	9.52
19	.064	6.08	0.20	5.88	0.64	5.44
20	.047	3.46	0.20	3.26	0.65	2.81
21	.554	9.67	0.34	9.33	1.01	8.66
22	.048	3.79	0.34	3.45	0.78	3.01
23	.0	0.06	0.01	0.05	0.02	0.04
24	.0	1.85	0.17	1.68	0.45	1.40
25	.0	0.02	0.0	0.02	0.01	0.01

Contd...

Table 2 Contd...

1	2	3	4	5	6	7
26	.039	1.07	0.08	0.99	0.20	0.87
27	.0	0.20	0.02	0.18	0.08	0.12
28	.0	0.50	0.03	0.47	0.08	0.42
29	.3¼	20.32	1.32	19.00	3.3¼	16.98
30	.136	1.09	0.11	0.98	0.29	0.80
31	.027	0.57	0.04	0.53	0.11	0.46
32	.0	1.88	0.04	1.84	0.14	1.74
33	.033	8.18	0.25	7.93	0.82	7.36
34	.252	19.73	1.37	18.36	2.29	16.34
35	.0	9.33	0.44	8.89	1.19	8.14
36	.0	0.51	0.02	0.49	0.07	0.44
37	.0	0.47	0.01	0.46	0.06	0.41
38	.314	9.90	0.49	9.41	2.09	7.81
39	.0	0.02	0.0	0.02	0.0	0.02
40	.011	0.58	0.05	0.53	0.12	0.46
41	.0	0.0	0.0	0.0	0.0	0.0
42	.0	0.02	0.0	0.02	0.0	0.02
43	.326	18.39	1.54	16.85	3.88	14.51
44	.0	0.19	0.02	0.17	0.05	0.14
45	.0	0.16	0.01	0.15	0.03	0.13
46	.0	0.02	0.0	0.02	0.0	0.02
47	.0	0.04	0.0	0.03	0.02	0.02
48	.0	0.01	0.0	0.01	0.0	0.01
49	.0	0.03	0.0	0.03	0.01	0.02
50	.0	0.0	0.0	0.0	0.0	0.0

Contd...

Table 2 Contd...

1	2	3	4	5	6	7
51	.147	5.12	0.62	4.50	1.44	3.68
52	.020	0.75	0.04	0.71	0.12	0.63
53	.053	5.64	0.62	5.02	1.28	4.36
54	.0001	0.05	0.0	0.05	0.01	0.04
55	.0	0.03	0.0	0.03	0.01	0.02
56	.182	18.56	0.48	18.08	3.26	15.30
57	.0	0.10	0.0	0.10	0.03	0.07
58	.005	0.24	0.01	0.23	0.03	0.21
59	.032	1.76	0.13	1.63	0.40	1.36
60	.486	13.78	0.67	13.11	2.30	11.48
61	.009	2.66	0.20	2.46	0.66	2.00
62	.0	13.27	1.29	11.98	4.44	8.83
63	.0	16.49	2.07	14.42	4.99	11.50
64	.0	12.22	0.39	11.83	2.07	10.15
65	.643	293.98	9.09	284.89	51.48	242.50
66	.593	433.57	185.01	248.56	300.31	133.26
Total	9.980	2805.84	274.03	2531.82	562.93	2242.91

Table 3: Skill Intensity Per Crore Rupees of Import-Replacement, 1973-74

Sector	Imports (Rs. Million)	Total Labour Required	Definition 1		Definition 2	
			Skilled Workers	Unskilled Workers	Skilled Workers	Unskilled Workers
1	2	3	4	5	6	7
1-5	.611	477.32	18.00	459.32	44.50	432.82
6	.0	7.97	0.27	7.70	0.66	7.31
7	.002	30.27	1.05	29.22	2.52	27.75
8	.0	2.76	0.09	2.67	0.23	2.53
9	.663	27.86	0.97	26.89	2.32	25.54
10	.067	62.72	2.18	60.54	5.22	57.50
11	.0	0.03	0.0	0.03	0.0	0.03
12	.133	0.96	0.06	0.09	0.21	0.75
13	.0	0.0	0.0	0.0	0.0	0.0
14	.109	4.57	0.10	4.47	0.40	4.17
15	.017	0.86	0.02	0.84	0.07	0.79
16	.006	2.44	0.05	2.39	0.17	2.27
17	.007	0.15	0.01	0.14	0.02	0.13
18	.002	0.42	0.01	0.41	0.05	0.37
19	.0	1.04	0.03	1.01	0.10	0.95
20	.307	13.74	0.78	12.96	2.59	11.15
21	.0	0.0	0.0	0.0	0.0	0.0
22	.004	1.19	0.11	1.08	0.24	0.95
23	.740	9.73	1.98	7.75	3.27	6.46
24	.277	12.12	1.15	10.97	2.98	9.14
25	.256	0.32	0.07	0.25	0.11	0.21

Contd...

Table 3 Contd...

1	2	3	4	5	6	7
26	.050	0.71	0.05	0.66	0.14	0.57
27	.130	3.06	0.37	2.69	1.14	1.92
28	.024	0.26	0.02	0.24	0.04	0.22
29	.189	10.84	0.70	10.14	1.78	9.06
30	.500	2.93	0.30	2.63	0.78	2.15
31	.0	0.18	0.01	0.17	0.03	0.15
32	.0	3.74	0.08	3.82	0.29	3.45
33	.162	19.69	0.60	19.09	1.97	17.72
34	.544	37.77	2.63	35.14	6.48	29.29
35	.527	56.80	2.69	54.11	7.28	49.52
36	.002	1.52	0.08	1.44	0.22	1.30
37	.001	0.83	0.03	0.80	0.12	0.71
38	.039	1.37	0.07	1.30	0.29	1.08
39	.004	0.16	0.01	0.15	0.04	0.12
40	.010	0.52	0.04	0.48	0.11	0.41
41	.046	0.89	0.07	0.82	0.19	0.70
42	.030	11.96	0.18	1.78	0.40	1.56
43	.924	105.33	8.80	96.53	22.21	83.12
44	.007	1.34	0.16	1.18	0.38	0.96
45	.004	0.35	0.03	0.32	0.08	0.27
46	.0	0.04	0.0	0.04	0.01	0.03
47	.001	0.04	0.0	0.04	0.03	0.01
48	.0	0.01	0.0	0.01	0.0	0.01
49	.003	0.15	0.02	0.13	0.04	0.11
50	.008	0.23	0.03	0.20	0.06	0.17

Contd...

Table 3 Contd...

1	2	3	4	5	6	7
51	.134	4.57	0.56	4.01	1.29	3.28
52	.0	0.04	0.0	0.04	0.01	0.03
53	.025	3.60	0.17	3.43	0.62	2.98
54	.004	0.21	0.01	0.20	0.03	0.18
55	.034	1.81	0.22	1.59	0.55	1.26
56	.031	4.10	0.11	3.99	0.72	3.38
57	.0	0.08	0.00	0.08	0.02	0.06
58	.0	0.0	0.0	0.0	0.0	0.0
59	.022	1.22	0.09	1.13	0.27	0.95
60	.007	1.04	0.05	0.99	0.17	0.87
61	.016	2.90	0.21	2.69	0.73	2.17
62	.0	17.69	1.72	15.97	5.92	11.77
63	.0	15.06	1.89	13.17	4.56	10.50
64	.0	21.21	0.68	20.53	3.60	17.61
65	.343	186.61	5.77	180.84	32.68	153.93
66	1.975	663.54	283.15	380.39	459.60	203.94
Total	9.97	1830.93	338.60	1492.64	620.64	1210.29

Table 4: Skill Intensity of Exports in Different Variants of the Fifth Plan

		Variants of the Plan			
		1	3*	4	5
Annual Rate of Growth of Exports (per cent)		7.5	7.0	6.5	8.0
Total Exports (Rs. million)		28339.1	27777.4	27047.9	28877.4
Occupational Categories					
0	Professional, Technical and Related workers	536710	527005	512251	546825
1	Administrative, Executive and Managerial workers	124345	122089	118678	126688
2	Clerical and Related Workers	660809	648844	630696	673263
3	Sales workers	9178	9014	8760	9351
4	Farmers, Fishermen and Related workers	2599967	2551506	2481500	2648973
5	Miners, Querrymen and Related workers	94785	93403	90456	96560
6	Workers in Transport and Communication	331847	325809	316729	338103
7&8	Craftsmen and Production Process workers	1205925	1184498	1150963	1228645
9	Service, Sports and Recreation workers	378181	371333	360947	385309
	TOTAL	5941747	5833502	5670982	6053717

*3D is the preferred variant of the Approach Paper of the Fifth Five Year Plan.

References

Delehanty, G.E., 1968, Non-Production Workers in U.S. Manufacturing Industries (North-Holland, Amsterdum).

Directorate General of Employment and Training, Ministry of Labour, Employment and Rehabilitation, Government of India, Occupational and Educational Pattern in India, Public and Private Sector, New Delhi.

Gaiha, R. and S. Mohammad, 1975, Employment Strategies in the Fifth Five Year Plan: An Evaluation, Demography India, Vol. IV, No. 2.

Keesing, D.B., 1965, Labour Skills and International Trade: Evaluating Many Trade Flows with a Single Measuring Device, Review of Economics and Statistics, August.

Keesing, D.B., 1966, Labour Skills and Comparative Advantage, The American Economic Review, Vol. LVI, No. 2, May.

Planning Commission, 1973, A Technical Note on The Approach to the Fifth Plan of India, 1974-79, Government of India, New Delhi.

APPENDIX A

Occupational Categories (D.G.E.&T. Classification)

Code	Title
0	Professional, Technical and Related workers
1	Administrative, Executive and Managerial workers
2	Clerical and Related workers
3	Sales workers
4	Farmers, Fishermen and Related workers
5	Miners, Quarrymen and Related workers
6	Workers in Transport and Communication occupations
7&8	Craftsmen and Production Process workers
9	Service, Sports and Recreation workers.

- 0 -