

Income, Output and Employment Linkages and Import Intensities of Manufacturing Industries in India

by Atul Sarma and Kewal Ram*

The major thrust of planned development in India has been on employment and income generation and self-reliance. The study evaluates ex-post income, output and employment linkages and import intensities of manufacturing sectors using an input-output model. It shows that among the four broad groups of industries, namely agrobased, non-agrobased final goods, intermediate and capital goods, agrobased industries through technological interdependence, particularly backward linkages, generate relatively more income and employment and use less imported inputs. The non-agrobased final goods industries with larger import requirements provide potential for income and employment generation if their required imported inputs are internalised.

I. INTRODUCTION

Despite massive investment in the industrial sector in India, the value added (net) in this sector recorded a growth rate of only 5.13 per cent per annum during the period 1950-51 to 1983-84. Even in 1981 the organised manufacturing sector (comprising factories which employ more than 10 workers if using power and more than 25 workers not using power) provided employment to some six million people and additional two million people if those employed in mining, electricity, gas and water supply are included. Employment in the manufacturing sector grew at the rate of about three per cent per annum from 1961 to 1981, which is only a little higher than the population growth (2.3 per cent). It can be argued that concentrating resources in the activities having high domestic linkages on the basis of technological interdependence among production activities, it should be possible to stimulate a more rapid growth of output, income and employment.

Keeping this in view, this paper addresses itself to evaluating income, output and employment linkages together with import intensities. More specifically it attempts to examine:

- the relative importance of direct and total (direct plus indirect)

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domestic income, output and employment generated by 83 sectors of the Indian economy, more particularly by 53 manufacturing sectors;

- variations in domestic income, output and employment generations across four broad categories of manufacturing sectors, namely (i) agrobased, (ii) non-agrobased final goods, (iii) non-agrobased intermediates and (iv) capital goods;
- the relative importance of direct and total import intensities and variations thereof across the manufacturing sectors generally and the above four broad categories of the manufacturing sectors particularly;
- the strength of backward and forward output and employment linkages; and
- finally, to indicate key sectors for domestic income, output and employment generation.

The article has been presented in five sections. The following section briefly discusses the methodology of estimating total income, output and employment multipliers and import intensities. It also discusses the methodology of computing backward and forward linkages. Section three analyses the empirical results and section four indicates key sectors for income, output and employment generation. The final section highlights the major results of the study.

II. THE METHODOLOGY

The total effects of an industry on income, output, employment generation and import intensities can be captured in an input-output (I-O) table. Therefore, to capture these effects, the I-O table for 1979-80 as given in the Technical Note for Sixth Five Year Plan [Government of India, 1981] has been used.¹ To further analyse the strength of a sector in terms of backward and forward inducement to output and employment generation, backward and forward output and employment linkages have been computed. The methodology adopted for estimating the total effects and the linkages is presented in this section.

Direct and Indirect Output Generation

If A^d = matrix of domestic technical coefficients (nxn)

X = vector of gross output (nx1)

F = vector of final demand (nx1)

then Leontief inverse can be written as

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

If there is a unitary increase in final demand for sector j (say F_j), the direct and indirect increase in domestic output can be estimated with the help of (1).

Direct and Indirect Income Generation

If V is the row vector $(1 \times n)$ of value added coefficients,² the domestic income generation implications for the i -th sector can be worked out with the help of

$$V(I - A^0)^{-1} = V^* \quad (2)$$

The values of V^* indicate direct and indirect increase in value added with a unitary increase in final demand for sector j .

Backward Linkages

Let $a_{ij}^d = [X_{ij}^d/X_j]$

where x_{ij}^d = flow of domestic inputs from sector i to sector j . $\sum a_{ij}^d$ gives the direct stimulus to the economy by increasing final demand in j -th sector. It is a measure of direct domestic input requirements across each of i -th sector corresponding to a unitary increase in production in j -th sector.

However, $\sum a_{ij}^d$ measures only direct domestic requirements generated with the unitary increase in the final demand in sector j . To estimate direct and indirect requirements of a unit increase in the final demand, the Leontief inverse is used. A normalised procedure is carried out by comparing the average stimulus generated by sector j with overall average. This direct and indirect linkage measure (Y_j), (Rasmussen, 1957), is defined as follows.

$$Y_j = [\sum r_{ij}/N] / [\sum \sum r_{ij}/N^2] \quad \forall i \quad (3)$$

where r_{ij} = coefficients of $(I - A^0)^{-1}$, N = number of sectors. $\sum r_{ij}/N$ measures the average direct and indirect stimulus provided to the economy by a unitary increase in final demand for sector j while $\sum \sum r_{ij}/N^2$ measure the average stimulus to the economy with the unitary increase in final demand of all the sectors.

Forward Linkages

Rasmussen (1957) has also given a measure of forward linkage which can be worked out by using Leontief inverse. According to this measure, the sum of row of Leontief inverse indicates the strength of forward linkage. The greater the sum of the row, the greater will be the strength of forward linkage. However, the sum of row in the Leontief inverse is not an appropriate measure of forward linkage. If a large part of output of input supplying sector is sold to the sector whose own output is relatively small and, similarly, a small part of output of the input supplying sector is sold to the sector whose own output is relatively big, the coefficients will give a totally distorted picture of the strength of forward linkage [Jones, 1976: 328]. Therefore, to overcome this problem, the allocation matrix (also

known as output approach or output inverse approach) is used to work out forward linkage [Augustinovic, 1970: 242-9; Jones; 1975], and, more recently, by Bulmer-Thomas [1982]. The allocation matrix has the following identity.

$$X' = V(1-B^d)^{-1} \quad (4)$$

Let us say $B-\bar{M} = B^d$ is a $n \times n$ matrix which is represented by coefficient b_{ij}^d . $\sum_j b_{ij}^d = (W)$ denotes the strength of sector i as a supplier to other sectors. The greater the value of $\sum_j b_{ij}^d$, the greater will be the strength of sector i in stimulating other sectors. The direct and indirect significance of a sector can be captured by using values of $(1-B^d)^{-1}$ (also known as the output inverse). If r_{ij}^d is an element of the output inverse $(1-B^d)^{-1}$, it will indicate the direct and indirect output brought forward by sector i with a unitary increase in value added in sector i . A normalised direct and indirect stimulus generated through forward linkage can be measured by,

$$Z_i = [\sum_j r_{ij}^d / N] / [\sum_j \sum_j r_{ij}^d / N^2] \quad \forall j \quad (5)$$

Direct and Indirect Employment Generation

The labour coefficient for sector i can be defined¹ as

$$L_i = Q_i / X_i$$

where Q_i = Number of persons employed in sector i .

We have the Leontief open-static system as defined earlier

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

Pre-multiplying the diagonal matrix of labour coefficients (L) with $(I-A^d)^{-1}$, we get

$$E = L(I-A^d)^{-1}F = KF \quad (6)$$

where $E = (n \times 1)$ vector of direct and indirect labour requirement of the final demand vector F .

The elements of $L(I-A^d)^{-1}$, (k_{ij} 's) give an estimate of direct and indirect employment generation with the unitary increase in final demand for each of the sector. Backward linkages of employment with the help of K can be estimated as follows:

$$Y_j = [\sum_i k_{ij} / N] / [\sum_j \sum_j k_{ij} / N^2] \quad \forall i \quad (7)$$

where k_{ij} 's are the element of K .

As discussed earlier, Leontief technology matrix does not give the correct measure of forward linkages. To measure forward employment linkages, we use the identity (4) by pre-multiplying with L in the following way:

$$E' = V L(1-B^0)^{-1} = V K^* \quad (8)$$

The element $(K^*)_i$'s of K^* ($n \times n$) show the generation of direct and indirect employment in sector i with unitary increase in value added in sector i . As in the case of output linkages, the following normalised index is considered appropriate to estimate forward employment linkages

$$Z_i = [\sum_j k_{ij}/N] / [\sum_j \sum_k K_{kj}/N^2] \quad \forall j \quad (9)$$

Import Intensities

Direct and indirect import intensities of sector j can be estimated with the help of following identity:

$$M^* = M(1-A^0)^{-1} \quad (10)$$

where M^* = $n \times n$ matrix of direct and indirect import coefficients (m_{ij}). $\sum_j m_{ij}$ measures the direct and indirect import intensity (or leakages) across sectors by increasing final demand of sector j .

III. EMPIRICAL RESULTS

Relative Importance of Direct and Total Effects: All Sectors

As is well known, direct linkages capture the first layer intersectoral relationships through the purchase of inputs of a production sector from various sectors and sale of its output to different sectors. On the other hand, the total effects are traced through chain reactions in production processes of a sector (j) and they are captured by the summation of elements of the column pertaining to inputs of j -th sector in the Leontief inverse. It should be pointed out that since the present exercise relates to the evaluation of linkages *ex post*, total income, output and employment effects have been estimated using technological coefficients based on the domestic inputs, and import intensities have been separately worked out by using import coefficients.

Table 1 shows direct and total income, output and employment generation per million rupees worth of output as also the difference between the total and the direct effects. The table also shows the direct and total import requirements per million rupees worth of output. Further, all the 83 sectors have been ranked in terms of the magnitude of total effects of each of the above characteristics.

It can be seen from the table that sectors relating to agriculture and mining rank very high in terms of both income and employment generation (direct). For example, eight out of the first ten sectors arranged in descending order of the magnitude of income generation relate to agriculture and mining. In contrast, none of the agriculture and mining related sectors has figured amongst the first ten sectors arranged in descending order of the magnitude of output generation. Nor have they

TABLE I
DIRECT AND TOTAL INCOME, OUTPUT, EMPLOYMENT GENERATION AND
IMPORT INTENSITIES (Per Million Rupees Worth of Output)

I-D Sector No.	Name of the Sector	INCOME			OUTPUT				
		DIR	TOT	DIFF	DIR	TOT	DIFF	DIFF	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	Rice and Products	0.78	0.93	17	0.15	0.18	1.10	70	1.12
2.	Wheat and Products	0.69	0.93	19	0.24	0.27	1.47	68	1.20
3.	Jowar and Products	0.94	0.99	3	0.05	0.06	1.09	80	1.03
4.	Bajra and Products	0.83	0.96	14	0.13	0.14	1.25	73	1.11
5.	Other cereals	0.65	0.91	27	0.20	0.30	1.54	63	1.24
6.	Pulses	0.51	0.88	29	0.37	0.43	1.77	44	1.54
7.	Sugarcane	0.81	0.94	16	0.13	0.14	1.26	71	1.12
8.	Jute (raw)	0.95	0.98	8	0.03	0.04	1.07	82	1.03
9.	Cotton (raw)	0.85	0.96	13	0.11	0.12	1.23	74	1.11
10.	Plantations	0.32	0.78	58	0.46	0.54	1.99	29	1.45
11.	Other crops	0.94	0.99	2	0.05	0.05	1.08	81	1.03
12.	Milk and Milk Products	0.55	0.98	10	0.43	0.45	1.56	59	1.11
13.	Other Animal Husbandry	0.27	0.97	12	0.70	0.73	1.91	34	1.18
14.	Forestry and Logging	0.88	0.98	6	0.10	0.12	1.21	77	1.09
15.	Fishing	0.86	0.98	9	0.12	0.14	1.22	75	1.08
16.	Coal and Lignite	0.74	0.97	11	0.23	0.26	1.41	67	1.15
17.	Petroleum and Natural Gas	0.74	0.92	20	0.18	0.23	1.36	69	1.13
18.	Iron Ore	0.36	0.73	67	0.37	0.54	1.98	37	1.34
19.	Other Minerals	0.65	0.84	40	0.10	0.29	1.47	65	1.18
20.	Misc. Food Products	0.09	0.90	28	0.81	0.89	2.38	5	1.49
21.	Sugar	0.14	0.92	21	0.76	0.86	2.27	10	1.41
22.	Gur and Khandsari	0.13	0.91	26	0.78	0.85	2.33	6	1.48
23.	Vanaspatti	0.14	0.88	30	0.74	0.82	2.23	12	1.41
24.	Edible Oils	0.13	0.78	56	0.65	0.77	2.32	7	1.55
25.	Tea and Coffee	0.12	0.74	66	0.62	0.77	2.45	4	1.68
26.	Other Beverages	0.42	0.84	41	0.42	0.48	1.91	35	1.43
27.	Tobacco Manufactures	0.76	0.80	52	0.04	0.65	2.15	18	1.50
28.	Cotton Textiles	0.26	0.91	24	0.65	0.73	2.10	21	1.37
29.	Cotton Textiles (Handloom and Khadi)	0.23	0.81	51	0.58	0.71	2.30	8	1.59
30.	Woolen and Silk Textiles	0.11	0.60	79	0.49	0.68	2.20	15	1.52
31.	Art Silk Fabrics	0.41	0.56	80	0.15	0.30	1.48	46	1.18
32.	Jute Textiles	0.24	1.04	1	0.82	0.86	2.52	2	1.66
33.	Readymade Garments	0.53	0.83	45	0.30	0.40	1.72	48	1.32
34.	Misc. Textile Products	0.10	0.52	81	0.42	0.53	1.67	38	1.34
35.	Carpet Weaving	0.58	0.66	75	0.08	0.11	1.22	76	1.11
36.	Wood Products	0.46	0.85	39	0.39	0.47	1.72	49	1.25
37.	Paper, Paper Products and Newsprint	0.24	0.79	54	0.55	0.66	2.10	23	1.44
38.	Printing and Publishing	0.41	0.81	68	0.40	0.47	1.81	41	1.34
39.	Leather and Leather Products	0.16	0.91	22	0.75	0.84	2.54	1	1.70

TABLE 1 (cont.)

I-O Sector No.	Name of the Sector	EMPLOYMENT				IMPORT INTERMITTIES			
		DIR	TOT	RANK	DIFF	DIR	TOT	RANK	DIFF
(1)	(2)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1.	Rice and Products	161.93	182.22	18	20.69	0.023	0.036	66	0.013
2.	Wheat and Products	118.62	148.32	26	30.70	0.031	0.052	53	0.021
3.	Jowar and Products	364.51	377.54	4	13.03	0.002	0.005	82	0.003
4.	Bajra and Products	331.00	354.52	6	25.52	0.011	0.023	70	0.012
5.	Other cereals	339.06	362.02	3	42.96	0.020	0.046	56	0.026
6.	Pulses	202.54	275.24	11	72.70	0.009	0.047	55	0.038
7.	Supercane	103.88	116.47	34	12.59	0.026	0.038	65	0.012
8.	Jute (raw)	457.62	460.77	2	3.15	0.007	0.010	75	0.003
9.	Cotton (raw)	110.45	124.23	30	13.78	0.012	0.023	69	0.011
10.	Plantations	192.92	230.85	14	37.93	0.092	0.139	15	0.047
11.	Other crops	101.69	107.15	35	5.46	0.006	0.009	77	0.003
12.	Milk and Milk Products	239.06	296.54	8	57.48	0.0	0.008	79	0.008
13.	Other Animal Husbandry	205.12	295.86	9	90.74	0.0	0.013	72	0.013
14.	Forestry and Logging	479.07	492.36	1	13.29	0.0	0.009	76	0.009
15.	Fishing	305.48	326.28	7	20.80	0.0	0.009	78	0.009
16.	Coal and Lignite	51.49	85.97	44	34.48	0.0	0.010	76	0.010
17.	Petroleum and Natural Gas	12.93	37.25	80	24.32	0.002	0.031	67	0.029
18.	Iron Ore	36.95	74.71	52	33.76	0.0	0.112	22	0.112
19.	Other Minerals	57.56	75.29	51	17.73	0.001	0.060	48	0.059
20.	Misc. Food Products	27.12	167.80	22	140.68	0.001	0.040	64	0.039
21.	Sugar	35.59	121.54	31	85.95	0.002	0.043	60	0.041
22.	Gur and Khandsari	115.00	213.83	16	98.75	0.0	0.042	62	0.042
23.	Vanaspathi	6.01	80.75	47	74.74	0.055	0.099	28	0.044
24.	Edible Oils	9.97	152.70	25	142.73	0.023	0.099	27	0.076
25.	Tea and Coffee	30.13	153.67	24	123.54	0.0	0.088	32	0.088
26.	Other Beverages	81.68	139.24	27	57.56	0.018	0.042	63	0.024
27.	Tobacco Manufactures	106.05	206.30	17	100.34	0.011	0.072	40	0.061
28.	Cotton Textiles	25.90	102.31	38	76.41	0.002	0.042	61	0.040
29.	Cotton Textiles (Handloom and Khadi)	273.55	357.67	5	84.12	0.004	0.057	51	0.053
30.	Woolen and Silk Textiles	46.30	119.74	32	73.44	0.048	0.170	6	0.122
31.	Art Silk Fabrics	28.36	40.40	77	12.04	0.091	0.212	3	0.121
32.	Jute Textiles	77.67	288.93	10	211.26	0.0	0.044	59	0.044
33.	Ready-made Garments	43.40	84.79	45	41.39	0.003	0.045	58	0.042
34.	Misc. Textile Products	25.95	70.29	57	44.44	0.012	0.063	46	0.051
35.	Carpet Weaving	30.67	42.83	74	12.16	0.0	0.013	71	0.013
36.	Wood Products	106.18	171.76	20	65.58	0.005	0.060	49	0.055
37.	Paper, Paper Products and Newsprint	16.07	77.20	49	61.13	0.026	0.080	35	0.054
38.	Printing and Publishing	40.88	75.82	50	34.94	0.059	0.097	31	0.038
39.	Leather and Leather Products	15.32	158.16	23	142.84	0.007	0.050	54	0.043

TABLE I (cont.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
40.	Leather Footwear	0.31	0.81	46	0.50	0.58	2.26	11	1.60
41.	Rubber Products	0.19	0.70	69	0.51	0.68	2.22	13	1.54
42.	Petroleum and Related Prods.	0.18	0.43	83	0.27	0.33	1.55	60	1.22
43.	Inorganic Heavy Chemicals	0.40	0.68	73	0.28	0.33	1.54	54	1.23
44.	Chemical Fertilizers	0.35	0.85	37	0.50	0.61	2.04	27	1.43
45.	Insecticides,Fungicides etc.	0.20	0.71	68	0.51	0.69	2.19	17	1.50
46.	Drugs Pharmaceuticals	0.20	0.76	62	0.50	0.61	2.11	20	1.50
47.	Refractories	0.34	0.80	53	0.46	0.52	1.77	45	1.25
48.	Cement	0.26	0.81	50	0.55	0.63	2.10	22	1.47
49.	Other M-mat. Min. Prods.	0.32	0.81	49	0.49	0.58	1.95	33	1.37
50.	Iron and Steel	0.25	0.77	59	0.52	0.63	2.07	25	1.44
51.	Castings and Forgings	0.32	0.67	74	0.35	0.43	1.73	46	1.30
52.	Iron and Steel Structures	0.19	0.52	82	0.33	0.42	1.70	50	1.28
53.	Non-ferrous Metals	0.32	0.70	70	0.58	0.48	1.80	83	1.32
54.	Metal Products	0.36	0.69	71	0.33	0.40	1.67	52	1.27
55.	Tractor & Agri. Implements	0.58	0.87	32	0.29	0.35	1.58	57	1.23
56.	Machine Tools	0.28	0.76	64	0.48	0.61	2.05	26	1.44
57.	Office, Domestic and Commercial Equipments	0.60	0.91	23	0.39	0.40	1.66	53	1.28
58.	Other Non-Electrical Machinery	0.34	0.68	72	0.34	0.46	1.79	42	1.33
59.	Electric Motors	0.25	0.81	47	0.56	0.72	2.30	9	1.58
60.	Electric Cables and Wires	0.20	0.74	65	0.54	0.71	2.20	14	1.49
61.	Batteries	0.47	0.78	57	0.31	0.40	1.63	55	1.23
62.	Electrical Household Goods	0.38	0.77	81	0.39	0.50	1.84	39	1.34
63.	Comm. & Electronic equipments	0.42	0.91	25	0.49	0.50	2.02	28	1.43
64.	Other Electricals Machinery	0.32	0.65	77	0.33	0.42	1.72	47	1.30
65.	Ships and Boats	0.49	0.85	36	0.36	0.45	1.78	43	1.33
66.	Rail Equipments	0.16	0.66	78	0.50	0.66	2.19	16	1.53
67.	Motor Vehicles	0.33	0.85	38	0.52	0.67	2.12	19	1.45
68.	Motor Cycles and Bicycles	0.42	0.83	44	0.41	0.52	1.89	36	1.37
69.	Other Transport Equipment	0.32	0.76	63	0.44	0.56	1.97	31	1.41
70.	Watches and Clocks	0.37	0.87	33	0.30	0.35	1.55	62	1.20
71.	Misc. Manufacturing Industries	0.56	0.87	34	0.31	0.39	1.60	56	1.21
72.	Construction	0.32	0.87	35	0.55	0.64	2.07	24	1.43
73.	Electricity, Gas and Water Supply	0.43	0.84	42	0.41	0.50	1.82	40	1.32
74.	Railways	0.60	0.87	31	0.27	0.35	1.64	54	1.29
75.	Other Transport	0.45	0.77	60	0.32	0.41	1.70	51	1.29
76.	Communications	0.92	0.98	7	0.06	0.08	1.13	79	1.05
77.	Trade, Storage and Warehouses	0.74	0.96	15	0.22	0.25	1.38	68	1.13
78.	Banking and Insurance	0.85	0.99	5	0.14	0.15	1.20	78	1.05
79.	Real Estate and Ownership of Dwellings	0.88	0.99	4	0.11	0.12	1.25	72	1.13
80.	Education	0.33	0.83	43	0.50	0.58	1.96	32	1.38
81.	Medical Health	0.21	0.78	55	0.57	0.73	2.47	3	1.74
82.	Other Services	0.64	0.93	18	0.29	0.33	1.55	61	1.20
83.	Petrochemicals	0.27	0.65	78	0.38	0.62	1.99	30	1.37

TABLE 1 (cont.)

(1)	(2)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
40.	Leather Footwear	170.60	243.20	13	72.51	0.002	0.074	38	0.072
41.	Rubber Products	14.33	84.47	41	70.14	0.048	0.156	10	0.108
42.	Petroleum and Related Prods.	8.92	34.44	81	25.52	0.405	0.437	1	0.032
43.	Inorganic Heavy Chemicals	15.17	42.56	75	27.39	0.031	0.063	45	0.032
44.	Chemical Fertilizers	14.50	58.66	65	44.16	0.041	0.098	29	0.057
45.	Insecticides,Fungicides etc.	8.96	57.36	68	48.40	0.058	0.165	7	0.107
46.	Drugs Pharmaceuticals	18.03	69.90	58	51.87	0.065	0.124	18	0.059
47.	Refractories	164.53	218.64	15	54.11	0.103	0.134	16	0.031
48.	Cement	29.38	100.75	39	71.37	0.039	0.086	33	0.047
49.	Other N-met. Min. Products	68.90	117.74	33	48.78	0.036	0.086	34	0.048
50.	Iron and Steel	11.00	59.00	64	48.00	0.097	0.161	8	0.064
51.	Castings and Forgings	22.42	54.92	69	32.50	0.074	0.116	21	0.042
52.	Iron and Steel Structures	29.25	58.49	66	29.24	0.115	0.160	9	0.045
53.	Non-Ferrous Metals	9.29	38.39	78	29.10	0.094	0.144	13	0.050
54.	Metal Products	37.92	66.01	61	28.09	0.114	0.154	11	0.040
55.	Tractor & Agri. Implants	17.43	37.49	79	20.06	0.044	0.077	37	0.033
56.	Machine Tools	50.27	95.29	40	45.02	0.062	0.129	17	0.067
57.	Office, Domestic and Commercial Equipments	51.05	77.70	48	28.65	0.009	0.067	43	0.058
58.	Other Non-Electrical Machinery	34.29	61.64	43	27.37	0.091	0.148	12	0.093
59.	Electric Motors	16.72	61.84	62	45.12	0.025	0.118	20	0.093
60.	Electric Cables and Wires	9.48	49.96	71	40.28	0.077	0.179	5	0.102
61.	Batteries	17.41	41.08	76	23.67	0.034	0.057	50	0.023
62.	Electrical Household Goods	25.07	58.14	67	33.07	0.042	0.097	30	0.053
63.	Comm.& Electronic Equipments	23.07	68.33	59	44.36	0.056	0.144	14	0.088
64.	Other Electricals Machinery	17.12	44.30	73	27.18	0.063	0.108	24	0.045
65.	Ships and Boats	39.52	74.20	53	34.68	0.022	0.066	44	0.044
66.	Rail Equipments	44.94	94.00	41	49.06	0.007	0.079	36	0.072
67.	Motor Vehicles	18.60	72.01	55	53.41	0.041	0.110	23	0.049
68.	Motor Cycles and Bicycles	20.50	54.12	70	33.42	0.045	0.104	26	0.059
69.	Other Transport Equipment	31.81	71.04	56	39.23	0.157	0.230	2	0.073
70.	Watches and Clocks	69.19	104.55	37	35.36	0.036	0.062	47	0.026
71.	Misc. Manufacturing Industries	74.94	105.44	36	30.50	0.017	0.073	39	0.056
72.	Construction	22.10	92.31	43	70.21	0.017	0.068	41	0.051
73.	Electricity, Gas and Water Supply	29.25	66.70	60	37.45	0.002	0.045	57	0.043
74.	Railways	103.59	132.40	28	28.81	0.023	0.056	52	0.033
75.	Other Transport	54.79	93.40	42	38.61	0.063	0.121	19	0.058
76.	Communications	164.54	170.97	21	6.43	0.0	0.008	80	0.008
77.	Trade, Storage and Warehouses	44.28	73.50	54	29.22	0.0	0.012	73	0.012
78.	Banking and Insurance	32.74	64.73	72	11.99	0.0	0.004	83	0.004
79.	Real Estate and Ownership of Dwellings	1.14	12.78	83	11.64	0.0	0.008	81	0.008
80.	Education	208.03	262.19	12	54.16	0.030	0.067	42	0.037
81.	Medical Health	80.12	131.86	29	51.74	0.024	0.106	25	0.082
82.	Other Services	139.36	178.44	19	39.08	0.004	0.024	68	0.020
83.	Petrochemicals	2.37	33.69	82	31.32	0.03	0.208	4	0.178

Note: DIR = Direct
TOT = Total
DIFF = Difference

figured in the bottom ten sectors in terms of direct income and employment generation, and most of the ten bottom sectors in terms of output generation relate to agriculture. The point that emerges, therefore, is that agriculture and related sectors are highly significant for direct income and employment generation but not to the same extent for output generation.

When direct and indirect linkage effects are taken into account, it is found that the sectors occupying the first ten ranks in terms of the magnitude of the total income generation are mostly (except for two service sectors) related to agriculture and related activities, although these sectors are not always the same as those having high significance in terms of direct linkages effects. As regards total linkage effects, similar observation can also be made for employment generation. It should be noted, however, that total income or employment generation is relatively high in agriculture related sectors not because of their indirect linkage effects being high but mostly because of their high direct linkage effects.

As in the case of direct output generation, the agriculture related sectors do not occupy high ranks in total output generation.

Variations in Total Effects Across Four Categories of Manufacturing Sectors

With these broad observations taking all the sectors of the Indian economy into consideration, we proceed to examine a little more closely the relative importance of 53 manufacturing sectors for income, output and employment generation as also for import intensities. For the purpose of analysis, 53 manufacturing sectors have been classified into four broad categories namely (i) agrobased industries, (ii) non-agrobased final goods industries, (iii) non-agrobased intermediate goods industries and (iv) capital goods industries. The sectors falling in each of these categories have been distributed between those showing higher and lower than all manufacturing sectors' average (Table 2).

Table 2 shows that in terms of total income generation, ten out of 20 agrobased industries, five out of 12 non-agrobased final goods industries, two out of 14 non-agrobased intermediate goods industries and two out of seven capital goods industries stand above all-manufacturing sectors' average level of total income generation. Similarly, in term of total output generation, 16 from among the agrobased industries, seven from among the non-agrobased intermediate goods industries and five from amongst capital goods industries, have shown output generation at a level higher than all-manufacturing sectors' average. But the total employment generated is higher than all-manufacturing sectors' average in 11 out of 20 agrobased industries sectors, in one sector out of 14 non-agrobased intermediate goods sectors and in none of the 12 non-agrobased final goods sectors and seven capital goods sectors.

Similarly, total import requirements are found to be higher than all-manufacturing sectors' average only in five out of agrobased goods sectors while it is so, in nine, ten and six out of non-agrobased final goods, intermediate goods and capital goods respectively. However, total import requirements per million worth of output is very high in Art Silk Fabrics

TABLE 2
INDUSTRIES ABOVE AND BELOW THEIR RESPECTIVE ALL MANUFACTURING
SECTORS' AVERAGES IN TERMS OF INCOME, OUTPUT, EMPLOYMENT
GENERATION AND IMPORT LEAKAGES

Category	Income		Output		Employment		Import Intensities	
	≥Average	<Average	≥Average	<Average	≥Average	<Average	≥Average	<Average
A. Agro-based Industries	32, 21, 28 39, 22, 20 23, 36, 28 33	29, 40, 27 37, 24, 25 25, 30, 31 34	39, 32, 25 33, 36, 31 29, 21, 40 23, 30, 27 37, 28, 26 34	33	29, 32, 40 22, 27, 36 20, 19, 25 24, 26	21, 30, 28 33, 23, 37 34, 35, 31	31, 30, 23 24, 25	37, 40, 27 34, 36, 29 39, 33, 32 21, 26, 22 28, 20, 35
B. Non-Agro-based Final Goods Industries	57, 70, 71 67, 68	49, 36, 62 46, 41, 54 49, 68, 62	41, 67, 46 54, 57, 71 42, 70		49, 71, 70 61, 57, 38 20, 19, 25 67, 46, 54 64, 68, 42	42, 41, 54 46, 67, 68 38, 62, 49	71, 57, 70	
C. Non-Agro-based Intermediate Goods Industries	65, 44	48, 47, 61 50, 60, 45 53, 43, 51 66, 83, 52	60, 66, 45 48, 59, 44 83, 53 52, 61, 43	47	48, 66, 65 50, 44, 52 45, 51, 60 43, 61, 53 83	83, 60, 45 50, 52, 53 47, 51, 44 48	66, 65, 43 61	
D. Capital Goods Industries	63, 55	59, 56, 69 58, 64	59, 56, 63 64, 55		56, 69, 63 59, 58, 64 55	69, 58, 63 56, 59, 64	55	
TOTAL	19	34	36	17	12	41	30	23

Note: I-O Sector numbers are arranged in descending order of the values of multipliers while import intensity in ascending order.

(31) and Woollen and Silk Textiles (30) ranking third and sixth respectively among 53 manufacturing sectors. In non-agrobased final goods industries, total import requirements per million worth of output varies from Rs.4.37 lakhs in Petroleum and Related Goods (42) to Rs.62,000 in Watches and Clocks (70), in non-agrobased intermediates from Rs.2.1 lakhs to Rs.57,000 and in capital goods industries from Rs.2.3 lakhs to Rs.77,000. As against this, it varies from Rs.99,000 to Rs.13,000 in agrobased industries leaving out the two exceptional sectors as mentioned above.

It therefore, follows that agrobased goods sectors have tremendous consequences on employment and domestic income generations, though to a much lesser extent in the case of the latter, as compared to the three other broad categories of manufacturing industries. Even in regard to import requirements, agrobased sectors have much greater edge over the other categories of industries.

Relative Contribution of Direct and Indirect Effects to Total Effects

Having examined the relative importance of various sectors under the four broad categories of industries in terms of total effects on income, output, employment and imports, it may be useful to briefly examine the relative contribution of direct and indirect linkage effects to the total. While the total and direct income, output and employment effects and the differences thereof have been shown for each of the sectors in Table 1, our discussion will be restricted to the sectors which are above the all manufacturing sectors' average level. It is interesting to note that the indirect income linkage effects of the sectors under the category of agrobased industries are, by and large, higher than those relating to the sectors falling under non-agrobased final goods, non-agrobased intermediate and capital goods. A similar observation can also be made in respect of employment generation. For example, an increase of output worth one million rupees generates, indirectly, employment in the range of 58 to 211 standard person years in above average agrobased industries, while it generates indirect employment of 54 and 58 standard person years (SPY) respectively in each of the non-agrobased intermediate goods and capital goods sectors which are above the all-manufacturing sectors' average level. In indirect output generation, however, no pattern is discernible. In most of the above average sectors under any of the four broad categories, indirect output generation is much higher than their respective direct output generation.

Strength of Backward and Forward Linkages

Now we may proceed to examine the strength of backward linkages (BL) and forward linkages (FL) in output and employment generation. The values of BL and FL with their corresponding ranks for both output and employment are presented in Table 3. However, BL and FL of the above average industries falling in each of the four broad categories as stated above will be examined a little more closely.

Table 3 shows that out of 53 manufacturing sectors, BL of output is

TABLE 3
 BACKWARD AND FORWARD EMPLOYMENT AND OUTPUT LINKAGES AND
 THEIR RESPECTIVE RANKS FOR MANUFACTURING SECTORS

Sector		Employment				Output			
Sl. No.	No.	Linkages		Ranks		Linkages		Ranks	
		BL	FL	BL	FL	BL	FL	BL	FL
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	20	1.262	0.246	8	33	1.321	0.722	4	40
2.	21	0.914	0.297	13	26	1.258	0.664	9	45
3.	22	1.608	0.865	4	8	1.299	0.598	5	52
4.	23	0.607	0.074	26	52	1.239	0.979	11	21
5.	24	1.148	0.084	11	51	1.288	0.674	6	44
6.	25	1.156	0.236	10	36	1.358	0.624	3	50
7.	26	1.067	0.616	12	12	1.058	0.601	30	51
8.	27	1.152	0.072	6	7	1.195	0.655	17	48
9.	28.	0.770	0.259	18	31	1.169	0.797	20	36
10.	29	2.490	2.189	1	2	1.277	0.437	7	49
11.	30	0.900	0.470	14	17	1.221	0.809	13	32
12.	31	0.304	0.257	49	32	0.820	0.722	52	41
13.	32	2.173	1.304	2	4	1.401	1.537	2	10
14.	33	0.638	0.403	22	20	0.957	0.760	40.5	36
15.	34	0.529	0.286	31	28	1.041	0.881	32	26
16.	35	0.322	0.250	46	34	0.878	0.649	53	47
17.	36	1.292	1.156	7	5	0.957	1.107	40.5	17
18.	37	0.581	0.278	25.5	29	1.167	1.379	21	7
19.	38	0.570	0.607	27	13	1.007	1.184	34	16
20.	39	1.189	0.154	9	46	1.413	0.800	1	33
21.	40	1.829	1.251	5	5	1.243	0.564	10	53
22.	41	0.635	0.216	23	39	1.230	1.201	12	15
23.	42	0.259	0.149	52	47	0.860	1.326	51	11
24.	43	0.320	0.325	47	25	0.866	1.707	49	2
25.	44	0.641	0.277	38	30	1.156	1.522	25	5
26.	45	0.431	0.182	41	44	1.215	1.620	16	3
27.	46	0.526	0.292	32	27	1.169	1.292	19	12
28.	47	1.599	2.837	5	1	0.994	1.376	32	9
29.	48	0.758	0.312	19	16	1.166	1.388	22	6
30.	49	0.886	0.936	5	6	1.053	1.081	29	19
31.	50	0.644	0.190	37	41	1.150	1.378	23	8
32.	51	0.413	0.357	42	24	0.948	1.267	39	16
33.	52	0.640	0.377	39	21	0.947	1.025	43	20
34.	53	0.289	0.184	50	43	0.999	1.576	35	4
35.	54	0.498	0.350	34	14	0.927	1.155	44	18
36.	55	0.282	0.158	51	45	0.878	0.722	48	39
37.	56	0.717	0.454	20	19	1.139	0.719	24	42
38.	57	0.581	0.469	25.5	18	0.924	0.732	45	37
39.	58	0.466	0.373	36	23	0.995	0.851	36	30
40.	59	0.688	0.144	35	48	1.275	0.696	8	43
41.	60	0.376	0.092	44	50	1.220	0.758	14	35
42.	61	0.309	0.140	48	49	0.908	0.641	46	48
43.	62	0.437	0.227	40	38	1.022	0.723	33	38
44.	63	0.514	0.251	33	33	1.122	0.833	26	51
45.	64	0.833	0.186	45	42	0.955	0.866	42	28
46.	65	0.558	0.832	28	11	0.990	1.374	38	13
47.	66	0.707	0.536	21	15	1.210	0.950	19	22
48.	67	0.342	0.200	29	40	1.171	0.856	18	29
49.	68	0.607	0.232	43	37	1.051	0.901	31	25
50.	69	0.334	0.374	30	22	1.004	0.938	28	23
51.	70	0.788	0.805	17	10	0.861	0.928	50	26
52.	71	0.795	0.820	16	9	0.891	0.872	47	27
53.	83	0.253	0.054	53	53	1.108	1.054	27	1

greater than one in 34 sectors while FL is greater than one in 20 sectors. It follows, therefore, that the strength of BL of output is higher than that of FL in larger number of sectors. Similarly, BL of employment is greater than one in 12 sectors while FL is so only in five sectors, which also indicates greater strength of BL than that of FL for employment generation. Rank correlations run to examine the association between the ranks of BL and FL of output and employment suggest that the strength of BL is negatively associated with the strength of FL both in the case of output (-0.33) and employment (-0.09) although correlation coefficients are not significant.

Examining BL and FL of output in above sectors under the four broad categories of industries, the following observations can be made. First the strength of BL of output in agrobased industries is much higher than that of FL in most cases. In fact, the sectors included in the category of agrobased industries occupy first 13 ranks except for eighth and twelfth among 53 manufacturing sectors. Second, as can be expected, FL of output is much stronger in non-agrobased intermediate sectors. In the case of non-agrobased final goods industries and capital goods categories, no clear pattern has emerged. In certain sectors, BL is stronger than FL and in some other sectors, it is the other way round.

Further examination of BL and FL of employment in the above average sectors under four broad categories brings out that the sectors falling in the category of agrobased industries occupy the first 12 ranks among 53 manufacturing sectors in terms of the magnitude of BL while in the only above average sector under the category of non-agrobased intermediate industries, the strength of FL is much higher than that of BL.

IV. KEY SECTORS

For Income, Output and Employment Generation

In the light of the above discussion on income, output and employment this section attempts to indicate the sectors which have relatively higher income, output and employment potentials.

For this purpose, all the 53 manufacturing sectors have been divided into four groups on the basis of their respective ranks in total income, output and employment generation per million rupees worth of output. In the case of import requirement per million rupees worth of output, the sectors have been grouped according to their ascending order of import intensities. The distribution of such ranking of manufacturing sectors has been presented in Table 4.

For each of the characteristics, there are four quadrants – the first quadrant showing the sectors having ranks from 1 to 13.5, the second from 14 to 26.5, the third from 27 to 39.5 and the fourth from 40 to 53. Each of the sectors in a quadrant has been arranged according to the magnitude of total effects per million rupees worth of output in descending order. In the case of import intensities, sectors have been arranged in the reverse order.

It can be seen from the table that five agrobased sectors viz. Jute

TABLE 4
DISTRIBUTION OF MANUFACTURING SECTORS BY RANKS

Class Interval of Ranks	Income	Output	Employment	Import
1 - 13.5	32, 21, 57, 28, 63, 39, 22, 20, 23, 70, 71, 55	39, 32, 25, 20 22, 24, 29, 59, 21, 40, 23, 41, 30, 60	29, 32, 40, 47 22, 27, 34, 20, 39, 25, 24, 26, 21	35, 20, 28, 22, 26, 21, 32, 33, 39, 29, 61, 36, 70
14 - 26.5	36, 65, 67, 44, 26, 68, 33, 29, 59, 40, 49, 48, 38, 27, 47	66, 45, 27, 87, 46, 48, 37, 28, 50, 56, 44, 63	30, 49, 71, 70 28, 48, 56, 66 33, 41, 23, 57, 37	43, 34, 65, 57 27, 71, 40, 55, 66, 37, 48, 49, 25, 62, 38
27 - 39.5	37, 61, 24, 62, 50, 46, 56, 69, 60, 25, 45, 33, 41	83, 69, 49, 26, 68, 34, 62, 36, 33, 58, 65, 47, 51	38, 65, 67, 69, 34, 46, 63, 54, 59, 58, 50, 44, 52	44, 24, 23, 68, 64, 67, 51, 59, 46, 56, 47
40 - 53	54, 43, 58, 51, 35, 66, 64, 83, 30 31, 52, 34, 42	33, 64, 36, 52, 54, 37, 61, 71, 55, 43, 42, 70, 31, 35	62, 45, 61, 68, 60, 64, 35, 43, 61, 31, 53, 55, 42, 83	53, 63, 58, 54, 41, 52, 50, 45, 30, 60, 83, 31, 69, 42

Note: For total income, output and employment effects sectors have been arranged in descending order while for total effects on imports they have been arranged in ascending order.

Textiles (32), Sugar (21), Leather and Leather Products (39), Gur and Khandani (22) and Miscellaneous Food Products (23), have figured in the first quadrant with respect to each of the characteristics. This indicates that these agrobased sectors generate very high income, output and employment with least import requirement per million rupees worth of output.⁴

Beyond these five sectors, a trade off is involved. This trade off has, obviously, to be determined considering the objectives pursued. For example, if the objective is to generate more employment, Wood

Products (36), Other Beverages (26), Tobacco Manufacturing (27) and Refractories (47), could be the sectors. But these sectors will not ensure equally high total income and output generation and least import requirements per million rupees worth of output, although Wood Products sector requires very low import. If, on the other hand, the objective is to generate more income, Office Domestic and Commercial Equipments (57), Cotton Textiles (28), Communication and Electronics Equipments (63), Vanaspati (23), Watches and Clocks (70), Miscellaneous Manufacturing Industries (71) and Tractors and Agricultural Implements (55) are the sectors which would generate high income but relatively low output and employment. However, Cotton Textiles and Watches and Clocks still require least import.

Import Internalisation⁵

All but two, namely Woollen and Silk Textiles (30) and Art Silk Fabrics (31) of the 14 sectors appeared in the highest class interval (40-53) of import intensities in Table 4 are non-agrobased final goods and intermediate goods industries. In most of these sectors particularly in Petroleum and Related Industries (42), Other Transport Equipment (69), Petrochemicals (83) Iron and Steel (50), Iron and Steel Structures (52), Metal Products (54), Other Non-electrical Machinery (58), Communication and Electronic Equipments (63) and Non-Ferrous Metals (53), the policy of import substitution has been pursued after independence, but more vigorously since mid-1950s. Since these industries are still most import intensive in terms of direct and indirect import requirements, creation of domestic production facilities in these sectors and the upstream sectors from which they buy raw materials would result in substantial foreign exchange saving. The quantum of foreign exchange saving per million rupees worth of output may vary from Rs.4.37 lakhs in Petroleum and Related Products (42) to Rs.1.44 lakhs in Non-Ferrous Metals (53).

Thus, import internalisation in these sectors will have significant implications on (i) foreign exchange saving and (ii) income and employment generation in the economy. As regards the first point, it should, however, be borne in mind that the benefit would be positive only when the production activity is carried out efficiently. If the domestic resource cost of transforming raw material into finished goods is higher than the exchange rate, it might result in inefficient import substitution.⁶ This may entail net loss instead of benefits to the economy. However, these sectors will have considerable impact on income and employment generation, although it may not be of the highest order. Most of the above 14 sectors fall in the last two class intervals of income and employment generation (income - seven in 40-53 and six in 27-39.5; Employment - six in 40-53 and six in 27-39.5). Only one sector, namely Communication and Electronic Equipments (63) is listed in the top class interval of income generation. Similarly, only two sectors, namely Rubber Products (41) and Woollen and Silk Textiles (30) fall in the second class interval of ranks. Nevertheless, these industries could be considered for import internalisation.

tion on the ground of income and employment generation even if they are less than efficient in pure economic terms.

V. CONCLUSION

The *ex post* evaluation of linkages of Indian manufacturing sectors suggests that a shift in product-mix in favour of agrobased industries would have favourable impact on income and employment generation. But the extent of such shift that could be feasible will depend on the final demand structure and the changing pattern therein. The change in final demand structure is very important because as has been observed in a study [Venkataramaiah, 1986: 154]: '... on an average only ... one-third of the change in output is due to changes in technology while two-thirds of the change in output is due to change in the structure of the final demand'. Again, from the long-run angle, a strategy based on the development of only agrobased industries for the consideration of income and employment generation will be hazardous. Therefore, there has to be a judicious mix of agrobased and non-agrobased industries taking into account the relative employment implications of the sectors within each of the categories.

It will be interesting to examine whether the past industrial investment pattern is consistent with the income and employment consequences of various industries and whether the lack of such consistency provides an explanation for low income and employment generation in the manufacturing sector.

Finally, it may be pointed out that apart from the usual limitations of input-output analysis, the linkage measures described above do not capture the inducement effects of the capital goods as the present exercise is based on current input flows and does not take into consideration the capital flows.

NOTES

1. The original 89 × 89 table has been reduced to 83 × 83 table by merging eight petroleum and chemicals sectors into one and separating out petro-chemical industry from the above eight sectors.
2. Refers to the ratio of value added to gross output coefficients. They have been computed on the basis of information given in the Technical Note.
3. The employment coefficients (Q/L) for 1979-80 have been worked out on the basis of the Planning Commission estimates (see Government of India, *Computation of Labour Coefficients for 89 Sectors of the I-O Tables for 1977-78*, Draft Plan Employment Studies, EMD and PPD, Planning Commission, New Delhi, 1978). Since these estimates are for 1977-78 at 1976-77 prices, they have been adjusted for prices so as to make them consistent for the I-O Table for 1979-80 (83 × 83).
4. Similar results were obtained by Hazari and Krishnamurthy in their study: 'Employment Implications of India's Industrialisation: Analysis in an Input-Output Framework', *Review of Economic and Statistics*, May 1970, p.183.
5. Import internalisation has been interpreted as *ex ante* import substitution. It may be recalled here that import intensities have been based on import coefficients while income, output and employment multipliers on domestic coefficients.

6. DRC is high in a number of basic and final goods industries in India. For details on DRC estimates, see Industrial Credit and Investment Corporation of India (1985) and The World Bank (1984).

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