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Sectoral Interdependence Among the Small Scale Industries of Rajasthan.

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INTRODUCTION

Policy makers and planners are generally interested in knowing the total direct and indirect impact of expenditure and to use this information for choosing between competing projects and programmes. Within an input-output frame it is possible to calculate the indices for the sectoral interdependence between the various sectors of the economy.

In this paper an attempt has been made to examine the interrelatedness among the different sectors of the small scale industries in Rajasthan (a State of Indian Union). The input-output table for the small scale industries of Rajasthan is formulated in the Ph.D. thesis of the author.[1] The data for this input-output table was lifted directly from the original 7062 schedules canvassed by the Director of Industries for the census study of the small scale industries in Rajasthan. The sectoral scheme was formulated on the basis of usual criteria of aggregation and input-output table was cast into 18 sectors. The intersectoral flow matrix is at producers prices for the year 1974.

To investigate the sectoral interdependence of the small scale industries in Rajasthan following three types of analysis have been done.[2]

- Grouping of sectors with the help of Chenery and Watanbe's backward and forward linkages.
- Calculation of the Yan and Ames index of interrelatedness with the help of order matrix.
- Rasmussen's backward and forward linkages.

GROUPING OF SECTORS WITH THE HELP OF CHENERY AND WATANBE'S FORWARD AND BACKWARD LINKAGES

The extent of sectoral interdependence in Rajasthan's small scale industries has been studied by working out the input use and output disposal patterns for each sector.

The Chenery and Watanbe's[3] sector classification method, uses the ratio of purchased inputs to total output to measure the intensity of backward linkages (B_j). Similarly the ratio of intermediate demand to total output (F_i) has been treated as a measure of the intensity of forward linkage.

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To calculate B_j's values, the column sum of each sector has been divided by the gross output of that sector; and row sum of each sector has been divided by its gross output to obtain values of F_i's. The column sum represents the total purchased inputs excluding primary inputs such as labour, land and capital, while the row sum depicts the total sales to intermediate demand by a particular sector.

Tow way classification of the small scale industrial sectors in Rajasthan can be set-up on the basis of above mentioned B_j and F_i values. A criterion value for B_j and F_i has been developed to group the sectors in four different classificacions. "B_j-criterion value" has been arrived at by dividing the total of all column sums of the input-out-put matrix by the gross output. Similarly, for "F_i-criterion value", total of all row-sums of the input-output table has been divided by gross output value. Obviously both these values will be the same. B_j and F_i criterion value for our study comes out to be 0.3449.

Each sector of an economy can be classified into four categories according to its B_j and F_i values as suggested by Yan.[4]

Classification of Industries

Output → / Input ↓	Final (or Low F_i)	Intermediate (or High F_i)
Manufacturing (or High B)	III : Final Manufacturing	II : Intermediate Manufacturing
Primary Production (or Low B)	IV : Final Primary Production	I : Intermediate Primary Production

All the 18 sectors of the small scale industries in Rajasthan have been classified according to above criterion. The linkage values were identified as high or low on comparing them with calculated cirterion value.Following Calssification describes the two way classification of the sectors of small scale industries depending on whether the value of forward and backward linkages is less or greater than the criterion value 0.3449.

As could be observed in the classification of sectors as per Chennery and Watanbe's Backward and Forward Linkages, six sectors viz. Dairy Products (1) Sugar Khandsari and Gur (3), Paper and paper products (7), Leather, Leather and fur products (9), Rubber and plastic products (10), and Basic metal and Alloys (13) show high forward as well as backward linkages. Hence they are placed under the classification II of Intermediate manufacturing. At the other extreme, 5 sectors show very low forward and backward linkages. These are Food products (2), Textile products (5), Wood and wood products (6), Non-metallic mineral products (12) and other manufacturing industries (18). These sectors are producing goods for the final production and fall under classification IV.

Classification of Sectors as per Chennery and Watanbe's Backward and Forward Linkages

Classification I : Intermediate Primary Production

High $F_i \geq 0.3449$ and Low $B_j \leq 0.3449$

Not a single sector was found under this classification.

Classification II : Intermediate Manufacturing

High $F_i \geq 0.3449$ and High $B_j \geq 0.3449$

Sector No.

1. Dairy Production (3,7)*
3. Sugar, Khandsari, Gur and Confectionery (5,8)
7. Paper and Paper Products (17,6)
9. Leather, Leather and Fur Products (6,8)
10. Rubber and Plastic Products (11,7)
13. Basic Metal and Alloy Industries (9,6)

Classification III : Final Manufacturing

Low $F_i \leq 0.3449$ and High $B_j \geq 0.3449$

4. Beverage and Malt Industries (1,5)
8. Printing, Publishing and Allied (0,6)
11. Chemical and Chemical Products (18,11)
14. Metal Products and Parts (18,9)
15. Machinery, Machine tools and parts (3,10)
16. Electrical Machinery (5,10)
17. Transport equipment and parts (0,9)

Classification IV : Final Primary Production

Low $F_i \leq 0.3449$ and Low $B_j \leq 0.3449$

2. Food Products (5,8)
5. Textile Products (14,6)
6. Wood and Wood Products (18,4)
12. Non-metallic mineral products (2,7)
18. Other manufacturing industries (1,8).

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*Figures in parenthesis are the total number of forward and backward linkages respectively. For example, (3,7) means that the sector Dairy Products sells to 3 other sectors while pruchases from 7 sectors.

The sectors under the classification III are Beverage and Malt industries (4), Printing and publishing (8), Chemical and chemical products (11), Metal products and parts (14), Machinery, machine tools and parts (15), Electrical Machinery (16) and Transport equipment and parts (7). Not a single sector of the total 18 could satisfy the criterion;

$$F_i \geq 0.3449 \text{ and } B_j \leq 0.3449:$$

that is to say, no sector could be lebelled as Intermediate Primary Producing sector.

INDEX OF INTERRELATEDNESS WITH THE HELP OF YAN AND AMES ORDER MATRIX

In the first method the small scale industries of Rajasthan's interdependence was examined with the help of backward and forward linkages. The methodology considered only the ratio of intermediate to aggregate demand for a given products. Hence there is every chance of the underestimating or over-estimating the values of B_j and F_i due to aggregation. It is argued by Krishna Bhardwaj[5] that linkages are suggestive of inducements, but those inducements may not be effective unless "the absolute level of demand generated is at least equal to the minimum size for the given industry." Second, linkages may be high due to high material intensity and in some cases the possibility of wasteful use of resources is not ruled out.[6] Moreover, the method while measuring inter-industry relatedness takes into consideration only the direct purchase and sales. Thus the technique suggested by Chennery and Watanbe measures only the direct interconnections between the sectors. However, in order to see how important a sector is in an economy, it is not enough to examine the direct interrelations between the various sectors. A sector may sell to or buy directly from a few sectors, yet its customers and suppliers may be connected with many other sectors of the economy. This is to say that the sector might have profound influence on the economy through its indirect relations with other sectors. It is therefore, desirable to consider all direct and indirect relations of a sector with others to evaluate the importance of each sector.

The technique suggested by Yan and Ames[7] disaggregates the sectors to a greater degree so as to sharpen the distinction between intermediate and final use of the produce of the sector.

Yan and Ames associate with each technical coefficient matrix, A, an order matrix O^{YA}, and use the latter to define an "interrelatedness function." This function, in its most aggregated version, is expressed by a single number, the interrelatedness index I^{YA}, for a row or a column.

The value of Row Index of the sectors 6, 11 and 14 in Table 1 is equal to one; it means wood and wood products (6), chemical and chemical products (11) and Metal products and parts (14) are used by almost all the 18 sectors. These three sectors, therefore, are most important to other sectors as the supplier of intermediate inputs to them. Other important output supplying sectors are; Paper and paper products (7), Textile products (5), Rubber and plastic products (10), Basic metal and Alloys (13) and Food products (2).

Table 1
Yan and Ames Indices of Interrelatedness

	Sector No.	Value of Row Index	Value of column Index
1.	Dairy products	0.4478	0.5972
2.	Food products	0.6389	0.6361
3.	Sugar Khandsari and Confectionary	0.6294	0.5989
4.	Beverage and Malt	0.2778	0.5528
5.	Textile products	0.8889	0.5600
6.	Wood and wood products	1.0000	0.4950
7.	Paper and paper products	0.9583	0.5600
8.	Printing, publishing and Allied	0.0428	0.5600
9.	Leather, Leather and Fur products	0.6150	0.5972
10.	Rubber and Plastic products	0.8056	0.5878
11.	Chemical and chemical products	1.0000	0.7083
12.	Non-metallic mineral products	0.3750	0.6017
13.	Basic Metal and Alloy industries	0.7500	0.5183
14.	Metal products and parts	1.0000	0.6111
15.	Machinery, Machine tools and parts	0.5644	0.6528
16.	Electrical Machinery	0.6200	0.6528
17.	Transport Equipment and parts	-	0.5600
18.	Other Manufacturing	-	0.6383
	Average of Indices	0.5927	0.5943

The value of column indices reveals that all the 18 sectors are important as users of intermediate products. The reason being the low variation (0.2133) between the highest and lowest indices. Some important users of the intermediate output are chemical and chemical products (11), Machinery (15), Electrical Machinery (16), other manufacturing (18), Food products (2) and non-metallic minerals (12).

The average index of the column indices is equal to 0.5943 and of row indices is equal to 0.5927. This shows that various sectors of small scale industries of Rajasthan are interrelated intensively.

A critique of the Yan and Ames measure by Blin and Murphy[8] seems to be fully justified. If one wants to take into account the appropriate magnitudes of inter-industry connections, it appears to be more reasonable to consider simply the power series I, A, A^2, A^3..... which leads to the Leontief inverse. The latter is a better approximation of the importance of particular linkages in I-O structure. Yan and Ames method count only i-j distance, while ignoring all other connections in the model. The Leontief inverse covers all paths and also takes into account the magnitudes of the flows.

RASMUSSEN'S BACKWARD AND FORWARD LINKAGES

The elements of the Leontief's inverse incorporate both direct and indirect connections between sectors. Therefore, possibly more useful and comprehensive measure of the backward and forward linkages can be calculated from the $(I-A)^{-1}$ matrix. Indices of sectoral linkages based on inverse matrix developed by Rasmussen[9] in a study of structural change. In this paper an attempt has also been made to calculate the Rasmussen's indices for the small scale industries of Rajasthan. There are two main reasons for using Rasmussen's indices.

(a) By using the inverse of an I-O matrix, these indices take into account the direct as well as the indirect effects of an increase in autonomous expenditure.

(b) They are properly weighted and can, therefore, more correctly depict the importance of strategic sectors of the economy.

U_j is the index of backward linkages and U_i is the index of forward linkage. The indices of the coefficient of variation defined by V_i and V_j in standard form of input-output literature.

A high V_j means that a particular industry draws unilaterally on the system of industries, and a low V_j means that an industry draws evenly from the other sectors. The V_i's can be interpreted in the same way.

Table 2
Rasmussen's Backward and Forward Linkage Indices

No.	Sector	Backward Linkages U_j	Backward Linkages V_j	Forward Linkages U_i	Forward Linkages V_i
1.	Dairy Products	1.1988 (1)	3.2400 (12)	1.3083 (3)	3.5567 (16)
2.	Food Products	0.7211 (18)	3.8075 (6)	0.7523 (9)	4.5410 (14)
3.	Sugar, Khandsari and Confectionery	1.1256 (5)	3.6388 (8)	1.2079 (4)	3.8992 (15)
4.	Beverage and Malt	1.0276 (11)	2.6823 (17)	0.5827 (15)	5.8698 (4)
5.	Textile Products	0.7377 (17)	4.0255 (2)	0.6675 (11)	5.4481 (6)
6.	Wood and Wood Products	0.7844 (16)	4.1138 (1)	0.7693 (8)	5.0186 (11)
7.	Paper and Paper Products	0.9860 (12)	3.9645 (3)	3.8456 (1)	2.4994 (18)
8.	Printing, Publishing and Allied	1.0367 (10)	2.7886 (16)	0.5776 (17)	5.9289 (2)
9.	Leather, Leather and Fur Products	1.0433 (9)	3.9482 (4)	0.8924 (6)	5.4042 (8)
10.	Rubber and Plastic Products	1.1306 (3)	3.4501 (10)	0.9876 (5)	4.6359 (13)
11.	Chemical and Chemical Products	0.9811 (13)	3.6108 (9)	0.8318 (7)	5.0557 (10)
12.	Non-metallic mineral products	0.8492 (14)	3.6952 (7)	0.6670 (12)	5.7566 (5)
13.	Basic Metal and Alloys Industries	1.0741 (8)	3.8358 (5)	1.7551 (2)	3.0524 (17)
14.	Metal Products and Parts	1.1292 (4)	2.9363 (13)	0.7221 (10)	4.8679 (12)
15.	Machinery, Machine Tools and Parts	1.1057 (7)	2.8106 (14)	0.6476 (13)	5.2393 (9)
16.	Electrical Machinery	1.1454 (2)	2.6174 (18)	0.6299 (14)	5.4386 (7)
17.	Transport Equipments and Parts	1.1136 (6)	2.7950 (15)	0.5775 (16)	5.9290 (1)
18.	Other Manufacturing	0.8100 (15)	3.3715 (11)	0.5777 (18)	5.9268 (3)

Figures in parenthesis indicate ranks.

It is evident from the classification of sectors as per Chennery and Watanbe's backward and forward linkages and Table 2 that if we compare Rasmussen's first type of backward and forward linkages (i.e. U_j and U_i) with the Chennery and Watanbe's criterion then the results are almost similar. In other words the sectors, which showing higher or lower backward and forward linkages, are more or the less same according to these two methods. As mentioned earlier these two methods are based on averages and sensitive to the extreme values. So we have also calculated the values of linkages by the Rasmussen's second method, i.e. V_j and V_i. If we compare these values with Chennery and Watabne's method and Rasmussen's first method then the results are quite different.

Classification of Sectors as per Rasmussen's Forward and Backward Linkages Indices

Classification I : Intermediate Primary Production

High $V_i \geq 4.8900$ and Low $V_j \leq 3.4073$

No.	Sector
(4)	Beverage and Malt
(8)	Printing, Publishing and Allied
(15)	Machinery, Machine tools and parts
(16)	Electrical Machinery
(17)	Transport Equipment and parts
(18)	Other Manufacturing.

Classification II: High $V_i \geq 4.8900$ and High $V_j \geq 3.4073$

(6) Wood and Wood products

(9) Leather, Leather and Fur products

(10) Rubber and Plastic products

(11) Chemical and Chemical products

(12) Non-metallic mineral products

Classification III: Low $V_i \leq 4.8900$ and High $V_j \geq 3.4073$

(2) Food products

(3) Sugar, Khandsari and Confectionery

(7) Paper and paper products

(13) Basic Metal and Alloys Industries

Classification IV : Low $V_i \leq 4.8900$ and Low $V_j \leq 3.4073$

(1) Dairy products

(14) Metal products and parts

Above classification of sectors as per Rasmussen's forward and backward linkages indices gives the classification of the 18 sectors of the small scale industries in Rajasthan as suggested by Yan and Ames. We identified the linkage values as high or low on comparing them with the average value of the respective columns.

FOOTNOTES

1. K.K. Saxena, "An Input-Output Model for Registered Small Scale Industries of Rajasthan", unpublished Ph. D. Thesis submitted to Udaipur University, 1981.

2. K.K. Saxena, "Measures of the Sectoral Interdependence in the Input-Output Framework to Identify the "Key" Sectors of an Economy for Future Economic Growth", The Economic Journal of Nepal, Vol. 10, No. 4, Issue 40, October-December 1987.

3. H.S. Chennery and T. Watanbe, "International Comparison of the Structure of Production", Econometrica, Vol. XXVI, October 1958.

4. C.S. Yan, Qualitative Analysis of Input-Output Tables Introduction to Input-Output Economics, Holt, Rinchart and Winston, New York, 1969.

5. Krishna Bhardwaj, "A Note on Structural Interdependence and the Concept of 'Key' sector", Kyklos, Vol. 19, 1966.

6. Ibid., p. 318.

7. C.S. Yan and Ames, "Economic Interrelatedness" Review of Economic Studies, October 1965, No. 4.

8. J.M. Blin and F. Murphy, "On Measuring Economic Interrelatedness", Review of Economic Studies, XLI, 1974.

9. P.N. Rasmussen, Studies in Intersectoral Relations, Amsterdam, North Holland Publishing Co., 1953 and A. Hirschman, The Strategy of Economic Development, New Haven; Yale University Press, 1958.