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Basic Needs and Linkages:
A Case Study of Sri Lanka*

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I. Introduction

This paper takes a critical look at the notion of linkages[1] as guides to sectoral expansion in less developed countries which are defined on the Leontief inverse, $(I-A)^{-1}$. In particular, a distinction is drawn between linkages (typically defined on the inverse of the Leontief technology matrix) and linkages adjusted for basic needs and income inequalities as reflected in the consumption pattern of different income groups. It is argued that the technological indices ignore basic needs and therefore unbalanced (growth) economic expansion based on such indices fails to foster the real process of development. This process in our judgement consists of alleviating poverty and also providing the opportunities for the lower income groups to fulfill their ideas for living lives they would like to lead. Our approach would also highlight Kalecki's concern with the wage-goods bottleneck.[2]

In this paper we utilize the Sri Lankan input-output table and consumption data[3] by income and commodity groups to define the following linkages: (i) Rasmussen forward and backward linkages, (ii) a Rasmussen forward linkage for each income group, and finally (iii) a backward linkage for each income group. In this paper we show that the ranking of industries by these linkages differs. The difference in rankings are

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1 A more detailed treatment of these linkages is available in Rasmussen (1956).
2 See Kalecki (1976).
3 The sources of the data used are given in the Appendix.

substantial enough to suggest that the choice of the correct measure is not a trivial issue. Furthermore, it is shown that if sectors are only chosen on the basis of technology then the poor may be neglected as basic needs need not be necessarily met. Also the Kaleckian wage goods bottlenecks may arise if sectors are chosen on the basis of technological indices.

II. Indices of Interdependence

This part of the paper deals with the methodology used in measuring linkages.

A. The Traditional Method

The analysis of the elements of the matrix $(I-A)^{-1}$ reveals the direct and indirect interdependence of an economy. The Rasmussen measures of linkages are based on an analysis of the elements of this matrix.

The sum of the column elements of the matrix $(I-A)^{-1}$:

$$(1) \qquad \sum_{i=1}^{m} A_{ij} = A_{.j}$$

indicates the total input requirements for a unit increase in the final demand for the jth sector.

In a similar way the sum of the row elements:

$$(2) \qquad \sum_{j=1}^{m} A_{ij} = A_{i.}$$

indicates the increase in the output of sector i needed to cope with the unit increase in the final demand of all the sectors.

The averages:

$$(3) \qquad \frac{1}{m} A_{.j} \quad ; \qquad j = 1 \ \ldots \ m$$

are interpreted by Rasmussen "... as an estimate of the direct and indirect increase in output to be supplied by an industry chosen at random if the final demand for the products of industry number j ($j = 1 \ \ldots \ m$) increases by one unit."

A similar interpretation has been given by Rasmussen to the set of averages:

$$(4) \qquad \frac{1}{m} A_{i.} \quad ; \qquad i = 1 \ \ldots \ m$$

In order to make inter-sectoral comparisons the averages presented in equations (3) and (4) are not suitable. They need to be normalized, so that one can classify sectors as being better or worse than the normalized averages as far as linkages are concerned. The overall average defined below is for normalization purposes:

$$(5) \qquad \frac{1}{m^2}\sum_{j=1}^{m}\sum_{i=1}^{m} A_{ij} = \frac{1}{m^2}\sum_{j=1}^{m} A_{\cdot j} = \frac{1}{m^2}\sum_{i=1}^{m} A_{i\cdot}$$

By using equations (3), (4) and (5) the following terms can be defined:

$$(6) \qquad U_j = \frac{\frac{1}{m} A_{\cdot j}}{\frac{1}{m^2}\sum_{j=1}^{m} A_{\cdot j}} \quad ; \qquad j = 1 \ldots m$$

and

$$(7) \qquad U_i = \frac{\frac{1}{m} A_{i\cdot}}{\frac{1}{m^2}\sum_{i=1}^{m} A_{i\cdot}} \quad ; \qquad i = 1 \ldots m$$

The indices U_j and U_i are known as the 'Index of Power of Dispersion' and 'Index of Sensitivity of Dispersion' respectively. The indices U_j and U_i are also interpreted as measures of Hirschman's backward and forward linkages.[4]

The averages $(1/m)\ A_{\cdot j}$ have been interpreted earlier shwoing the requirements of inputs if the final demand of industry number j increases by one unit, the value of $U_j > 1$ then indicates that the industry draws heavily on the rest of the system, and vice versa in case of $U_j < 1$. Similarly, the value of $U_i > 1$ indicates that the industry number i will have to increase its output more than others for a unit increase in final demand from the whole system.

B. Linkages Adjusted to Reflect Income Distribution

In the case of Sri Lanka we constructed consumption data for eleven income groups for 26 sectors of the input output table. Let C^i denote the consumption vector of the ith income group. Hence, we can construct the

4 Indices of variance have not been constructed. These are not essential for the main point of the present paper.

following output vector for the i th group.

$$(I-A)^{-1}\ (C^i) = (X^i)\ ;\qquad i = 1\ \ldots\ m$$

For the Sri Lankan case the above can be converted to an output matrix as shown below:

$$(8)\qquad (X^i) = \begin{bmatrix} X_1^1 & X_1^2 & \cdots & X_1^{11} \\ X_2^1 & X_2^2 & \cdots & X_2^{11} \\ & - - - - - - - - & & \\ X_{26}^1 & X_{26}^2 & \cdots & X_{26}^{11} \end{bmatrix}$$

The matrix in equation (8) relates the technology to the consumption vectors of the different income groups. It shows the output requirements of different income groups and the consumption pattern associated with them. Consider Row 1 ($X_1^1\ X_1^2\ ..X_1^{11}$). The term X_1^1 shows the direct and indirect output requirement for supporting the consumption of group 1 which is the lowest income group. The term X_1^2 shows the direct and indirect output requirement of commodity 1 by income group 2 and so on. Hence, the vector (X_1^1, X_1^2 .. X_1^{11}) shows the direct and indirect output requirement of commodity 1 by different income groups. We can, therefore, define a forward linkage based on the consumption pattern and underlying income distribution in the following manner:

$$(9)\qquad \frac{\frac{1}{m}\sum_{i=1}^{m} X_j^i}{(\frac{1}{m})\sum_{j=1}^{n}\sum_{i=1}^{m} X_j^i} = U_j^I\ ;\quad j = 1, \ldots\ldots, n$$

These linkages can then be compared with U_j. If the rankings differ substantially then it is clear that linkages based on technology may not meet the social requirements of the system. The socially important sectors in terms of forward linkage are shown by U_j^I.

It is also possible to construct a backward linkage based on the matrix in equation (8). Let us first provide an interpretation for one of the columns, for example, (X_1^1, X_2^1, X_3^1 .. X_{26}^1). This column vector shows the direct and indirect output requirements of the consumption pattern of group 1 (the lowest income group) from all the sectors in the economy. Thus it shows the backward linkage of group 1's consumption pattern. We construct this index in the following manner:

$$(10) \qquad \frac{\frac{1}{n}\sum_{j=1}^{n} X_j^i}{\left(\frac{1}{mn}\right)\sum_{j=1}^{n}\sum_{i=1}^{m} X_j^i} = U_i^I \; ; \quad i = 1, \ldots, 11$$

By using equation (10) we obtain 11 backward linkages for the 11 income groups for whom data is available.

III. Results

Table 1 records the following variables: (1) the backward linkage, (ii) the forward linkage and (iii) the forward linkage adjusted for consumption pattern and income distribution. The backward linkage has been computed for the sake of completeness. No further comments will be made regarding this linkage.

We shall focus our attention on the forward linkages (columns 2 and 3 of Table 1). On the basis of the technological linkage the following sectors are important: Coconut, Paddy, Other Agriculture, Other Manufacturing, Petroleum and Gas, Electricity, Trade and Transport, Copra and Dessicated Coconut.

When adjustments are made for consumption pattern and income distribution the following sectors emerge as important in terms of forward linkage: Paddy, Other Agriculture, Rice, Milling, Food Processing, Other Manufacturing, Construction, Petroleum and Gas, Trade and Transport and other services. The following sectors are common to both types of measurement: Paddy, Other Agriculture, Other Manufacturing, Construction, Petroleum and Gas, and Trade and Transport and Other Services. Thus the ranking of sectors changes when the difference in the consumption pattern is taken into account. The rank correlation between these measures turns out to be 0.506 pointing to the importance of the effect of differnces in consumption pattern of different income groups.

We now proceed to present the relating to the backward linkage for each income group. These are presented in Table 2. It is clear that under the income of Sri Lankan Rs. 800 no income group has a strong backward linkage. Thus the consumption of the relatively and absolutely poor does not create any strong backward linkages. All income groups above the Sri Lankan Rs. 800 mark (with the exception of Sri Lankan Rs. 2,501-3,000 group) create strong backward linkages.

IV. Concluding Remarks

Table 1

BACKWARD AND FORWARD LINKAGES

Sector	Backward Linkage (Traditional) (1)	Forward Linkage (Traditional) (2)	Forward Linkage with Income Distribution (3)
1. Tea	0.888	0.691	0.146
2. Rubber	0.777	0.712	0.022
3. Coconut	0.779	1.461	0.804
4. Paddy	0.908	1.398	2.214
5. Other Agriculture	0.763	1.091	3.149
6. Mining & Quarrying	0.710	0.877	0.123
7. Rice Milling	1.568	0.701	2.111
8. Flour Milling	0.813	0.784	0.671
9. Copra and Dessicated Coconut	1.241	1.110	0.116
10. Coconut Oil	1.503	0.718	0.197
11. Textiles	0.909	0.793	0.497
12. Garments	0.881	0.693	0.196
13. Transport Equipment	0.837	0.711	0.067
14. Electrical Equipment	0.905	0.701	0.095
15. Other Machinery	1.089	0.759	0.012
16. Light Engineering	0.933	0.753	0.063
17. Food Processing	1.045	0.724	2.695
18. Agro-chemicals	1.712	0.778	0.110
19. Structural Clay Products	1.168	0.809	0.323
20. Other Manufacturing	1.110	1.118	1.187
21. Basic Metal	0.921	0.794	0.036
22. Construction	1.081	0.959	1.049
23. Petroleum and Gas	0.733	2.441	1.636
24. Electricity	1.001	1.079	0.236
25. Trade and Transport	0.827	2.359	4.426
26. Other Services	0.892	0.986	3.817

Table 2

Income Group	Backward Linkage for Each Income Group
0 — 100	0.002
101 — 200	0.018
201 — 400	0.185
401 — 600	0.512
601 — 800	0.860
801 — 1,000	1.089
1,001 — 1,500	2.317
1,501 — 2,000	1.545
2,000 — 2,500	1.056
2,501 — 3,000	0.829
over 3,000	2.585

Our results clearly show the importance of drawing a distinction between technological linkages and linkages adjusted for the needs of different income groups. Unbalanced growth[5] paths based on investment strategy of expanding the technologically defined key sectors may run into wage-goods bottlenecks. Such bottlenecks arise if commodities required to meet the growing basic needs (growth in demand generated by investment) of the society are not produced in adequate quantities. This problem would not exist in a system where technological linkages and basic needs adjusted linkages gave almost identical ranking. Unbalanced growth paths could be advocated in such a system. Balanced growth is essential in a system where a disparity exists in the ranking of sectors by technology and basic needs. In the presence of disparities it is important to follow a balanced growth[6] approach to avoid wage-goods (basic needs) bottleneck.

5 The main proponent of unbalanced growth is Hirschman (1958).
6 The idea of balanced growth is expounded in Nurkse (1953).

Appendix

Data Sources

The main data of this study is the 1981 input-ouput table for Sri Lanka prepared by the Ministry of Finance and Planning. Although the original 1981 input-output table contains 24 sectors, we modified this table to create two more sectors, namely, copra and dessicated coconut and coconut oil.

To disaggregate private consumption vector of the 1981 input-output table among the 11 income groups, we obtained cross-section data from the Report on Consumer Finances and Socio-Economic Survey — 1981/82 conducted by the Central Bank of Ceylon. This report provides expenditure data on most of consumption items according to the different income groups. We aggregate some of these items of consumption expenditure, to make consistent with the input-output commodity classification.

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