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Analysis of Inter-Industry Relations in Pakistan for 1975-76

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INTRODUCTION

Input-Output tables provide a detailed accounting of the goods and services that individual industries buy from and sell to each other, and, therefore, constitute a useful medium for an analysis of the interdependent nature of the various sectors of an economy. The PIDE's release of input-output (I-O) tables of Pakistan's economy for the year 1975-76 [9] is an important contribution in this respect. An 'open' output determination of model of the Leontief type[1] is applied to the said data base to delineate the structural interdependence of Pakistan's economy. Some salient features of the economy such as sectoral distribution of the value added, cost composition of the value of sectoral outputs, output and income multipliers are discussed in Section I. The notion of interdependence arising through technological interconnections between various sectors implies structural linkages – both 'backward' and 'forward'. Quantification of these linkages provides an effective way of identifying "key sectors" of the economy. Section II discusses the methodology used and the empirical results obtained pertaining to key sectors of the Pakistan's economy. Some concluding remarks are offered in Section III.

I. SOME ASPECTS OF THE STRUCTURAL CHARACTERISTICS OF PAKISTAN'S ECONOMY, 1975-76

Some structural indicators of the economy of Pakistan derived from the I-O tables for the year 1975-76 are presented in Table 1. During the year in question goods and services worth Rs. 243.3 billion were producted. This resulted in generating of about Rs. 117 billion worth of gross domestic product (at factor cost) – 48

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[1] The formal structure of the model is given in the appendix to this paper.

percent of the total output. The direct import content of goods and services embodied in production amounted to Rs. 21 billion. Almost similar amount was spent on the imports of goods and services for final consumption. The total import bill accounted for some 34.4 percent of the gross domestic product at market prices.

Table 1

Some Structural Indicators Derived from Input-output Tables of Pakistan's Economy: 1975-76

	Structural Indicators		(Million Rupees)
1.	Gross value of total output		243,340
2.	Gross Domestic Product (factor cost)		116,816
3.	Indirect taxes less subsidies		3,754
4.	Gross Domestic Product (market prices)		120,570
5.	Value of total imports		41,548
6.	Total imports as a proportion of GDP (market prices)		0.344
7.	GDP (factor cost) as a proportion of total output		0.480
8.	Total intermediate demand for goods and services produced		122,770
	From domestic sources	101,877	
	From imports	20,893	
9.	Total final demand of goods and services produced		161,997
	From domestic sources	141,342	
	From imports	20,655	
10.	Domestic intermediate use as a proportion of total output		0.42

Source: [9].

An economy's sectoral interdependence is characterized by the amount of goods and services it delivers to various sectors of the economy for further processing. Pakistan's economy delivered about 42 percent of the output (Rs. 102 billion) for intermediate use. This proportion rises to about 51 percent if imports are taken into account. This compares favourably with the situation that existed in 1954 when the intermediate use of the output stood at 36 percent [8].

Primary production activities contributed 35 percent of the gross value added at factor cost and 33.9 percent of the gross value added at market prices. Manufacturing activities accounted for 11.7 percent and 14.4 percent of the gross value added at factor cost and market prices, respectively. Tertiary activities explain

shares of 53.3 percent and 51.7 percent of the gross value added at factor cost and market prices respectively.

The maximum contribution is made by "agriculture" (crop sector) alone – 22.1 percent of gross domestic product (GDP) at factor cost and 21.4 percent at market prices. The second largest contribution of 15.2 percent and 14.7 percent is made by wholesale and retail sector respectively. This is followed by livestock sector which accounts for 10.8 percent of GDP at factor cost and 10.4 percent in market prices. Although maufacturing industries as a group contribute about 12 percent of GDP at factor cost, it is important to note that of the 81 manufacturing industries there are only seven industries whose contribution is of any significance – five-tenths of one percent or slightly more.

The disaggregation of the value added by 118 sectors has provided an improvement, for analytical purposes, over the traditional 11-sector National Accounts presentation. This improvement is, however, restricted by the fact that various components of the value added – wages and salaries, income of unincorporated business, operating surplus – have not been spelled out. This additional information is essentially required in its own right but is also crucial to link income (of the households) to consumption expenditures – an element required to derive the 'closed' I-O model for the economy.

The cost of material inputs and services (both domestic and imported) for the economy as a whole accounted for 50.4 percent of output with taxes, while the gross value added at factor cost comes to 48 percent. Taxes (less subsidies) account for 1.6 percent of the output.

The taxes are maximum for cigarettes and other tobacco products (sector 026), explaining about 50 percent of the value of output. On sugar refining they account for 25 percent of the value of output, whereas perfumes and cosmetics (sector 045) and paints and varnishes (sector 046) explain about 24 percent and 20 percent taxes, respectively.

The cost of material inputs expressed as the percentage value of output with taxes is highest for cotton ginning (sector 063), rice husking (sector 069), *gur* and *khandsari* (sector 070), and edible oils (sector 071), explaining more than 90 percent of the value of output. Rice milling (sector 018) and steel furniture (sector 082) account for 84 percent or more of the cost of the materials used.

For sectors in which indirect taxes on outputs as well as cost of materials and services are low, the share of the value added at factor cost is high and vice versa. Mostly, primary activities like fishing (sector 014), forestry (sector 015), and mining and quarrying (sector 016) fall in this category. Similarly, in public services like water transportation (sector 112), radio (sector 114), and telephones, telegraphs and post (sector 115) the cost of materials accounts for only 18 to 20 percent with correspondingly very high value added.

Impact Analysis

The relationship between the initial expenditure and the total effect triggered by the expenditure is known as the impact of the sector on the economy as a whole – the multiplier effect. As such, the study of multipliers has come to be called impact analysis. The modern concept of income multipliers is usually associated with Keynes [2]. Since Keynes dealt with broad aggregates, his income and employment multipliers were also highly aggregated. Although these aggregative multipliers are useful analytical tools, they do not show the details of how multiplier effects are worked out throughout the economy.

Analysts are most often interested in sectoral details rather than in overall impact. Assume, for example, that one wishes to measure the disaggregated effects of the initial stimulus to the agriculture sector of the economy. There will be undoubtedly an immediate (direct) impact on this sector, but how will these effects of stepped up activity in agriculture ramify throughout the economy? Given the interdependent nature of economic activities, it is apparent that the *total* impact will not be limited to those industries that are directly affected. Sectoral multipliers, derived from an I-O model, provide this important and useful information.

The impact matrix for the industries under study captures both the direct and indirect requirements of domestically produced commodities and services per rupee of delivery to final demand.[2] The direct inputs are those used by the industry under consideration, whereas indirect input requirements refer to the inputs purchased by all other industries in which production is required to enable them to supply inputs to the first industry, and so on. Thus, an impact matrix traces the total impact of an initial stimulus throughout the economy.

In a fashion analogous to output multipliers, one can also compute value-added (or income) multipliers. These relate to the sectoral income arising as a result of a unit increase in final demand.[3]

Income and Output multipliers calculated for 118 sectors of Pakistan's economy for 1975-76 are presented in Table 2. Column (1) of this table shows observed direct value added coefficients, whereas in Column (2) total value added in each of the sectors is shown. If we divide the values reported in Column (2) by their corresponding values in Column (1), we would obtain what is described as income or value added multipliers.[4] In Column (4) the output multipliers for the sectors in

[2] The impact matrix of the economy of Pakistan is not being reproduced in this paper. It is, however, available on request, from the Pakistan Institute of Development Economics, Islamabad.

[3] The formulation of income multipliers is given in the appendix to this paper.

[4] The reported multipliers, it should be pointed out, are "partial multipliers" as these refer to an open I-O model used in this study. "Complete multipliers are obtained when the model is closed to the households. Consult Moore [6] for a detailed explanation of the distinction.

Table 2

Sectoral Multipliers

	Income			Output
	Direct VA Coeff.	Total VA Coeff.	Multiplier	Output Multiplier
001 Wheat Growing on Small Farms	0.5956	0.7582	1.2730	1.0658
002 Wheat Growing on Large Farms	0.5438	0.8380	1.5411	1.0598
003 Rice Growing on Small Farms	0.5721	0.6833	1.1945	1.0268
004 Rice Growing on Large Farms	0.2954	0.4392	1.4867	1.0368
005 Cotton Growing on Small Farms	0.6002	0.9156	1.5255	1.0210
006 Cotton Growing on Large Farms	0.5609	0.9878	1.7609	1.0223
007 Sugar-cane Growing on Small Farms	0.6625	0.7782	1.1747	1.0384
008 Sugar-cane Growing on Large Farms	0.6611	0.8236	1.2459	1.0307
009 Tobacco Growing	0.7391	0.8825	1.1940	1.0463
010 Oilseeds other than Cotton Seeds	0.6012	0.6426	1.0689	1.0130
011 Pulses	0.2357	0.2709	1.1493	1.0757
012 Other Crops	0.6228	1.5164	2.4349	1.1104
013 Livestock	0.5684	2.2975	4.0422	1.0635
014 Fishing	0.8609	0.9484	1.1016	1.0000
015 Forestry	0.7904	1.6197	2.0491	1.0003
016 Mining and Quarrying	0.6378	3.3272	5.2168	1.0378
017 Grain Milling	0.1511	0.1653	1.0943	1.0000
018 Rice Milling	0.1524	0.1524	1.0000	1.0000
019 Sugar Refining	0.1575	0.2802	1.7787	1.0000
020 Edible Oils	0.0729	0.2835	3.8917	1.8222
021 Tea Blending	0.1738	0.4415	2.5401	2.5401
022 Fish and Fish Preparations	0.1460	0.1460	1.0000	1.0000
023 Confectionery and Bakery	0.1804	0.1804	1.0000	1.0000
024 Other Food Industries	0.2639	0.3030	1.1481	1.0189
025 Beverages	0.3414	0.3605	1.0558	1.0525
026 Cigarettes and other Tobacco Products	0.1380	0.1380	1.0000	1.0000
027 Cotton Yarn	0.2503	1.0643	4.2529	1.0139
028 Cotton Fabrics	0.2097	0.4973	2.3720	1.0050
029 Silk and Synthetic Textiles	0.1382	0.4672	3.3803	1.2075
030 Woollen Textiles	0.2592	0.3557	1.3723	1.0153
031 Hosiery	0.0522	0.0523	1.0014	1.0014

Continued –

Table 2 – (*Continued*)

	Income			Output
	Direct VA Coeff.	Total VA Coeff.	Multiplier	Multiplier
032 Thread Ball Making	0.1898	0.1982	1.0438	1.0000
033 Carpets and Rugs	0.3074	0.3074	1.0000	1.0000
034 Other Textiles	0.2756	0.5320	1.9304	1.1518
035 Footwear other than Rubber Footwear	0.1092	0.1092	1.0000	1.0000
036 Wearing Apparel	0.3763	0.3763	1.0000	1.0000
037 Wood, Cork and Furniture	0.2604	0.3584	1.3764	1.2118
038 Paper, Paper Board and Paper Product	0.2858	1.1381	3.9815	1.3273
039 Printing and Publishing	0.2790	0.4603	1.6497	1.0449
040 Leather and Leather Products	0.1956	0.6780	3.4670	1.0403
041 Rubber Footwear	0.1009	0.1009	1.0000	1.0000
042 Other Rubber Products	0.1610	0.4311	2.6779	1.0292
043 Pharmaceutical and Medicinal Preparation	0.1055	0.1177	1.1164	1.0641
044 Fertilizer	0.3263	0.6368	1.9516	1.0001
045 Perfumes and Cosmetics	0.1470	0.1470	1.0000	1.0000
046 Paints and Varnishes	0.0411	0.1102	2.6779	1.1685
047 Soaps and Detergents	0.1305	0.1306	1.0005	1.0000
048 Matches	0.1234	0.1234	1.0000	1.0000
049 Other Chemicals	0.3355	1.5182	4.5251	1.1765
050 Plastic Products	0.3572	0.4953	1.3867	1.0178
051 Petroleum Products	0.1506	2.5824	17.1451	1.0719
052 Cement	0.2089	0.6750	3.2319	1.0001
053 Glass and Glass Products	0.1164	0.3419	2.9378	1.2202
054 Other Non-Metallic Mineral Products	0.3104	0.4431	1.4276	1.0004
055 Basic Metals	0.1794	4.2345	23.6068	1.9543
056 Metal Products	0.1927	1.2542	6.5079	1.0172
057 Agricultural Machinery	0.0761	0.1533	2.0147	1.0001
058 Other Non-Electrical Machinery	0.3381	1.4393	4.2570	1.0710
059 Electrical Machinery	0.1495	0.6200	4.1473	1.5466
060 Bicycles	0.1989	0.1989	1.0000	1.0000
061 Auto-Assembly and Parts	0.2324	0.5559	2.3921	1.1085
062 Ship Building	0.4575	0.5762	1.2594	1.0000
063 Cotton Ginning	0.0876	0.8907	10.1658	1.0051

Continued –

Table 2 – (*Continued*)

	Income			Output
	Direct VA Coeff.	Total VA Coeff.	Multiplier	Multiplier
064 Office Equipment	0.0503	0.1191	2.3684	1.0178
065 Sports Goods	0.3783	0.3783	1.0000	1.0000
066 Surgical Instruments	0.5335	0.5345	1.0019	1.0000
067 Other Large-scale Manufacturing	0.5629	0.9035	1.6053	1.0056
068 Grain Milling	0.0693	0.0960	1.3845	1.0000
069 Rice Husking	0.0983	0.1634	1.6627	1.0000
070 Gur and Khandsari	0.0871	0.0917	1.0538	1.0000
071 Edible Oils	0.0909	0.1022	1.1245	1.0000
072 Other Food Industries	0.3914	0.3966	1.0133	1.0000
073 Beverages	0.4434	0.4434	1.0000	1.0000
074 Tobacco	0.3297	0.5022	1.5231	1.5231
075 Cotton Textiles	0.2275	0.3680	1.6174	1.1646
076 Silk and Artsilk Textiles	0.1697	0.1697	1.0000	1.0000
077 Carpets	0.4563	0.4608	1.0098	1.0000
078 Other Textiles	0.0747	0.6271	8.3963	1.6605
079 Shoe Making	0.4330	0.4330	1.0000	1.0000
080 Wood	0.3954	0.5826	1.4736	1.0004
081 Furniture	0.4866	0.4890	1.0048	1.0000
082 Steel Furniture	0.1602	0.1602	1.0000	1.0000
083 Printing and Publishing	0.1856	0.1940	1.0451	1.0002
084 Leather Goods	0.3769	0.5572	1.4784	1.0003
085 Rubber Products	0.1669	0.1936	1.1601	1.1026
086 Chemicals	0.2218	0.4087	1.8424	1.8135
087 Plastic Products	0.4058	0.7481	1.8436	1.4121
088 Non-Metallic Mineral Products	0.2680	1.0096	3.7669	1.7033
089 Iron and Steel Remoulding	0.5425	0.8699	1.6036	1.1819
090 Metal Products	0.7695	0.9397	1.2211	1.0045
091 Agricultural Machinery	0.5284	0.5284	1.0000	1.0000
092 Non-Electrical Machinery	0.4747	0.4799	1.0109	1.0033
093 Electrical Machinery	0.2935	0.3181	1.0838	1.0485
094 Transport Equipment	0.3925	0.3925	1.0000	1.0000
095 Sports Goods	0.3583	0.3583	1.0000	1.0000
096 Surgical Instruments	0.0814	0.0814	1.0000	1.0000
097 Other Small-scale Manufacturing	0.3459	0.3459	1.0000	1.0000
098 Low-cost Residential Buildings	0.4366	0.4610	1.0558	1.0000

Continued –

Table 2 – (*Continued*)

	Income			Output
	Direct VA Coeff.	Total VA Coeff.	Multiplier	Multiplier
099 Luxurious Residential Buildings	0.3997	0.4078	1.0204	1.0000
100 Rural Buildings	0.5000	0.5345	1.0689	1.0000
101 Factory Buildings	0.4036	0.4550	1.1274	1.0001
102 Public Buildings	0.4258	0.4258	1.0000	1.0000
103 Roads	0.5549	0.5549	1.0000	1.0000
104 Infrastructure	0.4165	0.4165	1.0000	1.0000
105 Ownership of Dwellings	0.8997	0.8997	1.0000	1.0000
106 Electricity	0.7671	1.3193	1.7199	1.0012
107 Gas	0.8159	1.3756	1.6860	1.0059
108 Wholesale and Retail Trade	0.9449	6.0205	6.3714	1.0026
109 Road Transportation	0.3157	2.9445	9.3270	1.0430
110 Rail Transportation	0.5510	0.9730	1.7658	1.0056
111 Air Transportation	0.4092	0.4372	1.0685	1.0001
112 Water Transportation	0.8198	0.8232	1.0041	1.0000
113 Television	0.5354	0.5534	1.0335	1.0003
114 Radio	0.7669	0.7760	1.0118	1.0001
115 Telephone, Telegraph and Post	0.8055	1.0267	1.2747	1.0159
116 Banking and Insurance Services	0.7285	1.7674	2.4259	1.0275
117 Government Services	0.5342	1.5582	2.9169	1.1704
118 Services, N.E.S.	0.9581	2.6976	2.8155	1.0052
Total	42.8801	85.4257	267.2137	128.4732

question are reported. These are the diagonal elements of the impact matrix and, therefore, do not indicate the impact on the economy as a whole.

A unit increase in the bill of final demand, for example, for wheat growing on small farms (sector 001) leads to an increase of Rs 1.06 in output in this sector. This results in an increase of Rs 1.27 in income in this sector. The largest output multiplier value of 2.54 is recorded for tea blending (sector 021) which is followed by basic metals (sector 055) and edible oils (sector 020) having multiplier values of 1.95 and 1.82, respectively. The largest income increases are reported by basic metals (sector 055), petroleum products (sector 051), and cotton ginning (sector 063) with values of 23.60, 17.14, and 10.16, respectively.

The above sectoral summary measures, based as they are on an I-O model of Pakistan's economy, can serve as a useful guide to an analyst in choosing between competing alternatives of income generation versus output stimulation.

II. STRUCTURAL LINKAGES AND KEY SECTORS IN PAKISTAN'S ECONOMY

Hirschman [4] has been instrumental in defining operationally the linkage effects and also in describing the causal link between linkages and economic development. The structural linkages can be analysed in two ways. An activity absorbs inputs from others and, as such, whenever it operates at a positive level, it provides stimulus for the expansion (or initiation) of production in the input-providing industries – the backward linkage effect. Secondly, an activity provides inputs to other industries and, in so doing, either through the cheapening of its products or through greater availabilities, stimulates increases in the output levels of the absorbing industries – the forward linkage effect. The potential importance of a particular sector in generating growth depends upon the strength of these stimuli, and it is argued that the backward linkage effects, which are more powerful in their operation than the forward linkage effects, could be used as a basis for development planning.

Following earlier studies,[5] we have used the I-O table of Pakistan's economy for 1975-76 to empirically determine these linkages. A measure of backward linkage for any industry may be defined as the ratio of its intermediate consumption to its total output [1]. Correspondingly, the forward linkage for any industry may be estimated as the ratio of intermediate demand for the output of that industry to the total availability of the output of that industry. These are, however, average measures and do not give the distribution of inputs or deliveries among the various industries. Thus, these estimates of linkages do not distinguish between industries which have highly skewed inputs or deliveries pattern and those whose structural relations might be more even.

A more refined way of computing these linkages has been suggested by Rasmussen [7] who makes use of the inverse matrix for this purpose. We have utilized his formulation in this paper.[6]

Concept of a Key Industry

Having operationally defined backward and forward linkages, we may define a 'key' industry as one for which (a) both $K_{\cdot j}$ and $K_{i \cdot}$ are greater than unity; and (b) both $L_{\cdot j}$ and $L_{i \cdot}$ are relatively low. This designation of a key industry can be defended on the ground that if $K_{\cdot j}$ is relatively large and $L_{\cdot j}$ is relatively low, an increase in the final demand for the products of industry j would cause a relatively greater share of the increase in final demand to be returned to the system of industries in general. And it can be argued that large effects on other industries are

[5] Some relevant studies are by Hazari [3], Hirschman [4], Rasmussen [7], Laumas [5], and Syed [10].

[6] See appendix to this paper for the exact formulation used in this study.

the most significant characteristics of a key industry. This formulation also follows Hirschman's characterization of a key industry in that he defines a key industry as one which has a high backward as well as forward linkage.

Industries with high backward and forward linkages as well as key industries determined on the basis of the formulation discussed above are shown in Table 3. An examination of this table reveals that of the 118 industries examined there are only 26 industries that show high backward linkages. The number of industries with high forward linkages is 34. Of the high backward-linkage industries road transportation (sector 109), petroleum products (sector 051), and other chemicals (sector 149) show relatively strong backward linkages, whereas agricultural machinery (sector 057), cotton fabrics (sector 043), and soaps and detergents (sector 047) are among the industries showing strong forward linkages.

Based on the chosen criterion, only 6 industries – out of a total of 118 industries – can be designated as key industries. These are cotton yarn (sector 027), silk and synthetic textiles (sector 029), metal products (sector 056), other non-electrical machinery (sector 058), electrical machinery (sector 059), and other textiles (sector 078).

It should be borne in mind that characterization of key industries, as has been reported in this study, is by no means unique. Another criterion, such as employment generation or final demand propogation, may result in the choice of a quite different set of key industries from the one identified here. Our choice is dependent entirely on technological considerations – that is, an analysis of the inverse matrix of the economy of Pakistan.

III. CONCLUDING REMARKS

The PIDE's release of I-O table of Pakistan's economy for 1975-76 has provided a rich data-base for analysing the interdependent nature of the various sectors of the economy. Applying the traditional Leontief type open I-O model to this database, this paper has highlighted some aspects of the structural characteristics of the economy. Sectoral income and output multipliers, based on the impact matrix, have been estimated. Relatively large income multipliers have been obtained for basic metals, petroleum products, and cotton ginning, whereas tea-blending, and edible oils report high output multipliers. Analysis of the impact matrix has been extended further to quantify backward and forward linkages. Based on these indices, key industries for the economy have been identified. They include cotton yarn, metal products, and silk and synthetic textiles, among others.

Table 3

Structural Linkages and Key Industries: Pakistan, 1975-76

Industry	High Backward Linkage & Low Coeff. of Variation		Industry	High Forward Linkage & Low Coeff. of Variation		Industry	Key Industries			
	$K_{\cdot j}$	$L_{\cdot j}$		$K_{i \cdot}$	$L_{i \cdot}$		$K_{\cdot j}$	$L_{\cdot j}$	$K_{i \cdot}$	$L_{i \cdot}$
005	1.17	4.27	018	1.22	3.91					
006	1.44	3.51	023	1.22	3.91					
012	1.58	3.45	027	1.22	5.53	027	2.07	2.79	1.22	5.53
013	2.76	2.04	028	1.24	4.23					
015	1.61	3.08	029	1.19	5.70	029	1.22	4.95	1.19	5.70
016	4.09	1.48	031	1.39	3.44					
020	1.28	6.89	032	1.25	3.81	056	1.95	3.32	1.28	4.68
027	2.07	2.79	034	1.16	4.76					
029	1.22	4.95	035	1.33	3.59	058	2.42	2.65	1.19	5.62
038	2.02	3.24	036	1.13	4.25					
040	1.10	5.36	041	1.15	4.16	059	1.09	6.92	1.29	5.79
049	3.07	1.99	042	1.19	4.26					
051	3.67	1.84	043	1.22	4.18	078	1.30	6.41	1.55	5.33
056	1.95	3.32	046	1.12	5.03					
058	2.42	2.65	047	1.28	3.73					
059	1.09	6.92	056	1.28	4.68					
063	2.12	2.67	057	1.50	3.18					

Continued –

Table 3 – (*Continued*)

Industry	High Backward Linkage & Low Coeff. of Variation		Industry	High Forward Linkage & Low Coeff. of Variation		Industry	Key Industries			
	$K_{\cdot j}$	$L_{\cdot j}$		$K_{i\cdot}$	$L_{i\cdot}$		$K_{\cdot j}$	$L_{\cdot j}$	$K_{i\cdot}$	$L_{i\cdot}$
078	1.30	6.41	058	1.19	5.62					
088	1.27	6.60	059	1.29	5.79					
106	1.28	3.86	060	1.33	3.59					
107	1.29	3.80	061	1.13	4.68					
108	8.19	1.11	062	1.33	3.63					
109	4.21	1.51	064	1.11	4.43					
116	2.14	2.40	068	1.18	4.05	Average $L_{\cdot j}$ = 8.64				
117	1.67	3.44	069	1.29	3.74					
118	2.73	1.94	071	1.29	3.70	Average $L_{i\cdot}$ = 5.88				
			075	1.30	4.27					
			076	1.31	3.65					
			078	1.55	5.33					
			083	1.21	3.95					
			085	1.14	4.63					
			093	1.19	4.23					
			096	1.16	4.14					
			097	1.15	4.18					

Appendix

AN OUTPUT DETERMINATION MODEL OF PAKISTAN'S ECONOMY

The formal structure of the I-O accounts for the economy can be expressed as

$$g_i = M_i + X_i = \sum_j X_{ij} + F_i = W_i + F_i \qquad \ldots \qquad \ldots \qquad (1)$$

$$X_j = \sum_i X_{ij} + V_j = U_j + V_j \qquad \ldots \qquad \ldots \qquad (2)$$

$$(i = 1, \ldots, n)$$
$$(j = 1, \ldots, n)$$

where

g_i = total supply of commodity i;
X_i = total production of commodity i;
M_i = imports of commodity i;
X_{ij} = amount of commodity i used in sector j;
F_i = total final demand for commodity i;
W_i = total intermediate use of commodity i $(\sum_j X_{ij})$;
U_j = total use by sector j of inputs purchased from other industries $(\sum_i X_{ij})$; and
V_j = total use of primary inputs (value added) in sector j.

Equation (1) states that for each commodity total supply is equal to demand, which is composed of intermediate demand plus final demand, whereas equation (2) implies that total production in each sector is equal to the value of inputs purchased from other sectors plus the value added in that sector.

Assuming that a given product is supplied only by one sector, that there are no joint products, and that the amount of each input used in production by any sector is determined by the level of the output of that sector, we can write

$$X_{ij} = a_{ij} X_j \qquad \ldots \qquad \ldots \qquad \ldots \qquad (3)$$

Substituting (3) into (1) yields

$$X_i - \sum_j a_{ij} X_j = F_i - M_i \qquad \ldots \qquad \ldots \qquad (4)$$

or, more generally,

$$X - AX = F$$

$$X = (I - A)^{-1} F \qquad \ldots \qquad \ldots \qquad (5)$$

SECTORAL INCOME MULTIPLIERS

Sectoral value added (or income) multipliers can be calculated as

$$K_i\ v_i\ (c_{i1}F_1 + C_{i2}F_2 + \ldots\ldots + c_{in}F_n) \qquad \ldots \qquad \ldots \qquad (6)$$

where

K_i = value added (total) in sector i;
v_i = ratio of value added (direct) to the value of sectoral output;
F_i = final demand of outputs of sector j; and
c_{ij} = elements of the inverse matrix $(I\text{-}A)^{-1}$.

STRUCTURAL LINKAGES : BACKWARD AND FORWARD

Rewriting equation (5) as

$$X = CF \qquad \ldots \qquad \ldots \qquad \ldots \qquad (7)$$

where $C = (I\text{-}A)^{-1}$, let us denote the sum of the column and row elements, respectivley, as

$$\sum_{i=1}^{n} c_{ij} = C_{\cdot j} \qquad \ldots \qquad \ldots \qquad \ldots \qquad (8)$$

$$\sum_{j=1}^{n} c_{ij} = C_{i\cdot} \qquad \ldots \qquad \ldots \qquad \ldots \qquad (9)$$

For making suitable inter-industry comparisons, we use the following indices as suggested by Rasmussen [7] :

$$K_{\cdot j} = 1/n\ C_{\cdot j} \Big/ 1/n^2 \sum_{j=1}^{n} C_{\cdot j} \qquad \ldots \qquad \ldots \qquad (10)$$

$$K_{i\cdot} = 1/n\ C_{i\cdot} \Big/ 1/n^2 \sum_{i=1}^{n} C_{i\cdot} \qquad \ldots \qquad \ldots \qquad (11)$$

Indices $K_{\cdot j}$ and $K_{i\cdot}$ are termed as "index of power of dispersion" and "index of sensitivity of dispersion", respectively. These indices can also be interpreted as measures of Hirschman's backward and forward linkages, respectively.

To avoid the bias created by the averaging principle, Coefficients of Variation of the above indices are constructed and used :

$$L_{\cdot j} = \sqrt{1/n{-}1 \sum_{i=1}^{n} \left(c_{ij} - 1/n \sum_{i=1}^{n} c_{ij}\right)^2} \Big/ 1/n \sum_{i=1}^{n} c_{ij} \qquad \ldots \qquad (12)$$

$$L_{i\cdot} = \sqrt{1/n{-}1 \sum_{j=1}^{n} \left(c_{ij} - 1/n \sum_{j=1}^{n} c_{ij}\right)^2} \Big/ 1/n \sum_{j=1}^{n} c_{ij} \qquad \ldots \qquad (13)$$

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Comments on "Analysis of Inter-Industry Relations in Pakistan for 1975-76"

Let me begin by saying that any work on input-output analysis of the economy of Pakistan is most welcome as this has been my hobby horse throughout my professional career. The technique of input-output analysis was formally introduced in Pakistan's planning in the early Sixties. But I must say that over the last quarter of a century we have not made as much progress in this regard as others have made in similar situations. I take this opportunity to congratulate the Pakistan Institute of Development Economics (PIDE) on reactivating research in this area and, specifically, on their contribution in the form of the input-output table of Pakistan's economy released in 1983, on which the paper under discussion is based.

Before discussing the paper, I must also pay my compliments to Aftab Ali Syed, the author of the paper, who must have put in a tremendous effort in carrying out a number of applications of the input-output technique to the input-output table of the economy of Pakistan. For discussion purposes the entire paper can be divided into three parts.

In the first part of the paper, the author analyses the cost structure of 118 different sectors into which the economy is divided, by looking at the columns of the table. The analysis shows that intermediate inputs account for 90 percent of the gross value of output in the agricultural processing industries, like cotton ginning, edible oils, etc. On the other hand, the value added as a ratio of output is highest for those sectors in which indirect taxes on inputs and outputs are lowest. Examples are fishing, forestry, mining and quarrying, etc.

In the second part, the paper presents the usual exercise of analysing the effect of change in one segment of the economy on the rest of the economy by using the Leontief-type inverse of direct input coefficient matrix. The matrix of 'direct' and "indirect" input coefficients so derived helps the author to quantify the total impact of an initial stimulus throughout the economy, sector by sector.

The last part of the paper is devoted to an analysis of the structural linkages in the inter-industry relationships of the economy. This is done by studying the 'backward' and 'forward' linkage effects with a view to guiding investment policy decisions. Basically, the criterion applied here lays emphasis on interdependence among industries and hence the need for striking a balance in the relative rates of

growth of such interlinked industries as support each other. The idea is to underline the importance of simultaneous creation of effective demand. The second aspect is to explore the technological interdependence among certain industries. Investment decisions would thus be guided by the so-called 'key' sectors of the economy which have the highest technological linkages.

Input-output technique in this case is used to explore such linkages on the following presumptions.

(a) Expansion of a sector obviously provides direct stimulus to its input-delivering sectors. This may be known as the 'backward' linkage effect.
(b) Increase in the level of output of a sector is again usually meant for delivery of its output to another sector, thereby stimulating that sector. This may be called the 'forward' linkage effect.

The potential strength of a particular sector is thus proportional to the above two linkage effects, and, according to the author of the paper, should therefore be used as a basis for investment decisions.

I have two main comments to offer on the paper. My first comment pertains to the third part of the paper, where the input-output technique is used to identify 'backward' and 'forward' linkage effects with the objective of using the same as a guide for investment policy decisions. I believe such an approach is extremely inadequate for the following reason. Whereas an application of such an approach may be appropriate for a technologically advanced economy in which practically all processes of production are already in operation, it would not suit a developing economy, especially when an important element in its development strategy is to pursue a policy of economic diversification. This would mean that it has yet to introduce many new processes. Under such circumstances, making the existing inter-industry relations a basis for new investment decisions would be utterly inadequate. As an illustration, one may look at that stage of Pakistan's economic development in the Sixties when cotton-textile manufacturing was predominant in our industries. Such a framework would hardly provide a clue to introduction of new processes like the Steel Mills and even synthetic fibre plants which are more recent introductions into the system. Obviously, applications of the input-output framework as developed in the third part of the paper would be completely inadequate as a guide for investment decisions under such circumstances.

My second point relates to the weaknesses in basic statistics: while discussing the cost structure in the first part of the paper, the author mentions that manufacturing constitutes 12 percent of the total GDP. If one looks up the latest *Statistical Bulletin,* published by the Federal Bureau of Statistics, Government of Pakistan, the contribution of the manufacturing sector amounts to 20 percent of the total GDP in

Pakistan. In absolute terms, the difference comes to some Rs. 30 billion. I do not blame the author for such a gap, for he could hardly do much while in Canada. But I do believe that such a discrepancy is typical of our statistical gaps which call for an urgent attention to this aspect of the problem before sophisticated applications are made which are essentially dependent on these data.

By the way, my second comment may get higher ranking than the first.

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