THE JORDANIAN SECTORAL LINKAGES, LEADING SECTORS AND IMPORT LEAKAGES
-AN EMPIRICAL AND STRATEGIC STUDY-

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Abstract

The main objective of this paper is to structure and quantify a simple input-output model, to derive the various sectors forward and backward linkages, and to identify the leading sectors of the Jordanian economy. This is besides, quantify the sectoral import leakages, and hence, identify these activities that have a higher potential for strategic import substitution policy.

This paper and its contents considered the first modelling attempt to derive and calculate various sector linkages and import leakages in the economy. That said, such results are of vital important for rational policy making, and for optimal allocation of limited investment resources among various sectors of the economy, to achieve more balanced and sustainable socio-economic development, through time.

Furthermore, the paper has derived various sectoral import leakages. This is very significant indicators for putting forward more realistic future import substitution strategies and

policies. Such import substitution strategies would be based on these derived import leakages factors and sectoral comparative advantages, amongst others.

The empirical solutions of the used models are based on series of input-output tables that have been structured and built for the Jordanian economy as an upper-middle income developing economy. However, the basic fact on setting up this approach, here, was that the series of these used input-output tables, i.e. domestic, total and import tables, are built based, as far as possible, on independent Jordanian data of 2006, together with full use of the existed various Jordanian economic surveys and published data.

Keywords: Input-Output Tables, Techniques, Jordan, Forward and Backward Linkages, Import Leakages, Leading Sectors, Development Strategies, Resources Allocation, Impacts, Analysis.

JEL Classification Codes: 017; R 15

1. Introduction

In order to describe the structural interdependence of the sectors/industries within the economy, two measures have been devised. These are; the backward and forward linkage indices. The first of these indicates the relative ability of an industry or sector to stimulate output amongst the various sectors within the economy, and the other indicates the relative dependence of an industry or sector upon demand of its output by different sectors of the economy.

However, and for the purpose of formulating development growth strategy for the national economy, the linkages have been used to identify the key (leading) sectors in the economy for growth and development. The leading sectors are these sectors which are in a favourable position to induce the expansion and development of other sectors of the economy, and hence to accelerate the development process and stimulate growth in the national economy. These are a

fundamental development measures and issues that we are restrict ourselves to follow in order to deriving the key sectors in the Jordanian economy.

The import leakages from the economy to outside world are also examined and measured and hence potential for import substitution assessed.

2. The Backward and Forward Linkages

The backward linkage, b_j , is define, in an input-output context, as:

$$b_j = \sum_i r_{ij} \qquad \text{……. (1)}$$

Where, r_{ij} , is the elements (cells) of Leontief Inverse matrix $(I-A)^{-1}$. Thus b_j is the total change in the gross output of the economy brought about by one unit change in demand for sector/ industry j output.

The forward linkage, c_i , is defined as:

$$c_i = \sum_j r_{ij} \qquad \text{…….. (2)}$$

This shows the output generated in sector i when final demand in each sector of the economy is increased by one unit.

Having derived the above, an index is constructed to measure the relative strengths of each of the linkages; by dividing each of b_j and c_i by their respective average backward and forward linkages for the Jordanian economy as a whole, that is:

$$v_j = \frac{\sum_i r_{ij}}{n} \Big/ \frac{\sum\sum_{i\ j} r_{ij}}{n^2} \qquad \text{……..(3)}$$

Or using another methodological setting, this as:

$$v_j = n * b_j \Big/ \left(\sum_j b_j\right) \qquad \text{…… (4)}$$

With n as the number of the sectors in the economy, and (*) is sign for multiplication.

While for the forward linkage indices (u_i), the calculation systems are:

$$u_i = \frac{\sum_j r_{ij}}{n} \Big/ \frac{\sum_i \sum_j r_{ij}}{n^2} \qquad \text{……..(5)}$$

Or in another way it can be calculated as:

$$u_i = n * c_i \Big/ \left(\sum_i c_i\right) \qquad \text{……. (6)}$$

Those sectors with a higher than average backward linkage index (i.e. $v_j > 1$) generate an above average response in the other sectors of the economy, and the status for the relative performance of different industries is shown in table (1). These are driven from both; domestic I/O coefficient matrix (A) and total I/O coefficient Matrix (A^T).

A higher than average forward linkage index means that these sectors display above average dependence on the demand from other sector. By increasing the output of such sectors it is hoped that the industries which purchase them will be encouraged by the greater availability of supplies to increase their own output.

The Five main sectors are construction, air Transport, electricity, iron and steel and telecommunications, all of which are major inputs to several other sectors and industries. still,

the remaining leading sectors in this case including; mining, paper and paper products, painting industry, plastic industry and water supply, all of which are purchased by virtually every sector in the economy.

Table 1. The Domestic and Total Sectoral Linkages and Ranking in the Jordanian Economy

#	Sector	Domestic				Total			
		Backward		Forward		Backward		Forward	
		Index	Rank	Index	Rank	Index	Rank	Index	Rank
1	Vegetables	1.125	11	0.744	49	0.956	54	0.536	61
2	Fruits	1.029	31	0.706	64	0.848	63	0.517	65
3	Crops & Other Agriculture	0.778	74	1.610	7	0.597	77	2.736	5
4	Livestock's & Livestock's Products	0.946	54	1.101	19	0.897	57	0.863	28
5	Poultry and Eggs	1.120	12	1.102	18	1.073	32	0.821	30
6	Fishing	0.957	52	0.680	73	0.899	56	0.490	74
7	Crude Oil & Natural Gas	0.712	79	0.714	59	0.541	80	4.901	1
8	Mining	1.020	33	1.347	13	0.882	60	1.012	21
9	Quarrying	0.847	70	1.302	15	0.752	68	1.053	20
10	Meat & Fish Products	1.301	5	0.841	35	1.117	25	0.671	45
11	Olive Oil & Other Oils	1.106	17	0.906	29	1.103	27	0.808	33
12	Dairy products	1.295	6	0.710	62	1.261	6	0.532	62
13	Grain mill products	0.892	61	0.816	38	1.068	34	0.742	39
14	Prepared Animal Feed	1.091	20	0.898	30	1.147	22	0.687	43
15	Bakery Products	1.009	38	0.680	74	1.034	40	0.486	75
16	Sugar & Confectionery	1.070	23	0.717	57	1.179	18	0.687	44
17	Other Food Products	0.897	60	0.973	26	0.747	70	0.782	34
18	Soft Drink Beverages	1.094	19	0.677	76	1.125	24	0.485	76
19	Alcoholic Drinks	0.889	63	0.714	60	0.887	58	0.521	64
20	Tobacco Products	0.986	42	0.864	32	0.873	61	0.761	38
21	Textile Industry	0.937	56	0.733	50	1.001	50	1.222	17
22	Carpets	0.799	73	0.676	77	1.093	30	0.484	78
23	Clothing	0.807	72	0.694	68	1.084	31	0.505	70
24	Leather products	1.016	36	0.783	41	1.207	13	0.769	37
25	Footwear	1.019	34	0.723	56	1.047	38	0.570	55
26	Wood Products Except Furniture	0.976	47	0.760	46	1.027	45	0.770	36

27	Furniture	1.002	39	0.702	67	1.056	35	0.512	68
28	Paper & Paper Products	1.089	21	1.082	23	1.218	10	1.756	9
29	Printing & Publishing	0.979	43	0.863	33	1.028	43	0.698	42
30	Refinery & Refined products	0.729	77	4.099	1	1.029	41	4.080	2
31	Fertilizers & Insecticide	1.349	3	0.943	27	1.202	14	0.734	41
32	Paint Industry	1.064	24	1.016	25	1.240	8	0.998	22
33	Pharmaceuticals products	0.962	51	0.923	28	0.988	51	0.954	25
34	Soap and Detergents	1.117	13	0.724	55	1.158	19	0.561	57
35	Other Chemical Products	0.968	49	1.312	14	1.029	42	3.190	4
36	Rubber products	0.910	59	0.705	65	1.253	7	0.951	26
37	Plastics products	1.032	30	1.085	22	1.192	15	1.291	14
38	Cement Industry	1.036	29	0.873	31	1.007	48	0.635	48
39	Bricks, articles of cement concrete	1.254	7	0.751	47	1.097	28	0.543	58
40	Cutting Shaping Finishing Stone	1.080	22	0.710	61	1.056	36	0.515	67
41	Manufacture of Glass and Clay	0.996	40	0.769	43	1.007	47	0.899	27
42	Other Non-Metallic Minerals	1.110	16	0.726	54	1.151	20	0.574	54
43	Iron and Steel Industry	1.040	28	1.483	10	1.414	3	3.487	3
44	Non Ferrous Metal Industry	0.989	41	1.098	20	1.135	23	2.288	7
45	Basic Metals Products	0.932	58	0.732	51	1.006	49	0.538	60
46	Structural Metals Products	0.938	55	0.764	44	1.186	16	0.634	49
47	Fabricated Metal Products	0.955	53	0.827	37	1.148	21	0.737	40
48	Machinery and Equipments	0.977	46	0.709	63	1.274	5	0.635	47
49	Domestic Appliances	1.010	37	0.681	72	1.227	9	0.496	71
50	Electrical Machinery	0.977	45	0.763	45	1.358	4	0.771	35
51	Engineering Instruments	1.027	32	0.731	52	1.215	11	1.231	16
52	Motor Vehicles Bodies, Trailers	0.874	65	0.690	70	1.183	17	0.810	32
53	Other Transport Equipments	1.228	8	0.688	71	1.212	12	0.492	73
54	Jewellery	0.890	62	0.676	78	1.027	44	0.484	79

55	Other Manufacturing Industries	0.722	78	0.672	81	1.054	37	0.586	52
56	Electricity	1.111	14	1.759	5	1.107	26	1.627	10
57	Water Supply	1.111	15	1.033	24	1.069	33	0.821	31
58	Construction	1.316	4	1.090	21	1.416	2	0.852	29
59	Trade	0.970	48	2.528	3	0.793	65	2.329	6
60	Hotels & Restaurants	1.019	35	0.797	40	0.859	62	0.591	51
61	Road Transport	0.963	50	2.741	2	0.884	59	2.261	8
62	Rail Transport	1.061	25	0.691	69	0.976	53	0.495	72
63	Pipelines transport	0.697	80	1.215	17	0.935	55	0.982	24
64	Sea Transport & Ports	1.194	9	0.676	79	1.036	39	0.484	80
65	Air Transport	1.618	1	1.440	12	1.496	1	1.081	19
66	Services Incidental to Transport	0.979	44	1.247	16	0.775	67	0.996	23
67	Storage & Warehousing	0.868	66	0.800	39	0.670	73	0.584	53
68	Travel, Tour Operators Services	1.356	2	0.677	75	1.097	29	0.485	77
69	Postal Services	1.182	10	0.714	58	0.986	52	0.516	66
70	Telecommunication Services	1.050	26	1.469	11	0.784	66	1.149	18
71	Information &Computer Technology	0.934	57	0.746	48	0.748	69	0.543	59
72	Banking Sector	0.882	64	1.788	4	0.666	74	1.499	11
73	Insurance	1.105	18	0.852	34	0.845	64	0.648	46
74	Other Financial Sector	0.854	68	0.837	36	0.632	76	0.633	50
75	Business Services	0.840	71	1.580	8	0.645	75	1.293	13
76	Real estate	0.764	75	1.521	9	0.560	78	1.244	15
77	Ownership of Dwellings	0.742	76	0.676	80	0.555	79	0.484	81
78	Education	0.849	69	0.729	53	0.692	71	0.527	63
79	Health Services	1.040	27	0.771	42	1.016	46	0.562	56
80	Public Administration and Defence	0.676	81	0.705	66	0.484	81	0.509	69
81	Others Services	0.867	67	1.655	6	0.680	72	1.316	12

3. They Key (Leading) Sectors in the Jordanian Economy

Key or leading sectors are defined as those sectors for which both backward and forward linkages indices are greater than one. They are, accordingly, the basic industries, whose products are distributed as inputs to many other domestic industries, as well as being sold directly to final

demand. At the same time they purchase the products of a considerable number of other industries (sectors) productions in order to produce their outputs. For Jordan the key sectors are:

- Construction
- Iron and Steel
- Plastic Products
- Mining
- Electricity
- Paper and Paper Products
- Poultry and Eggs Products
- Painting Industry
- Water
- Air Transport
- Telecommunications

The most interesting aspect of the above list is the appearance of iron and steel industry products and paper and paper products which, compared with the other sectors there, are relatively underdeveloped sectors and thus offers considerable potential in any growth strategy and future investment plans.

Furthermore, and as mentioned above, there is an economically viable and important remark that worth mentioning at this conjuncture, that measuring key sector in this way may caters inadequately for the capital goods sectors, such as machinery and equipments, motor vehicles, electrical machinery, transport equipment, and general engineering because these sectors sell their output to investment, which is part of the final demand in input-output tables, and hence do not figure significantly in these measures as they depend on intermediate flows. However, the adopted techniques and the quantitative tool to identify the leading sectors in the economy are quite viable from economic development and strategic planning point of view. Significantly, the measurement of linkages and delineating the leading and potential growth sectors, would, undoubtedly, assist the

decision making process in clustering such growth potential activities, and hence prioritizing the related investment projects that connected to these leading sectors' activities, accordingly, in order to direct the country's limited resources and development efforts, and reallocating them, in an optimal and feasible way, to achieve a better coordinated, balanced and sustainable socio-economic development and realistic growth patterns.

4. Import Leakages in the Jordanian Economy

When Supply is inelastic in the economy and the economy is open like the case in Jordan, expanding industries will have to look outside the national economy border for additional inputs, thus there is an import leakage of the efforts of national development. In this situation, as output rises so do leakages and some of the impacts on domestic industry and hence the national economy is lost and the linkages neutralized.

Potential linkages may be thwarted by the export of intermediate outputs rather than their sale to domestic industries. Thus, for example, in certain circumstances export of bulk iron ore, may be a leakage in that the potential forward linkages of steel making, processing and fabrication are forfeited with export. The conversion of such leakages into linkages may occur as part of the development process of expanding the domestic industrial base and facilitating import substitution.

To assess some aspects of this within Jordan, the ranking of sectors by their linkages as derived from the domestic I/O coefficients table (A) is compared in table (1) and (2) with those derived from the total flows and coefficients (A^T) I/O table (i.e. including imports). These latter results represent the extreme situation in which all imports are replaced by domestically produced goods, which may not be possible, in the short term, due to natural resource and environment constraints.

From examination of the backward linkages in tables (1) and (2) one can judge and identify which industry and sector should be encouraged to switch their purchases from outside to

Jordanian suppliers in order to generate the greatest effect, and hence real development elsewhere in the national economy. Iron and steel, rubber, painting and paper and paper product industry appear to be such industries; however, this is due to the replacement of large imports of raw iron, rubber, paper and paints, by assumed domestic production which, particularly in the case of iron, and to lesser extent rubber, would not be very feasible. The five machinery and equipment sectors, such as; electrical machinery, machinery and equipments, domestic appliances, engineering instruments and other transport equipments sector, all show significant gains in importance, this suggests for a greater scope of better integration between themselves and with the rest of the economy. The recent growth of a quite few of firms operating in these sectors activities is, no doubt, part of the reason for their present dependence upon imports.

	Table 2. The Sectors with Highest Domestic and Total Linkages in Jordan				
	Backward			Forward	
Rank	Domestic	Total	Rank	Domestic	Total
1	Air Transport	Air Transport	1	Refinery & Refined products	Crude Oil & Natural Gas
2	Travel, Tour Operators Services	Construction	2	Road Transport	Refinery & Refined products
3	Fertilizers & Insecticide	Iron and Steel Industry	3	Trade	Iron and Steel Industry
4	Construction	Electrical Machinery	4	Banking Sector	Other Chemical Products
5	Meat & Fish Products	Machinery and Equipments	5	Electricity	Crops & Other Agriculture
6	Dairy products	Dairy products	6	Others Services	Trade
7	Bricks, articles of cement concrete	Rubber products	7	Crops & Other Agriculture	Non Ferrous Metal Industry
8	Other Transport Equipments	Paint Industry	8	Business Services	Road Transport
9	Sea Transport & Ports	Domestic Appliances	9	Real estate	Paper & Paper Products
10	Postal Services	Paper & Paper Products	10	Iron and Steel Industry	Electricity
11	Vegetables	Engineering Instruments	11	Telecommunication Services	Banking Sector
12	Poultry and Eggs	Other Transport Equipments	12	Air Transport	Others Services

The differences between the domestic and total (domestic plus imports) forward linkages volume, indicate those industries with the greatest potential to replace imported goods. As would be expected none (or lightly) traded industries such as construction, distribution, road transport, electricity, etc., have little or no additional sales potential, and are thus demoted in the total forward linkage rankings (see table (2) above). Refinery and refine product has the highest forward linkage; however, this is a natural phenomenon as it supplying most of the sectors of the economy with its output. Notwithstanding, both crude oil and natural gas and refinery and refined products sectors are fully depending on imports for their inputs which, is highly unlikely and quite infeasible to (contemplate)substitute. Iron and steel, other chemical products, crops and other agriculture and paper and paper products sector are all shown to have untapped markets, and hence their activities ought to be enhanced, developed and expanded.

Further to its status as a key sector, iron and steel products sector is also seen to have some potential for import substitution (see tables (1) and (2)).

By and large, the above driven positive effect is resulting from assuming that the economy is pursuing a strategy for selective import substitution of given commodities. This, however, may not be possible for some sectors at present time, but it is an indicative approach where various selective economically viable sectors of the national economy have been identified as feasible potentials, to be used as main ingredients for future strategy of import substitution, particularly, for the competitive imported commodities segment.

5. Conclusions

This report represent the first attempt of using quantitative and analytical models to analyze some important aspects of the Jordanian economy in recent years, based on actually collected comprehensive statistical data on a highly disaggregated sectoral level. The results of

these efforts have identified the main leading sectors, amongst others, for the purpose of directing, prioritizing and hence achieving future balanced development in the country. Besides, it has attempted to quantify and identify the leakage of the national development efforts, and hence measuring the economic loss as a high proportion of the value-added in the national economy, by some sectors, due to the importation from the outside world and lack of productive capacity in some sectors and activities within the economy, which in turn curtails its ability to in meeting the domestic demand by different sectors.

Having said that, the followings are summary of the main results and findings:

- The most significant twelve sectors that characterized with strong **backward linkages**, and they are capable for creating structural change in the size of the national economy, due to their high output and production multipliers, are: **Air Transport, Travel, Tour Operators Services, Fertilizers & Insecticide, Construction, Meat & Fish Products, Dairy products, Bricks and articles of cement concrete, Other Transport Equipments, Sea Transport & Ports, Postal Services, Vegetables and Poultry and Eggs sector.**

- The mostly characterized sectors with high **forward linkages**, which have the capabilities to increase their production in appropriate proportions when the total demand on other sectors in the economy has increased. Moreover, such sectors would have the ability to change the production patterns and productive capacity of the sectors that using their products as inputs. These are: **Refinery & Refined products, Road Transport, Trade, Banking Sector, Electricity, Others Services, Crops & Other Agriculture, Business Services, Real estate, Iron and Steel Industry, Telecommunication Services and Air Transport sector.**

- There is a, somehow critical, tendency of dependency on the imported intermediate and raw material inputs of the domestic industries. Such dependency constitutes on average (36.5%)

of total intermediate inputs of the sectoral production process. This, by and large, may require creating wider production base to support future development and to insulate the national economy from, unwanted, external shocks and fluctuations.

- The analysis and the obtained results indicated the availability of quite few significant opportunities for import substitutions in some sectors of the Jordanian economy. These sectors have been identified in this paper. Hence, such opportunities and the development of the related sectors have to be objectively considered when setting development programme and selecting and approving development projects, related to these sectoral activities, for implementation.

- The study and its modelling empirical outcomes have identified eleven sectors as the leading sectors for future strategic development and sustainable growth of the national economy. These identified key sectors are; **Construction, Iron and Steel, Plastic Products, Mining, Electricity, Paper and Paper Products, Poultry and Eggs Products, Painting Industry, Water, Air Transport and Telecommunications sectors.**

- Finally, it is advisable that future investment, being government, private (domestic) and/or foreign (FDI), should be encouraged to be, thoroughly, evaluated and hence channelled to these sectors. This is besides, when starting allocating resources within the medium-term projects (investment) budget in Jordan; special consideration should be given to the productive projects related to each of these leading sectors in the economy. This is quite imperative to be pursued in order to achieve the aimed at sustainable and integrated socio-economic development without bottlenecks, and to mitigate the impact of any external shocks on the national economy.

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