Structural Interdependence in the Turkish Economy: Sectoral Forward and Backward Linkage Effects and Energy Sector[1]

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Abstract
Energy sector has great importance for producers and consumers. Turkish energy sector has been found as a leading sector in the analysis carried out in this paper by using input-output tables which are constructed by Turkish Statistical Institute (TUİK) for certain periods. Turkey is one of the energy dependent countries. Sustainable development of the Turkish economy would be realized easily if this dependencycan be reduced and the feature of being leading sector of energy sector can be utilized.

Key Words: Input-Output Analysis, Structural Interdependence, Energy Sector.
Jel Classification: C67, Q43.

Türkiye Ekonomisinde Yapısal Bağınlaşma: Sektörel İleri ve Geri Bağlantı Etkileri ve Enerji Sektörü

Özet
Enerji sektörü, gerek üreticiler gerekse tüketiciler için büyük öneme sahiptir. Türkiye İstatistik Kurumu'nun belirli dönemlerde hazırlamış olduğu girdi-çıktı tabloları kullanılarak yapılan analiz sonucunda enerji sektörünün son dönemde kilit sektör olduğu görülmüştür. Türkiye enerji kullanımında dış ülkelere bağımlı ülkelerden bir tanesidir. Türkiye ekonomisinde kalkınmanın gerçekleştirilebilmesi; enerji kaynakları kullanımında dışa olan bağımlılığın azaltılabilmesi ve enerji sektörünün kilit sektör olma özelliği kullanılabilirse çok daha kolay olacaktır.

Anahtar Kelimeler: Girdi-Çıktı Analizi, Yapısal Bağınlaşma, Enerji Sektörü.

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I.Introduction

Energy is one of the important inputs in production process. As energy is required to perform the production, countries must either have the energy or import it. Energy resources are used as inputs by other sectors in manufacturing industries. Therefore, it is important to know the influence level of the changes in supply and demand level of this sector, in other words, the forward and backward linkages of this sector for the functioning of economy.

Resulting of the recent high current account deficits from energy imports in Turkey has demonstrated the importance of energy resources as a result of the beginning of the arguments about energy supply security in production process again. In this context, this study analysis the forward and backward linkage effect changes of energy sector and the findings will be tried to be interpreted.

The purpose in this study is to observe the direct and indirect effects of input exchange between sectors and their change over the years. The main data set used in the study is the Input-Output Flow Tables about Turkish economy that is prepared by the Turkish Statistical Institute (TUIK). The data for 1996, 1998 and 2002 are used in the study.

II. The Importance of the Energy Sector

An increase in energy prices also increases the costs of inputs and product prices. Energy prices influence inflation and increase the pressure for economic stagnation through affecting total demand. The more important the use of energy resources in an economy the higher the inflationist pressure against the increases in oil prices (LeBlanc and Chinn, 2004: 8).

Increases in the prices of energy resources raise the costs of airways, transportation and the costs of the companies that produce chemical products and therefore, lead to inflation. For this reason, any change in energy prices is watched very closely (Bennet, 2003: 1).

Plants in the energy sector should be planned long before the demand for energy exists. Otherwise, delays in planning and investments raise the cost of energy and adversely affect economic activities and societal wealth. It is imperative to determine the potential needs in the energy sector at least ten years in advance, decide the projects to cover the increasing demand, and make necessary political decisions (Gerek, 1998: 370-371).

In developing countries like Turkey, the sectors that produce energy have important structural ties with other sectors. Especially electricity sector in Turkey positively affect economic growth because of its backward linkage. In today's modern societies, electrical energy used increasingly ignite other sectors of the economy by providing considerable amounts of inputs. The insufficiency of electric energy supply that should increase parallel to economic growth adversely affects economic growth as well as prevents the stimulatory effect on the economy (Terzi, 1998: 63).

III. Input-Output Analysis

The input-output model is a model that considers the relationship between the level of activities in the all sectors of economy (Akkaya and Pazarlioglu, 2000: 14). The input-output models are simple mathematical equilibrium models that quantitatively analysis the mutual linkages between production and consumption units on the whole economy scale in a multi-sectoral way. Different from micro economical analysis that focuses on the behaviors of firms and households and macro-economic analysis that analyzes the whole economy, the input-output analysis' focus is on sectors and good exchanges between sectors. The input-output models provide an opportunity to quantitatively analyze the production and use of outputs of productive sectors on whole economical and sectoral basis and fulfill and important gap between partial and total analyses especially in the analysis of empirical problems (Aydogus, 1999: 1-2). In the input-output model, under the assumption that the share of technology or inputs in production costs is constant, the equilibrium prices of goods and services produced in every sector can be obtained as the prices of main inputs (Aydogus, 1993: 36).

In input-output tables columns indicate the inputs, thus purchases and lines indicate the outputs, thus production. The amount of input that all sectors provide to and get from other sector in production process is expressed in the table. Since tables include all sectors of economy and the collection and processing of the required data need much time, they are generally prepared by 5-year intervals. The start of the use of these tables in economics encounters with the period of first five-year development plan. Through the use of Input-Output tables it is intended to provide the consistency and equilibrium between all sectors and consequently economy overall.

Input coefficient matrix (technology coefficient or technical coefficient) is prepared on the basis of input-output tables. To create this table, the columns of values for the input-output table is reached by proportioning the production sector. In other words, the input amount of each sector in columns is proportioned to the total input amount at the end of the column included in its added value.

These proportions show how many units of other goods is needed to obtain 1 unit of production (output) from any goods. These proportions are called as "technical coefficient or technological coefficients". After technical coefficients are calculated, sectoral production and demands can be planned by regarding these coefficient as data. (Afsar, 206). The equality of total demand and can be expressed by these equations (Senesen, 2005):

Total Production =Production for intermediate demand + Production for final demand

$$X = Z+D$$

D in the equation is Gross Domestic Products with respect to expenses.

D= C + I + CS + G + E - M

In equation C indicates private final consumption expenses, I indicates Gross Fixed capital formation, CS indicates changes in stocks, G indicates state final consumption expenses, E indicates export and M indicates import. The evaluations about the success of economy emphasize on final demand, i.e. GDP because the intermediate inputs are consumed in production process.

Intermediate input relationships between production sectors in economy can be written as,

$X_1 = X_{11} + X_{12} + X_{13} + \ldots\ldots\ldots + X_1n + D_1$

$X_2 = X_{21} + X_{21} + X_{21} + \ldots\ldots\ldots + X_{2n} + D_2$

.   .   .

.   .   .

$X_n = X_{n1} + X_{n2} + X_{n3} + \ldots\ldots + X_{nn} + D_n.$

For each sector Z (intermediate demand) value is the total intermediate inputs that it gives to n sector including itself. However, there are n*n values about cross-sectoral input exchanges. X_{12} indicates the input sale of sector 1 to sector 2 (input purchase of sector 2 to sector 1). If this structure can be expressed as the total demand functions ($X_{ij} = a_{ij} X_j$; $0 < a_{ij} < 1$) of sectors, sectoral total demands will be ;

$X_1 = a_{11}X_1 + a_{12}X_1 + a_{13}X_1 + \ldots\ldots\ldots + a_{1n}X_1 + D_1$

$X_2 = a_{21}X_2 + a_{22}X_2 + a_{23}X_2 + \ldots\ldots\ldots + a_{2n}X_2 + D_2$

.   .   .   .

.   .   .   .

$X_n = a_{n1}X_n + a_{n2}X_n + a_{n3}X_n + \ldots\ldots + a_{nn}X_n + D_n$

In Input-output model by handling also the intermediate goods demands with the final demand in Keynesian model, we reach the total demand.

$$X_i = \sum_{j=1}^{n} a_{ij}X_j + D_j$$

Here X_i indicates i. Sector output, the part shown with the total symbol indicates the total intermediate goods demand to sector output, Dj, indicates the total final demand to sector output. Goods and services produced by a sector are demanded both by other sectors as intermediate and by final users as consumption (Yildirim et al., 2009: 103). Sectoral production for any sector can be expressed as the functions of intermediate

inputs and labour and capital. In input-output model production factor is linear, as the prices are considered fixed, production function is defined in quantity.

Not only technology (Technical) coefficient matrix can be expressed as to indicate to what extent the total demand is made of intermediate demands of sectors and to what extent of total demands, but also it can be expressed as production function to indicate to what extent total production is made of intermediate inputs and to what extent of labour and capital inputs. In this case ($X_{ij} = a_{ij}X_i$; $0 < a_{ij} < 1$) column totals of a_{ij} s will give the intermediate input rate of sector j. In this study this form of definition of a_{ij} s is based. The general solution of input-output model can be expressed by matrix algebra like this (Ozyurt, 2007: 123-124):

$$X = AX + D$$

Here X is an n lined vector including n sector output in nxn dimension. D is an n lined vector including final demand of n sector in nx1 dimension. A is the intermediate coefficient matrix including n column and n line including technology (technical) coefficient in nxn dimension. This is called as sectoral dependency matrix. A matrix indicates the exchange structure of direct input of sectors each other. However, this equation is called as input-output matrix equation or only input-output equation. If the equation is solved;

$$X = AX + D$$

$$X - AX = D$$

$$(I-A)X = D$$

$X = (I-A)^{-1}.D$ is obtained. (I: matrix per unit.)

$X = (I-A)^{-1}. D$ equation indicates the output (production) vector (X) corresponding to a final demand vector (D) determined exogeneously while production technology (A) is data. $(I-A)^{-1}$ is called as Leontief or technology inverse matrix and this matrix enables to calculate the extra intermediate input demands resulted from the cross-sectoral dependency in production once and automatically together with final demands without any iteration (Aydodogus,1999: 28-38) Leontief inverse matrix above $(I-A)^{-1}$ is commonly utilized in the analysis of issues like production, employment, income etc. in an economy. So it helps determine the direct and indirect effects of final demand increases on the production of sectors. Also it is used to compare the reaction of each demand increase on each sector (Ersungur and Kiziltan, 2008).

Production multiplier to be used in the study is the column total (sum) of Leontief inverse matrix for each industry indicating the increase in outputs corresponding to one unit of increase in final demand. For instance, simple production (output) multiplier for j industry is the column total of that industry in Leontief inverse matrix. We can express this like this (Turker, 1999: 232; Ten Raa, 2005: 27):

$$z_j = \sum_{i=1}^{n} A_{ij}$$

Here;

z_j: the simple production multiplier of j industry,

n : the number of industry in input-output flow matrix, for instance the Formula for the first sector will be in the form of;

$z_1 = A_{11} + A_{21} + \ldots\ldots A_{n1}$

A_{ij} indicates the components of Leontief inverse matrix $(I-A)^{-1}$.

Production multiplier indicates the level of structural linkage between each industry and the other indutries of economy. According to this, as the numerical value of production multiplier gets bigger, structural linkage increases.

IV. Inter-Sectoral Dependency

Enabling of cross-sectoral backward and forward linkage effects to measure numerically is one of the most significant results of input-output analysis. For a typical j sector the concept of backward linkage effect is about the input purchase from the other sectors (i=1 ...n) including itself, but for a typical i sector the concept of forward linkage is about the input sale (j=1 ...n) to the other sectors including itself.

This sector (the final demand stimulated) will demand input from other sectors including itself to make certain production and all sectors including itself will make production up to this demand. In input-output analysis this first effect is called as *direct backward linkage effect* and it emphasizes on the fact that the input of a sector is the output of other sectors. On the other hand, the production that all sectors need to produce in order to meet this input demand will produce cross-sectoral demands again and these demands will be ended with production increase again (This mechanism is similar with the increasing effects of investments on income). This effect out of direct backward linkage effect is calles as *indirect backward linkage effect* and the total of two effect is called as *total backward linkage effect*.

Some parts of one unit- production of a sector including itself will meet the intermediate input demand of other sectors, the other parts will meet the final demand. In input-output analysis the proportion of sale total of sectoral intermediate input to the sectoral production gives us direct forward linkage effect and it emphasizes on the fact that an output of a sector is the input for the other sectors. Except this first effect, the production (output) of sectors using the output of this sector as input will again be the input of other sectors and this mechanism will repeat. This effect out of the direct forward linkage effect is called as *indirect forward linkage effect* and the total of two effect is called as *total forward linkage effect*.

The sectors –whose backward linkage effects are high- using great amounts of intermediate input from other sectors is expected to stimulate the production increases in sectors using the outputs of these sectors and the sectors – whose forward linkage effect is high- producing for intermediate use rather than final use is expected to stimulate the production increases in sectors using the outputs of these sectors as input. So the sectors with high bakward and forward linkage effects are "leader" or "key sector" in economy.

To sum up, the total production increased caused by one unit of final demand increase in a sector can be defined as the total backward linkage effect of that sector and the increase by one unit of final demand increases in all sectors in certain production of a sector can be defined as the total forward linkage effect of a sector. Direct linkage effect indicates the direct exchange of a sector with the others. Indirect effect presents the chained interaction between a sector and the others (Ozdemir and Mercan, 2012).

According to Hirschman, the effects of forward and backward linkages reflecting "feeding" and "stimulating" powers of sectors on other sectors must be considered (Hirschman, 1958: 9). In Hirschman's unbalanced growth model, one of the most important factors that restricts economic growth is the ability of decision making, especially the ability to take an investment decision.

Inferring from Hirschman's ideas, a quadruple grouping can be developed. The categories of this grouping that considers forward and backward linkages together can be summarized as follows:

Category 1: Sectors that have high forward and backward linkage effects.

Category 2: Sectors that have high backward but low forward linkage effects.

Category 3: Sectors that have high forward but low backward linkage effects.

Category 4: Sectors that have low backward and forward linkage effects.

The above arrangement shows sectoral investment priorities from the lowest to the highest. According to this, the sectors in the first category constitute the key sectors in the economy and have the highest investment priority. The scarce resources should primarily be devoted to these sectors. If there are still unused resources, then, they should be devoted to the sectors in the second category. Sectors in the III. and IV. categories come last in terms of investment priorities, that is, these sectors are expected to be stimulated by the key sectors (Aydogus, 1999: 100-101).

V. The Forward and Backward Linkage Effects for 1996, 1998, and 2002

The 1996 and 1998 input-output tables prepared by TUIK consist of total 97 sectors and the 2002 table consists of 59 sectors. The forward and backward linkage effects are as follows in terms of sectoral arrangement. The Table consists of 97 sectors but to observe it more clearly it is divided. In Table 1, there are Forward Linkage Effects (FLE) and Backward Linkage Effects (BLE) of the first 20 sectors.

Table 1: 1996, 1998 ve 2002 Years Total Backward and Forward Linkage Effect of First Twenty Sector (Direct+Indirect)

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
1-Growing of cereals and other crops n.e.c.	5,89	1,66	5,07	1,42	Agriculture, hunting and related service activities	1,86	3,66
2-Growing of vege- tables, horticultural specialities and nursery products	1,21	1,50	1,23	1,31	Forestry, logging and related service activities	1,35	1,45
3-Growing of fruit, nuts, beverage and spice crops	1,54	1,20	1,89	1,14	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing	1,64	1,06
4- Farming of animals	2,53	1,93	2,00	1,74	Mining of coal and lignite; extraction of peat	1,60	1,37
5-Agricultural and animal husbandry service activities (excl. veterinary act.)	1,92	2,13	1,42	1,78	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	1,05	3,24
6-Forestry, logging and related service activities	1,87	1,22	1,72	1,17	Mining of uranium and thorium ores	1,00	1,00
7- Fishing	1,16	1,41	1,15	1,26	Mining of metal ores	1,92	1,16
8- Mining of coal and lignite	1,65	1,33	1,50	1,44	Other mining and quarrying	2,14	1,82
9-Extraction of crude petroleum and natural gas	4,31	1,23	1,32	1,25	Manufacture of food products and beverages	2,95	2,52
10- Mining of metal ores	1,26	1,61	1,16	1,45	Manufacture of tobacco products	2,79	1,14
11- Quarrying of stone, sand and clay	1,33	1,40	1,38	1,27	Manufacture of textiles	2,98	3,81
12- Mining and Quarrying n.e.c.	1,23	1,31	1,24	1,23	Manufacture of wearing apparel; dressing and dyeing of fur	3,21	1,32
13- Production, proces- sing and preserving of meat and meat products	1,72	2,49	1,55	2,07	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	2,94	1,69
14-Processing and preserving of fish and fish products	1,11	1,86	1,02	1,74	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2,88	1,68
15- Processing and preserving of fruit and vegetables	1,13	1,96	1,37	1,70	Manufacture of pulp, paper and paper products	2,59	3,99

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
16- Manufacture of vegetable and animal oils and fats	1,54	2,33	1,53	2,06	Publishing, printing and reproduction of recorded media	2,65	1,65
17-Manufacture of dairy products	1,10	2,19	1,21	1,87	Manufacture of coke, refined petroleum products and nuclear fuels	2,30	2,81
18-Manufacture of grain mill produtcs, starches and starch products	1,57	2,14	1,55	1,81	Manufacture of chemicals and chemical products	2,06	5,82
19-Manufacture of preparad animal feeds	1,33	2,32	1,27	2,04	Manufacture of rubber and plastic products	2,69	2,63
20-Manufacture of bakery products	1,02	2,16	1,03	2,03	Manufacture of other non-metallic mineral products	2,66	2,39

Note: Linkage effects calculated by writer using the Input-Output Table 1996, 1998 ve 2002 Years and Matlab 7.9 software.

Table 2: 1996, 1998 ve 2002 Years Total Backward and Forward Linkage Effect of Second Twenty Sector (Direct+Indirect)

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
21- Manufacture of sugar	1,37	2,18	1,33	1,94	Manufacture of basic metals	2,35	5,74
22-Manufacture of cocoa, chocolate, sugar confertionery and other food products n.e.c.	1,43	2,02	1,34	1,88	Manufacture of fabricated metal products, except machinery and equipment	2,60	2,17
23-Manufacture of alcoholic beverages	1,24	1,56	1,16	1,51	Manufacture of machinery and equipment n.e.c.	1,94	2,27
24- Manufacture of soft drinks; production of mineral waters	1,27	2,24	1,08	2,10	Manufacture of office machinery and computers	1,17	1,21
25- Manufacture of tobacco products	1,08	2,00	1,08	1,83	Manufacture of electrical machinery and apparatus n.e.c.	2,40	1,96
26-Manufacture of textiles	2,96	2,45	2,67	1,76	Manufacture of radio, television and communication equipment and apparatus	2,21	1,98
27- Manufacture of other textiles	1,26	2,13	1,22	1,68	Manufacture of medical, precision and optical instruments, watches and clocks	1,57	1,20
28-Manufacture of knitted and fabrics and articles	1,13	2,49	1,07	1,76	Manufacture of motor vehicles, trailers and semi-trailers	2,52	1,92
29- Manufacture of wearing apperel, except fur apparel	1,13	2,37	1,53	1,88	Manufacture of other transport equipment	1,73	1,37
30-Dressing and dyeing of fur; manufacture of articles of fur	1,39	2,45	1,01	1,86	Manufacture of furniture; manufacturing n.e.c.	2,85	1,26
31- Tanning and dressing of leather; manufac.of luggage, handbags & harness	1,91	2,46	1,69	1,96	Recycling	3,25	1,02
32-Manufacture of footwear	1,14	2,55	1,07	2,00	Electricity, gas, steam and hot water supply	2,98	4,98
33-Sawmilling and planing of wood	2,19	2,42	2,06	2,08	Collection, purification and distribution of water	1,55	1,38
34- Manufacture of wood and of products of wood and cork	1,43	2,17	1,45	1,98	Construction	2,56	1,54
35- Manufacture of paper and paper products	3,41	2,10	2,39	1,69	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale services of automotive fuel	2,24	2,62
36-Publishing	1,09	1,86	1,09	1,53	Wholesale trade and commission trade, except of motor vehicles and motorcycles	2,13	4,59
37- Printing and service activities related to printing	1,51	2,10	1,52	1,62	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	1,86	3,14

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
38- Manufacture of coke, refined petroleum produtcs	5,79	1,55	3,92	1,13	Hotels and restaurants	2,53	1,57
39- Manufacture of basic chemicals, plastics in primary & synthetics rubber	4,89	2,16	1,79	1,58	Land transport; transport via pipelines	2,10	4,76
40- Manufacture of fertilizers and nitrogen compounds	1,77	2,16	1,30	1,66	Water transport	1,80	1,89

Note: Linkage effects calculated by writer using the Input-Output Table 1996, 1998 ve 2002 Years and Matlab 7.9 software.

Table 3: 1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of Third Twenty Sector Tables (Direct+Indirect)

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
41-Manufacture of pesticides, other agro-chemicals and paints, varnishes	1,49	2,01	1,32	1,59	Air transport	2,68	1,36
42-Manufacture of pharmaceuticals, medicinal chemicals & botanical products	1,68	1,84	1,27	1,54	Supporting and auxiliary transport activities; activities of travel agencies	2,41	3,38
43-Manufacture of cleaning materials, cosmatics and other chemicals & fibres	2,19	2,06	1,67	1,72	Post and telecommunications	2,20	2,17
44- Manufacture of rubber products	1,47	2,09	1,39	1,72	Financial intermediation, except insurance and pension funding	1,91	4,47
45- Manufacture of plastic products	1,64	2,31	1,56	1,69	Insurance and pension funding, except compulsory social security	1,64	1,26
46-Manufacture of glass and glass products	1,32	1,83	1,28	1,61	Activities auxiliary to financial intermediation	2,54	1,38
47-Manufacture of ceramic products	1,08	1,79	1,10	1,58	Real estate activities	1,59	2,33
48-Manufacture of cement, lime and plaster related articles these items	1,24	1,83	1,44	1,60	Renting of machinery and equipment without operator and of personal and household goods	2,20	1,18
49- Cutting and finishing of stone and man. of other non-metallic mineral products n.e.c.	1,06	1,54	1,04	1,68	Computer and related activities	1,95	1,27
50-Manufacture of basic iron and steel	4,61	2,26	3,28	1,81	Research and development	2,90	1,33
51-Manufacture of basic precious and non- ferrous metals	3,05	2,13	1,80	1,74	Other business activities	1,98	4,64
52- Casting of metals	1,13	2,18	1,28	1,67	Public administration and defence; compulsory social security	2,06	1,02
53-Manufacture of fabricated metal products, tanks, reser.&steam gen.	1,16	2,24	1,50	1,69	Education	1,60	1,14
54- Manufacture of other fabricated metal products; metal working services	2,40	2,10	1,81	1,73	Health and social work	2,32	1,12
55-Manufacture of general purpose machinery	1,51	2,01	1,15	1,68	Sewage and refuse disposal, sanitation and similar activities	2,37	1,43

Sectors	1996		1998		Sectors	2002	
	FLE	BLE	FLE	BLE		FLE	BLE
56- Manufacture of special purpose machinery	2,85	2,02	1,37	1,76	Activities of membership organisation n.e.c.	2,23	1,46
57- Manufacture of domestic appliances n.e.c.	1,10	2,04	1,06	1,57	Recreational, cultural and sporting activities	2,14	1,70
58-Manufacture of office, accounting and computing machinery	1,59	1,61	1,05	1,49	Other service activities	2,23	1,11
59-Manufacture of electrical machinery and apparatus n.e.c.	1,73	2,15	1,26	1,66	Private households with employed persons	1,00	1,00
60-Manufacture of radio, television and communication equip- ment & apparatus	1,82	1,81	1,20	1,44			

Note: Linkage effects calculated by writer using the Input-Output Table 1996, 1998 ve 2002 Years and Matlab 7.9 software.

Table 4: 1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of Fourth Twenty Sector (Direct+Indirect)

Sectors	1996		1998	
	FLE	BLE	FLE	BLE
61-Manufacture of medical, precision &optical instruments, watches and clocks	1,29	1,82	1,04	1,56
62- Manufacture of motor vehicles, trailers and semi-trailers	1,60	2,15	1,21	1,72
63- Building and repairing of ships, pleasure &sporting boats	1,10	1,48	1,01	1,54
64-Manufacture of railway and &tramvay lokomo-tives & rolling stock	1,30	1,93	1,02	1,48
65-Manufacture of aircraft and spacecraft	1,18	1,16	1,02	1,23
66-Manufacture of transport equipment n.e.c.	1,39	2,25	1,08	1,66
67-Manufacture of furniture	1,07	2,24	1,08	2,01
68- Manufacturing n.e.c.	1,21	1,96	1,05	1,27
69-Production, collection and distribution of electricity	4,38	1,45	3,69	1,35
70-Manufacture of gas; distribution of gaseous fuels	1,16	1,77	1,18	1,18
71-Collection, purification and distribution of water	1,53	1,25	1,38	1,19
72-Construction	1,06	2,02	1,16	1,67
73-Sale, maintenance and repair of motor vehicles, motorcycles; retail sale of fuel	2,40	1,45	2,17	1,29
74-Wholesale trade and commission trade, except of motor vehicles & motorcyles	5,87	1,39	3,54	1,26
75-Retail trade, repair of personal and household materials	2,65	1,46	2,97	1,25
76-Hotels; camping sites and other provision of short-stay accommodatin	1,61	1,81	1,23	1,69
77-Restaurants, bars and canteens	1,40	1,91	1,80	1,70
78-Transport via railways	1,24	2,20	1,07	1,58
79-Land transport; transport via pipelines	6,05	1,54	5,11	1,35
80-Water transport	2,12	1,80	1,70	1,48
81- Air transport	1,17	1,97	1,20	1,55
82-Supporting and auxiliary transport activities; activities of travel agencies	1,15	2,28	1,03	1,86
83-Post and telecom- nications	2,19	1,38	2,22	1,15
84-Financial intermedediation, except insurance and pension funding	5,34	1,48	5,23	1,43
85- Insurance	1,34	1,74	1,20	1,44
86-Real estate activities	1,51	1,51	1,55	1,52
87-Renting of machinery and equipment without operator & of personal and household goods	1,08	1,60	1,18	1,62
88-Computer and related activities	1,11	1,95	1,13	1,53
89- Research and development	1,28	1,14	1,30	1,61
90- Other business activities	3,42	1,75	2,92	1,48
91-Education	1,02	1,74	1,05	1,53
92-Health and social work services	1,04	1,59	1,03	1,29
93-Activities of membership organizations n.e.c	1,00	1,47	1,04	1,48
94- Recreational, cultural and and sporting activities	1,38	1,53	1,47	1,48
95-Other service activities	1,21	1,63	1,10	1,46
96- Public services	1,00	1,00	1,00	1,00
97-Ownership of dwelling	1,00	1,31	1,00	1,25

Note: Linkage effects calculated by writer using the Input-Output Table 1996, 1998 ve 2002 Years and Matlab 7.9 software.

The total increase in production caused by the increase in demand by one unit of final demand increase in a particular sector indicates the total backward linkage effect of that sector and the sectors with high direct backward linkage effects are the sectors having the effect factor in terms of stimulating the production level of other sectors. In other words, since the sectors with high direct backward linkage effects will demand input from other sectors, they cause to stimulation and revival of the economy. The increase caused by one-unit increase in final demand in the production of a certain sector can be defined as the total forward linkage effect of the sector. Since the sectors with high forward linkage effects are used as inputs in other sectors, they have the importance for decreasing the dependency on external resources. In this context, the study includes calculations of both forward and backward linkage effects for 1996, 1998 and also 2002 because it is closer today and the most recently published input-output flow table.

As can be seen in Tables 1, 2, 3, and 4 for the year 1996, the sectors with the highest total (direct and indirect) forward linkage effects are the 79th sector highway transportation (6,05), 1st sector grain and vegetable plantation (5,89), 74th sector wholesale and trade brokering (5,87), 38th sector coke furnace and refined petroleum product manufacturing (5,78). As can be seen the other sectors of the economy used the most input from highway transportation and then agricultural sector. The energy sub-sectors such as refined petroleum products and electricity production and distribution are among the first five sectors in terms of providing inputs to other sectors. Also iron and steel and manufacturing industry are among the sectors having high linkage effect in terms of providing input for other sectors.

When we observe, the first five sectors having high backward effects in 1996 are 32th sector manufacture of footwear (2.55), 13th sector production, processing and preserving of meat and meat products (2.49), 28th sector manufacture of knitted and fabrics and articles (2.49), 31st sector tanning and dressing of leather (2.46), 26th sector manufacture of textiles (2.45) in turn. Production increases of these sectors stimulate the other sectors most,in other words, they are the sectors with high backward linkage effects. The sectors having the highest backward linkage effect are agriculture, manufacturing industry and transportation.

As can be observed in Table 1, 2, 3, and 4 the first five sectors having the highest total forward linkage effect for 1998 are 84th sector financial intermedediation, except insurance and pension funding (5.22), 79th sector land transport (5.11), 1st sector growing of cereals and other crops (5.07), 38th sector manufacture of coke, refined petroleum produtcs (3.92), 69th sector production, collection and distribution of electricity (3.69) in turn.The first five sector having the highest total backward linkage effect are 24th sector manufacture of soft drinks (2.10), 33rd sector sawmilling and planing of wood (2.08), 13th sector production, processing and preserving of meat and meat products (2.07), 16th sector manufacture of vegetable and animal oils and fats and 19th sector manufacture of preparad animal feeds

(2.03) in turn.

As can be observed in tables 1, 2, 3, and 4 the first five sectors having the highest total (direct and indirect) forward linkage effect for 2002 are manufacture of wearing apparel (3.21), production, collection and distribution of electricity, gas, vapour and hot water (2.97), manufacture of textiel products (2.97), manufacture of food products and beverages (2.95) and Tanning and dressing of leather; manufac. of luggage, handbags & harness (2.93) in turn. The first five sectors having the highest backward linkage effect are manufacture of chemical products (5.82), manufacture of basic metals (5.74), production, collection and distribution of electricity, gas, vapour and hot water (4.98), land transport and pipe line transportation (4.756) and other service activities (4.63) in turn.

Sectors having both forward and backward linkage effects are defined as locomotive (leader) sectors.When the similar studies carried out before are observed, it is found out that manufacturing industry by sectors is a key (locomotive, leader) sector in 1980 and 1990's. When we consider the first twenty sectors in 1996 , iron-steel basic industry and manufacture of textiles are key sectors as their both forward and backward linkage effects are high. When we consider the first twenty sectors in 1998 iron-steel basic industry and sawmilling and planing of wood sectors are key sectors as their both forward and backward linkage effects are high. When we consider the first twenty sectors in 2002, production and distribution of electricity, gas, vapour and hot water, manufacture of textiles, manufacture of other non-metallic mineral products, manufacture of paper and paper products secotrs are key sectors and investments on these sectors will contribute to economy most. Although the locomotive sectors in 1996 and 1998 are manufacture of textiles, iron-steel basic industry and sawmilling and planing of wood sectors, energy sector as well as manufacturing industry shows the distinction of being locomotive sector and contributes to economic revival.

When the direct backward linkage effects for all sectors in 1996, 1998 and 2002 are analyzed, high backward linkage effects of manufacturing sub-sectors stands out. It is known that manufacturing industry is important to stimulate the production levels of other sectors in developing countries.

In 1996 and 1998, while backward linkage effects of sub-sectors of energy sector are low, backward linkage effect of all sub-sectors in 2002 is high. For instance, in terms of backward linkage effects, while production, collection and distribution of electricity sector is in 82th line in 1996, in 78th line in 1998, it goes up to 3rd line in 2002. While extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying sector is in 86th level in 1998, it is in 12th line; while manufacture of coke, refined petroleum products and nuclear fuels sector is in 96th line in 1998, it is in 14th line in 2002.

As we look at 1996, 1998 and 2002 as a whole, the sub-sectros of energy sector, manufacture of coke, refined petroleum products and nuclear fuels sector and production, collection and distribution of electricity sectors

in 1996 and 1998 and production, collection and distribution of electricity, gas, vapour and hot water sectors in 2002 are among the first five sectors in terms of forward linkage effects, thus providing input for other sectors of economy and have a role in feeding the other sectors of economy as input.

Conclusion

When the sectors with high forward and backward linkage effects are generally analyzed, sectors having high total backward linkage effects are observed as the sub-sectors of manufacturing industry in the years observed 1996 and 1998. In 2002, however, it can be seen that both forward and backward linkage effect of energy sector as well as manufacturing industry are high. According to Hirschman category, the sectors with high both forward and backward linkage effects at the same time are defined as key (locomotive) sectors. In other words, key sectors due to their high forward linkage effects, they provide inputs for other sectors and contributes the imports to decrease and also due to their high backward linkage effects, production increases in related sector considerably stimulate the other sectors. Therefore, sub-sectors of energy sector are suitable for this definition.

Turkish economy saw the highest level with $75 billion of account deficit and its proportion to GDP reached 9.9%. As a result that the recent higher account deficits in Turkey are derived for energy imports, energy imports are higher than account deficits in some years (2002, 2004 and 2010), and %74 of energy need of Turkey is supplied via imports (Babacan, 2010) and energy supply security is began to be discussed, energy resources present its importance. For that reason, investments in the energy sector in Turkey should be increased. In this context, studies aiming to reduce dependency on foreign powers in energy should be done. Especially, the industrial model based on the fossil fuel increases dependency. Turkey can support the other sectors only if can it use resources such as wind, solar and hydrologic energy.

Another noticeable finding in the analysis is that the sectors having relatively less importance in terms of forward and backward linkage effects in previous years begin to stand out. In 2002 compared to 1996 and 1998, when the forward linkage effects are considered, research and development services, construction sector, airway transport, became important and took place in the first twenty sectors instead of agricultural and highway transportation sectors. However, in 2002 when the backward linkage effects are considered, the stimulation level of others and importance of sub-sectors of energy sector, generating and distribution of electricity, gas, vapour and hot water, Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying, Manufacture of coke, refined petroleum products and nuclear fuels and also manufacture of chemicals and chemical products, insurance and pension funding, except compulsory social security, transport activities, travel agencies services and real estate services sectors increased compared to previous years.

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