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The Intersectoral Linkage Effects in Turkish Economy: An Application of Static Leontief Model

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Summary: In this study, the leading activities of Turkish Economy whose changes in their structure of production, value-added and employment are interrelated with the other activities of the economy, are found by using the input-output model which is presented and called as an 'Application of the General Equilibrium Theory' by Leontief. For this purpose; firstly theoretical foundations of the input-output model are examined. After that, 59 activities of the 2002 Input-Output Table of the Turkish Economy are aggregated at 52 sectors and classified into three categories as Ricardo Sectors, High-Technology Sectors and Heckscher-Ohlin Sectors like Dasgupta and Chakraborty did for the Indian Economy in 2005. Then, the leading, key or strong activities of the economy that are more interrelated with other activities are calculated and found by the Static Leontief Model which is used by the Traditional Methods as the techniques to calculate the linkage effects like Chenery-Watanabe and Rasmussen methods to determine the sectors having the highest priority at investment policies according to the Hirschmanian Unbalanced Growth Model. As a result of the interpretation of Leontief Model, using the traditional methods of Chenery-Watanabe and Rasmussen while calculating the linkage effects rather than the hypothesis extraction methods like Strassert's Original Extraction Method, Cella's Extraction Method, Sonis' Pure Linkage Method and Dietzenbacher and Van der Linden's Method or a SAM (Social Accounting Method) model which does not omit the income generating process (distributing income among primary factors and households as a result of production) of a sector, in Turkey, the Heckscher-Ohlin Sectors mostly seen in the manufacturing industry which Kaldor refers as the engine of growth, are stronger than the other sectors.

Key words: Leontief Input-Output Model, Ricardo Sectors, Heckscher-Ohlin Sectors and High-Technology Sectors, General Equilibrium Analysis, Multiplier Analysis.

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Introduction and theoretical foundations

The leading model of the General Equilibrium Theory that is simplified by matrix algebra, The Static Leontief Input-Output Model, has been changing by creating new application fields for the last 60 years. In this study, the model which is classically a stage and the main technique of the economic planning and is called by Leontief as an application of the General Equilibrium Theory has been applied to the 2002 domestic input-output table to obtain the interindustrial relations of the Turkish economy.

"The use of interindustry analysis as a tool of development policy arises from the need to co-ordinate investment plans in interrelated sectors of the economy", says, Hollis B. Chenery (1960) who firstly applied the Static Leontief Model for calculating the direct linkage effects with Rasmussen's indirect linkage effects after Leontief. According to Chenery (1960) the use of interindustry analysis for development policy is still in an experimental stage. What is most needed is the accumulation of input-output data over time and the more systematic exploitation of technological information, especially for new types of production. Nicholas Kaldor (1986), the Neo-Keynesian economist who determined the effect of production of the manufacturing sector on the overall growth of an economy, emphasized that, a stable and permanent economical growth will need the formation of new and complementary products and sectors as a result of the interaction of all the products and sectors of the economy.

Leontief, the creator of the model, thinks like that: "The world economy like the economy of a single country can be visualized as a system of interdependent processes. Each process generates certain outputs and absorbs a specific combination of inputs. Direct interdependence between two processes arises whenever the output of one becomes an input of the other: coal, the output of the coal mining industry, is an input of the electric power generating sector. The chemical industry uses coal not only directly as a raw material but also indirectly in the form of electric power… The state of a particular economic system can be conveniently described in the form of a two-way input-output table showing the flows of goods and services among its different sectors, and to and processes and entities (value-added and final demand) viewed as falling outside the conventional borders of an input-output system. As the scope of the inquiry expands, new rows and columns are added to the table and some of the external in-flows and outflows become internalized…" (Wassily Leontief 1974, 823).

The general characteristics of the model are given below:

1) Leontief, himself, calls his analyses which combine the different sectors/activities of an economy by input-output tables as 'Walrasian, General and Mutual Dependence'. Leontief Model can be seen as an application of the Walrasian equilibrium model (Leontief 1937). Walras' approach is purely theoretical and is remote from to-

day's economic life. On the other hand, Leontief's approach is based on the empirical Input-Output tables, but theoretically it also is not suitable for real economies (Ezra Davar 2005).

2) Leontief introduces his analysis as an attempt of The Tableau Economique of the American Economy referring to Quesnay (Almarin Phillips 1955).
3) Leontief (1937) classifies his model as a general-static one after making the classical discussion of economics, general or partial equilibrium and static or dynamic analysis. A general and static approach of L-Model may bring up the interrelations between the most complicated national activities and the pure local activities of an economy.
4) L-Model is known as a Neo-Walrasian model. Analysis of Leontief is related with the production and supply-side of the economy. However, Walrasian General Equilibrium Model includes also the demand-side of the economy and analyses the both sides of the economic system. In L-Model (Leontief refers his analysis of dynamic systems as L-Model but we also use this term for the static model), the output levels of an economy can be different from the equilibrium and so that the Leontief Model may be general but may not be in equilibrium (William J. Baumol 1958). Alpha C. Chiang (1986) emphasizes that the correct output levels (not including any supply/demand surplus) will give the technical input and output relations but not the market equilibrium. Leontief (1949a), also states that his analysis is an empirical equilibrium one (or you wish, general equilibrium one) rather than a theoretical Walrasian analysis.
5) The square Input-Output Table which Leontief used firstly for the American Economy indicates that the nominal value of the output of an activity can be easily changed into the input of another activity (Leontief 1949b).
6) Leontief (1949b) stated that, there is a clear-cut relationship between the total output of a given industry and the total input it absorbs of commodities and services from other industries. This is the relationship that Walras describes in terms of his production function, his coefficients of production with each coefficient describing the amount of any particular input necessary to produce one unit of the final output. The ratio between the input of a particular good in a given industry divided by the total output of that industry, in other words, it is input per unit of output. According to Leontief (1967), a comparison of the structural properties of two economies-or of the structural characteristics of the same economy at two different points of time-can be reduced to a comparison of two A (input coefficient matrices) matrices. Se-Hark Park (1994) also uses a ratio be-

tween a_{ij} (input coefficient) and $\sum a_{ij}$ (the column sum of an input coefficient matrix) which is known as the dependency ratio that measures the degree of importance of an input to the total inputs required by the production of an output, to compare two sectors (like manufacturing and services) of an economy at a point of time rather than comparing two economies.

7) To compute the input requirements of an industry for a prescribed output, one would only have to know its 'input coefficient', that is, the constant quantities of each of the various inputs absorbed per unit of its final product. With a given set of input coefficients describing the internal structures of all the productive sectors of the economy and a known bill of final demand, a complete input-output table of the economy can be reconstructed from the bottom up, through solution of a system of simultaneous linear equations (Leontief 1952).
8) L-Model, which provides a planning model for production and investment policies or a detailed calculation system of national accounts, has two basic hypotheses.
    A) Industries produce only one kind of homogeneous goods but mostly a bunch of many kinds of goods may be aggregated in an industry.
    B) The input levels of all the production processes of an economy that has a linear-homogeneous production function are at constant rates and those rates can only be changed due to an increase at the level of the output.

After 1941, when Leontief introduced the first I-O tables for the American economy, the input-output analysis became an indispensable means for studying numerous views on mutual interwinements of sectors of the economy. Consequently, the input-output tables began to be used quite early by Poul N. Rasmussen (1958) and Chenery and Tsunehiko Watanabe (1958) for establishing the linkages between sectors of the economy. These linkages were studied on the side of inputs (the side of supply) to individual sectors (backward linkages) as well as on the side of outputs (the side of sales) of an individual sector to other sectors (forward linkages) (Lovrenc Pfajfar and Alena Lotric Dolinar 2000). Besides these traditional methods of linkage effects calculation, HEM and SAM models were improved. Hypothesis Extraction Methods (HEM) are those to elicit the economic role of a sector, or a cluster of sectors and a Social Accounting Matrix (SAM) method measures the income generating process of a sector by making the missing income links explicit while measuring the production process, to elucidate the sector's true economic impact (Alejandro M. Cardenete and Ferran Sancho 2006).

L-Model with all those characteristics may be reduced to an analysis of a simultaneous linear equation system by using matrix algebra (in dynamic L-Model simultaneous differential linear equation systems are used) but this complicated matrix algebra may surpass the economical structure of the system.

Leontief Model stated in this paper is about static analysis. Leontief (1961) also studied on the stability of dynamic systems and emphasized that an economy described by a set of simultaneous differential linear equations in which there are capital coefficients (c_{ij}) besides the input/output coefficients (a_{ij} and b_{ij}), starting with any given combination of positive outputs would sooner or later approach a state of steady growth.

For this purpose; firstly theoretical foundations of the static input-output model are examined. After that, 59 activities of the 2002 Input-Output table are aggregated at 52 sectors and classified into three broad categories as national resource intensive Ricardo Sectors, high-technology intensive High-Technology Sectors and capital-labour intensive Heckscher-Ohlin Sectors like Paramita Dasgupta and Debesh Chakraborty (2005) did for the Indian Economy in 2005 according to the Input-Output Table of 1993. Then, the leading, key or strong activities of the economy that are more interrelated with other activities are calculated and found by the Leontief Matrix, Ghosh Matrix, Inverse Leontief Matrix or Inverse Ghosh Matrix which are used by the Traditional Methods like Chenery-Watanabe Method (using the Leontief matrix for the backward linkage effect and Ghosh matrix for the forward linkage effects calculation), Rasmussen Method (using only the inverse Leontief matrix for both of the backward and forward linkage effects calculation) and Augmented Rasmussen Method (using the inverse Ghosh matrix for the calculation of the forward linkage effect after the criticize of the former Rasmussen method's forward linkage effect calculation by Jones, Augustinovicz and Ghosh instead of the inverse Leontief matrix of the former Rasmussen Method) to determine the sectors those are the owner of the highest priority at investment policies according to Hirschmanian Unbalanced Growth Model (This complicated analysis is simply called by Michael Sonis, Geoffrey J. D. Hewings, and Jiemin Guo (2000) as a familiar Rasmussen-Hirschman Key Sector Analysis-and the calculated indices are called as Rasmussen-Hirschman Indices- in which they use a MPM (Multiplier Product Matrix) offering a macro-level comparing method of structures of two or more countries by using only Inverse Leontief Matrix).

1. Methodology

The main discovery of the Leontief model is the Inverse Leontief Matrix. Many applications of the Inverse Leontief Matrix like Rasmussen and Ghosh models were used mostly for planning and to determine the backward and forward linkage effects' coefficients. These coefficients can make it easy to find the sectors of an economy that have the highest priority at investment according to Hirschmanian Unbalanced Growth Model in which Albert O. Hirschman (1988) rejects balanced growth rates at all the activities of an economic system and offers an investment priority for some industries those have bigger backward and forward linkage effects' coefficients especially in the developing countries rather than a balanced Harrod-Domar growth model which guarantees an amount of investment at a point of equality of the 'production capacity' and the 'production quantity'.

The inverse Leontief Matrix, the hardcore of the model, that can be easily shown by the geometrical series, has the same mathematical background with the Keynesian Multiplier Model and proves the transformation of the dynamic effects to static effects by the time*. While the multiplier analysis determines the last effect which is created by an economic activity, the input-output analysis is a more complicated model that brings out the intersectoral input-output relations. If we use a small simple model of an Input-Output Table, for example a three sector model, it will be easy to understand this complicated analysis.

Table 1: A Mini-model of input-output table

	S_1	S_2	S_3	W	C	I	E	Y	AD
S_1	x_{11}	x_{12}	x_{13}	W_1	C_1	I_1	E_1	Y_1	AD_1
S_2	x_{21}	x_{22}	x_{23}	W_2	C_2	I_2	E_2	Y_2	AD_2
S_3	x_{31}	x_{32}	x_{33}	W_3	C_3	I_3	E_3	Y_3	AD_3
U	U_1	U_2	U_3	$\sum U=\sum W$	$\sum C$	$\sum I$	$\sum E$	$\sum Y$	$\sum AD$
L	L_1	L_2	L_3	$\sum L$					
M	M_1	M_2	M_3	$\sum M$					
V	V_1	V_2	V_3	$\sum V$					

$$\lim_{n\to\infty}\frac{\Delta X}{\Delta Y}\ \lim_{n\to\infty}(I+A+A^2+\ldots A^n)\ \frac{I}{I-A}=(I-A)^{-1}$$

$$\lim_{m\to\infty}\frac{\Delta X'}{\Delta V}\ \lim_{n\to\infty}(I+B+B^2+\ldots B^m)\ \frac{I}{I-B}=(I-B)^{-1}$$

(As the term number of the economy (n or m), goes to an infinite number, the increase of total output (ΔX = total supply) or the increase of total uses ($\Delta X'$ = total demand) would stop and become to a static phase, although the increase of final demand (ΔY) or value added (ΔV) continues. A and B are input and output coefficient matrices and $0\langle A\leq 1$ or $0\langle B\leq 1$).

X	X_1	X_2	X_3	$\sum X$					
AS	AS_1	AS_2	AS_3	$\sum AS$					

Source: I-O table for a three sector economy prepared by the authors.

At the rows of Table 1; x_{11}, x_{12} and x_{13} indicates the inputs which the first sector gives to the first, second and third sector respectively. W_1 is the intermediate demand, C_1 is the consumption, I_1 is the investment and E_1 is the export of the first sector. Y_1 is the total of C_1, I_1 and E_1, and indicates the final demand and AD_1 is the total of W_1 and Y_1 and indicates the aggregate demand. At the columns of Table 1; x_{11}, x_{21} and x_{31} indicates the inputs which the first sector takes from the first sector, second sector and third sector respectively. U_1 is the intermediate input, L_1 is the labour factor payments, M_1 is the import, V_1 is the value-added, X_1 is the total supply or output and AS_1 is the aggregate supply of the first sector.

Intermediate demand (W):

Intermediate Demand Column Vector (W) = Input Coefficient Matrix (A)* Total Supply/Output Column Vector (X)
(The core of the L-model is the input coefficients like the fabrication coefficients of Walras).

Input Coefficient: $a_{ij} = \dfrac{x_{ij}}{X_j}$

Input Coefficient Matrix : $|A| = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}_{3x3}$

(By summarizing the columns of A matrix, we can obtain the coefficients of the direct backward linkage effects according to Chenery and Watanabe (1958) Method which is based on a direct input or output coefficient matrix and measures only the first round of effects generated by the inter-relations between sectors and which neglects the indirect effects).

Output/Supply Column Vector: $|X| = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}_{3x1}$

$$AX = W$$

$$\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}_{3x3} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}_{3x1} = \begin{bmatrix} a_{11}X_1 + a_{12}X_2 + a_{13}X_3 \\ a_{21}X_1 + a_{22}X_2 + a_{23}X_3 \\ a_{31}X_1 + a_{32}X_2 + a_{33}X_3 \end{bmatrix} = \begin{bmatrix} x_{11} + x_{12} + x_{13} \\ x_{21} + x_{22} + x_{23} \\ x_{31} + x_{32} + x_{33} \end{bmatrix} = \begin{bmatrix} W_1 \\ W_2 \\ W_3 \end{bmatrix}_{3x1} = |W|$$

Inverse Leontief matrix:

Total Demand (AD) = Total Supply (AS)

AD=AS
Intermediate Demand (W) + Final Demand (Y) = Total Supply/Output (X) + Imports of Products (M_p)

M_p= 0 in Domestic Input-Output Table

W + Y= X

Y = Consumptions (C) + Investments (I) + Exports of Products (E)

W + (C + I + E) = X

$AX = W$ and Y= C+I+E

AX + Y = X

$$\frac{Y}{X} = (1 - A)$$

$1 - A$: Leontief Matrix

We can extract the Input Coefficient Matrix from Unit Matrix.

$$\frac{Y}{X} = (1 - A) = \begin{vmatrix} 1 - a_{11} & -a_{12} & -a_{13} \\ -a_{21} & 1 - a_{22} & -a_{23} \\ -a_{31} & -a_{32} & 1 - a_{33} \end{vmatrix}$$

$\frac{X}{Y} = (I - A)^{-1}$ **: Inverse Leontief matrix**

(By summarizing the columns of Inverse Leontief Matrix, we can obtain the coefficients of the backward linkage effects according to Rasmussen (1958) and Augmented Rasmussen Methods those reflect the effects of an increase in the final demand of one sector on overall output and by summarizing the rows of Inverse Leontief Matrix we can obtain the coefficients of the forward linkage effects according to the Rasmussen Method which measures the magnitude of output increase in one sector, if the final demands in each sector were to increase by one unit).

Intermediate input (U):

Intermediate Input Row Vector (U) = Output Coefficient Matrix (B)* Total Use/Demand Row Vector (X')

Output Coefficient: $b_{ij} = \frac{x_{ij}}{X_i}$

Output Coefficient Matrix : $|B| = \begin{vmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{vmatrix}_{3x3}$

(By summarizing the rows of B matrix, we can obtain the coefficients of the direct forward linkage effects according to Chenery-Watanabe Method).

Total Use/Demand Row Vector: $|X'| = \left[X_1' X_2' X_3'\right]_{1x3}$

$$X'B = U$$

$$= \left[X_1' X_2' X_3'\right]_{1x3} \cdot \begin{vmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{vmatrix}_{3x3}$$

$$= \left| b_{11}X_1' + b_{21}X_2' + b_{31}X_3' \quad b_{12}X_1' + b_{22}X_2' + b_{32}X_3' \quad b_{13}X_1' + b_{23}X_2' + b_{33}X_3' \right|$$

$$= \left| x_{11} + x_{21} + x_{31} \quad x_{12} + x_{22} + x_{32} \quad x_{13} + x_{23} + x_{33} \right|$$

$$= \left[U_1 U_2 U_3\right] = |U|$$

Inverse Ghosh matrix:

Total Supply (AS) = Total Demand (AD)

AS=AD

Intermediate Input (U) + Final Input (V_t) = Total Uses (X')

U+ V_t = X'

V_t = Value Added (V_d) + Payments to Labour Force (L) + Imports of Inputs (M_i)

U+ (V_d + L + M_i) = X'

$X'B = U$ and V=V_d+L

M_i=0 in Domestic Input-Output Table

BX' +V= X'

$$\frac{V}{X'} = (1 - B)$$

$1 - B$: Ghosh Matrix

We can extract the Output Coefficient Matrix from Unit Matrix.

$$\frac{V}{X'} = (1 - B) = \begin{vmatrix} 1 - b_{11} & -b_{12} & -b_{13} \\ -b_{21} & 1 - b_{22} & -b_{23} \\ -b_{31} & -b_{32} & 1 - b_{33} \end{vmatrix}$$

$$\frac{X'}{V} = (I - B)^{-1}$$ **: Inverse Ghosh matrix**

(By summarizing the rows of Inverse Ghosh Matrix, we can obtain the coefficients of the forward linkage effects according to Augmented Rasmussen Method measuring the extent to which a unit change in the primary input of one sector causes production increases in all sectors).

The backward linkages are called as Rasmussen's power of dispersion while the forward linkages are defined as Rasmussen's sensitivity of dispersion which Leroy P. Jones (1976) questions (the use of Rasmussen's index of sensitivity of dispersion as a measure of forward linkages) and argues that there is not much sense in exploring what happens to an industry if all industries are to expand their output by an identical unit increase. Jones considers such an identical unit-increase as an unlikely situation and instead proposes to utilize the output inverse matrix (Inverse Ghosh Matrix) in the calculation of the index. The output inverse matrix is calculated from output coefficients ($b_{ij} = x_{ij} / x_i$) and contains elements expressing the increase in output of an industry j required to utilize the increased output brought about by a unit of primary input into an industry i (Ina Drejer 2002).

While the sum of the column of the matrix of multipliers (the inverse matrix of inputs) represent the power of the sectoral backward linkage, that is called as the sum of the index of the power of dispersion of the sector; the index of the sensitivity of dispersion of the sector will be determined as the sum of the row of the inverse matrix of outputs (Pfajfar and Dolinar 2000). This is the main practical difference between Leontief's and Ghosh's models as mentioned by Davar (also determines the theoretical differences between two models and shows that the two models can not be equivalent) who specialized on Walras, Leontief and Ghosh or on the General Equilibrium Theory that is complemented by the input-output system. According to Davar (2005), one of the main reasons for preferring Leontief's or Ghosh's model, is the problem of the stability of direct input coefficients and direct allocation coefficients which Ambika Ghosh (1958) firstly called as 'supply coefficients' (instead of allocation coefficients) and almost all post-Ghosh economists (like Augustinovicz, Dietzenbacher, Oosterhaven) used the alternative title 'output coefficients' or alternatively 'distribution coefficients'.

We will calculate both of the forward linkage effects while one method utilizes the inverse matrix of inputs (Rasmussen method) and the other utilizes the inverse matrix of outputs that we called as the Augmented Rasmussen method.

2. An application of the static Leontief model

Before the calculations of the linkage effects, 2002 Input-Output Table of Turkey and Aggregated Input-Output Table will be given below:

Table 2: 59 Sectors of 2002 symmetric input-output (I-O) table for domestic production

1	Agriculture, hunting and related service activities
2	Forestry, logging and related service activities
3	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing
4	Mining of coal and lignite; extraction of peat
5	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
6	Mining of uranium and thorium ores
7	Mining of metal ores
8	Other mining and quarrying
9	Manufacture of food products and beverages
10	Manufacture of tobacco products
11	Manufacture of textiles
12	Manufacture of wearing apparel; dressing and dyeing of fur
13	Tanning and dressing of leather; manufacture of luggage, handbags, saddler, harness and footwear
14	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
15	Manufacture of pulp, paper and paper products
16	Publishing, printing and reproduction of recorded media
17	Manufacture of coke, refined petroleum products and nuclear fuels
18	Manufacture of chemicals and chemical products
19	Manufacture of rubber and plastic products
20	Manufacture of other non-metallic mineral products
21	Manufacture of basic metals
22	Manufacture of fabricated metal products, except machinery and equipment
23	Manufacture of machinery and equipment n.e.c.
24	Manufacture of office machinery and computers
25	Manufacture of electrical machinery and apparatus n.e.c.
26	Manufacture of radio, television and communication equipment and apparatus
27	Manufacture of medical, precision and optical instruments, watches and clocks
28	Manufacture of motor vehicles, trailers and semi-trailers
29	Manufacture of other transport equipment
30	Manufacture of furniture; manufacturing n.e.c.
31	Recycling
32	Electricity, gas, steam and hot water supply
33	Collection, purification and distribution of water
34	Construction
35	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale services of automotive fuel

36	Wholesale trade and commission trade, except of motor vehicles and motorcycles
37	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
38	Hotels and restaurants
39	Land transport; transport via pipelines
40	Water transport
41	Air transport
42	Supporting and auxiliary transport activities; activities of travel agencies
43	Post and telecommunications
44	Financial intermediation, except insurance and pension funding
45	Insurance and pension funding, except compulsory social security
46	Activities auxiliary to financial intermediation
47	Real estate activities
48	Renting of machinery and equipment without operator and of personal and household goods
49	Computer and related activities
50	Research and development
51	Other business activities
52	Public administration and defence; compulsory social security
53	Education
54	Health and social work
55	Sewage and refuse disposal, sanitation and similar activities
56	Activities of membership organisation n.e.c.
57	Recreational, cultural and sporting activities
58	Other service activities
59	Private households with employed persons

Source: Turkish Statistical Institute - TÜİK (2008).

The four aggregations that we made on the 2002 Symmetric Input-Output Table for domestic production of Turkish Economy can be seen on the Table 3.

Table 3: Aggregated sectors on 2002 symmetric input-output table

Aggregation number	**Aggregated sectors on 2002 symmetric input-output table**	**The new number of the aggregated sectors on the 52*52 input-output table**
1	6+7	6
2	32+33	31
3	36+37	34
4	55+56+57+58+59	52

Source: Aggregation table prepared by the authors.

We obtained a new input-output table with 52 sectors (shown at Table 4) from the aggregation table by aggregating the 6th (mining of uranium and thorium ores) and 7th (mining of metal ores) sectors, 32nd (electricity, gas, steam and hot water supply) and 33rd (collection, purification and distribution of water) sectors, 36th (wholesale trade and commission trade, except of motor vehicles and motorcycles) and 37th (retail trade, except of motor vehicles and motorcycles; repair of personal and household goods) sectors and 55th (sewage and refuse disposal, sanitation and similar activities), 56th (activities of membership organization n.e.c.), 57th (recreational, cultural and sporting activities), 58th (other service activities) and 59th (private households with employed persons) sectors of the 2002 Input-Output Table so that we can abstain from a round-off error with invalid input/output coefficients which John M. Ryan (1953) emphasized, if the sector number is smaller than 50 after an aggregation.

Table 4: Aggregated I-O table for domestic production at 52 sectors

1	Agriculture, hunting and related service activities
2	Forestry, logging and related service activities
3	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing
4	Mining of coal and lignite; extraction of peat
5	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
6	Mining of metal ores; including uranium and thorium ores
7	Other mining and quarrying
8	Manufacture of food products and beverages
9	Manufacture of tobacco products
10	Manufacture of textiles
11	Manufacture of wearing apparel; dressing and dyeing of fur
12	Tanning and dressing of leather; manufacture of luggage, handbags, saddler, harness and footwear
13	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
14	Manufacture of pulp, paper and paper products
15	Publishing, printing and reproduction of recorded media
16	Manufacture of coke, refined petroleum products and nuclear fuels
17	Manufacture of chemicals and chemical products
18	Manufacture of rubber and plastic products
19	Manufacture of other non-metallic mineral products
20	Manufacture of basic metals
21	Manufacture of fabricated metal products, except machinery and equipment
22	Manufacture of machinery and equipment n.e.c.

23	Manufacture of office machinery and computers
24	Manufacture of electrical machinery and apparatus n.e.c.
25	Manufacture of radio, television and communication equipment and apparatus
26	Manufacture of medical, precision and optical instruments, watches and clocks
27	Manufacture of motor vehicles, trailers and semi-trailers
28	Manufacture of other transport equipment
29	Manufacture of furniture; manufacturing n.e.c.
30	Recycling
31	Electricity, gas, steam and hot water supply; Collection, purification and distribution of water
32	Construction
33	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale services of automotive fuel
34	Wholesale trade and commission trade; Retail trade and repair of personal and household goods except of motor vehicles and motorcycles
35	Hotels and restaurants
36	Land transport; transport via pipelines
37	Water transport
38	Air transport
39	Supporting and auxiliary transport activities; activities of travel agencies
40	Post and telecommunications
41	Financial intermediation, except insurance and pension funding
42	Insurance and pension funding, except compulsory social security
43	Activities auxiliary to financial intermediation
44	Real estate activities
45	Renting of machinery and equipment without operator and of personal and household goods
46	Computer and related activities
47	Research and development
48	Other business activities
49	Public administration and defence; compulsory social security
50	Education
51	Health and social work
52	Other services activities

Source: Aggregated I-O Table at 52 sectors prepared by the authors.

We aim to study the structure of the Turkish Economy using the classification of sectors due to the intensity of the factors in production which Dasgupta and Chakraborty (2005) applied to the Indian Economy by using the 1993 Input-Output Table of India. Dasgupta and Chakraborty (2005) emphasized that all economic activities can be classified into three broad categories as 'natural resource intensive Ricardo Sec-

tors (R)', 'high-technology intensive High-Technology Sectors (H-T)' and 'capital-labour intensive Heckscher-Ohlin Sectors (H-O)'. Ricardo Sectors are those which use natural resources intensively in their production process. Production of agricultural crops, manufacture of textiles, manufacture of food products and beverages, manufacture of pulp, paper and paper products etc. are basically natural resource intensive and therefore treated as Ricardo Sectors. High-Technology Sectors require higher proportion of research and development. This category contains most of the technology-using manufacturing sectors like manufacture of chemicals and chemical product, manufacture of electrical machinery, manufacture of radio, television and communication equipment, manufacture of motor vehicles, education sector, health and social work sector. Heckscher-Ohlin Sectors use relatively standardized production technologies and this category contains the sectors which are either capital and labour intensive like publishing, printing and reproduction of recorded media, manufacture of basic metals, electricity, gas, steam and hot water supply, construction, wholesale trade and commission trade, hotels and restaurants, land, water and air transport, financial intermediation, insurance and pension finding etc. (Categories of all the 52 sectors of Table 4 can be observed by the S and C columns of the Table 5 and Table 6).

After the categorization of the sectors, we can weight and indice the calculated backward and forward linkage effects' coefficients. Prem S. Laumas (1976) offers to calculate the weighted linkage effects' coefficients by taking the share of each sector in the final demand column for determining the backward linkage effect and by taking the share of each sector in the intermediate input row for determining the forward linkage effect (Bernadette Andreosso-O'Callaghan and Gouqiang Yue 2007). According to Mohammed F. Khayum (1995), a conceptual problem surrounding the use of linkage indexes to identify the critical sectors is that the magnitudes may be increasing due to a weighting problem. The basic argument is that the various linkage indexes are inadequate measures of the importance of individual sectors since they assume equal weights for all sectors of the economy. Khayum emphasizes that those weighted- indexed linkage effects are useful because they allows for a proper comparison of the overall backward or forward stimulus experienced by an economy over time since the backward and forward linkage effects' coefficients' indexes are weighted according to the relative importance of each sector in the economy (Khayum 1995).

The backward linkage effects' coefficients' indexes' formulas calculated according to Rasmussen and Augmented Rasmussen methods (I_B^R and I_B^{AR}) and forward linkage effects' coefficients' indexes' formulas calculated according to Rasmussen and Augmented Rasmussen methods (I_F^R and I_F^{AR}) are given below:

$$I_B^R = \frac{\sum_{\forall i} p_{ij}}{\sum p_{ij} / n} \quad p_{ij} = (I - A)^{-1}$$

$$I_F^R = \frac{\sum_{\forall j} p_{ij}}{\sum p_{ij} / n} \quad p_{ij} = (I - A)^{-1}$$

$$I_B^{AR} = \frac{\sum_{\forall i} p_{ij}}{\sum p_{ij} / n} \quad p_{ij} = (I - A)^{-1}$$

$$I_F^{AR} = \frac{\sum_{\forall j} q_{ij}}{\sum q_{ij} / n} \quad q_{ij} = (I - B)^{-1}$$

(n is equal to 52 which is the number of the sectors of the aggregated input-output table of 2002)

Now, we can calculate the indexed weighted or indexed unweighted backward and forward linkage effects which use the input/output coefficient matrix and inverse Leontief/Ghosh matrix mostly used in traditional methods of linkage effects analysis like Chenery-Watanabe (CW) and Rasmussen (R and AR) methods. After that, we can classify the sectors with an integration integrator (II) like strong (S) if coefficients are bigger than 1, intermediate (I) if coefficients are equal or smaller than 1 or weak (W) if coefficients are equal or smaller than 0.8 (0.8 and 1 are the same threshold values with Dasgupta and Chakraborty's application in India).

Table 5: Indexed and weighted linkage effects according to 3 methods

IWCW							IWR							IWAR						
S	C	IWCWb	IWCWf	T	A	II	S	C	IWRb	IWRf	T	A	II	S	C	IWARb	IWARf	T	A	II
34	HO	3.197	6.814	10.011	5.006	S	8	R	1.060	1.014	2.074	1.037	S	34	HO	1.018	1.046	2.064	1.032	S
1	R	2.373	7.033	9.406	4.703	S	1	R	1.011	1.042	2.053	1.026	S	8	R	1.060	1.001	2.061	1.030	S
8	R	8.110	1.176	9.286	4.643	S	34	HO	1.018	1.033	2.051	1.025	S	1	R	1.011	1.048	2.060	1.030	S
36	HO	3.500	4.174	7.674	3.837	S	10	R	1.015	1.025	2.041	1.020	S	36	HO	1.021	1.025	2.046	1.023	S
32	HO	4.690	0.474	5.164	2.582	S	36	HO	1.021	1.020	2.040	1.020	S	32	HO	1.030	0.996	2.026	1.013	S
10	R	2.844	2.190	5.035	2.517	S	32	HO	1.030	0.997	2.028	1.014	S	10	R	1.015	1.009	2.025	1.012	S
41	HO	0.867	3.535	4.402	2.201	S	11	R	1.023	0.996	2.018	1.009	S	41	HO	0.999	1.020	2.019	1.010	S
44	HO	2.095	2.051	4.146	2.073	S	41	HO	0.999	1.012	2.010	1.005	S	44	HO	1.009	1.009	2.018	1.009	S
11	R	3.749	0.203	3.952	1.976	S	44	HO	1.009	1.001	2.010	1.005	S	11	R	1.023	0.994	2.017	1.008	S
48	HT	0.234	3.685	3.920	1.960	S	49	HT	1.016	0.992	2.008	1.004	S	48	HT	0.994	1.021	2.015	1.008	S
31	HO	0.706	2.514	3.220	1.610	S	31	HO	0.998	1.010	2.007	1.004	S	31	HO	0.998	1.012	2.010	1.005	S
49	HT	3.004	0.021	3.025	1.513	S	48	HT	0.994	1.013	2.007	1.003	S	49	HT	1.016	0.992	2.009	1.004	S
35	HO	2.379	0.408	2.787	1.394	S	35	HO	1.012	0.995	2.006	1.003	S	35	HO	1.012	0.995	2.007	1.003	S
39	HO	0.587	2.093	2.680	1.340	S	17	HT	0.999	1.006	2.005	1.002	S	39	HO	0.997	1.009	2.005	1.003	S
33	HO	0.738	1.855	2.593	1.296	S	39	HO	0.997	1.007	2.003	1.002	S	33	HO	0.998	1.007	2.005	1.002	S
17	HT	0.886	1.336	2.222	1.111	S	20	HO	0.996	1.007	2.003	1.001	S	17	HT	0.999	1.003	2.002	1.001	S
52	HT	1.071	0.860	1.931	0.965	I	33	HO	0.998	1.005	2.002	1.001	S	52	HT	1.001	0.999	1.999	1.000	I

40	HO	0.790	1.061	1.852	0.926	I	19	HO	0.994	1.007	2.002	1.001	S	40	HO	0.998	1.001	1.999	0.999	I
22	HO	1.201	0.564	1.765	0.882	I	22	HO	1.002	0.998	2.000	1.000	I	22	HO	1.002	0.997	1.998	0.999	I
27	HT	1.372	0.285	1.657	0.829	I	27	HT	1.003	0.996	1.999	1.000	I	27	HT	1.003	0.994	1.997	0.999	I
20	HO	0.514	1.126	1.640	0.820	I	52	HT	1.001	0.998	1.998	0.999	I	20	HO	0.996	1.001	1.997	0.998	I
19	HO	0.308	1.270	1.577	0.789	W	40	HO	0.998	0.999	1.997	0.998	I	19	HO	0.994	1.002	1.996	0.998	I
51	HT	1.184	0.108	1.292	0.646	W	18	HO	0.994	1.002	1.996	0.998	I	51	HT	1.001	0.993	1.994	0.997	I
29	HO	0.962	0.089	1.051	0.526	W	21	HO	0.995	1.001	1.996	0.998	I	29	HO	1.000	0.993	1.992	0.996	I
18	HO	0.300	0.704	1.004	0.502	W	16	R	0.993	1.002	1.994	0.997	I	18	HO	0.994	0.998	1.992	0.996	I
21	HO	0.362	0.613	0.975	0.487	W	51	HT	1.001	0.993	1.994	0.997	I	21	HO	0.995	0.997	1.992	0.996	I
50	HT	0.751	0.191	0.943	0.471	W	29	HO	1.000	0.993	1.993	0.997	I	50	HT	0.998	0.994	1.991	0.996	I
37	HO	0.237	0.639	0.876	0.438	W	24	HT	0.996	0.997	1.992	0.996	I	37	HO	0.994	0.997	1.991	0.995	I
24	HT	0.490	0.357	0.847	0.424	W	50	HT	0.998	0.993	1.991	0.995	I	24	HT	0.996	0.995	1.991	0.995	I
38	HO	0.529	0.186	0.714	0.357	W	38	HO	0.996	0.995	1.991	0.995	I	38	HO	0.996	0.994	1.990	0.995	I
14	R	0.079	0.549	0.629	0.314	W	14	R	0.992	0.997	1.990	0.995	I	14	R	0.992	0.996	1.989	0.994	I
7	R	-0.133	0.687	0.554	0.277	W	37	HO	0.994	0.996	1.989	0.995	I	25	HT	0.996	0.993	1.988	0.994	I
25	HT	0.472	0.080	0.551	0.276	W	25	HT	0.996	0.993	1.989	0.994	I	7	R	0.991	0.997	1.988	0.994	I
16	R	0.137	0.364	0.501	0.250	W	12	R	0.994	0.994	1.988	0.994	I	16	R	0.993	0.995	1.988	0.994	I
15	HO	0.087	0.398	0.485	0.242	W	13	R	0.993	0.995	1.988	0.994	I	15	HO	0.992	0.995	1.988	0.994	I
12	R	0.301	0.145	0.447	0.223	W	15	HO	0.992	0.995	1.987	0.994	I	12	R	0.994	0.993	1.987	0.994	I
9	R	0.406	0.022	0.428	0.214	W	9	R	0.995	0.992	1.987	0.994	I	9	R	0.995	0.992	1.987	0.994	I
13	R	0.135	0.202	0.337	0.168	W	28	HT	0.992	0.994	1.986	0.993	I	13	R	0.993	0.994	1.986	0.993	I
4	R	0.089	0.226	0.315	0.158	W	46	HT	0.992	0.994	1.986	0.993	I	4	R	0.992	0.994	1.986	0.993	I
46	HT	0.056	0.255	0.311	0.156	W	7	R	0.991	0.995	1.986	0.993	I	46	HT	0.992	0.994	1.986	0.993	I
2	R	0.021	0.225	0.247	0.123	W	47	HT	0.992	0.994	1.985	0.993	I	2	R	0.992	0.994	1.986	0.993	I
28	HT	0.070	0.159	0.229	0.114	W	4	R	0.992	0.993	1.985	0.993	I	28	HT	0.992	0.993	1.986	0.993	I
5	R	0.009	0.202	0.211	0.105	W	42	HO	0.992	0.993	1.985	0.992	I	42	HO	0.992	0.993	1.985	0.993	I
42	HO	0.060	0.151	0.210	0.105	W	45	HO	0.992	0.993	1.985	0.992	I	5	R	0.992	0.994	1.985	0.993	I
47	HT	0.002	0.185	0.188	0.094	W	26	HT	0.992	0.992	1.985	0.992	I	47	HT	0.992	0.994	1.985	0.993	I
45	HO	0.033	0.152	0.185	0.092	W	43	HO	0.992	0.993	1.985	0.992	I	45	HO	0.992	0.993	1.985	0.993	I
43	HO	0.000	0.183	0.183	0.091	W	3	R	0.992	0.992	1.984	0.992	I	43	HO	0.992	0.994	1.985	0.993	I
3	R	0.038	0.078	0.116	0.058	W	2	R	0.992	0.992	1.984	0.992	I	3	R	0.992	0.993	1.985	0.992	I
26	HT	0.079	0.025	0.104	0.052	W	5	R	0.992	0.992	1.984	0.992	I	26	HT	0.992	0.992	1.985	0.992	I
6	R	0.021	0.073	0.093	0.047	W	6	R	0.992	0.992	1.984	0.992	I	6	R	0.992	0.993	1.985	0.992	I
23	HT	0.009	0.020	0.029	0.014	W	23	HT	0.992	0.992	1.984	0.992	I	23	HT	0.992	0.992	1.984	0.992	I
30	HO	-0.001	0.004	0.003	0.002	W	30	HO	0.992	0.992	1.983	0.992	I	30	HO	0.992	0.992	1.984	0.992	I

Note: Column S is the sector number given on the Table 4, column C shows the categories that are classified according to factors used intensively in the production process which R is Ricardo Sector, HO is Heckscher-Ohlin sector and HT is High-Technology Sector, IWCWb, IWCWf, IWRb, IWRf, IWARb and IWARf are Indexed Weighted Backward and Forward Linkage Effects according to Chenery-Watanabe, Rasmussen and Augmented Rasmussen methods respectively, column T is the total of the backward and forward effects, column A shows the average of both two effects and II is the Integration Indicator with the rest of economy in terms of backward and forward linkage effects which S refers to Strong Integration (II is bigger than 1), I to Intermediate Integration (II is between 0.8 and 1) and W to Weak Integration (II is smaller than 0.8).

Source: Calculated from 2002 Turkish Domestic Input-Output Table by the authors.

Table 6: Indexed and unweighted linkage effects according to 3 methods

IUCW							IUR							IUAR						
S	C	IUCWb	IUCWf	T	A	II	S	C	IURb	IURf	T	A	II	S	C	IUARb	IUARf	T	A	II
30	HO	1.692	2.088	3.780	1.890	S	34	HO	0.867	2.893	3.760	1.880	S	30	HO	1.331	1.924	3.255	1.628	S
7	R	0.917	2.716	3.632	1.816	S	31	HO	1.060	2.231	3.291	1.645	S	7	R	0.951	2.025	2.976	1.488	S
43	HO	1.225	1.864	3.089	1.545	S	20	HO	1.123	1.949	3.072	1.536	S	43	HO	1.062	1.593	2.655	1.328	S
47	HT	1.239	1.847	3.086	1.543	S	36	HO	0.920	2.068	2.988	1.494	S	47	HT	1.118	1.433	2.551	1.276	S
14	R	1.257	1.709	2.966	1.483	S	10	R	1.219	1.538	2.757	1.378	S	14	R	1.115	1.435	2.550	1.275	S
19	HO	1.269	1.553	2.822	1.411	S	41	HO	0.878	1.850	2.728	1.364	S	31	HO	1.060	1.376	2.436	1.218	S
20	HO	1.229	1.487	2.716	1.358	S	48	HT	0.884	1.819	2.704	1.352	S	6	R	1.012	1.376	2.388	1.194	S
15	HO	1.131	1.531	2.662	1.331	S	17	HT	1.072	1.587	2.658	1.329	S	20	HO	1.123	1.258	2.381	1.190	S
13	R	1.305	1.353	2.658	1.329	S	39	HO	1.047	1.498	2.545	1.273	S	15	HO	1.062	1.288	2.350	1.175	S
18	HO	1.175	1.457	2.632	1.316	S	14	R	1.115	1.422	2.537	1.269	S	5	R	0.790	1.512	2.303	1.151	S
21	HO	1.249	1.325	2.574	1.287	S	1	R	0.866	1.401	2.267	1.133	S	19	HO	1.116	1.134	2.250	1.125	S
31	HO	1.095	1.462	2.557	1.278	S	18	HO	1.082	1.148	2.230	1.115	S	18	HO	1.082	1.166	2.247	1.124	S
39	HO	1.108	1.379	2.486	1.243	S	8	R	1.247	0.983	2.229	1.115	S	39	HO	1.047	1.195	2.242	1.121	S
10	R	1.377	1.085	2.462	1.231	S	19	HO	1.116	1.083	2.199	1.099	S	17	HT	1.072	1.159	2.230	1.115	S
17	HT	1.180	1.264	2.444	1.222	S	33	HO	0.926	1.229	2.155	1.078	S	10	R	1.219	0.976	2.195	1.097	S
6	R	1.015	1.340	2.355	1.178	S	21	HO	1.132	0.974	2.106	1.053	S	13	R	1.114	1.072	2.186	1.093	S
48	HT	0.730	1.605	2.335	1.168	S	24	HT	1.111	0.856	1.968	0.984	I	21	HO	1.132	1.038	2.170	1.085	S
45	HO	0.956	1.378	2.334	1.167	S	27	HT	1.176	0.791	1.967	0.984	I	48	HT	0.884	1.260	2.144	1.072	S
16	R	0.703	1.550	2.253	1.127	S	11	R	1.274	0.680	1.954	0.977	I	45	HO	0.970	1.174	2.144	1.072	S
24	HT	1.217	0.954	2.170	1.085	S	16	R	0.838	1.110	1.948	0.974	I	16	R	0.838	1.257	2.095	1.048	S
28	HT	0.948	1.148	2.096	1.048	S	40	HO	0.953	0.979	1.932	0.966	I	24	HT	1.111	0.938	2.049	1.024	S
8	R	1.625	0.456	2.081	1.041	S	22	HO	1.042	0.872	1.914	0.957	I	23	HT	0.910	1.060	1.971	0.985	I
5	R	0.495	1.544	2.039	1.019	S	13	R	1.114	0.798	1.913	0.956	I	33	HO	0.926	1.029	1.955	0.978	I
38	HO	1.335	0.679	2.014	1.007	S	30	HO	1.331	0.579	1.910	0.955	I	41	HO	0.878	1.066	1.945	0.972	I
33	HO	0.872	1.099	1.971	0.985	I	35	HO	1.091	0.795	1.886	0.943	I	8	R	1.247	0.673	1.920	0.960	I
12	R	1.164	0.801	1.965	0.982	I	12	R	1.088	0.787	1.875	0.937	I	27	HT	1.176	0.741	1.917	0.958	I
41	HO	0.783	1.178	1.961	0.980	I	15	HO	1.062	0.804	1.865	0.933	I	38	HO	1.123	0.789	1.912	0.956	I
46	HT	0.720	1.190	1.910	0.955	I	47	HT	1.118	0.743	1.861	0.931	I	12	R	1.088	0.817	1.905	0.952	I
23	HT	0.819	1.088	1.907	0.954	I	7	R	0.951	0.903	1.854	0.927	I	28	HT	0.987	0.904	1.891	0.945	I
27	HT	1.325	0.526	1.851	0.925	I	52	HT	0.940	0.896	1.836	0.918	I	42	HO	0.884	0.996	1.880	0.940	I
40	HO	0.946	0.824	1.769	0.885	I	44	HO	0.762	1.056	1.817	0.909	I	4	R	0.842	1.011	1.853	0.926	I
42	HO	0.788	0.966	1.754	0.877	I	38	HO	1.123	0.692	1.815	0.907	I	40	HO	0.953	0.898	1.851	0.926	I
1	R	0.728	1.009	1.737	0.869	I	43	HO	1.062	0.728	1.790	0.895	I	46	HT	0.859	0.987	1.845	0.923	I
37	HO	0.683	0.982	1.665	0.833	I	32	HO	1.063	0.684	1.746	0.873	I	37	HO	0.856	0.986	1.841	0.921	I
22	HO	1.064	0.587	1.651	0.825	I	9	R	1.095	0.611	1.707	0.853	I	11	R	1.274	0.561	1.835	0.917	I
11	R	1.447	0.167	1.614	0.807	I	25	HT	0.987	0.713	1.700	0.850	I	2	R	0.696	1.122	1.818	0.909	I
34	HO	0.727	0.851	1.578	0.789	W	37	HO	0.856	0.808	1.663	0.832	I	22	HO	1.042	0.754	1.796	0.898	I
36	HO	0.844	0.726	1.570	0.785	W	29	HO	1.018	0.630	1.648	0.824	I	1	R	0.866	0.904	1.770	0.885	I
26	HT	1.021	0.524	1.546	0.773	W	6	R	1.012	0.620	1.632	0.816	I	36	HO	0.920	0.846	1.766	0.883	I
4	R	0.649	0.876	1.526	0.763	W	28	HT	0.987	0.636	1.622	0.811	I	34	HO	0.867	0.892	1.759	0.879	I
52	HT	0.906	0.572	1.478	0.739	W	26	HT	1.007	0.604	1.611	0.806	I	26	HT	1.007	0.721	1.728	0.864	I
35	HO	1.189	0.251	1.439	0.720	W	45	HO	0.970	0.641	1.611	0.805	I	35	HO	1.091	0.630	1.721	0.861	I
2	R	0.314	1.071	1.385	0.692	W	51	HT	0.987	0.612	1.599	0.799	W	52	HT	0.940	0.765	1.705	0.852	I
25	HT	0.979	0.401	1.380	0.690	W	46	HT	0.859	0.668	1.526	0.763	W	25	HT	0.987	0.675	1.662	0.831	I
9	R	1.246	0.125	1.371	0.685	W	42	HO	0.884	0.635	1.519	0.760	W	9	R	1.095	0.536	1.631	0.816	I

32	HO	1.106	0.151	1.257	0.628	W	49	HT	0.930	0.575	1.506	0.753	W	32	HO	1.063	0.555	1.617	0.809	I
29	HO	1.015	0.216	1.231	0.616	W	23	HT	0.910	0.590	1.500	0.750	W	29	HO	1.018	0.588	1.606	0.803	I
51	HT	0.995	0.105	1.101	0.550	W	4	R	0.842	0.652	1.494	0.747	W	51	HT	0.987	0.541	1.527	0.764	W
3	R	0.453	0.553	1.006	0.503	W	5	R	0.790	0.655	1.445	0.722	W	3	R	0.758	0.693	1.450	0.725	W
49	HT	0.855	0.006	0.861	0.431	W	2	R	0.696	0.717	1.414	0.707	W	49	HT	0.930	0.502	1.432	0.716	W
44	HO	0.438	0.292	0.730	0.365	W	50	HT	0.760	0.617	1.376	0.688	W	44	HO	0.762	0.638	1.400	0.700	W
50	HT	0.453	0.089	0.543	0.271	W	3	R	0.758	0.591	1.348	0.674	W	50	HT	0.760	0.534	1.294	0.647	W

Note: Column S is the sector number given on the Table 4, column C shows the categories that are classified according to factors used intensively in the production process which R is Ricardo Sector, HO is Heckscher-Ohlin sector and HT is High Technology Sector, IUCWb, IUCWf, IURb, IURf, IUARb and IUARf are Indexed Unweighted Backward and Forward Linkage Effects according to Chenery-Watanabe, Rasmussen and Augmented Rasmussen methods respectively, column T is the total of the backward and forward effects, column A shows the average of both two effects and II is the Integration Indicator with the rest of economy in terms of backward and forward linkage effects which S refers to Strong Integration (II is bigger than 1), I to Intermediate Integration (II is between 0.8 and 1) and W to Weak Integration (II is smaller than 0.8).

Source: Calculated from 2002 Turkish Domestic Input-Output Table by the authors.

These tables will give us the highest backward linkage effect owner sectors of the Turkish economy which can stimulate the production of other sectors by using their intermediate inputs and also can provide higher domestic production of these intermediate inputs. We can also see the highest forward linkage effect owner sectors of the Turkish economy; those can provide an increase in the production of the sectors which use the products of a high forward linkage effect owner sector, as intermediate products. Therefore, it is said that capital, relatively the meager factor of an economy may be allocated into those strong sectors having higher backward and forward linkage effects, according to Hirschmanian Unbalanced Growth Model which may be a useful model for an economist-planner who lives in underdeveloped areas.

According to Table 5 which concludes the weighted-indexed backward and forward linkage effects' coefficients, we can not observe the difference between the average of the both backward and forward linkage effects especially by Rasmussen and by Augmented Rasmussen methods which use the Inverse Leontief/Ghosh Matrices, because weighted-indexed coefficients of the backward and forward linkage effects are nearly the same for many sectors and according to these two methods no weak sector occurs in the economy. Weighted-indexed coefficients of Table 5 have 16 strong sectors according to both of the Chenery-Watanabe method and Augmented Rasmussen method and 18 strong sectors according to Rasmussen method. Some of these sectors are 34 (wholesale trade and commission trade; retail trade and repair of personal and household goods except of motor vehicles and motorcycles), 1 (agriculture, hunting and related service activities), 8 (manufacture of food products and beverages), 36 (land transport; transport via pipelines), 32 (construction), 10 (manufacture of

textiles), 41 (financial intermediation, except insurance and pension funding), 44 (real estate activities), 11 (manufacture of wearing apparel; dressing and dyeing of fur), 48 (other business activities), 31 (electricity, gas, steam and hot water supply; collection, purification and distribution of water) and 39 (supporting and auxiliary transport activities; activities of travel agencies). We see from the table that sectors like agriculture, hunting and related service activities, manufacture of food products, wholesale trade and commission trade, manufacture of textiles, supporting and auxiliary transport activities; activities of travel agencies, construction and financial intermediation, except insurance and pension funding which occur from a combination of too many activities, have great backward and forward effects.

An observation from Table 6 (indexed and unweighted) seems more logical because there occur differences between the sectors and a classification of integration can be made in terms of the sectors of the economy. We see that 24 strong sectors occur by the calculation of Chenery-Watanabe method, 16 by Rasmussen and 21 by Augmented Rasmussen method on Table 6.

We can also put in order the sectors which have backward and forward linkage effects from the biggest to the smallest according to the unweighted and indexed linkage effects of Table 6 shown on Table 7, Table 8 and Table 9 and obtain the strong sectors of the Turkish Economy clearly.

Table 7: Ranking of backward linkage effects according to 3 methods from Table 6

IUCW				IUR				IUAR			
S	C	IUCWb	II	S	C	IURb	II	S	C	IUARb	II
30	HO	1.692	S	30	HO	1.331	S	30	HO	1.331	S
8	R	1.625	S	11	R	1.274	S	11	R	1.274	S
11	R	1.447	S	8	R	1.247	S	8	R	1.247	S
10	R	1.377	S	10	R	1.219	S	10	R	1.219	S
38	HO	1.335	S	27	HT	1.176	S	27	HT	1.176	S
27	HT	1.325	S	21	HO	1.132	S	21	HO	1.132	S
13	R	1.305	S	38	HO	1.123	S	38	HO	1.123	S
19	HO	1.269	S	20	HO	1.123	S	20	HO	1.123	S
14	R	1.257	S	47	HT	1.118	S	47	HT	1.118	S
21	HO	1.249	S	19	HO	1.116	S	19	HO	1.116	S
9	R	1.246	S	14	R	1.115	S	14	R	1.115	S
47	HT	1.239	S	13	R	1.114	S	13	R	1.114	S
20	HO	1.229	S	24	HT	1.111	S	24	HT	1.111	S
43	HO	1.225	S	9	R	1.095	S	9	R	1.095	S
24	HT	1.217	S	35	HO	1.091	S	35	HO	1.091	S
35	HO	1.189	S	12	R	1.088	S	12	R	1.088	S
17	HT	1.180	S	18	HO	1.082	S	18	HO	1.082	S
18	HO	1.175	S	17	HT	1.072	S	17	HT	1.072	S
12	R	1.164	S	32	HO	1.063	S	32	HO	1.063	S
15	HO	1.131	S	43	HO	1.062	S	43	HO	1.062	S
39	HO	1.108	S	15	HO	1.062	S	15	HO	1.062	S

32	HO	1.106	S	31	HO	1.060	S	31	HO	1.060	S
31	HO	1.095	S	39	HO	1.047	S	39	HO	1.047	S
22	HO	1.064	S	22	HO	1.042	S	22	HO	1.042	S
26	HT	1.021	S	29	HO	1.018	S	29	HO	1.018	S
6	R	1.015	S	6	R	1.012	S	6	R	1.012	S
29	HO	1.015	S	26	HT	1.007	S	26	HT	1.007	S
51	HT	0.995	I	25	HT	0.987	I	25	HT	0.987	I
25	HT	0.979	I	28	HT	0.987	I	28	HT	0.987	I
45	HO	0.956	I	51	HT	0.987	I	51	HT	0.987	I
28	HT	0.948	I	45	HO	0.970	I	45	HO	0.970	I
40	HO	0.946	I	40	HO	0.953	I	40	HO	0.953	I
7	R	0.917	I	7	R	0.951	I	7	R	0.951	I
52	HT	0.906	I	52	HT	0.940	I	52	HT	0.940	I
33	HO	0.872	I	49	HT	0.930	I	49	HT	0.930	I
49	HT	0.855	I	33	HO	0.926	I	33	HO	0.926	I
36	HO	0.844	I	36	HO	0.920	I	36	HO	0.920	I
23	HT	0.819	I	23	HT	0.910	I	23	HT	0.910	I
42	HO	0.788	W	48	HT	0.884	I	48	HT	0.884	I
41	HO	0.783	W	42	HO	0.884	I	42	HO	0.884	I
48	HT	0.730	W	41	HO	0.878	I	41	HO	0.878	I
1	R	0.728	W	34	HO	0.867	I	34	HO	0.867	I
34	HO	0.727	W	1	R	0.866	I	1	R	0.866	I
46	HT	0.720	W	46	HT	0.859	I	46	HT	0.859	I
16	R	0.703	W	37	HO	0.856	I	37	HO	0.856	I
37	HO	0.683	W	4	R	0.842	I	4	R	0.842	I
4	R	0.649	W	16	R	0.838	I	16	R	0.838	I
5	R	0.495	W	5	R	0.790	W	5	R	0.790	W
50	HT	0.453	W	44	HO	0.762	W	44	HO	0.762	W
3	R	0.453	W	50	HT	0.760	W	50	HT	0.760	W
44	HO	0.438	W	3	R	0.758	W	3	R	0.758	W
2	R	0.314	W	2	R	0.696	W	2	R	0.696	W

Source: Prepared from Table 6 by the authors.

Table 8: Ranking of forward linkage effects according to 3 methods from Table 6

IUCW				IUR				IUAR			
S	C	IUCWb	II	S	C	IURb	II	S	C	IUARb	II
30	HO	1.692	S	30	HO	1.331	S	30	HO	1.331	S
8	R	1.625	S	11	R	1.274	S	11	R	1.274	S
11	R	1.447	S	8	R	1.247	S	8	R	1.247	S
10	R	1.377	S	10	R	1.219	S	10	R	1.219	S
38	HO	1.335	S	27	HT	1.176	S	27	HT	1.176	S
27	HT	1.325	S	21	HO	1.132	S	21	HO	1.132	S
13	R	1.305	S	38	HO	1.123	S	38	HO	1.123	S
19	HO	1.269	S	20	HO	1.123	S	20	HO	1.123	S
14	R	1.257	S	47	HT	1.118	S	47	HT	1.118	S
21	HO	1.249	S	19	HO	1.116	S	19	HO	1.116	S
9	R	1.246	S	14	R	1.115	S	14	R	1.115	S
47	HT	1.239	S	13	R	1.114	S	13	R	1.114	S

20	HO	1.229	S	24	HT	1.111	S	24	HT	1.111	S
43	HO	1.225	S	9	R	1.095	S	9	R	1.095	S
24	HT	1.217	S	35	HO	1.091	S	35	HO	1.091	S
35	HO	1.189	S	12	R	1.088	S	12	R	1.088	S
17	HT	1.180	S	18	HO	1.082	S	18	HO	1.082	S
18	HO	1.175	S	17	HT	1.072	S	17	HT	1.072	S
12	R	1.164	S	32	HO	1.063	S	32	HO	1.063	S
15	HO	1.131	S	43	HO	1.062	S	43	HO	1.062	S
39	HO	1.108	S	15	HO	1.062	S	15	HO	1.062	S
32	HO	1.106	S	31	HO	1.060	S	31	HO	1.060	S
31	HO	1.095	S	39	HO	1.047	S	39	HO	1.047	S
22	HO	1.064	S	22	HO	1.042	S	22	HO	1.042	S
26	HT	1.021	S	29	HO	1.018	S	29	HO	1.018	S
6	R	1.015	S	6	R	1.012	S	6	R	1.012	S
29	HO	1.015	S	26	HT	1.007	S	26	HT	1.007	S
51	HT	0.995	I	25	HT	0.987	I	25	HT	0.987	I
25	HT	0.979	I	28	HT	0.987	I	28	HT	0.987	I
45	HO	0.956	I	51	HT	0.987	I	51	HT	0.987	I
28	HT	0.948	I	45	HO	0.970	I	45	HO	0.970	I
40	HO	0.946	I	40	HO	0.953	I	40	HO	0.953	I
7	R	0.917	I	7	R	0.951	I	7	R	0.951	I
52	HT	0.906	I	52	HT	0.940	I	52	HT	0.940	I
33	HO	0.872	I	49	HT	0.930	I	49	HT	0.930	I
49	HT	0.855	I	33	HO	0.926	I	33	HO	0.926	I
36	HO	0.844	I	36	HO	0.920	I	36	HO	0.920	I
23	HT	0.819	I	23	HT	0.910	I	23	HT	0.910	I
42	HO	0.788	W	48	HT	0.884	I	48	HT	0.884	I
41	HO	0.783	W	42	HO	0.884	I	42	HO	0.884	I
48	HT	0.730	W	41	HO	0.878	I	41	HO	0.878	I
1	R	0.728	W	34	HO	0.867	I	34	HO	0.867	I
34	HO	0.727	W	1	R	0.866	I	1	R	0.866	I
46	HT	0.720	W	46	HT	0.859	I	46	HT	0.859	I
16	R	0.703	W	37	HO	0.856	I	37	HO	0.856	I
37	HO	0.683	W	4	R	0.842	I	4	R	0.842	I
4	R	0.649	W	16	R	0.838	I	16	R	0.838	I
5	R	0.495	W	5	R	0.790	W	5	R	0.790	W
50	HT	0.453	W	44	HO	0.762	W	44	HO	0.762	W
3	R	0.453	W	50	HT	0.760	W	50	HT	0.760	W
44	HO	0.438	W	3	R	0.758	W	3	R	0.758	W
2	R	0.314	W	2	R	0.696	W	2	R	0.696	W

Source: Prepared from Table 6 by the authors.

Table 9: Sectors that have backward and forward linkage effects both bigger than 1

IUCW				IUR				IUAR			
S	C	IUCWb	IUCWf	S	C	IURb	IURf	S	C	IUARb	IUARf
30	HO	1.692	2.088	10	R	1.219	1.538	30	HO	1.331	1.924
10	R	1.377	1.085	20	HO	1.123	1.949	21	HO	1.132	1.038
13	R	1.305	1.353	19	HO	1.116	1.083	20	HO	1.123	1.258
19	HO	1.269	1.553	14	R	1.115	1.422	47	HT	1.118	1.433
14	R	1.257	1.709	18	HO	1.082	1.148	19	HO	1.116	1.134
21	HO	1.249	1.325	17	HT	1.072	1.587	14	R	1.115	1.435
47	HT	1.239	1.847	31	HO	1.060	2.231	13	R	1.114	1.072
20	HO	1.229	1.487	39	HO	1.047	1.498	18	HO	1.082	1.166
43	HO	1.225	1.864					17	HT	1.072	1.159
17	HT	1.180	1.264					43	HO	1.062	1.593
18	HO	1.175	1.457					15	HO	1.062	1.288
15	HO	1.131	1.531					31	HO	1.060	1.376
39	HO	1.108	1.379					39	HO	1.047	1.195
31	HO	1.095	1.462					6	R	1.012	1.376
6	R	1.015	1.340								

Source: Prepared from Table 7 and Table 8 by the authors.

Conclusion

In an economy, a sector which has coefficients of high backward and high forward linkage effects calculated according to some methods after Leontief's Inverse Matrix, are determined as the key or leading or locomotive or strong sector that has great effects on both sides, through purchases from other sectors and through sales to other sectors. Therefore, a policy maker may focus on recoveries of the activities of this strong sector whose expansion would lead to a general increase in all of the economic activities, or at least most activities. In this paper, those strong sectors of the Turkish economy are investigated by using the calculations of 2002 Input-Output data. We can see from Table 9 which is the summary of Table 5, Table 6, Table 7 and Table 8; number 14, 17, 18, 19, 20, 31 and 39 sectors have backward and forward linkage effects greater than 1 according to the all 3 traditional methods, number 6, 13, 14, 15, 17, 18, 19, 20, 21, 30, 31, 39, 43 and 47 sectors have backward and forward linkage effects greater than 1 according to the Chenery-Watanabe and Augmented Rasmussen methods (only 10 is different) and the number 10 sector has backward and forward lin-kage

effects greater than 1 according to the Chenery-Watanabe and Rasmussen methods. In Turkish Economy, 9 Heckscher-Ohlin Sectors (15, 18, 19, 20, 21, 30, 31, 39 and 43), 4 Ricardo Sectors (6, 10, 13 and 14) and 2 High-Technology Sectors (17 and 47) can be defined as strong sectors that are interrelated with the other sectors' inputs and outputs. As a result of the analysis of 2002 Domestic I-O Table by Static L-Model, in Turkey, research and development sector (47) of High-Technology Sectors category, manufacture of pulp, paper and paper products (14) of Ricardo Sectors category and recycling (30), manufacture of basic metals (20) and electricity, gas, steam and hot water supply; collection, purification and distribution of water (31) sectors of Heckscher-Ohlin Sectors category are determined as the strong sectors which may have the highest priority at investment policies of the economy.

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