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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

KEY SECTOR ANALYSIS FOR TURKEY: MODIFICATION OF RASMUSSEN MEASURES

TÜRKİYE İÇİN GİRDİ – ÇIKTI YÖNTEMİ İLE KİLİT SEKTÖR ANALİZİ VE RASMUSSEN ÖLÇEĞİNİN BİR UYARLAMASI

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Abstract

This paper investigates key sectors of Turkish Economy by using the key sector classification proposed by Hewings (1974). The paper proposes a new measure based on Rasmussen's forward linkage measure "sensitivity of dispersion index". The measures given by Rasmussen are based on Leontief inverse matrix, which is demand driven. The paper translates Rasmussen's forward linkage measure to supply-driven models by using Ghosh inverse matrix. Application part calculates backward and forward linkages of Turkey by using 2012 Input-Output table which is released by TURKSTAT (2020) and classifies key sectors of Turkish Economy by comparing new and old measures.

Keywords: Input-output Matrix, Key Sectors, Power of Dispersion Index, Sensitivity of Dispersion Index, Coefficient of Variation, Ghosh Inverse, Leontief Inverse

Jel Classification: C67, D57, L14

Öz

Bu çalışma, Hewings (1974) tarafından önerilen kilit sektör sınıflamasını kullanarak Türk ekonomisinin kilit sektörlerini araştırmaktadır. Bu çalışma, Rasmussen'e ait bir ileri bağlantı ölçeği olan "dağılım hassasiyeti" endeksinin bir uyarlamasını önermektedir. Rasmussen tarafından ortaya sunulan ölçekler talep-güdümlü Leontief ters matrisini kullanmakta idi. Bu çalışma Rasmussen'in ölçeğini Gosh ters matrisini kullanarak arz-güdümlü modellere uygulamaktadır. Uygulama kısmında Türkiye'nin ileri geri bağlantıları ve kilit sektörleri TUİK'in 2012 Girdi-Çıktı tabloları kullanılarak hesaplanmıştır (TURKSTAT, 2020). Ayrıca her iki ölçek kullanılarak yapılan sınıflamalar karşılaştırılmıştır.

Anahtar Kelimeler: Girdi–çıktı Matrisleri, Kilit Sektörler, Dağılım Gücü Endeksi, Dağılım Hassasiyeti Endeksi, Varyasyon Katsayısı, Ghosh Ters Matrisi, Leontief Ters Matrisi

Jel Sınıflandırması: C67, D57, L14

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1. Introduction

Economic growth does not occur at random; it is a planned process and there must be some strategies to achieve the desired growth level. According to Hirschman's (1958) unbalanced growth strategy it is not best to support simultaneously all the sectors in an economy. If governments support some strategic sectors, the aimed growth levels can be achieved by effective usage of limited resources. Hirschman proposes to use sectoral linkages for determination of strategic sectors. He suggests supporting the "key" sectors of the economy, which have the highest interconnection with the other sectors. According to Hewings (1974: 439), a "key" sector is a sector which has a substantial effect on the economy with the effects of its influence on the other sectors, employment and value added, or through its connection with final demand sectors. Briefly, the main feature of 'key sector' is that it is the sector which has the greatest impact on the growth of the country.

Input-output studies allow for investigation of intersectoral dependence. Sectoral interdependence at input-output level is measured by "linkage" concept. There are several methods for measuring intersectoral linkages.

The way Hirschman (1958) uses sectoral linkages is proficient when compared to the further advancements. He uses a qualitative way rather than a quantitative way. Hirschman (1958: 104-109), commentates the analysis of 4 countries (US, Japan, Italy, Norway) by Chenery and Watanabe's (1958: 492 – 494) and adapts it to his key sector classification. Hirschman (1958: 108) finds Chenery and Watanabe's interconnection linkages very rough and he suggests using Rasmussen's linkage measure as a more refined measure that captures both direct and indirect effects through Leontief inverse matrix. Actually, Hirschman's classification is based on total linkage effect concept.

Although Rasmussen's measures are powerful, it has some drawbacks. Rasmussen's power of dispersion index – which refers to backward linkage effect – is a meaningful way of measuring direct and indirect backward linkage effects. But his sensitivity of dispersion index – which refers to forward linkage effect – is confusing. In the literature, it is proposed to calculate direct and indirect forward linkage effects, but Rasmussen calculates this index by using the row sums of the Leontief inverse matrix (as cited in Hazari, 1970; Hewings, 1974). However, Leontief inverse matrix is derived from a demand-driven coefficient matrix. This makes an ambiguity about why a supply-driven concept (forward linkage [1]) was tried to be measured from a demand-driven model.

This paper says that, Rasmussen's sensitivity of dispersion index measures something different than forward linkage effect. Rasmussen's sensitivity of dispersion measure, which is based on the Leontief inverse matrix, calculates the output increase of a specific industry in case of a final

1 Formally, forward linkage effect of sector i can be defined as the increase of inputs i used by all the sectors due to the increase in sector i's gross output.

demand increase for all of the goods produced in the economy [2]. Such a situation may occur in case of a dramatical increase in the population growth or per capita income. What Rasmussen's index measures is that how much the supplier industry's product used by the rest of the economy. But, the new sensitivity of dispersion measure (which is proposed in this paper) based on the Ghosh inverse matrix calculates the output growth realized in the whole system based on a specific sector's primary input [3] increment, i.e. it measures how the whole economy can boost by rising up one sectors' primary input. Increasing primary inputs of the sectors whose sensitivity of dispersion measure (based on the Ghosh inverse matrix) is high, generates greater output growth levels in the whole system. So, investing on such sectors is a strategic decision. Jones (1976: 327-328) and Bayers (1976: 231-232) also suggest using Ghosh inverse matrix in the forward linkages by this reason, but they do not propose any specific index.

In section 2, I give a summary of past studies related with the input-output analysis for Turkey. In section 3, I give the theoretical information about Leontief and Ghosh inverse matrices and their mathematical formulation. In section 4, I introduce the linkage measures of Hazari (1970), Hewings (1974) and Rasmussen, and give some background information about them. In section 5, I define a total forward linkage measure based on Ghosh inverse matrix by inspiring from the measures of Hazari (1970), Hewings (1974) and Rasmussen. In section 6, I explain the methodology to determine the key sectors in this paper. In section 7, I introduce the dataset used in the application part. In section 8, I present key sectors of Turkish Economy both by using Ghosh matrix and Leontief matrix. Then I compared the results of these analysis. In section 9, I summarize the paper, and give some remarks on key sectors of Turkey and the automotive industry. In the Appendix part, I present some important tables; sectors in Turkish Economy together with their linkage measures, Nace Rev. 2 classification and a sample of a primitive input-output table.

2. Literature Review

Kula (2008), classifies key sectors of Turkish Economy by using Chenery and Watanabe (1958) and Rasmussen linkage measures and their weighted form Turkey's 2002 I-O table. According to his classification key sectors of Turkey are "*agriculture, hunting and related services, food products and beverages, textiles, chemical and chemical products, Other non-metallic mineral products, basic metals, Electrical energy, gas, steam and hot water, wholesale and retail trade, land transport, Supporting and auxiliary transport services; travel agency services, real estate activities*" (Kula, 2008: 15-19).

Also, Yay and Keçeli (2009) uses Chenery and Watanabe (1958) and Rasmussen linkage measures both from the Leontief and Ghosh perspective to classify the key sectors of Turkey for 2002. They make an aggregation of the sectors in Turkish economy from 59 sectors to 52 sectors and

2 This situation refers to a demand increase in the overall economy.

3 Primary inputs are denoted in the value added part of an I-O table, they are basically tax, labor wage and capital.

classify all economic activities into 3 categories these are "'*natural resource intensive sectors (R)', 'high-technology intensive High-Technology Sectors (H-T)' and 'capital labor intensive Heckscher-Ohlin Sectors (H-O)*'" (Yay & Keçeli, 2009: 305-315). Moreover they state that " … *research and development sector of High – Technology Sectors category, manufacture of pulp, paper and paper products of Ricardo Sectors category and recycling manufacture of basic metals and electricity, gas, steam and hot water supply; collection, purification and distribution of water sectors of Heckscher-Ohlin Sectors category are determined as the strong sectors which may have the highest priority at investment policies of the economy*." (Yay & Keçeli, 2009: 325).

Akbulut (2019: 242), offers to focus supply side of the economy to determine the sectors which require public investment and subsidy. She analyzes the subsectors of the manufacturing sector by using OECD 2015 input-output tables and deduces that electrical equipment, metal production, coal and petroleum products and other manufactured goods sectors are important for Turkish Economy for their return on capital, value added and labor income (Akbulut, 2019: 246-51).

Pehlivanoğlu and İnce (2020), investigates the structural change in the Turkish Economy between 1970 and 2012 by using a dynamic input-output analysis. They found that intermediate good industries are the key sectors of Turkish economy in every period and also, they observe the structural change from agriculture to energy intensive industry sectors (Pehlivanoğlu & İnce, 2020: 179-185).

3. Theoretical Background

It is important to understand Leontief and Ghosh inverse matrices for understanding the meaning of Rasmussen's linkage measures and what is the difference of the offered measure from the Rasmussen's.

3.1. Leontief Inverse Matrix

The basic mathematical modelling of an input-output matrix gives rise to the following

$$(\boldsymbol{I} - \boldsymbol{A}).\boldsymbol{X} = \boldsymbol{F} \qquad [1]$$

where $\boldsymbol{A}$ is the *"direct input coefficient matrix"*. Using matrix algebra, there can be found a unique set of solutions for $\mathbf{X}$ if $(\boldsymbol{I} - \boldsymbol{A})$ is invertible [4]. Now suppose that the determinant of $(\boldsymbol{I} - \boldsymbol{A})$ is nonzero, then $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ exists. [5] Then equation [1] turns out to be

$$\boldsymbol{X} = (\boldsymbol{I} - \boldsymbol{A})^{-1}.\boldsymbol{F} \ . \qquad [2]$$

The matrix $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ is called as the "*Leontief Inverse Matrix*". [6] It is denoted by,

4 From matrix algebra it is known that $(\boldsymbol{I} - \boldsymbol{A})$ is invertible iff determinant of $(\boldsymbol{I} - \boldsymbol{A})$ is nonzero.

5 In mathematics, $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ is called as the inverse of the matrix $(\boldsymbol{I} - \boldsymbol{A})$.

6 Some authors call $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ as the "*total requirements matrix*".

$$\boldsymbol{L} = \left[l_{ij}\right] = (\boldsymbol{I} - \boldsymbol{A})^{-1}. \quad [3]$$

Leontief inverse matrix connects each sector's gross output value to the final demand values in the economy through the relation

$$\boldsymbol{X} = \boldsymbol{L}.\boldsymbol{F}. \quad [4]$$

Equation [4] can be written as a system of linear equations, it is seen that gross output of each sector is a linear combination of each of the final demands. In other words,

$$x_i = l_{i1}f_1 + l_{i2}f_2 + \cdots + l_{in}f_n. \quad [5]$$

Equation [5] shows that output value of any sector in the economy is dependent on the amount of the final demand for the products of *all* the sectors. In fact, the Leontief inverse matrix $\boldsymbol{L}$ plays a role in input-output models similar to the "*Keynesian multiplier*" in national income decomposition (Aydoğuş, 1999: 43-44). If the demand for j^{th} good increases in the economy, then sector *j* purchases inputs from other sectors of the economy [7] in proportion of the j^{th} column of the direct input coefficient matrix $\boldsymbol{A}$ in the first stage. In the second stage, all the sectors selling inputs to sector *j* increases their production in proportion of the j^{th} column of $\boldsymbol{A}$, this causes them to purchase inputs from the rest of the economy in proportion of $\boldsymbol{A}.\boldsymbol{A}$ to perform this production increase. In the third stage, $\boldsymbol{A}.\boldsymbol{A}.\boldsymbol{A}$ ratio demand increase occur in the economy due to the production increase happened in the second stage, and so on… The increase happening in the first stage due to $\boldsymbol{A}$ is called as the "*direct effect*", the other increases occurred in the other stages are called as the "*indirect effects*". Leontief inverse matrix $\boldsymbol{L}$ captures all the *direct* and *indirect* effects. This can be proven mathematically from the power series expression of the Leontief inverse matrix,

$$\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1} = \boldsymbol{I} + \boldsymbol{A} + \boldsymbol{A^2} + \boldsymbol{A^3} + \cdots. \quad [6]$$

The matrix $\boldsymbol{I}$ in equation [6] denotes the first one unit increase in final demand.

There are several indices using Leontief inverse matrix as the measurement of intersectoral dependence in the input-output framework. These indices are used as a total linkage measure. Leontief inverse matrix is derived from the demand-side of the economy. Alternatively, a similar model from the supply-side of the economy can be constructed and for the solution of this type of models I use supply-driven Ghosh inverse matrix.

3.2. Ghosh Inverse Matrix

Leontief inverse matrix relates gross output to final demand. Alternative to the Leontief model Ghosh inverse matrix relates gross production of each sector to the primary inputs (in other

7 In a real economy not all the sectors sell and purchase intermediate goods to each other. But in the modelling part of this paper it is assumed that all the sectors are in trade reation with each other. If sector *i* sells no good to sector *j*, then the ij^{th} entry of the transaction matrix is zero.

words the value added part) used by all the sectors (Jones, 1976: 328; Miller & Blair, 2009: 543;). Ghosh inverse matrix is obtained from the "*direct output coefficient matrix*" $\boldsymbol{B}$ from a similar method to the Leontief inverse matrix (Miller & Blair, 2009: 543). "*Ghosh inverse matrix*" $\boldsymbol{G}$ is defined as following

$$\boldsymbol{G} = (\boldsymbol{I} - \boldsymbol{B})^{-1}. \quad [7]$$

Mathematically, Ghosh inverse matrix can be derived by reading Table 7 from column side; by summing up the j^{th} column of Table 7 it is obtained that,

$$X_j = \sum_{i=1}^{n} x_{ij} + V_j. \quad [8]$$

where $\mathrm{V_j}$ is the value-added part of the j^{th} sector. Considering the whole system of *n* equations, equation [8] turns to be

$$\boldsymbol{X'} = \boldsymbol{i'Z} + \boldsymbol{V'}.^{8} \quad [9]$$

Replacing $b_{ij} = \frac{x_{ij}}{X_i}$ in equation [8] gives,

$$X_j = \sum_{i=1}^{n} b_{ij} X_i + V_j. \quad [10]$$

Then considering [10] as a system of *n* linear equations and writing them in the matrix form, the below equation is obtained

$$\boldsymbol{X'}.(\boldsymbol{I} - \boldsymbol{B}) = \boldsymbol{V'}. \quad [11]$$

Solving the above equation,

$$\boldsymbol{X'} = \boldsymbol{V'}.(\boldsymbol{I} - \boldsymbol{B})^{-1} = \boldsymbol{V'}.\boldsymbol{G}. \quad [12]$$

The entries $\mathrm{g_{ij}}$ of the matrix $\boldsymbol{G}$ measure the value of sector *j*'s production increase per unit of *primary input*[9] increase occurred in sector *i* (Jones, 1976: 328; Miller & Blair, 2009: 544). In other words, if sector *i* increases its labor or capital then by the theory of production function its output increases, then this leads to an increase in the supply of inputs to sector *j* from sector *i;* as a result of this, output of sector *j* increases.

In the demand-driven Leontief model, it is assumed that the input coefficients $\mathrm{a_{ij}}$ are stable. This means that if the inputs used by sector *i* are doubled, then the output of sector *i* is doubled. In contrast to this, in the supply-driven Ghosh model, output coefficients $\mathrm{b_{ij}}$ are stable; i.e. if the output of sector *i* is doubled, then all the sales of sector *i* are doubled (Ghosh, 1958: 61; Miller & Blair, 2009: 544).

8 The prime (′) on a vector denotes that it is a row vector. In equation [8], $\mathbf{X'}$ denotes the row vector of gross outputs, $\mathbf{V'}$ denotes the row vector of value added of each sector and $\mathbf{i'} = [1 \quad 1 \quad 1]$.

9 Payments to the primary factors of production, i.e. wages, rent and interest paid to labor, land, capital and taxes, imports, etc.

4. Rasmussen-Hazari-Hewings's Linkage Measures

There are several linkage measures proposed by several authors. These are mainly proposed by Bayers (1976), Chenery and Watanabe (1958), Dhawan and Saxena (1992), Hazari (1970), Hewings (1974), Hirschman (1958), Leontief, Rasmussen, Yotopoulos and Nugent (1973). Among all, the combination of Hazari (1970), Hewings (1974) and Rasmussen measures can be thought as the most detailed one, because they both deal with the strength of input demand or output supply of the sectors and the dispersion of this demand. Their measure can discriminate the sectors which are interconnected only a few sectors and the sectors which are linked most of the sectors in the economy. This property makes of Hazari (1970), Hewings (1974) and Rasmussen's measures more powerful than the others. This is also appropriate to the key sector theory of Hirschman (1958: 116-19), which concerns the sectors that can stimulate the rest of the economy evenly by a small unit increase in itself.

Rasmussen proposed two measures which are given by the row and column sums of the Leontief inverse matrix. He used the averages of the row and column sums of the demand-driven Leontief inverse matrix as backward and forward linkage measures, respectively. They can be formulated as

$$PD_j^R = \frac{\sum_{i=1}^{n} l_{ij}}{n} \text{ and } SD_i^R = \frac{\sum_{j=1}^{n} l_{ij}}{n} \qquad [13]$$

where l_{ij} is an entry of the Leontief inverse matrix $\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1}$.

Hazari (1970: 301) points that the above measures are not appropriate for interindustry comparisons. The normalizations of these measures are used by many authors in the literature. I show these normalized measures in below.

4.1. Power of Dispersion Index

The "power of dispersion measure" is formulated as below

$$U_j = \frac{\frac{\sum_{i=1}^{n} l_{ij}}{n}}{\frac{\sum_{j=1}^{n}\sum_{i=1}^{n} l_{ij}}{n^2}} = \frac{PD_j^R}{\frac{\sum_{j=1}^{n} PD_j^R}{n}} \qquad [14]$$

This can be interpreted as a backward linkage measure. Intuitively, PD_j^R is an estimate of the average increase in the output of the supplier industries when the demand for intermediate goods of industry j increases by one unit. By the nature of a total linkage index, this demand for intermediate goods stems from the input requirements of the user industry due to the final demand increase. The denominator of U_j denotes the average of this estimate for all industries. Therefore, U_j is a way of the comparison of the economic revival in the region created by the final demand increase in sector j with the other sectors. Hence, $U_j > 1$ means that sector j draws

heavily on the rest of the economy (Hazari, 1970: 301). In other words, sector j's input usage in the economy is more than the average value of all the other sector's input usage.

4.2. Sensitivity of Dispersion Index

The "sensitivity of dispersion measure" is formulated as

$$U_i = \frac{\frac{\sum_{j=1}^{n} l_{ij}}{n}}{\frac{\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}}{n^2}} = \frac{SD_i^R}{\frac{\sum_{i=1}^{n} SD_i^R}{n}} \quad [15]$$

This can be interpreted as a forward linkage measure. As in the same way of "power of dispersion index", SD_i^R is an average estimate of the output increase of sector *i* if the final demand of all the industries in the economy increases by one unit. Similarly, the denominator of U_i is an average of this estimate for all the industries in the region. So, U_i is a way of the comparison of the economic revival occurred in sector *i* with the other sectors in the economy in case of a final demand increase in all the sectors. Hence, U_i >1 means that sector i is a crucial input supplier for the rest of the economy. Because if the final demand increases in every industry, then sector *i's* output is needed more than the other industries (Hazari, 1970: 302). In other words, sector *i*'s output is used as an input by the other sectors in the economy more than the average value of all the other sector's output in the system, or the goods of the i^{th} sector are demanded more than the other sector's goods. As can be seen, Rasmussen's sensitivity of dispersion index is a demand-driven forward linkage measure.

4.3. Coefficient of Variation Index

The above indices are based on the averaging method and for outliers averaging methods may give misleading results. For example, consider that an industry uses extremely high amount of inputs from one or two industries such that the "power of dispersion index" of this industry is greater than others. In this case, an increase in the final demand for the goods of this industry will affect only one or two sectors but not the others. To achieve this problem Hazari (1970: 302) proposed to use "coefficient of variation indices",

$$V_j = \frac{\left[\frac{1}{n-1}\sum_{i=1}^{n}\left(l_{ij} - \frac{1}{n}\sum_{i=1}^{n} l_{ij}\right)^2\right]^{1/2}}{\frac{1}{n}\sum_{i=1}^{n} l_{ij}}, \quad [16]$$

$$V_i = \frac{\left[\frac{1}{n-1}\sum_{j=1}^{n}\left(l_{ij} - \frac{1}{n}\sum_{j=1}^{n} l_{ij}\right)^2\right]^{1/2}}{\frac{1}{n}\sum_{j=1}^{n} l_{ij}} \quad [17]$$

where *i, j=1,…,n.* The numerator of the coefficient of variation indices are standard deviations of the corresponding "power of dispersion" and "sensitivity of dispersion" indices. The indices $\mathrm{V_j}$

and V_i measure the variability of the dispersion around the mean. A high value of $\mathrm{V_j}$ indicates that sector *j* purchases inputs from a few sectors while a low value of $\mathrm{V_j}$ indicating that sector *j* purchases inputs from most of the sectors equally. Similarly, a high value of V_i indicates that sector *i* sells its good to a few sectors while a low value of V_i implying that sector *i*'s good is evenly used by most of the sectors. So, low values of $\mathrm{V_j}$ and V_i show that the sector is interconnected with most of other sectors. [10]

5. Application of Rasmussen-Hazari's Linkage Measures to Ghosh's Supply-Side Model

This model requires the translation of Rasmussen's forward linkage measure to supply-driven models. As I mentioned before, Rasmussen's sensitivity of dispersion index measure [11] the value of output increase of a given sector when the final demand for the goods of all industries in the system increases by one unit. It is a demand-driven measure based on the Leontief inverse matrix. But this approach catches the output growth of the industries depending on the demand coming from the rest of the system. If someone is interested in the output growth occurred in the whole system due to a specific sector's output growth stemming from its endogenous dynamics, he has to use supply driven models. With the aim of measuring this effect, I will apply Rasmussen's forward linkage measure $\mathrm{SD_i^R}$ to the supply-driven Ghosh inverse matrix.

Take the row sums $\sum_{\mathrm{j=1}}^{\mathrm{n}} \mathrm{g_{ij}}$ of the Ghosh inverse matrix $\boldsymbol{G} = (\boldsymbol{I} - \boldsymbol{B})^{-1}$. I will denote this supply-driven measure as $\mathrm{SD_i^R(G)}$. Then

$$SD_i^R(\boldsymbol{G}) = \frac{\sum_{j=1}^{n} g_{ij}}{n}. \qquad [18]$$

is an estimate of the average output increase of a random industry due to a primary input increase of i^{th} industry. Using Hazari's (1970) method I construct the normalized version of the supply-driven $\mathrm{SD_i^R(G)}$-measure as following

$$U_i(\boldsymbol{G}) = \frac{SD_i^R(\boldsymbol{G})}{\frac{\sum_{i=1}^{n} SD_i^R(\boldsymbol{G})}{n}}. \qquad [19]$$

Thus, $U_i(G)$ is the average output increase of the sectors in the economy due to a primary input increase of i^{th} sector. $U_i(G)$>1 means that sector $i's$ output is highly used by many industries. To avoid misleading results for the outliers in such averaging methods, I derived the corresponding coefficient of variation index by inspiring from Hazari (1970). This helps to measure the variability of dispersion relative to its mean. The following index is an application of equation [17] to Ghosh inverse matrix, I will call it as the "*supply-driven coefficient of variation of the sensitivity of dispersion index*". The formula is given as below

10 "j" denotes the sector in matter is considered from the colums (as a backward effect), "i" denotes the sector in matter is considered form the rows (as forward effect).

11 Rasmussen's sensitivity of dispersion index measure refers to the forward linkage effect.

$$V_i(\boldsymbol{G}) = \frac{\left[\frac{1}{n-1}\sum_{j=1}^{n}\left(g_{ij}-\frac{1}{n}\sum_{j=1}^{n}g_{ij}\right)^2\right]^{1/2}}{\frac{1}{n}\sum_{j=1}^{n}g_{ij}}. \qquad [20]$$

A high value of $V_i(G)$ indicates that the primary input growth of sector *i* benefits only a few sectors, while a low value of $V_i(G)$ indicates that primary input growth of sector *i* benefits most of the sectors in the economy evenly.

6. Forward and Backward Linkages and Key Sector Classification

As a forward linkage measure, this paper uses sensitivity of dispersion measure which is calculated by using the Ghosh inverse matrix in section 5. Since Ghosh inverse matrix is supply-driven, this measure catches the total linkage effects in case of any supply increment. As a backward linkage measure, the paper uses power of dispersion index by using Leontief inverse matrix which is proposed by Hazari (1970: 301)-Hewings (1974: 441-42) – Rasmussen which is defined in section 4.1.

As Hewings (1974:441-43) suggested, for key sector identification I will use the combination of dispersion and variation indices, U's and V's. Key sectors will be determined as those U's are bigger than 1 and V's are relatively low [12]. This method helps to specify the sectors both creating high linkage effect relative to the mean and having interaction with wide range of sectors. The reason why I use coefficient of variation indices together with power of dispersion and sensitivity of dispersion indices is that a sector having high value of U_i and U_j might be affecting only a few sectors in case of any demand or primary input increase. At this point, I also interested in the variability of the dispersion. Because this better reflects the strength of the interconnection. Hazari (1970: 302) also supports the idea that spread effects of industrial diversification is important for economic development. However, Hirschman (1958: 108) disregards the spread effects when classifying key sectors, he focuses Rasmussen's total linkage measures to catch the direct and indirect effects. In this paper, I focused both the total effects and the spread effects.

7. Data and Model

This paper uses national input-output table of Turkey for the year 2012, named as "*Domestic Input-Output Table, 2012 (at basic prices)*", which is the most current one (TURKSTAT, 2020). The input-output table released by TurkStat is for 64 sectors, sector and product classification of the table is in accordant with NACE Rev 2 ("*Statistical classification of economic activities in the European Community*") and CPA 2008 ("*Statistical Classification of Products by Activity in the European Economic Community*") (Eurostat, 2008: 43-44). There are two empty columns and rows in the data, which belong to the sectors, "Imputed rents of owner-occupied dwellings (L68A)" and "Services of

12 A sector is determined as a 'key sector' if its power of disspersion index U_j and sensitivity of dispersion index U_i are bigger than 1, and their corresponding variation indices V_j and V_i are relatively low.

households as employers; undifferentiated goods and services produced by households for own use (T)", sector 45 and sector 64 respectively. When dealing with the data, I replaced these empty cells by 0. Then I calculated the power of dispersion index by using the Leontief inverse matrix and supply-driven sensitivity of dispersion index by using Ghosh inverse matrix. I also calculated the demand-driven sensitivity of dispersion index by using Leontief inverse matrix to make a comparison of the results. These measures refer to the total linkage measures, so they catch all the direct and indirect effects. I also calculated the coefficient of variation index for both measures to see the diversity of the dispersion. Key sector classifications of Turkish economy both for the supply-driven and demand-driven models are discussed in the following section 8.

8. Key Sectors of Turkish Economy

8.1. Using Ghosh Inverse Matrix for The Sensitivity of Dispersion Index

Key sectors of Turkish Economy are determined from domestic input-output table for 2012. The sectors whose power of dispersion and sensitivity of dispersion indices are higher than 1, are listed in Table 1; there are 14 sectors both U_j and U_i indices are greater than 1.

Table 1: Sectors of Turkish Economy whose Power of Disperson and Sensitivity of Dispersion Indices are Greater than 1

No	CPA 2008	Sectors	PDI, U_j	CV, V_j	SDI, U_i	CV, V_i
49	M73	Advertising and market research services	1.38	4.74	1.67	3.51
42	K65	Insurance, reinsurance and pension funding services, except compulsory social security	1.20	4.83	1.11	4.56
14	C23	Other non-metallic mineral products	1.16	5.00	1.25	4.78
15	C24	Basic metals	1.13	5.20	1.13	4.82
7	C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.13	5.25	1.31	4.44
50	M74_ M75	Other professional, scientific and technical services and veterinary services	1.07	5.34	1.31	3.97
24	D35	Electricity, gas, steam and air conditioning	1.36	7.29	1.68	5.30
9	C18	Printing and recording services	1.06	5.21	1.63	3.14
37	J58	Publishing services	1.05	4.97	1.08	4.34
13	C22	Rubber and plastic products	1.05	5.28	1.11	4.57
38	J59_ J60	Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	1.17	5.80	1.66	3.88
8	C17	Paper and paper products	1.04	5.37	1.20	4.20
32	H50	Water transport services	1.03	5.60	1.15	4.44
35	H53	Postal and courier services	1.02	5.11	1.25	3.82

Source: TURKSTAT (2020) and Author's own calculations

Note: PDI: Power of Dispersion Index, SDI: Sensitivity of Dispersion Index, CV: Coefficient of Variation (for corresponding PDI or SDI)

Also, coefficient of variation of the sectors calculated and the sectors with low coefficient of variation are analyzed. The coefficient of variation for power of dispersion measure ranges between 3 and 8. The coefficient of variation for sensitivity of dispersion measure ranges between 4 and 8. I determined thresholds for the coefficient of variation indices as their mean. So, the threshold for the coefficient of variation of power of dispersion measure is 5.604, and the threshold for the coefficient of variation of sensitivity of dispersion measure is 5.500. Considering these criteria, I eliminated two sectors, these are "*Electricity, gas, steam and air conditioning*" sector and "*Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services*" sector. These two sectors backward and forward linkage effects are high, but they are not connected with every other sectors evenly. Especially, for their backward linkage effect, i.e. final demand increase in these sectors can create intermediate demand increase in some part of the economy not the whole.

Table 2 demonstrates the key sectors of Turkish Economy for the supply-driven model. There are 12 particularly important sectors for Turkish Economy. This means that if the final demand in these sectors rises then, then this increases the demand for intermediate goods in the rest of the economy; also, if a primary input increase occurs in these sectors, this leads to production increase in the rest of the economy. Investing on these sectors not only favors them but the rest of the economy evenly. Growth of these sectors both increases the demand and the supply in the economy.

Table 2: Key Sectors of Turkish Economy (Supply-driven Model)

No	CPA 2008	Sectors	PDI, U_j	CV, V_j	SDI, U_i	CV, V_i
49	M73	Advertising and market research services	1.38	4.74	1.67	3.51
42	K65	Insurance, reinsurance and pension funding services, except compulsory social security	1.20	4.83	1.11	4.56
14	C23	Other non-metallic mineral products	1.16	5.00	1.25	4.78
15	C24	Basic metals	1.13	5.20	1.13	4.82
7	C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.13	5.25	1.31	4.44
50	M74_ M75	Other professional, scientific and technical services and veterinary services	1.07	5.34	1.31	3.97
9	C18	Printing and recording services	1.06	5.21	1.63	3.14
37	J58	Publishing services	1.05	4.97	1.08	4.34
13	C22	Rubber and plastic products	1.05	5.28	1.11	4.57
8	C17	Paper and paper products	1.04	5.37	1.20	4.20
32	H50	Water transport services	1.03	5.60	1.15	4.44
35	H53	Postal and courier services	1.02	5.11	1.25	3.82

Source: TURKSTAT (2020) and Author's own calculations

In Table 2, sensitivity of dispersion index is calculated by using the new method offered in this paper (by using Ghosh inverse matrix in order to Leontief inverse matrix). If Ghosh inverse

matrix is used in the key sector identification, then this allows for the determination of the sectors which positively affect the rest of the economy due to any increase in their factors of production. Furthermore, the advantage of using Ghosh matrix in the sensitivity of dispersion measure is the determination of the sectors whose feeding effect is high.

8.2. Using Leontief Inverse Matrix for The Sensitivity of Dispersion Index

In this part, I calculated the sensitivity of dispersion measure by using Rasmussen's method (by using Leontief inverse matrix) and determined the key sectors by using this traditional way. According to this method, 9 demand-driven key sectors of Turkish Economy are represented in Table 3.

The key sectors in Table 3 are the sectors whose backward and forward linkage effects are high, i.e. these sectors stimulate production for most of the sectors in the economy by creating higher input demand requirements in case of any final demand increase for their products, and also if final demand increases for all the sectors in the rest of the sectors, then the output of the sectors in Table 3 increases.

In the previous supply-driven model, "*Paper and paper products*", *"Printing and recording services"*, *"Rubber and plastic products"*, *"Other non-metallic mineral products"*, *"Basic metals"* and *"Advertising and market research services"* were already determined as the key sectors. But using this old type demand-driven model of Rasmussen, the sectors "*Food, beverages and tobacco products"*, *"Constructions and construction works"* and *"Accommodation and food services"* are also determined as key sectors. So, by comparing two methods, it can be said that the output of construction, manufactured food and accommodation sectors are affected by the "demand" in the overall economy. [13]

Table 3: Key Sectors of Turkish Economy (demand-driven model)

No	CPA 2008	Sectors	PDI, U_j	CV, V_j	SDI, U_i	CV, V_i
5	C10-C12	Food, beverages and tobacco products	1.23	4.86	1.15	5.00
8	C17	Paper and paper products	1.04	5.37	1.03	5.39
9	C18	Printing and recording services	1.06	5.21	1.09	5.11
13	C22	Rubber and plastic products	1.05	5.28	1.11	4.98
14	C23	Other non-metallic mineral products	1.16	5.00	1.05	5.50
15	C24	Basic metals	1.13	5.20	1.66	3.68
27	F	Constructions and construction works	1.23	4.88	1.31	4.53
36	I	Accommodation and food services	1.08	4.75	1.03	5.02
49	M73	Advertising and market research services	1.38	4.74	1.29	4.97

Source: TURKSTAT (2020) and Author's own calculations

13 The sectors in Table 3 are considered under the Nace Rev.2 classification in Table 9.

If the key sectors are determined by using Leontief inverse matrix for both indices, then the stimulating and feeding effect of these sectors are dependent on the output demand inside or outside of the sectors. Investments on these kinds of key sectors need attention. Because if there is a general demand deficiency in the economy, the investments would remain inactive.

8.3. Comparison of Demand-driven and Supply-driven Key Sectors

Comparing the results of demand-driven and supply-driven sensitivity of dispersion measures, it is seen that there are some common sectors in the key sector classifications of two methods. These sectors are *"Paper and paper products", "Printing and recording services", "Rubber and plastic products", "Other non-metallic mineral products", "Basic metals"* and *"Advertising and market research services"*. Therefore, the common trait of these sectors is that their output is affected by the final demand increase of all the sectors in the rest of the economy and an increase in their factors of production affects the production of all the sectors in the economy. This is evident by the nature of supply-driven and demand-driven sensitivity of dispersion measures [14].

Table 4: Comparision of Key Sectors for Leontief and Ghosh Type Sensitivity of Dispersion Index

Sectors (Leontief)	Sectors (Ghosh)
Food, beverages and tobacco products	Advertising and market research services
Paper and paper products	Insurance, reinsurance, and pension funding services, except compulsory social security
Printing and recording services	Other non-metallic mineral products
Rubber and plastic products	Basic metals
Other non-metallic mineral products	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
Basic metals	Other professional, scientific and technical services and veterinary services
Constructions and construction works	Printing and recording services
Accommodation and food services	Publishing services
Advertising and market research services	Rubber and plastic products
	Paper and paper products
	Water transport services
	Postal and courier services

As a result, wood and paper industry, plastic manufacturing, metal manufacturing and professional activities are good decisions for investments. Because output levels of these sectors are dependent to the overall demand in the economy and also increasing their output level stimulates the rest of the economy. In other words, these sectors bidirectionally connected to the rest of the economy. In addition to these, it is evident from the demand-driven key sector classification (sectors (Leontief)) that if the overall demand in the economy increases then productions in food industry, construction sector and accommodation sector rise. In return,

14 Forward linkage effect in a way.

supply-driven key sector classification (sectors (Ghosh)) shows that if the factors of production in the wood manufacturing, technical services, publishing services, transportation services and postal services increase, then the output increases in the rest of the economy.

9. Conclusion

This paper presents a modification of Rasmussen's total forward linkage measure – sensitivity of dispersion index – which is based on Ghosh inverse matrix. Rasmussen's sensitivity of dispersion measure estimates the output increment of an industry when the final demand for the output of each industry in the economy increases, whereas the index proposed in this paper estimates the output growth in the economy (for each of the sectors) when a sector's primary input increases. As well as the strength of the sectoral linkages, variation of the interconnection is also emphasized in this paper. So, the coefficient of variation of the linkage measures are also analyzed.

In the application part, key sectors of Turkish Economy are classified both by the supply-driven and demand – driven model. Supply-driven model uses power of dispersion index based on Leontief inverse matrix, the sensitivity of dispersion index based on Ghosh inverse matrix and the coefficient of variation indices. Supply-driven key sectors of Turkish economy are *"Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials", "Paper and paper products", "Printing and recording services", "Rubber and plastic products", "Other non-metallic mineral products", "Basic metals", "Water transport services", "Postal and courier services", "Publishing services", "Insurance, reinsurance and pension funding services, except compulsory social security", "Advertising and market research services", "Other professional, scientific and technical services and veterinary services"*. As a development strategy, investment should be given to these sectors. Because by the nature of the measures used in this method those sectors have the highest interconnection with several sectors in Turkey, i.e. final demand increase in these sectors stimulates the production in the most of other sectors, and if the factors of production of those sectors increases then the output level grows in the most of the other sectors evenly.

Among these 12 sectors, *"Advertising and market research services", "Insurance, reinsurance and pension funding services, except compulsory social security", "Other non-metallic mineral products", "Basic metals"* are the sectors whose power of dispersion indices are high with lowest variation. [15] Due to their highest backward linkage effect these sectors stimulate the rest of the economy if their production increase. These 4 sectors require more attention for investment decisions in the Hirschmanian concept. Besides "*Advertising and market research services"* and *"Printing and recording services"* sectors show highest sensitivity of dispersion with lowest variation. This means that if any primary input increase occurs in these sectors, this leads to output increase in many sectors. So, these sectors need more attention due to their feeding effect for many sectors in the rest of the economy. It can be said that *"Advertising and market research services"* sector is very important both for its stimulating (backward linkage) and feeding (forward linkage) effect. The

15 The priority is given to the backward linkage effects as in Hirschmanian perspective.

priority should be given to *"Advertising and market research services"* sector in the supply-driven perspective.

Key sector classification in Table 2, shows that manufacturing industry in Turkey has a positive effect on the economic growth, but the key sectors in Turkish manufacturing industry are those low or middle-low technology sectors. Doğruel and Doğruel (2018: 278-84) show that the share of low technology sector groups is high both in labor, value added and average labor productivity. This study supports the idea of Doğruel and Doğruel (2018).

For comparison, I also calculated the sensitivity of dispersion index (based on Leontief inverse matrix) and classified key sectors of Turkish Economy by using this index and the power of dispersion index (based on Leontief inverse matrix) in section 8.2. There are 9 many demand-driven key sectors, 6 of them are the same as in supply-driven model. These are *"Paper and paper products", "Printing and recording services", "Rubber and plastic products", "Other non – metallic mineral products", "Basic metals"* and *"Advertising and market research services"*. This similarity shows that these common sectors have high backward linkage effect, and at the same time both their output is affected by the demand increase in the overall economy and those sectors boom the other sectors by increasing their primary input levels. There are also 3 different sectors in the demand-driven model; "*Food, beverages and tobacco products", "Constructions and construction works", "Accommodation and food services".* The output of these sectors is highly affected by the overall demand in the economy besides their high backward linkage effect. Construction sector appears in the demand-driven key sector classification whereas it is not appeared as a supply-driven key sector. Construction sector's power of dispersion index is 1.22, which is above the 1 threshold, its demand-driven sensitivity of dispersion index is 1.31, again above the 1 threshold, but its supply-driven sensitivity of dispersion index is. 0.73, which is below the classification threshold. [16] This proves the fact that construction sector is a leading sector of Turkish economy such that it uses inputs form many industries, and high demand-driven sensitivity of dispersion index for construction sector shows that its output growth is highly affected from economic booms and recessions. But its low its supply-driven sensitivity of dispersion index show that construction sector is deprived of the endogenous power of developing the economy by increasing its primary inputs. So, investments in construction sector should be made carefully. Investing on this kind of sectors can be insufficient for increasing economic activity in recession terms or in the long run.

According to the supply-driven key sector classification, tertiary sectors such as advertising, publishing, technical activities, transportation and finance-insurance sectors are also important for Turkey. This condition may indicate the structural change from industrial sectors to tertiary sectors. Furthermore, the manufacturing industry has high linkage effects, especially for metal, paper, plastic, wood and non-metallic mineral products. This kind of intermediate good producing sectors are good decisions for investments for enhancing further productivity.

16 Check from Table 6.

The sectors related with automotive industry show low forward linkage effects according to the sensitivity of dispersion measure based on Ghosh inverse. [17] Table 6 shows that the sectors *"Motor vehicles, trailers and semi-trailers"* and *"Other transport equipment"* have high backward linkage effect together with a low variation but low forward linkage effect together with high variation. This means that final demand increases in these sectors create production increase in the other sectors evenly; but if a primary input increase occurs in automotive industry, then this creates insignificant output increase in a few sectors. Therefore, automotive industry is also affected by the exogenous demand, but it is insufficient to increase economic activity endogenously by increasing its labor and capital.

Table 5 represents the key sectors of Turkish economy for the supply-driven method improved in this paper. Here I ordered the sectors with respect to Hirschman (1958) priority and Hazari (1970) perspective. Hirschman (1958: 98-120) attaches importnace to the backward linkage effect (power of dispersion) more than the forward linkage effect (sensistivity of dispersion). Hazari (1970: 302), indicates that low coefficient of variation shows the interconnection with many sectors.

Table 5: Key Sectors of Turkish Economy in the Ordered Form

No	CPA 2008	Sectors	PDI, U_j	CV, V_j	SDI, U_i	CV, V_i
49	M73	Advertising and market research services	1.38	4.74	1.67	3.51
9	C18	Printing and recording services	1.20	4.83	1.11	4.56
50	M74_ M75	Other professional, scientific and technical services and veterinary services	1.16	5.00	1.25	4.78
35	H53	Postal and courier services	1.13	5.20	1.13	4.82
7	C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.13	5.25	1.31	4.44
14	C23	Other non-metallic mineral products	1.07	5.34	1.31	3.97
42	K65	Insurance, reinsurance and pension funding services, except compulsory social security	1.06	5.21	1.63	3.14
8	C17	Paper and paper products	1.05	4.97	1.08	4.34
37	J58	Publishing services	1.05	5.28	1.11	4.57
15	C24	Basic metals	1.04	5.37	1.20	4.20
32	H50	Water transport services	1.03	5.60	1.15	4.44
13	C22	Rubber and plastic products	1.02	5.11	1.25	3.82

Source: TURKSTAT (2020) and Author's own calculations

17 Look at Table 6.

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Appendix

Table 6: Sectors of Turkish Economy and Their Corresponding Measures

No	CPA 2008	Sectors	PDI, U_j	CV, V_j	SDI, U_i	CV, V_i
1	A01	Products of agriculture, hunting and related services	0.92	6.63	0.99	5.81
2	A02	Products of forestry, logging and related services	0.76	6.74	1.16	4.20
3	A03	Fish and other fishing products; aquaculture products; support services to fishing	0.83	6.16	0.74	6.35
4	B	Mining and quarrying	0.93	5.65	1.40	3.69
5	C10-C12	Food, beverages and tobacco products	1.23	4.86	0.77	6.69
6	C13-C15	Textiles, wearing apparel, leather and related products	1.23	5.92	0.88	7.46
7	C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.13	5.25	1.31	4.44
8	C17	Paper and paper products	1.04	5.37	1.20	4.20
9	C18	Printing and recording services	1.06	5.21	1.63	3.14
10	C19	Coke and refined petroleum products	0.75	6.77	1.21	3.91
11	C20	Chemicals and chemical products	0.98	5.92	1.24	4.28
12	C21	Basic pharmaceutical products and pharmaceutical preparations	1.01	5.18	0.73	6.50
13	C22	Rubber and plastic products	1.05	5.28	1.11	4.57
14	C23	Other non-metallic mineral products	1.16	5.00	1.25	4.78
15	C24	Basic metals	1.13	5.20	1.13	4.82
16	C25	Fabricated metal products, except machinery and equipment	1.11	4.87	0.95	5.16
17	C26	Computer, electronic and optical products	0.98	5.49	0.73	6.67
18	C27	Electrical equipment	1.18	4.55	0.78	6.17
19	C28	Machinery and equipment n.e.c.	1.10	4.72	0.64	7.18
20	C29	Motor vehicles, trailers and semi-trailers	1.13	4.95	0.68	7.37
21	C30	Other transport equipment	1.02	5.13	0.67	7.07
22	C31_C32	Furniture and other manufactured goods	1.15	4.66	0.68	7.14
23	C33	Repair and installation services of machinery and equipment	0.98	5.12	1.15	3.95
24	D35	Electricity, gas, steam and air conditioning	1.36	7.29	1.68	5.30
25	E36	Natural water; water treatment and supply services	0.98	5.31	0.89	5.16
26	E37-E39	Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other wa...	0.98	5.65	1.35	4.36
27	F	Constructions and construction works	1.23	4.88	0.74	7.29
28	G45	Wholesale and retail trade and repair services of motor vehicles and motorcycles	0.97	5.33	1.02	4.63
29	G46	Wholesale trade services, except of motor vehicles and motorcycles	0.99	5.16	1.09	4.24
30	G47	Retail trade services, except of motor vehicles and motorcycles	0.94	5.37	0.72	6.34
31	H49	Land transport services and transport services via pipelines	0.99	6.14	1.02	5.38

32	H50	Water transport services	1.03	5.60	1.15	4.44
33	H51	Air transport services	1.04	5.15	0.71	6.77
34	H52	Warehousing and support services for transportation	0.98	5.86	1.45	3.71
35	H53	Postal and courier services	1.02	5.11	1.25	3.82
36	I	Accommodation and food services	1.08	4.75	0.69	6.61
37	J58	Publishing services	1.05	4.97	1.08	4.34
38	J59_J60	Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	1.17	5.80	1.66	3.88
39	J61	Telecommunications services	1.01	5.82	0.90	5.85
40	J62_J63	Computer programming, consultancy and related services; Information services	0.79	6.58	1.16	4.07
41	K64	Financial services, except insurance and pension funding	0.90	6.14	1.13	4.41
42	K65	Insurance, reinsurance and pension funding services, except compulsory social security	1.20	4.83	1.11	4.56
43	K66	Services auxiliary to financial services and insurance services	0.89	5.76	1.32	3.74
44	L68B	Real estate services excluding imputed rents	0.78	6.50	0.80	5.72
45	L68A	Imputed rents of owner-occupied dwellings	0.63	8.00	0.57	8.00
46	M69M70	Legal and accounting services;Services of head offices; management consulting services	0.84	6.21	1.40	3.37
47	M71	Architectural and engineering services; technical testing and analysis services	0.99	5.69	1.25	4.49
48	M72	Scientific research and development services	0.76	6.62	0.57	8.00
49	M73	Advertising and market research services	1.38	4.74	1.67	3.51
50	M74M75	Other professional, scientific and technical services and veterinary services	1.07	5.34	1.31	3.97
51	N77	Rental and leasing services	0.81	6.40	1.38	3.43
52	N78	Employment services	0.80	6.28	1.50	3.10
53	N79	Travel agency, tour operator and other reservation services and related services	1.24	4.30	0.62	7.66
54	N80-N82	Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	0.82	6.33	1.34	3.51
55	O84	Public administration and defence services; compulsory social security services	0.94	5.35	0.59	7.73
56	P85	Education services	0.77	6.56	0.60	7.60
57	Q86	Human health services	0.98	5.45	0.61	7.98
58	Q87Q88	Residential care services; social work services without accommodation	0.95	5.26	0.57	8.00
59	R90-R92	Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	0.92	6.00	0.68	7.35
60	R93	Sporting services and amusement and recreation services	1.16	4.50	0.77	6.16
61	S94	Services furnished by membership organisations	1.01	5.24	0.80	6.00
62	S95	Repair services of computers and personal and household goods	0.96	5.20	0.72	6.30

63	S96	Other personal services	1.09	4.59	0.58	7.75
64	T	Services of households as employers; undifferentiated goods and services produced by households for own use	0.63	8.00	0.57	8.00

Source: TURKSTAT (2020) and Author's own calculations

Note: For power of dispersion measure Leontief matrix is used and for sensitivity of dispersion measure Ghosh matrix is used.

Table 7: Basic Input-Output Table

Demand side / Supply side	Sector 1	Sector 2	Sector 3	Total Intermediate Usage	Final Demand	Exports	Imports (less)	Total Production (gross outputs)
Sector 1	x_{11}	x_{12}	x_{13}	$x_{11}+x_{12}+x_{13}$	F_1	E_1	M_1	X_1
Sector 2	x_{21}	x_{22}	x_{23}	$x_{21}+x_{22}+x_{23}$	F_2	E_2	M_2	X_2
Sector 3	x_{31}	x_{32}	x_{33}	$x_{31}+x_{32}+x_{33}$	F_3	E_3	M_3	X_3
Value Added	V_1	V_2	V_3					
Total Production (gross outputs)	X_1	X_2	X_3					

Source: Author's own demonstration

Table 8: Nace Rev. 2 Classification, "high-level SNA/ISIC aggregation A*10/11"

	ISIC Rev. 4/ NACE Rev. 2 sections	Description
1	A	Agriculture, forestry and fishing
2	B, C, D and E	Manufacturing, mining and quarrying and other industry
2a	*C*	*Of which: manufacturing*
3	F	Construction
4	G, H and I	Wholesale and retail trade, transportation and storage, accommodation and food service activities
5	J	Information and communication
6	K	Financial and insurance activities
7	L	Real estate activities*
8	M and N	Professional, scientific, technical, administration and support service activities
9	O, P and Q	Public administration, defence, education, human health and social work activities
10	R, S, T and U	Other services

Source: Eurostat (2008: 43)

Table 9: Nace Rev. 2 Classification, "Intermediate SNA/ISIC Aggregation A*38".

	A*38 code	ISIC Rev. 4/ NACE Rev. 2	Divisions
1	A	Agriculture, forestry and fishing	01 to 03
2	B	Mining and quarrying	05 to 09
3	CA	Manufacture of food products, beverages and tobacco products	10 to 12
4	CB	Manufacture of textiles, apparel, leather and related products	13 to 15
5	CC	Manufacture of wood and paper products, and printing	16 to 18
6	CD	Manufacture of coke, and refined petroleum products	19
7	CE	Manufacture of chemicals and chemical products	20
8	CF	Manufacture of pharmaceuticals, medicinal chemical and botanical products	21
9	CG	Manufacture of rubber and plastics products, and other non-metallic mineral products	22 + 23
10	CH	Manufacture of basic metals and fabricated metal products, except machinery and equipment	24 + 25
11	CI	Manufacture of computer, electronic and optical products	26
12	CJ	Manufacture of electrical equipment	27
13	CK	Manufacture of machinery and equipment n.e.c.	28
14	CL	Manufacture of transport equipment	29 + 30
15	CM	Other manufacturing, and repair and installation of machinery and equipment	31 to 33
16	D	Electricity, gas, steam and air-conditioning supply	35
17	E	Water supply, sewerage, waste management and remediation	36 to 39
18	F	Construction	41 to 43
19	G	Wholesale and retail trade, repair of motor vehicles and motorcycles	45 to 47
20	H	Transportation and storage	49 to 53
21	I	Accommodation and food service activities	55 + 56
22	JA	Publishing, audiovisual and broadcasting activities	58 to 60
23	JB	Telecommunications	61
24	JC	IT and other information services	62 +63
25	K	Financial and insurance activities	64 to 66
26	L	Real estate activities*	68
27	MA	Legal, accounting, management, architecture, engineering, technical testing and analysis activities	69 to 71
28	MB	Scientific research and development	72
29	MC	Other professional, scientific and technical activities	73 to 75
30	N	Administrative and support service activities	77 to 82
31	O	Public administration and defence, compulsory social security	84
32	P	Education	85
33	QA	Human health services	86
34	QB	Residential care and social work activities	87 + 88
35	R	Arts, entertainment and recreation	90 to 93
36	S	Other services	94 to 96
37	T**	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	97 + 98*
38	U**	Activities of extra-territorial organisations and bodies	99*

Source: Eurostat (2008: 44)