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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

DEPENDENCY ON IMPORTED ENERGY IN TURKEY: INPUT-OUTPUT ANALYSIS

TÜRKİYE'DE İTHAL ENERJİ BAĞIMLILIĞI: GİRDİ – ÇIKTI ANALİZİ

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Abstract

The main goal of this paper is to reveal the extent of the import dependency on electricity, gas, steam, and air conditioning supply (EGSA), the basic component of energy, in Turkey. Such that growing industrialization in Turkey has expanded the need for energy since many sectors use energy as input to produce output. However, Turkey's domestic production fails to meet the energy demand. For this reason, Turkey meets approximately 75 percent of its energy needs through imports, leading to an increase in the current account deficit. Energy imports, approximately 20 percent of total imports, have become the primary component of the current account deficit, exposing the Turkish economy to instabilities in global gas and oil prices and several additional risks. In this context, we analyzed the extent of the dependency on energy by the input-output tables of 2002 and 2012. The results underline that as production increases, energy imports increase, and the economic leakage generated by the rise in demand for energy increases. This creates a significant obstacle to the development of the Turkish economy. Hence, existing policies for domestic energy production need to be strengthened for sustainable development goals and to decrease the high current account deficit in Turkey.

Keywords: Input-Output Analysis, Import Dependency, Energy, Economic Leakages
JEL Codes: C67, D57, F14, F32

Öz

Bu çalışmanın amacı Türkiye'deki elektrik, gaz, buhar ve iklimlendirmedeki (EGBİ) ithalat bağımlılığının boyutunun girdi çıktı analizi ile ortaya konulmasıdır. Öyle ki Türkiye ekonomisinin büyümesi enerji ihtiyacını artırmaktadır. Tüm sektörler girdi olarak enerji kullanmakta; bu sebeple üretim arttıkça, enerji ihtiyacı artmaktadır. Ancak Türkiye, söz konusu enerji ihtiyacını yerel kaynaklardan karşılayamamaktadır. Yeterli düzeyde arza sahip olmayan Türkiye ithalata yönelmekte; enerji ihtiyacının yaklaşık yüzde 75'ini yurt dışından elde etmektedir. Öyle ki enerji ithalatı, Türkiye'nin toplam ithalatının yaklaşık yüzde 20'sini oluşturmaktadır. Böylelikle enerji ithalatı, Türkiye'nin cari işlemler açığının en temel bileşeni haline

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gelmiştir. Bu durum Türkiye ekonomisini, küresel gaz ve petrol fiyatlarındaki istikrarsızlıkların yanı sıra, pek çok farklı risklere maruz bırakmaktadır. Bu doğrultuda, bu çalışma çerçevesinde TÜİK tarafından yayınlanan 2002 ve 2012 yılı girdi çıktı tabloları ile Türkiye sanayiindeki enerji bağımlılığının boyutunun ortaya konulması amaçlanmaktadır. Analiz sonuçları, üretim artıkça enerji ithalatının arttığını ve enerji talebindeki artışın yarattığı ekonomik sızıntının arttığını ortaya koymaktadır. Bu durum Türkiye ekonomisinin gelişmesinin önünde önemli bir engel teşkil etmektedir. Bu nedenle, sürdürülebilir kalkınma hedefleri ve Türkiye'deki yüksek cari açığın azaltılması için yerli enerji üretimine yönelik mevcut politikaların güçlendirilmesi gerekmektedir.

Anahtar Kelimeler: Girdi Çıktı Analizi, İthalat Bağımlılığı, Enerji, Sızıntı Katsayıları

JEL Kodları: C67, D57, F14, F32

1. Introduction

Since all goods and services produced in an economy require energy (Machado et al., 2001:409), increasing industrialization and growth in Turkey have increased the demand for primary energy[1]. Turkey meets approximately 75 percent of this energy demand through imports (Eurostat, 2021a). Turkey's energy imports are increasing as production in Turkey increases to such an extent that Turkey's energy imports were 2,94 million TJ[2] in 2009, reaching 4,42 million TJ in 2019 (Eurostat, 2021b). This large import dependency exposes the Turkish economy to instabilities in global gas and oil prices and rises the demand for external financing, which engenders the Turkish economy's vulnerable structure. Besides, such high import dependency on energy creates a significant obstacle to the development of Turkey's manufacturing industry. Moreover, Turkey's energy needs are met by states with high political risks, such as Russia, Azerbaijan, Iraq, and Iran. Those countries with high political risks also cause plain risk to energy supply security in Turkey. Also, the consequences of the Russian-Ukrainian war on the global economy threaten Turkey in terms of energy supply security. So the Russian-Ukrainian war emphasizes not only the costs of foreign dependence on energy but also reveals the crucial importance of having domestic sources of energy. As a matter of fact, both the dependency on imported energy in Turkey and the import dependency of the Turkish manufacturing industry have been of significant interest to researchers for several reasons mentioned above. Among these, Topçuoğlu and Oral (2020) underlined Turkey's dependency on foreign energy and revealed the energy sector as the key sector by Input-Output analysis (hereafter I-O analysis). Besides Sözen, 2009; Demir, 2013; Sözen and İskender, 2014; Yılmaz et al., 2015; Katırcıoğlu et al., 2017 analyzed the imported energy dependency in Turkey using other techniques like the cointegration test, error correction model, data envelopment, vector autoregression analysis (VAR), band artificial neural network (ANN). On the other hand, Günlük – Şenesen and Şenesen 2001; Şenesen and Günlük – Şenesen, 2003; Günlük – Şenesen, 2005; Ersungur and Kızıltan, 2007; Eşiyok, 2008; Yükseler and Türkkan, 2008; Ersungur et al., 2011; Yalçın et al., 2012; Aydoğuş et al., 2015; Aydoğuş et al., 2018 focused on import dependence of the manufacturing industry in Turkey, by I-O analysis. The closest research to ours is from Topçuoğlu and Oral (2020) using I-O analysis where the structure, impact, importance, and relationship of the energy sector with other sectors in Turkey are examined. Although they underlined the high

1 coal, petroleum, and natural gas

2 "Terajoule" , an energy unit which is equal to 1.0E+12 joules.

production multiplier, they have not mentioned the imported inputs and the economic leakage that the energy sector generates. Instead, our paper takes an alternative approach that incorporates I-O analysis and focuses merely on the imported inputs and the economic leakage that EGSA, the basic component of energy, generates. Our empirical evidence leads us to formulate policy recommendations for Turkey.

I-O analysis is a multisectoral and quantitative general equilibrium analysis that shows the interdependence of sectors in the production process of an economy. As a theoretical scheme and applied economic tool, assessments of value added (Leontief, 1946) and import dependency (Leontief, 1953) can be maintained through I-O analysis in an economy. Due to its interindustry perspective, I-O analysis plays a major role in revealing the dependence on imports during the production phase. Categorizing the inputs as domestic and imported allows us to determine the extent of import dependence of each sector and the economic leakage generated subsequently. For this reason, I-O analysis is often used to examine the potential impact of an economic policy. Consequently, many governments practice I-O analysis in implementing economic policies. In this respect, we aim to reveal the extent of the import dependency on EGSA and examine the consequences of this dependency on EGSA through the I-O analysis and also offer policy recommendations with respect to the results of the analysis. For this reason, we calculated the linkage coefficients, imported input ratios, leakages, and key sectors of the sectors in Turkey from the I-O tables of both 2002 and 2012, which are the latest tables published by TURKSTAT. Within this context, our paper is organized as follows: the next section presents the related literature review. Section 3 briefly discusses Turkey's dependency on imported energy. Section 4 presents the methodology proposed for this analysis and describes the data. Section 5 presents the empirical results. Section 6 concludes by discussing the implications of the findings and policy recommendations.

2. Literature Review

I-O analysis was commenced by Leontief (1936), who utilized the "Tableau Economique" developed by Quesnay (1894), based on Walras' general equilibrium theory in a model of perfect competition. The Tableau Economique, as a descriptive analysis, presents the exchange of manufacturers and buyers in an economy in an analytical structure that allows economic forecasting (UN 1999:3). Leontief (1936) created an analytical model that evaluated the intersectoral link for the USA for 1919 and 1929. Rasmussen (1956) calculated the total linkage coefficients and normalized them using the inverse Leontief matrix. Rasmussen (1956) and Hirschman (1958) extended the model of the key sector and made an important contribution to I-O analysis. Chenery and Watanabe (1958) also evaluated the concept of key sectors by developing the technology matrix, and they also assessed the coefficients of direct backward and forward linkages. By comparing the production structures of the United States, Japan, Norway, and Italy, Chenery and Watanabe (1958) accelerated the development of I-O analysis. Hazari (1970) improved Rasmussen's power and sensitivity index of dispersion and calculated the key sectors. Since then, the scope of I-O analysis has been extended by researchers to many different fields of inquiry. Amongst them, Bullard et al. (1978) offered some methods for determining energy demand during the production process and described techniques combining process and I-O analysis. They presented methods for calculating the energy required, directly and indirectly, to produce all types of goods and services. Miller and Blair (1985) developed an energy I-O table with references to econometric extensions. Further, Wu and Chen (1990) developed an I-O framework for analyzing energy-related issues and reviewed an alternative supply-oriented I-O model. They focused on the application of the static I-O model to energy analysis in a proper way and examined some of the inherent and often neglected problems in applying the static I-O model to energy issues in the short run. They have also formulated the multiplier analysis, a modification for lessening the double-counting problem due to sectoral interdependence. On the other hand, Alcantara and Padilla (2003) focused on the key sectors' final energy use by utilizing I-O analysis in Spain and pointed out that the government should pay more attention to energy policy. Baynes et al. (2011) compared regional energy use in Australia through I-O analysis and pointed out the use of various policies. Tang, et al. (2012), by using I-O analysis, found out that although oil embodied in "Made in China" products affects China's oil consumption it actually makes tremendous contributions to China's economic growth. Besides, Chen & Chen (2013) used I-O analysis to examine the impact of domestic trade on China's regional energy supply. They determined that China is the largest energy exporting country while the U.S. is the largest importer and that the economic crisis in 2008 accelerated the energy demand of developing countries. Furthermore, Cui, et al. (2015) indicated that the energy embodied in global trade is increasing rapidly, growing faster than the total direct energy exported in the same period by I-O analysis. They have also pointed out that China is shown as an energy exporter in terms of embodied energy, and the embodied energy trade surplus increased from 156 Mtoe[3] in 2001 to 514 Mtoe in 2007. Besides, Chen, et al. (2018) underlined that the USA, China, and German, are at the forefront of network-based centrality measures and environmentally extended I-O analysis-based accountings. And also Lam, et al. (2019) examined the changes in total industry energy intensity and embodied energy flow in Australia between 2006 and 2015 through I-O analysis where they found that population growth and per capita demand for imported commodities are two major contributors to the increase in total embodied energy in Australia. Besides, Sözen (2009), using an artificial neural network, underlined the high need to utilize renewable and nuclear energy to eliminate the dependency. Besides, he stated that Turkey's foreign energy dependency rose to 72 percent in 2006 from 60 percent in 1998. Using the error correction model, cointegration test, and Granger causality with VAR analysis, Demir (2013) analyzed the relationship between energy import and the current account deficit in Turkey. He stated that the direction of causality in Turkey has been to the current account deficit from the industrial production index and energy import as one-way causality. Besides, Sözen and İskender (2014) have stressed the excessive import dependency on energy and argued that Turkey has to produce proper energy policies to decrease this dependency by using data envelopment analysis. Ylmaz et al. (2015) utilized the data set between the years 1984 and 2012 with reference to VAR to

3 million tons of oil equivalents

determine the correlation between energy consumption and growth in the economy by Johansen co-integrated analysis. They came to the conclusion that energy imports are the primary cause of Turkey's current account deficit and that there is a correlation between growth rate and energy consumption. Also, Katırcıoğlu et al. (2017), by causality, variance decompositions, and impulse responses analysis, stated that energy consumption in Turkey has significant effects on real income and real exchange rates. Besides they underlined that alternative energy sources are required to reduce the dependence on imports of energy. Besides, Günlük – Şenesen and Şenesen (2001) stated that Turkey has failed to generate alternative domestic energy sources and compensate for export revenues. Likewise, Şenesen and Günlük – Şenesen (2003) emphasized the excessive import dependency of production in Turkey and indicated that import dependency prevents Turkey from her development goals. Also, Günlük – Şenesen (2005) underlined the input dependency of the manufacturing industry (significantly construction, petroleum, textiles, and automobiles sectors) in Turkey. By measuring the import requirements of sectors in Turkey, Ersungur and Kızıltan (2007) have also affirmed the import dependency of the manufacturing sector in Turkey has increased regularly on yearly basis. Likewise, Eşiyok (2008) found that the import dependency of the Turkish manufacturing industry increased significantly between 1990 and 1998. Also, Yükseler and Türkkan (2008) emphasized the import-dependent structure of the Turkish industry between 1998 and 2007. They have also highlighted the increasing weight of intra-industrial trade within the dependence of production on imports in the manufacturing industry. Additionally, Ersungur et al. (2011) stressed the import-dependent structure of the Turkish industry in 2002, whereas Yalçın et al. (2012) affirmed the import requirement during the production phase increased in 1998-2002. Moreover, Aydoğuş et al. (2015) revealed the high import dependency of the Turkish manufacturing industry and highlighted that import dependency in Turkey is mainly due to raw material imports, mostly fuels, and Aydoğuş et al. (2018) affirmed the high dependence on intermediate imports, implying a higher pass-through[4]. Finally, Topçuoğlu and Oral (2020) underlined the energy sector as the key sector by using I-O analysis.

3. Turkey's Dependency on Imported Energy

Growing industrialization and growth in Turkey has expanded the primary energy requirements. Before 2000, Turkey met its energy needs intensively from primary energy sources and hydroelectric power plants. Turkey, which has not been able to supply the increasing energy needs from local sources, meets approximately 75 percent of this primary energy needs through imports, notably in recent years (Eurostat, 2021a). Turkey's energy imports were 2,94 million TJ in 2009, reaching 4,42 million TJ in 2019 (Eurostat, 2021b). Table 1 reveals Turkey's energy import figures and dependency rates.

4 the impact of the exchange rate on prices is questioned via exchange-rate pass-through method (Aydoğuş et al., 2018:323).

Table 1: Energy Imports and Dependency Rates (Turkey)

Year	Energy Imports (billion dollars)	Share of Energy Imports in Total Imports (percent)	Import Dependency Rate (percent)[5]
2008	48,3	23,9	72,40
2009	29,9	21,2	70,36
2010	38,5	20,7	70,65
2011	53,9	22,4	71,11
2012	59,8	25,3	75,64
2013	55,9	21,4	75,38
2014	54,9	21,8	76,29
2015	37,9	17,7	77,87
2016	27,2	13,4	75,48
2017	37,2	15,5	77,16
2018	43	18,6	73,80

Source: Turkstat, 2020 & Eurostat, 2021a.

With these rates, Turkey stands as eighth after Malta (97.8 percent), Luxembourg (95.1 percent), Cyprus (92.5 percent), Belgium (82.3 percent), Italy (76.3 percent), Portugal (75.6 percent) and Lithuania (74.2 percent), in 2018 among EU member/candidate countries (Eurostat, 2020). This high volume of imported energy, which is approximately 20 percent of the total imports of Turkey, causes a severe increase in the current account deficit (Turkstat, 2020). The high dependency also exposes the Turkish economy to instabilities in global gas and oil prices and increases the need for external financing, thus, enhancing the economy's fragility. In addition to that, Turkey's energy needs are met by states with high political risks, such as Russia, Azerbaijan, Iraq, and Iran. Those countries with high political risks also cause severe risk to energy supply security in Turkey. Also, the consequences of the Russian-Ukrainian war on the global economy threaten Turkey in terms of energy supply security. Thus the Russian-Ukrainian war emphasizes not only the costs of foreign dependence on energy but also reveals the crucial importance of having domestic sources of energy. As a matter of fact, Turkey has rearranged its energy strategy in the past decade. In this context, Turkey has commenced adopting energy strategies to utilize natural resources to develop renewable and nuclear energies to meet rising energy needs. Turkey has targeted to use of renewables in electricity generation and aimed to incite private sector investments through feed-in-tariffs. In this context, Turkey issued different laws in order

5 Energy dependence = Net imports (NI) / Gross available energy (GAE). NI are calculated as total imports minus total exports. GAE is a calculated value, defined as: Primary production + Recovered & recycled products + Imports – Exports + Stock changes (Eurostat, 2021a).

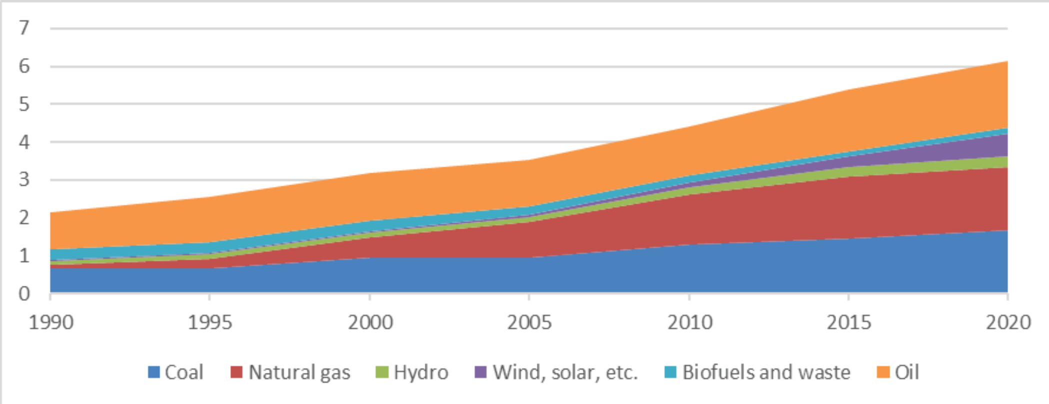
to create a competitive market[6]. In addition, Energy Exchange Istanbul (EXIST)[7], established in 2015, targeted to increase the predictability and transparency of pricing on energy (EPİAŞ, 2022). EXIST, a member of the Association of Power Exchanges (APEX) and the Association of European Energy Exchanges (EUROPEX), also targets to progress the strategy of liberalization of energy markets (EPİAŞ, 2022). Moreover, in the Eleventh Development Plan of 2019 – 2023, at least 20 percent of the annual primary energy needs and two-thirds of the electricity needs of Turkey are targeted to be met with renewables (Presidency of Strategy and Budget, 2018:33).[8] With that plan, Turkey has also pointed producing the equipment utilized in renewable energy production facilities domestically, developing technology for energy storage systems, and increasing the R&D activities for energy efficiency. Consequently, Turkey made remarkable progress in generating energy from renewables and increasing its power generation capacity from local sources (European Commission [EC], 2020). Additionally, due to the government incentives for the liberalization of energy markets, private ownership in electricity production reached 85 percent in 2018, while it was 40 percent in 2002 (IEA, 2021b:). Besides Turkey has also put relatively medium-term targets for 2017-2027 (10.000 MW from wind and solar and building a domestic coal power capacity of 7.500 MW) (IEA, 2021b:30). Figure 1 (below) reveals Turkey's total energy supply by source between 1990-2020. Examining Figure 1, we see that Turkey has experienced significant growth in total energy supply, notably in the last decade. The increase (almost 60 percent from 2014 to 2019) was driven particularly by renewables and coal (IEA, 2021b:21). Such that, 54 percent of total energy production in Turkey in 2019 was through renewables. The share of electricity generation from renewables has enlarged significantly on a yearly basis (19 percent in 2007, 20.9 percent in 2014, 32 percent in 2015, 32.9 percent in 2016, 29.4 percent in 2017, 32.1 percent in 2018) (EC, 2020: 85 & 123). Besides, the share of renewable energy in total power production in Turkey reached 44 percent in 2019, most of which is supplied by hydropower (IEA, 2021b:27). In addition, with the appointment of the nuclear power facility in 2023, the diversification of the energy supply is expected to increase (IEA, 2021a).

6 With the "Electricity Generation from Renewable Energy Sources" (issued on May 10, 2005, (number: 5346), increase in the use of renewable energy sources in electrical power generation is targeted. Besides, the law "Energy Efficiency"(issued on May 2, 2007 (number: 5627), aimed to increase the efficiency in the use of energy resources, to prevent waste, to alleviate the burden of energy costs on the economy and to protect the environment. Besides, with the "Energy Efficiency Strategy Document" (published in 2012), energy efficiency targets for 2023 were established (Industrial Development Bank of Turkey [TSKB], 2020:33). Also, with the "National Energy Efficiency Action Plan (2017-2023)", introduced on January 02, 2018, and Renewable Energy Resource Areas (YEKA) and Extension of Renewable Energy Support Scheme (YEKDEM), Turkey targeted to reduce primary energy consumption by 14 percent in 2023. For more information, please visit: Türkiye – Countries & Regions – IEA

7 Enerji Piyasaları İşletme A.Ş. (EPİAŞ) for further information, please see
EPİAŞ | Enerji Piyasaları İşletme A.Ş. (epias.com.tr).

8 With the Strategic Plan for 2019-2023, the Ministry of Energy and Natural Resources targeted to generate installed power of a total of 56,804 MW (composing of 32.037 MW in hydroelectric, 11.883 MW in wind, 10,000 MW in solar, and 2,884 MW in geothermal and biomass) as of 2023 (TSKB, 2020:45).

Figure 1: Total Energy Supply, in millions of Tj. (1990-2020)



Source: IE, 2021a

Turkey has experienced significant progress in energy production domestically but; due to increasing industrialization and growth, Turkey still imports heavily in order to meet the huge energy demand. Such that almost all the natural gas supply is met through imports. Likewise, domestic oil production corresponds to solely 7 percent of total demand. Despite the increase in domestic coal production, Turkey still relies on imports for 58 percent of its demand (IEA, 2021b:21). These high imports are likely due to the lack of large-scale domestic investments in energy, despite the incentives, especially the substantial feed-in tariffs, offered by the government. The primary reason for the shortfall of large-scale domestic energy investments in Turkey is financial deficiencies. In other words, the companies who are willing to invest in energy have difficulty in reaching long-term financing in reasonable terms. Even if the companies find ways to reach finance on favourable terms, this time, the collateral shortages restrain them to get loans from commercial banks or financial institutions. Besides, examining the feed-in-tariff[9] rates for renewable energies in Turkey, we see that the feed-in-tariff rates are planned relatively at low levels[10] in comparison to various European Union countries. We have also seen that the incentives concerning the feed-in-tariffs have been designed myopic and frequently revised which creates a significant obstacle to the development of large-scale investments. Hence, they do not hold the conditions to encourage large-scale and efficient investments. Growing industrialization in Turkey has expanded the need for energy since many sectors utilize energy as input to produce output. However, Turkey's domestic production fails to meet the energy demand. For this reason, Turkey meets approximately 75 percent of its energy needs through imports, leading to a severe increase in the current account deficit. Turkey's energy imports were 2,94 million TJ in 2009, reaching 4,42 million TJ in 2019 (Eurostat, 2021b). Energy imports, approximately 20 percent of total imports, have become the primary component of the current account deficit, exposing the Turkish economy to instabilities in global gas and oil prices and several additional risks. Such high

9 For the feed-in-tariffs in Turkey please visit: 9 Mayıs 2021 PAZAR (resmigazete.gov.tr).

10 For instance, feed-in-tariffs in Germany (the EEG Law in 2000) are established at 50.6 cents/ kWh for solar energy for the first 5 years and 48.1 cents / kWh for later (Hake, et al., 2015:540).

import dependency on energy not only causes a severe increase in the current account deficit but also increases the need for external financing, putting more pressure on its fragile economic structure.

4. Methodology and Data

Leontief (1937) presented the I-O matrix; a table that shows the inputs that each of the sectors uses from other sectors to produce one unit of output and the outputs of each of these sectors used as inputs by other sectors. Within the I-O model, Leontief (1937) displayed two different and impartial solutions, one for quantities and one for prices. Later, Leontief (1944) improved the open-version model in which he defined production as a function of final demand. Through the I-O analysis, we can calculate the share of sectors in the economy, inputs used by producer sectors, and the multiplier effect that sectors create. Moreover, we can find the proportion of imported inputs in production via the I-O analysis. According to Leontief (1949: 273-274), an empirical general-equilibrium analysis was considered too complex, and the shortcut device of aggregative analysis[11] was used since the advent of Keynesian theory. However, according to Leontief (1949: 274), in connection with many problems of policy-making and economic planning of any kind, aggregative concepts are very limited in their application because, in this type of question, we have to deal with concrete, different industries, with individual prices, or at least outputs and prices of small commodity groups. However, with the concept of a structural matrix of the national economy, the I-O analysis enables us to approach the solution to the problem of combining the general-equilibrium analysis with the preservation of a differentiated classification of all individual aspects of the economic phenomena (Leontief, 1949: 274). Moreover, the relations of any sector with other sectors with which the sector is connected can be examined through the I-O analysis. Besides, in general, analyzing an economy in its decomposed form will be a less difficult task than trying to analyze the system as a whole (Weil Jr, 1968:277). On the other hand, Ghosh (1958) presented an alternative to Leontief's model, which solved the allocation of output, where the production value depends on the value-added vector. Moreover, the edition of Ghosh (1958) is associated with a supply-sided economy, as coefficients are estimated on each sector's income from supplying goods for both final consumption and intermediate usage. In this context, Ghosh correlated the gross production of each sector to the primary inputs utilized by all sectors via the inverse matrix (Miller & Blair, 2009). The inverse matrix offered by Ghosh is obtained from the direct output coefficient matrix, where Ghosh adopted a similar method to Leontief's inverse matrix. Then Chenery and Watanabe (1958), Hazari (1970), and Laumas (1976) calculated forward and backward linkages on the technical coefficients. Jones (1976) and Bulmer-Thomas (1982) estimated forward linkages from the perspective of the allocation of outputs and the supply side of the I-O model (Reyes & Mendoza, 2013). The I-O table, a square matrix, contains sectors in columns and rows. Columns consist of the production components of a sector (inputs from other sectors and primary inputs for

11 It used to be an attempt to deal with a general-equilibrium problem involving all parts of the economic system implicitly, but at the same time to keep down the number of the variables by using extremely broad averages, i.e., by dealing with such composite variables as the "total level of production," or the "general price level, "all exports," "total employment," or "average productivity," all of which are obviously very broad index numbers (Leontief, 1949: 274).

production), the sum of the sector's production value, and the total supply of the sector consisting of the imports. Rows consist of the total use of a sector's production as intermediate goods and the final demand for that sector's product (including stock changes, domestic consumption, and exports). The I-O model consists of equilibrium equations and constructional equations. The production of a sector is used as inputs by either itself or other sectors or outside the producing sectors (by consumers). In this context, let us assume that there are n sectors in the economy, the demand equation for the good of producer i by the other producers j can be written as follows (Hurwicz, 1955);

$$X_i = X_{i1} + X_{i2} + \cdots \ldots . X_{in} + Y_i \quad (1)$$

where, $i = 1,2, \ldots \ldots , n$ and $j = 1,2, \ldots \ldots , n$

X_i represents the total output of i th sector,

X_{ij} represents the amount of i th sector's output, used as an input by sector j,

Y_i represents the amount of i th sector's production used by final consumers.

Then we can write the input coefficients matrix (the input coefficient of the i sector output, used in the j sector's production (Leontief, 1985:22-23) as follows;

$$a_{ij} = \frac{X_{ij}}{X_i} \quad (2)$$

where, the output of i sector, used by j sector for its one unit of production is represented as a_{ij} . Equation (2), the input coefficients matrix (all the a_{ij} 's), corresponding to the country's I-O table for all sectors, is called the structural matrix of the economy (A matrix). A Matrix (in the Appendix) provides quantitative information about the input structure of different economic sectors[12]. As the elements (a_{ij}) of A Matrix indicate the level of output of each sector as ; then the sum of the level of output (X_i) of each sector (if we consider exports as a component of final demand) indicates the production amount required either to meet the input requirement of other sectors ($a_{11}X_1 + a_{12}X_1 + \cdots . + a_{1n}X_1$), including itself, and final demand (the sum of final consumption and exports). In the matrix, presenting the economy's general production and demand structure, all the X_i's, indicating the level of output of a sector, are expressed as the demand function of independent goods. Since A Matrix represents the constant technology coefficients, this matrix is called the economy's structural matrix (Leontief, 1949:278). In this context, through the I-O model, we can find the equilibrium production value of each sector. To do this, for n productive sectors and n final demand vectors, we can write the required production value for the productive sectors as follows;

12 In any case, the elements of the input coefficients matrix (the structural matrix) (Matrix A) should be interpreted as a ratio, and it should be kept in mind that these ratios that make up the matrix are obtained by proportioning two physical values. Therefore, summing the rows in the matrix has no economic meaning (Küçükkiremitçi, 2011:912) whereas summing the columns reveals backward linkage coefficients.

$$X_1 = a_{11}X_1 + a_{12}X_2 + \cdots \ldots . + a_{1n}X_n + Y_1 \quad (3)$$

$$X_2 = a_{21}X_1 + a_{22}X_2 + \cdots \ldots . + a_{2n}X_n + Y_2 \quad (4)$$

$$X_n = a_{n1}X_1 + a_{n2}X_2 + \cdots + a_{nn}X_n + Y_n \quad (5)$$

where

the "X"s represents the production values of the sectors,

the "a"s represents the technical coefficients,

the "y"s represents the final demand vector.

We can write Equations (3), (4), (5) in matrix form as follows;

$$\begin{bmatrix} a_{11} & a_{12} & \cdot & a_{1n} \\ a_{21} & a_{22} & \vdots & a_{2n} \\ \cdot & \cdot & \vdots & \cdot \\ a_{n1} & a_{n2} & \cdot & a_{nn} \end{bmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ \cdot \\ x_n \end{bmatrix} + \begin{bmatrix} y_1 \\ y_2 \\ \cdot \\ y_n \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ \cdot \\ x_n \end{bmatrix}$$

Then, we can modify Equations (3), (4), (5) as follows;

$$(1 - a_{11}X_1) - a_{12}X_2 - \cdots - a_{1n}X_n = Y_1 \quad (6)$$

$$-a_{21}X_1 + (1 - a_{22}X_2) - \cdots - a_{2n}X_n = Y_2 \quad (7)$$

.. .. ..

$$-a_{n1}X_1 - a_{n2}X_2 - \cdots - (1 - a_{nn}X_n) = Y_n \quad (8)$$

We can write the above equations in matrix form as follows;

$$\begin{bmatrix} (1 - a_{11}) & -a_{12} & \cdot & -a_{1n} \\ -a_{21} & (1 - a_{22}) & \cdot & -a_{2n} \\ \cdot & \cdot & & \cdot \\ -a_{n1} & -a_{n2} & & (1 - a_{nn}) \end{bmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ \cdot \\ x_n \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ \cdot \\ y_n \end{bmatrix} \quad (9)$$

Since the left-hand side of the Matrix (9) is equal to the difference between the unit matrix (I) and the A Matrix; we can express it as (I-A) where,

X represents the production vector of sectors $(X_1, X_2 \; , X_n)$

Y represents the final demand (sum of domestic demand and exports) vector $(Y_1, Y_2 \; , Y_n)$

Therefore we can write Matrix (9) as follows;

(I-A) X=Y (10)

The solution of the X vector in Equation (10) is;

$X=(I-A)^{-1} Y$ where $(I-A)^{-1}$ is the Leontief inverse matrix.

The typical elements the Leontief inverse matrix reveals the amount of increase in sector i's output, due to an increase of final demand for sector j's output by 1 unit. In other words, Leontief inverse matrix expresses the amount of increase in sector i's output due to a 1 unit increase in final demand for sector j's output. Leontief inverse matrix $[(I-A)^{-1}]$, shows the all effects of an exogenous increase in final demand on all sectors within an economy. With $[(I-A)^{-1}]$, we can observe the technological interdependence of the production system and the production demand generation from final consumption, which is part of the net final demand within an economy. So it is possible to compute the levels of production required to satisfy different levels of net final demand, and therefore levels of production would have to change to satisfy the changes in final demand (UN, 1999:10).

Sectoral Linkages

Within the structure of the I-O model, production has two types of outcomes in the economy: increased demand and supply. When sector i increase its output, it will ask for more inputs from other sectors; this demand is indicated as *backward linkages*. Besides, an increase in production of other sectors leads to additional output required from sector i to supply inputs to meet the increased demand. This supply function is indicated as *forward linkage*. In this context, we calculated the direct backward linkage coefficients (DBLC) based on the A Matrix. The DBLC, indicating the sum of intermediate input requirements of a sector in the production phase, is equal to the sum of the a_{ij}'s in the referred Matrix A. On the other hand, we calculated the direct forward linkage coefficients (DFLC) by dividing "the ratio of the total sales of one sector to other sectors" (for other sectors' usage as inputs) to "the sector's total output" in the I-O table. In this respect our calculation of DBLC and DFLC, keeping up with Chenery and Watanabe (1958) method, can be written as follows in Equation (11) and Equation (12), respectively.

$$DBLC_i == \sum_{i=1}^{n} \frac{X_{ij}}{X_j} = \sum_{i=1}^{n} \boldsymbol{a_{ij}} \quad (11)$$

where

a_{ij} represents the elements (i, j) of Matrix A,

n represents the number of sectors.

$$DFLC_i = \sum_{j=1}^{n} \frac{x_{ij}}{x_i + y_i} \quad (12)$$

On the other hand, we can define the total backward linkage (TBLC) as the total rise in output in the economy, triggered by 1 unit rise in demand in a given sector. We can define the total forward linkage (TFLC) as the increase in the production of a particular sector by 1unit increase in all sectors. We calculated the total forward linkages by summing the rows in the Leontief inverse matrix. Rasmussen (1956) enhances this methodology to determine intersectoral links using the column (or row) sums of the Leontief inverse. In this respect our calculation of TBLC and TFLC, based on Rasmussen (1956) method, can be written as follows in Equation (13) and Equation (14), respectively

$$TBLC_i = \sum_{i=1}^{n} b_{ij} \quad (13)$$

$$TFLC_i = \sum_{j=1}^{n} b_{ij} \quad (14)$$

where

b_{ij} represents the elements (i, j) of Leontief inverse matrix.

Up to this point, we have expressed the inputs as total; without revealing any information if they are produced domestically or imported. In this respect, to reveal the import dependence we divide the Matrix A into domestic ($\boldsymbol{A^d}$) (domestic input matrix) and imported ($\boldsymbol{A^m}$) (imported input matrix) into 2 components, as;

$$\boldsymbol{A} = \boldsymbol{A^d} + \boldsymbol{A^m} \quad (15)$$

where,

$$\boldsymbol{A} = a_{ij} = \frac{X_{ij}}{X_i}$$

$$\boldsymbol{A^d} = a_{ij}^d = \frac{X_{ij}^d}{X_i}$$

$$\boldsymbol{A^m} = a_{ij}^m = \frac{X_{ij}^m}{X_i}$$

Each element of the $\boldsymbol{A^m}$ matrix, a_{ij}^m denotes the proportion of imported inputs used by sector j from sector i (partial direct import backward linkage coefficient), whereas $\sum_i a_{ij}^m$ denotes the direct import backward linkage coefficient of sector j. According to the Küçükkiremitçi, (2013:42), with the utilization of $\boldsymbol{A^m}(\boldsymbol{I}\text{-}\boldsymbol{A^d})$, we can reveal the increase in the imports of good i when j sector production increases by one unit; where,

X_i represents the production vector,

$\boldsymbol{A^d}$ represents the matrix of domestic input,

(I) represents the unit matrix,

Y^d represents the vector of domestic final demand.

The quantity of output to be produced using solely domestic inputs (Küçükkiremitçi, 2013:42) can be written as follows;

$$\boldsymbol{X_i} = (\boldsymbol{I}\text{-}\boldsymbol{A^d})^{-1}\boldsymbol{Y_i^d} \quad (16)$$

Multiplying the both sides of the Equation (16) by $\boldsymbol{A^m}$; we find;

$\boldsymbol{A^m} X_i = \boldsymbol{A^m}(I\text{-}\boldsymbol{A^d})^{-1} Y_i^d$

If $\boldsymbol{A^m} X_i$ represents M_i to denote the amount of imported inputs used in production, we have the following equation;

$$M_i = \boldsymbol{A^m}(I\text{-}\boldsymbol{A^d})^{-1} Y_i^d \quad (17)$$

Since Y_i^d represents the final demand vector of any sector, it can be replaced by another demand vector (i.e. exports). The import dependence of demand can be obtained by setting the import requirement for a unit of demand to 1 for the i. sector and 0 for other sectors. In the Equation (17), the matrix $\boldsymbol{A^m}(I\text{-}\boldsymbol{A^d})^{-1}$ is called the import inverse matrix. We should have to stress that we have calculated the import dependence as Küçükkiremitçi, (2013:43) suggested. According to him, A matrix is not concerned with whether the inputs used are imported or domestic; instead it reveals the ratios required for one unit of production. Thus, the only stage at which the import dependence of production can be analyzed is to examine "the ratio of imported inputs in total production inputs". To obtain this, within the paper we divided the import elements to the "total value of production" in the I-O table. Additionally, we take into account the fact that imported goods are utilized both as inputs and final goods in an open economy. Consequently, the rise in production generates an increase in imports. Basically this type of import increase (import for input use) is called "economic leakage" (Guo and Planting, 2001) and we can calculate it with the sum of j^{th} column of $\boldsymbol{A^m}(I\text{-}\boldsymbol{A^d})^{-1}$matrix the final demand for sector j increases by one unit. So we can write Equations (18) and (19) as follows;

$$LI = A^m(I - A^d)^{-1} \quad (18)$$

where;

LI is the modified Leontief import inverse matrix.

$$Leakage_i = \sum_{i=1}^{n} r_{ij} \quad (19)$$

where;

r_{ij} represents the elements (i, j) of LI

Finally, there are numerous proposals for divergent definitions and refinements of key sector measures, for instance, Rasmussen (1956), Hirschman (1958), Chenery and Watanabe (1958). Among them, the sector with a high forward and backward linkage is what Hirschman refers to as the key sector (Hazari, 1970). Hirschman (1958) classified the sectors according to their coefficients. The sectors in the first category are the ones with high backward and high forward linkage coefficients[13]. According to Hirschman (1958), sectors in the first category constitute the key sectors of the economy and have the highest investment priority so that, the available scarce resources should be allocated primarily

13 The sectors in the second category are the ones with high backward linkages and low forward linkages. The sectors in the third category are the ones with high forward linkages and low backward linkages, whereas the sectors in the fourth category are the ones with low backward and forward linkage effects. The above ranking indicates Hirschman's (1958) sectoral investment priorities.

to those sectors. Rasmussen's power (P) and sensitivity (S) indexes, on the other hand, are used to identify the key sectors (Rasmussen, 1956). The average ratio of the sector's DBLC to the average DBLC of the economy and the average ratio of the sector's sales to the average economic sales ratio[14]. are used to compute these sectors, respectively. In this paper, we computed the key sectors of whole sectors of the economy, based on both Rasmussen (1956) and Hirschman (1958). In this context, in this paper, we used both 2002 & 2012 I – O tables, that are issued by TURKSTAT after 1968, 1973, 1979, 1985, 1990, 1996, and 1998. These tables, 2002 and 2012, are the eighth and ninth tables, respectively, designed for the Turkish economy. The I-O data for 2012 comprises 64 sectors, while the I-O data for 2002 covers 59 sectors. Within this context, we processed the data for both years separately.

5. Results

Within the paper, we calculated the linkage coefficients, imported input ratios, leakages, and key sectors from the I-O tables of 2002 & 2012. The results derived from the 2002 & 2012 tables are listed in Table II and Table III, respectively.

Table 2: Linkage Coefficients of EGSA (2002)

DBL[15]	DFL[16]	TBL[17]	TFL[18]	IIRITI[19]	IIRITPV[20]	Leakage
0,6867	0,8001	2.5578	5.1840	0,2528	0,1736	0,3781

Source: Authors' own elaboration

Table II reveals that EGSA needs 69 units of input (from other sectors) to produce 100 units of product, according to DBL's calculations. Taking into the consideration of the IIRITI and IIRITPV, we see that 25 percent of these 69 units consist of imported inputs. (In other words, 17 units of imported inputs are used in its 100 units of production). According to the TBL calculation, overall production in the economy rises by approximately 2,6 units for every 1 unit increase in the ultimate demand for EGSA, leading to economic leakage of 0,38 units. In other words, the rise in demand for EGSA by 100 units creates a production increase of 260 units in the economy, leading to economic leakage of 38 units. We have also observed from the TFL calculation that EGSA production rises by 5,2 units when there is 1 unit increase in the final demand for whole sectors. By the calculation

14 The sector is considered a key sector if the sector has $P_j > 1$ and $S_i > 1$. The sector is considered a backward linkage-dependent sector if the sector has $P_j > 1$ and $S_i < 1$. The sector is considered a forward linkage dependent if the sector has $P_j < 1$ and $S_i > 1$. Finally, the sector is considered an independent sector if the sector has $P_j < 1$ and $S_i < 1$.

15 Direct Backward Linkage Coefficient

16 Direct Forward Linkage Coefficient

17 Total Backward Linkage Coefficient

18 Total Forward Linkage Coefficient

19 Imported Input Ratio in Total Inputs

20 Imported Input Ratio in Total Production Value

of DFL, we found out that EGSA has relatively large coefficient, eleventh among the 59 sectors, meaning that the output of EGSA is mainly used as input by others sectors.

Table 3: Linkage Coefficients of EGSA (2012)

DBL	DFL	TBL	TFL	IIRITI	IIRITPV	Leakage
0.7816	1.2543	2.7032	4.3601	0.2724	0.2129	0.4790

Source: Authors' own elaboration

Examining Table III, the calculation of DBL shows that 78 units of input from other sectors are used by EGSA to produce 100 units. Taking into the consideration of the IIRITI and IIRITPV, we see that 27 percent of these 78 units consist of imported inputs, (21 units of imported inputs are used in its 100 units of production). We have also seen that EGSA is the most used input in the production of all other sectors since DFL of EGSA is ranked first among 64 sectors. Besides by the calculation of TBL, we observe that when the demand for EGSA rises by 1 unit, the total production in the economy rises by 2.7 units, leading to 0.48 units of imported inputs in the economy. In other words the rise in demand for EGSA by 100 units creates a production increase of 270 units in the economy, leading to economic leakage of 48 units. By the calculation of TFL we have also observe that when the final demand for whole sectors rises by 1 unit, EGSA production rises 4.36 units.

Additionally, examining the results derived from the 2012 table, we see that, in addition to DFL, EGSA is also ranked first among 64 sectors in terms of DBL, TBL, TFL, and leakage coefficients. Moreover examining the results derived from both 2002 and 2012 I-O tables (shown in Tables I and II in the appendix, respectively), EGSA is found as one of the key sectors of the economy for both years, based on both Rasmussen (1956) and Hirschman (1958). Comparing the 2002 and 2012 I-O tables, we also see that the DFL of EGSA increased from 0.80 to 1.25; indicating the total sales of EGSA for utilization as input has increased. Although the DFL is normally expected to be between 0 and 1, the reason for the value greater than 1 is due to the negative stock change (the current supply was not sufficient to meet the current demand). Besides we see that the ranking of EGSA increased from the eleventh (out of 59 sectors) to the first (out of 64 sectors). We have also seen that 100 units of production of EGSA required 17 units of imported input in 2002, whereas 100 units of production of EGSA required 21 units of imported input in 2012; and the rise in demand for EGSA by 100 units leads to 38 units of economic leakage in 2002, where the rise in demand for EGSA by 100 units leads to 48 units of economic leakage in 2012.

6. Conclusion

Turkey's energy demand increased fast parallel with the economic growth, since all sectors utilize EGSA as input to produce output. However, Turkey's domestic production fails to meet the energy demand. For this reason, Turkey meets approximately 75 percent of its energy needs through imports, leading to an increase in the current account deficit. This large import dependency on energy exposes the Turkish economy to instabilities in global gas and oil prices. This large import dependency on energy also rises the demand for external financing, which engenders the Turkish economy's vulnerable structure. Besides, this high import dependency on energy generates a major barrier to the development of Turkey's manufacturing industry. In this context, in this paper, by I-O analysis we examined the extent of the dependency on energy in the Turkish economy by the input-output tables of 2002 and 2012. Therefore, we calculated the linkage coefficients, imported input ratios, leakages, and key sectors from the I-O tables of both 2002 and 2012, which are the latest tables published by TURKSTAT. The results underline that all the sectors are highly dependent on EGSA and EGSA is highly dependent on imports. So as the production increases, the economic leakage generated by the rise in demand for EGSA increases. Comparing the results derived from the I-O tables of 2002 & 2012, we see that the direct forward linkage of EGSA raised from 0,80 in 2002 to 1,25 in 2012, stating that the utilization of EGSA as an input has increased. Besides direct forward linkage coefficient of 1,25 in 2012 indicates that the sector's intermediate input utilization is higher than the final utilization. Obviously, the gap is met through imports. Besides, we also observed that the economic leakage generated by the rise in demand for EGSA has increased from 38 units to 48 units. This creates a significant obstacle to the development of the Turkish economy. Hence, existing policies for domestic energy production need to be strengthened for sustainable development goals and to decrease the high current account deficit in Turkey. The reader should note that our sample period has even lower energy imports then-current levels; therefore with the increasing energy import levels, our results will only get stronger.

Prioritizing energy supply security and efficiency as the most critical instrument, Turkey, with the new energy strategy, motivated the production of renewable energy (wind, biomass, solar, geothermal, hydroelectric), oil, and gas domestically in the last decade. Consequently, Turkey has significantly improved in increasing domestic production, by liberalizing energy markets, offering feed-in tariffs and diversifying energy sources. Mainly, renewable energy has performed immense growth due to the policies offered, i.e. feed-in-tariffs. However, much more determined reforms with a long-term vision are still required to increase domestic energy production. Besides, feed-in-tariffs, offered for the incitement of renewable energies, are short-term oriented, frequently revised and planned relatively at low levels compared to various European Union countries. For this reason, they do not hold the conditions to encourage large-scale investments. Moreover we see that the primary reason for the shortage of large scaled energy investments in Turkey is the financial deficiencies of the investor companies. Such that, the companies willing to invest have difficulty reaching long-term finance in reasonable terms. In this context, supporting the companies in terms of financing, particularly with subsidised loans or insurance or guarantee supports will lead to an increase in large-scale energy investments and subsequent development in R&D, innovative technologies.

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Appendix

A Matrix

Purchasing Sector / Producing Sector	1. Sector (A)	2. Sector (B)	Intermediate Consumption (A+B) (C)	Final Consumption (D)	Export (E)	Total Use (C+D+E) (F)
1. Sector (A)	a_{11}	a_{12}	$\sum a_{1j}$	**d1**	**e1**	$\sum a_{1j}$ **+d1+e1**
2. Sector (B)	a_{21}	a_{22}	$\sum a_{2j}$	**d2**	**e2**	$\sum a_{2j}$ **+d2+e2**
Basic Inputs (G)	$\sum a_{i1}$	$\sum a_{i2}$				

Source: Küçükkiremitçi, 2013

Note: DBLC= $\sum a_{i1}$ whereas DFLC $= \frac{\text{Intermediate Consumption}}{\text{Total Use}}$ (in I-O Table)

Leontief Inverse Matrix (I-A)$^{-1}$

Purchasing Sector / Producing Sector	1. Sector (A)	2. Sector (B)	Intermediate Consumption (A+B) (C)
1. Sector (A)	b_{11}	b_{12}	$\sum b_{1j}$
2. Sector (B)	b_{21}	b_{22}	$\sum b_{2j}$
Basic Inputs (G)	$\sum b_{i1}$	$\sum b_{i2}$	

Source: Küçükkiremitçi, 2013

Note: TBLC: $\sum b_{i1}$ whereas TFLC $\sum b_{1j}$

Table 1: Linkage Coefficients of Turkey (2002)

The Sector Code[21]	DBL	DFL	TBL	TFL	IIRITI	IIRITPV	Leakage
1	0,3364	0,5539	1.6638	3.0885	0,0681	0,0229	0,0851
2	0,1419	0,5945	1.2825	1.3685	0,0463	0,0065	0,0374
5	0,2325	0,2966	1.4872	1.0372	0,1613	0,0375	0,0915
10	0,3358	0,5542	1.7645	1.3533	0,1670	0,0560	0,1630
11	0,2450	0,8277	1.5642	3.5813	0,1299	0,0318	0,1020
12	0,0000	0,0000	1.0000	1.0000	0	0	0
13	0,5040	0,8298	2.1645	1.3147	0,1321	0,0666	0,2186
14	0,4418	14,207	1.9599	1.9643	0,1061	0,0469	0,1708
15	0,7430	0,2604	2.4504	2.1488	0,0576	0,0428	0,1504
16	0,6669	0,0658	2.3985	1.0725	0,1950	0,1300	0,2791
17	0,7284	0,5952	2.7823	3.2962	0,1854	0,1350	0,3547
18	0,7217	0,0904	2.8425	1.2535	0,1362	0,0983	0,3227
19	0,7308	0,4473	2.8285	1.5008	0,31396	0,2294	0,4720
20	0,7407	0,7311	2.6147	1.5355	0,2408	0,1783	0,3750
21	0,7198	0,9239	2.6880	3.5465	0,2479	0,1785	0,3994
22	0,6125	0,7966	2.4376	1.5537	0,2046	0,1253	0,3100
23	0,8058	0,7994	2.4152	2.6855	0,6242	0,5030	0,6460
24	0,6957	0,7129	2.5672	6.3124	0,2690	0,1871	0,3812
25	0,7267	0,7671	2.7382	2.5926	0,3034	0,2205	0,4581
26	0,6279	0,8357	2.3591	2.3064	0,1293	0,0812	0,2349
27	0,7567	0,8516	2.9597	7.3207	0,3003	0,2272	0,5265
28	0,6937	0,6975	2.7943	2.1442	0,2240	0,1554	0,4309
29	0,6218	0,2723	2.5691	2.3210	0,2628	0,1634	0,3984
30	0,5612	0,3037	2.3365	1.2274	0,3716	0,2085	0,4255
31	0,7060	0,4912	2.7718	2.0026	0,2576	0,1819	0,4457
32	0,7862	0,3741	3.1418	2.5400	0,4634	0,3644	0,7991
33	0,7092	0,2183	2.7554	1.3084	0,3795	0,2692	0,5478
34	0,7572	0,3416	2.9942	1.9259	0,2462	0,1864	0,4856
35	0,5368	0,4737	2.2945	1.2800	0,2395	0,1285	0,3055
36	0,7505	0,1346	2.9300	1.2020	0,4175	0,3133	0,6017
37	0,7802	11,199	2.9460	1.0272	0,0658	0,0514	0,3294
40	0,6867	0,8001	2.5578	5.1840	0,2528	0,1736	0,3781
41	0,1886	0,6497	1.4531	1.2670	0,2068	0,0390	0,1009
45	0,5434	0,0808	2.2948	1.3489	0,1231	0,0669	0,2392
50	0,4615	0,5895	1.9344	2.5009	0,1862	0,0859	0,1867
51	0,4120	0,5544	1.8361	4.4416	0,1209	0,0498	0,1352
52	0,3130	0,3587	1.6331	3.1507	0,1571	0,0492	0,1145
55	0,5349	0,1344	2.1070	1.5330	0,0428	0,0229	0,1136
60	0,4020	0,4004	1.8465	4.7196	0,0958	0,0385	0,1390

21 For the sector names please see TÜİK – Veri Portalı (tuik.gov.tr)

61	0,3915	0,6399	1.7994	1.9001	0,2479	0,0970	0,1856
62	0,6370	0,3677	2.2697	1.2771	0,0971	0,0618	0,1835
63	0,5040	0,7370	2.0281	3.0094	0,0533	0,0268	0,1135
64	0,4457	0,4437	1.9282	1.9488	0,0859	0,0382	0,1462
65	0,3521	0,6310	1.6541	3.9679	0,0426	0,0150	0,0666
66	0,3591	0,5319	1.6684	1.2251	0,0547	0,0196	0,0682
67	0,5698	10,000	2.0742	1.3167	0,0738	0,0420	0,1218
70	0,2068	0,1564	1.4614	2.1136	0,0875	0,0181	0,0715
71	0,4478	0,7126	1.9200	1.1761	0,0802	0,0359	0,12709
72	0,3617	0,6280	1.7321	1.2191	0,1427	0,0516	0,12990
73	0,6667	0,9907	2.5574	1.5370	0,1992	0,1328	0,32826
74	0,3609	0,8549	1.8135	4.0566	0,1283	0,0463	0,14485
75	0,3972	0,0033	1.8403	1.0141	0,0731	0,0290	0,11885
80	0,2132	0,0479	1.4478	1.1093	0,0840	0,0179	0,06772
85	0,4788	0,0564	2.0086	1.0897	0,1044	0,0500	0,15626
90	0,4911	0,6176	2.0601	1.2413	0,2045	0,1004	0,22178
91	0,4496	0,2588	1.8630	1.3152	0,0418	0,0188	0,08567
92	0,4519	0,4149	1.9125	1.5862	0,1466	0,0663	0,15611
93	0,4411	0,1870	1.9204	1.0636	0,1124	0,0496	0,15698
95	0,0000	0,0000	1.0000	1.0000	0	0	0

Source: Authors' own elaboration

Table 2: Linkage Coefficients of Turkey (2012)

The Sector Code[22]	**DBL**	**DFL**	**TBL**	**TFL**	**IIRITI**	**IIRITPV**	**Leakage**
A01	0.3271	0.6124	1.5381	2.1793	0.1403	0.0515	0.0994
A02	0.1398	0.1327	1.235	1.2067	0.0937	0.0146	0.0356
A03	0.2285	0.0316	1.4015	1.0385	0.1161	0.03	0.0761
B	0.1147	1.0067	1.1912	3.9273	0.1667	0.0705	0.044
C10-C12	0.6575	0.5929	2.1374	1.9575	0.148	0.1049	0.1933
C13-C15	0.5888	0.6195	2.1359	2.0677	0.1817	0.1217	0.2303
C16	0.5203	0.3443	1.8857	1.4945	0.2086	0.138	0.2039
C17	0.5005	0.6834	1.8844	2.212	0.3793	0.2692	0.3178
C18	0.6013	0.4757	2.0915	1.7	0.2707	0.171	0.3188
C19	0.438	1.0436	1.5422	2.7754	0.7291	0.6823	0.3933
C20	0.315	1.2259	1.4958	3.405	0.4488	0.3243	0.2118
C21	0.3056	0.1729	1.4971	1.2087	0.3422	0.2147	0.1622
C22	0.5892	0.4716	1.9977	1.8096	0.3872	0.2864	0.3776
C23	0.5746	0.3818	1.9725	1.6729	0.1532	0.099	0.1955
C24	0.53	1.1612	1.8752	2.9787	0.3742	0.3141	0.3115
C25	0.5098	0.343	1.9368	1.5422	0.2298	0.1429	0.254
C26	0.2047	0.2732	1.3245	1.3825	0.4086	0.2642	0.1235
C27	0.5236	0.3857	1.947	1.5776	0.3025	0.2434	0.2952
C28	0.3171	0.2361	1.5686	1.3409	0.3092	0.2103	0.1774

22 For the sector names please see CPA 2008 – CPA – Eurostat (europa.eu).

C29	0.4962	0.2854	1.9062	1.4168	0.3643	0.2954	0.3185
C30	0.2345	0.0913	1.4033	1.1154	0.3022	0.1763	0.1224
C31_C32	0.5186	0.192	1.9504	1.2325	0.2041	0.1304	0.2195
C33	0.4524	0.2385	1.7919	1.3672	0.2589	0.1263	0.2164
D35	0.7816	1.2543	2.7032	4.3601	0.2724	0.2258	0.4790
E36	0.3273	0.0947	1.6985	1.1369	0.0733	0.025	0.1217
E37-E39	0.2701	0.3412	1.4365	1.8367	0.2705	0.1395	0.1158
F	0.6047	0.6457	2.1397	2.0222	0.106	0.0664	0.1917
G45	0.4177	0.2818	1.7393	1.4676	0.1794	0.0801	0.1623
G46	0.3919	1.1061	1.678	2.8149	0.0777	0.0325	0.0944
G47	0.3477	0.3564	1.5915	1.5872	0.0766	0.0282	0.0834
H49	0.4478	1.2172	1.7549	3.3346	0.1392	0.0714	0.1651
H50	0.493	0.268	1.8101	1.4675	0.1536	0.0844	0.1639
H51	0.5832	0.1967	1.9634	1.2513	0.2106	0.1559	0.2932
H52	0.3602	0.6667	1.5943	2.142	0.1027	0.045	0.0921
H53	0.4509	0.1662	1.746	1.2496	0.0825	0.04	0.1113
I	0.4594	0.5088	1.8707	1.6762	0.0933	0.0465	0.1244
J58	0.4158	0.165	1.7895	1.2737	0.1061	0.0497	0.1357
J59_J60	0.4955	0.5467	1.9516	2.0974	0.1548	0.0919	0.1547
J61	0.3894	0.3601	1.6719	1.5528	0.047	0.0203	0.0637
J62_J63	0.1825	0.3252	1.3055	1.4934	0.0811	0.0156	0.0359
K64	0.2884	0.6918	1.4632	2.1922	0.0445	0.0142	0.0411
K65	0.633	0.2736	2.0644	1.4161	0.1473	0.1087	0.1601
K66	0.2883	0.3234	1.476	1.4724	0.0513	0.0158	0.0506
L68B	0.1791	1.0137	1.3167	2.6025	0.1612	0.0302	0.0638
L68A	0	0	1	1	0	0	0
M69_M70	0.2331	0.5783	1.3908	1.9007	0.0726	0.0181	0.0516
M71	0.3798	0.2359	1.6571	1.3484	0.0754	0.0308	0.0839
M72	0.1503	0	1.2603	1	0.1339	0.0216	0.0485
M73	0.6561	0.5979	2.3431	2.0285	0.0714	0.0509	0.1522
M74_M75	0.5006	0.2147	1.863	1.2932	0.1401	0.0738	0.1536
N77	0.2123	0.265	1.3536	1.4181	0.1245	0.0302	0.0674
N78	0.1883	0.0567	1.3187	1.0833	0.0459	0.0092	0.0348
N79	0.6133	0.1024	2.1589	1.1248	0.117	0.0803	0.1754
N80-N82	0.231	0.8189	1.3808	2.2143	0.1433	0.0357	0.0704
O84	0.3463	0.0783	1.6067	1.1123	0.0979	0.036	0.0966
P85	0.1542	0.0836	1.2752	1.1156	0.0615	0.0099	0.0386
Q86	0.4142	0.072	1.6978	1.0788	0.1318	0.0561	0.1173
Q87_Q88	0.3567	0	1.6288	1	0.0964	0.0362	0.0967
R90-R92	0.2761	0.1203	1.5124	1.1625	0.0406	0.0124	0.0463
R93	0.5123	0.1075	2.002	1.1597	0.07	0.04	0.1254
S94	0.3483	0.1159	1.7125	1.1522	0.0718	0.0311	0.0856
S95	0.4233	0.043	1.7444	1.0638	0.2277	0.1035	0.1814
S96	0.5374	0.0157	1.9516	1.0199	0.1425	0.0823	0.18
T	0	0	1	1			0

Source: Authors’ own elaboration