TÜRKİYE CUMHURİYET MERKEZ BANKASI

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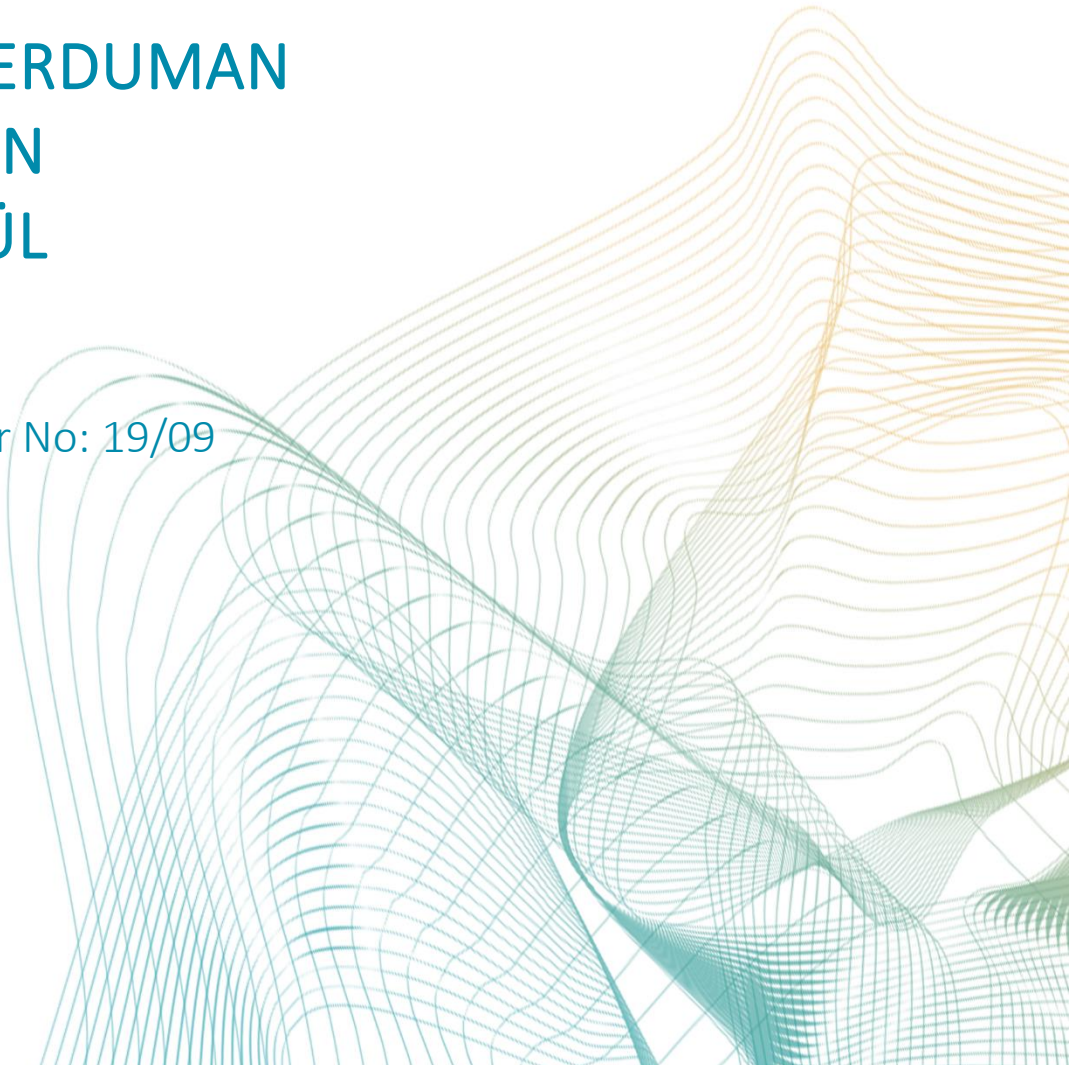

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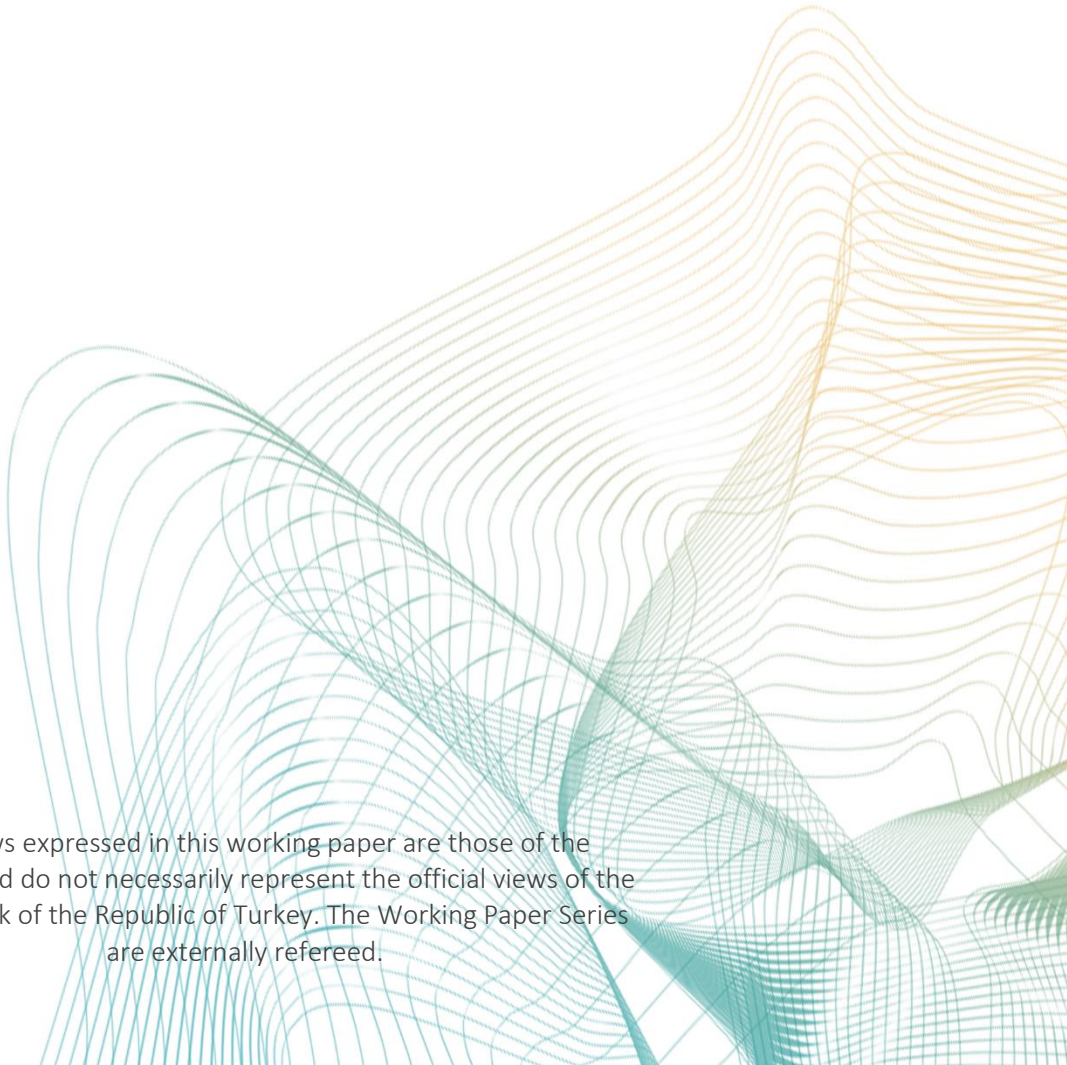

The Evolution of Import Content of Production and Exports in Turkey: 2002-2017

Yasemin Erduman, Okan Eren, Selçuk Gül*

Özet

Bu çalışmada, Türkiye'de üretim ve ihracatın ithal girdi içeriğinin 2002-2017 dönemindeki seyri incelenmektedir. 2002 ve 2012 girdi çıktı tablolarından yola çıkılıp, üretim ve dış ticarete ilişkin geniş bir veri setine dayanarak çoğunluğu imalat sanayiinde 20 sektör için kalan yıllardaki üretim ve ithal girdi kullanım değerleri tahmin edilmektedir. Her bir sektör için doğrudan ve dolaylı etkileri kapsayan ithal girdi oranları Leontief ters matrisi kullanılarak hesaplanmaktadır. Bulgular, ithal girdi bağımlılığının incelenen dönemde ihracatta arttığına, üretimde ise yatay seyrettiğine işaret etmektedir. Genel olarak üretimin ithal girdi oranı, ihracatınkinin altında kalmaktadır. Bunda en belirgin etken, görece daha düşük ithal girdi kullanımına sahip olan hizmet sektörünün üretim içerisinde yüksek paya sahip olmasıdır. İthal girdi oranı en yüksek sektörler sermaye ve teknoloji yoğunluğu fazla olan kok ve rafine petrol ürünleri, ana metal ve motorlu kara taşıtları sektörleridir. İthal girdi oranının en düşük olduğu sektörler ise tarım, ormancılık ve balıkçılık; hizmet ve madencilik sektörleridir.

JEL Kodları: C67, D57, F14, L60

Anahtar Kelimeler: Girdi-çıktı tabloları, Leontief ters matrisi, ithalat gereği

Abstract

This study explores the evolution of the import content of production and exports in Turkey for the 2002-2017 period. Using 2002 and 2012 input-output tables, we estimate the production and imported input use for the remaining years based on a large data set of production and foreign trade for 20 selected sectors, mostly from the manufacturing industry. Import requirement ratios, comprising both direct and indirect linkages, for each sector are calculated using the Leontief inverse matrix. Our findings indicate that import dependency increases for exports, but stays roughly the same for production over time. In general, the import content of production is below the import content of exports. This divergence can mainly be attributed to the services sector, which has relatively low import dependency, yet a significant share in production. Sectors with the highest import requirements are found to be those with higher capital and technology intensity such as coke and refined petroleum products, basic metals and motor vehicles. Agriculture, forestry, and fishery; service and mining sectors are found to have the lowest import requirements.

JEL Codes: C67, D57, F14, L60

Keywords: Input-output tables, Leontief inverse matrix, import content

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Non-technical Summary

Imported intermediate goods constitute roughly three fourths of Turkey's total imports, indicating the widespread use of imported inputs in domestic production. This can partly be explained by the globalization and integration trends to the global value chains in the recent decades. Another explanation is that, over the years, necessary inputs for production in Turkey either were not produced in sufficient amounts domestically, or necessitated certain skills and technologies that were not acquired by local firms. Price and quality advantages were additional factors that fed the upward trend in imported inputs, which in turn led import dependency to become a structural characteristic of the Turkish economy.

The degree of import dependency and its evolution over time are important issues, especially for developing countries with relatively high current account deficits, such as Turkey. Import dependency not only results in higher current account deficits especially during high growth periods, but also limits the price gains from currency depreciation. Moreover, it lengthens out the rebalancing of the current account during TL's depreciation periods.

In this study we explore the evolution of the import content of production and exports in Turkey for the 2002-2017 period. We calculate import requirement ratios for 20 selected sectors of the economy, mostly from the manufacturing industry, based on 2002 and 2012 input-output tables and a large data set of production and foreign trade statistics. Hereby, we shed some light on the whereabouts of import dependency in the Turkish economy during the more recent period.

Our findings indicate that import dependency increases for exports, but stays roughly the same for production over time. The import content ratio of production is always less than the import content ratio of exports. This divergence can mainly be attributed to the services sector, which has relatively low import dependency, yet a significant share in production. Sectors with the highest import requirements are found to be those with higher capital and technology intensity such as coke and refined petroleum products, basic metals and motor vehicles. Agriculture, forestry, and fishery; service and mining sectors are found to have the lowest import requirements.

1. Introduction

In recent decades, globalization and integration to the global value chains have contributed to increasing use of imported inputs in production. Strengthening of multinational companies, development of communication and transportation tools, and easier access to cheaper and higher quality products have accelerated the flow of goods. Firms all over the world are now inevitably connected through input linkages in production of goods for domestic use and for exports, a phenomenon known as vertical specialization in international trade. The situation in Turkey is no exception. Turkey has attracted a considerable amount of foreign direct investment in the past fifteen years which in turn has increased the demand for intermediate goods.[1] The fact that some of these inputs either were not produced in sufficient amounts domestically, or necessitated certain skills and technologies that were not acquired by local firms, has also contributed to the rise in the requirement for imported inputs, besides global vertical specialization trends. Price and quality advantages were additional factors that fed the upward trend in imported inputs. Yet import dependency of production became a structural characteristic of the Turkish economy.

The degree of import dependency and its evolution over time are important issues for developing countries especially those with relatively high current account deficits, such as Turkey. From a macroeconomic perspective, extensive use of imported inputs in production has direct influence on several economic relations.[2] Some important ones among these are the exchange rate elasticity of exports and imports, the pass-through of import prices to domestic prices[3] and the relationship between trade gains from increasing foreign demand and current account balance.[4] As for Turkey, import dependency not only results in higher current account deficits especially during high growth periods,[5] but also limits the price gains from currency depreciation. Moreover, it lengthens out the rebalancing of the current account during TL's depreciation periods.

Input-output analysis is a practical approach to examine the import content of production and exports. However, in order to get a clear and precise picture of the evolution of the import

[1] Turkey's stock of FDI liabilities increased more than ten times between 2002 and 2017, from 19 billion to 196 billion USD.
[2] See CBRT blog post by Özcan-Tok et al. (2017) for a brief assessment of the trends, costs and benefits of the use of imported inputs in Turkey.
[3] CBRT blog post by Ertuğ et al. (2018) analyze the relationship between imported input usage and pass-through of import prices to domestic prices for Turkey. They provide evidence that degree of pass-through from import prices and real exchange rate developments to domestic prices differs among sectors. They report that a positive correlation exists between this difference and import content of production of individual sectors.
[4] For instance, consider the response of an exporter firm to a real exchange rate shock. The share of imported goods in production affects its pricing strategy which eventually determines the export volume. Similarly, domestic price of a final good is prone to an exchange rate shock proportionately to the share of its import content. A high import dependency of production also weakens the link between net trade gains from foreign demand and current account balance. Conventionally, we would expect a decline in the current account deficit due to an increase in exports when foreign demand is strong. However, if the import requirement ratio is high for exports, imports of additional intermediate goods stimulated by foreign demand would lower net trade gains.
[5] See Appendix A for a brief discussion on the relation between intermediate good imports and economic activity.

requirements over time, one needs to have input-output tables (IOTs) that are published on a regular basis (ideally with an annual frequency). But even according to the European Union regulation, submission of these tables is only compulsory every five years and many other countries worldwide publish them irregularly (Rueda-Cantuche et al., 2017). Hence, in empirical studies, the analysis of import content either provides a snap shot of the situation in those years that input output tables are available or involves their estimation based on different techniques and other available data for the missing years.

The empirical studies on the import dependency in Turkey are based on analysis of 2002 and/or earlier input output tables (Saygılı et al., 2012; Yükseler and Türkan, 2006; and Şenesen and Şenesen, 2003).[6] The literature suggests that the average import requirement of production is increasing over time and that it is around one-fourth in the manufacturing sector in 2002. Unfortunately, due to the lack of an input output table beyond 2012, we have no indication on how import dependencies in sectors have evolved in the more recent period, or on the current levels they have reached.

In this study, we aim to examine how the import contents of production and exports change in Turkey from 2002 to 2017. Using the most recent IOTs for 2002 and 2012, we estimate the production and imported input use for the remaining years based on a large data set of production and foreign trade for 20 selected sectors, most of which operate in the manufacturing industry. We then calculate the import content ratios for each sector that take both direct and indirect linkages into account by using the Leontief inverse matrix.

Our findings indicate that the import content of exports increases considerably during the period of analysis while the import content of production stays almost the same for the Turkish economy. Moreover, there is a level difference between the two, import content of production being considerably lower. We attribute this difference to the services sector, which has relatively low import dependency, but a significant share in production. On the other hand, there exists a significant heterogeneity among sectors in terms of the import content. Sectors with the highest import requirements are the ones with higher capital and technology intensity such as coke and refined petroleum products, basic metals and motor vehicles. Agriculture, forestry and fishing; services and mining sectors are found to have the lowest import requirements.

The first contribution of our paper is that we estimate an input-output table for each missing year based on the official 2002 and 2012 tables and a wide range of micro and macro level statistics. Our methodology in estimating these figures exploits some practical assumptions that we will describe in Section 3, some of which are highlighted in Rueda-Cantuche et al. (2017). In that respect, it serves as

[6] The latest five input-output tables for Turkey are for 1985, 1990, 1998, 2002 and 2012 in chronological order.

a guide for similar research on other countries. The second contribution of our paper is that it fills a large gap in the related literature by shedding some light on the evolution of import dependency in the Turkish economy during the more recent period. Our quantitative findings between 2002 and 2017 provide good insight at both sectoral and aggregate levels for not only researchers interested in the field, but also for policymakers in the decision making process.

The rest of the paper is organized as follows. Section 2 provides a brief literature review regarding the import content of production in Turkey. Section 3 presents the data and methodology. Section 4 provides the findings and Section 5 concludes.

2. Literature Review

What we know about import content of production is largely based on empirical studies that examine the import dependency at the firm and sectoral levels. Some recent studies provide evidence regarding the benefits and costs of outsourcing inputs from abroad. Price and quality advantages and productivity gains are the main benefits highlighted in the literature (See Halpern et al. (2015) for Hungarian firms, Feng et al. (2016) for Chinese firms, and Imbruno and Ketterer (2018) for Indonesian firms). On the contrary, several other studies emphasize the costs of using imported inputs which are mainly the loss in domestic innovation and labor market distortions such as a decline in employment (See Liu and Qiu (2016) for Chinese firms and Boehm et al. (2017) for US firms).

The empirical literature regarding the estimation of import content of production follows two main approaches. The first approach, which we also employ, uses input-output analysis and matrix algebra to derive the direct and indirect use of imported inputs in production through the Leontief Inverse matrix.[7] The second approach, which is less common, uses the aggregate level statistics to calculate some indicators with regards to import dependency. While the former approach is advantageous to the latter by also taking into account the implicit linkages among sectors, it has a limitation. It requires the estimation of the IOTs for those years in which a given country does not publish an official input-output table. From a statistical perspective, Rueda-Cantuche et al. (2017) state that using the IOT structures of previous years usually performs better than any other approach, mostly because they gather detailed country specific information that is not expected to change in the short term. We employ a similar approach in our analysis to generate the IOTs of Turkey for the missing years.

There is an extensive empirical literature focusing on the vertical specialization in production that uses input-output analysis. Breda et al. (2008) estimate the import content of exports for seven

[7] Section 3 provides more details.

European countries and interpret the estimates as a degree of internalization. Combining the IOTs with international trade data, Amador and Cabral (2009) develop a vertical specialization measure and apply this measure to a large dataset of 79 countries. Anós-Casero and de Astarloa (2010) investigate the degree of vertical specialization in exports in Argentina. Bravo and Alvarez (2012) analyze the import content of industrial sectors in Spain comparing to the main European economies. To examine the energy content of manufacturing exports, Amador (2012) use a large dataset of 30 advanced and developing countries.

Most of the literature examining the import content of production in Turkey uses the IOTs. There are also a few studies that draw upon aggregate level statistics. Using survey and interview based data for 145 large-scale manufacturing firms; Saygılı et al. (2014) investigate the factors that lead to an increase in the use of imported intermediate goods. They list three main determinants of imported input use in production as (i) access to intermediate and investment goods of higher quality, (ii) supply of those goods in lower prices, and (ii) existence of multinational firms and foreign capital investments. In an earlier study, Saygılı et al. (2012) use IOTs in addition to survey based data and examine the import dependency in the 1998-2007 period. For the years between 1998 and 2002, they use the official IOTs and find that import content of production in manufacturing increased five points during the period, from 22.2 percent in 1998 to 26.7 in 2002.[8] They make inference for the years between 2002 and 2007 using the survey data. At the sectoral level, their findings indicate that import dependency increased for most of the products. However, they report that the upwards trend of import content of production is not specific to Turkey.

Yükseler and Türkan (2006) provide evidence indicating sector level heterogeneity in terms of import dependency of production for Turkish manufacturing industry. Using the 1998 IOT, they estimate the import content of production in manufacturing as 21.8 percent. Import requirement ratios are above the industry average for the manufacturing sectors of basic metals; chemical products; electrical machinery-equipment; plastic-rubber products; furniture; communication and radio-TV devices, and medical, precision and optical devices. In addition to IOTs analysis, they compute several aggregate level indicators such as imports/production, imports/total supply, exports/production and exports/total supply to examine the structural change in the manufacturing sector and quantify the degree of import dependency.[9] They report that the Turkish economy became more integrated into the global trade after the Customs Union and more import dependent.

[8] They refer to Temel et al. (1995) for the import content of production in manufacturing before 1998. According to this study, import requirement ratio realized as 11.6 and 20.9 in 1979 and 1990, respectively.
[9] The last two indicators are also used by Aydın et al. (2007). They calculate those ratios for Turkey, Czech Republic, Hungary, Poland and Slovakia to compare the import dependency of exports in each country.

Şenesen and Şenesen (2003) examine the import dependency of production before 2000. Using IOTs of 1973, 1985 and 1996, they investigate the structural changes in the production. They name the periods in the chronological order as the planned economy era, the transformation period and post-liberalization era. They provide evidence that import dependency of production increased gradually after abandoning import substitution policies. The increase realized as 33 percent from 1973 to 1985 while it occurred more limited between 1985 and 1996.

The latest figure on the extent of import dependency in Turkey is of OECD. These statistics are calculated by applying the matrix algebra to the national IOTs for the period between 1995 and 2011, and projected for the 2012 to 2014 period based on the latest benchmark year (2011), for 63 countries including Turkey. According to the OECD (2018) estimates, the import content of exports in Turkey was 21.8 percent in 2014.

In sum, empirical studies on the import content of the Turkish economy that use the official IOTs published in 2002 and earlier on have two main conclusions. First, the average import requirement of production is around 25 percent in the manufacturing sector. Second, the import requirement ratio of production in the manufacturing sector has increased since the 1980s.

3. Data and Methodology

The foundation of our paper rests on input-output analysis. Originated by Leontief, the input-output analysis reveals the production-related interdependencies between different sectors within an economy and with the rest of the world. An input-output table includes a series of rows and columns of data that quantify the supply chain for all sectors of an economy. Product groups that correspond to specific sectors of the economy are listed in the headers of each row and each column. The data in each column gives the levels of input use by that sector from other sectors.

The two most recent IOTs for the Turkish economy published by the Turkish Statistical Office (TurkStat) are available for 2002 and 2012. Our analysis covers between 2002 and 2017, based on these two tables. We estimate the figures for the other years in the period according to the methodology we describe in this section. First, we calculate the estimates of output for production at current prices for each year. Then, the value of imported inputs is obtained by using the relevant trade statistics. Finally, we calculate the direct and indirect import requirement ratios of each sector.

In the IOTs, the product categories are related to activities as defined by the statistical classification of economic activities in the European Community (NACE). To begin with, we define 20 sector categories from the NACE Economic Activity classification. These sectors can mainly be classified under three groups; (i) agriculture, forestry and fishing (ii) manufacturing industry and (iii) services. The selection is made based on the sector categories corresponding to the product groups (CPA -

Statistical Classification of Products by Activity in the European Economic Community) in the 2012 IOT. Since the classification in 2002 and 2012 are different, and the 2002 IOT presents a more detailed classification in manufacturing sectors, some product groups are merged to ensure the compatibility of the IOTs, as presented in Table 3.1.[10]

Table 3.1: Selected Sectors According to 2002 and 2012 IOT Product Group Classification

Product Groups	2012 (CPA 2008)	2002 (CPA 2002)
Agriculture, forestry and fishing products	A01+A02+A03	1+2+3
Mining and quarrying	B	10+11+12+13+14
Food, beverages and tobacco products	C10+C11+C12	15+16
Textiles, wearing apparel, leather, and related products	C13+C14+C15	17+18+19
Wood and of products of wood and cork, except furniture	C16	20
Paper and paper products	C17	21
Printing and recording services	C18	22
Coke and refined petroleum products	C19	23
Chemicals and chemical products	C20	24
Rubber and plastic products	C22	25
Other non-metallic mineral products	C23	26
Basic metals	C24	27
Fabricated metal products, except machinery and equipment	C25	28
Computer, electronic and optical products	C26	30+32+33
Electrical equipment	C27	31
Machinery and equipment n.e.c.	C28	29
Motor vehicles, trailers and semi-trailers	C29	34
Other transport equipment	C30	35
Furniture and other manufactured goods	C31+C32	36
Services (Other Sectors)	Rest of the above	Rest of the above

In order to estimate the production values for the 20 selected product groups (hereafter referred to as sector) in each year, we first get the production values for each sector from the 2002 and the 2012 IOTs. Then, we follow two different methods to calculate the estimates of the production values for agriculture, forestry and fishing sector and the other sectors, for those years that IOTs are not available.

For the manufacturing industry and the services sector, the production values of the years between 2003 and 2017 are calculated based on the annual growth rate of the production of each corresponding sector in TurkStat's Industry and Service statistics.

[10] In the 2012 table, there are 64 products that are classified according to CPA 2008. 19 of these products belong to the manufacturing industry. In the 2002 table, there are 59 products that are classified according to CPA 2002, of which 22 belong to the manufacturing industry.

Since TurkStat's Industry and Services statistics do not cover agriculture, forestry and fishing sectors, we estimate the production values of these sectors based on GDP data. The National Accounts framework classifies these three sectors under one item. Accordingly, we merge these sectors and use the nominal annual GDP growth rate of this item to estimate the current production value of these three sectors combined in each year. The number of sectors hereon drops to 20.

The second stage of the procedure deals with the estimation of imported input usage. The imported input values for 2002 and 2012 are taken from import IOTs. For the remaining years, we follow a four-step methodology as described below:

- In the first step, from the 2002 and 2012 IOTs, we calculate the sectoral distribution of imported intermediate goods that a given sector provides to other sectors. For example, in 2012, 25.7 percent of the total imported intermediate goods of the chemicals sector was used by the chemicals sector itself. It provided 20.9 percent of the imported intermediate goods to the rubber and plastic products sector, 13.1 percent to the textiles, apparel and leather products sector, and 11.6 percent to the agriculture and hunting products sector.
- In the second step, we use linear interpolation to calculate the sectoral distributions of imported intermediate goods that a given sector provides to other sectors for the years between 2002 and 2012. For the years beyond 2012, we assume that the sectoral distributions of imported intermediate goods stay the same. This approach stands on the assumption that the sectoral distributions of the imported intermediate goods across the sectors exhibit only a gradual change over the years, as suggested in Rueda-Cantuche et al. (2017).[11] Turning back to the example, the share of imported intermediate goods of the chemicals sector used by the chemical sector itself has increased from 23.2 in 2002, to 25.7 in 2012. Therefore in calculations, the share is assumed to increase by 0.25 points each year.
- The third step involves most of the data mining. From the TurkStat External Trade Statistics, we obtain imports data classified according to the Harmonized Commodity Description and Coding Systems (HS) at 6 digit level for each year. Then, we match each product item at HS 6 digit level with its corresponding Broad Economic Categories (BEC) classification to determine which items are intermediate goods. This conversion is made using HS to BEC correspondence tables for over 5000 items each year. The items identified to be imported

[11] Rueda-Cantuche et al. (2017) examine a few methods for the estimation domestic and import use tables at basic prices in the absence of official IOT data with a selection of auxiliary information from national statistical offices in the European context. For providing an indication of how much their estimates fit the reality, they assess the results against the official Supply, Use and Input–Output tables of Belgium, Germany, Italy, Netherlands, Finland, Austria and Slovakia by using matrix difference metrics. Their main conclusion is that using the IOT structures of previous years usually performs better than any other approach mostly because they gather detailed country specific information that is not expected to change in the short term. They also note that their analysis is carried out within the EU context because of the availability of homogenous additional data but it can be used as well in non-EU countries provided the same data are available.

intermediate goods are selected. Next, they are allocated to the sector categories according to the International Standard Industrial Classification (ISIC) using HS to ISIC conversion tables. The matching of these sectors with the corresponding sectors provided in Table 3.1 gives us the value of imported intermediate goods for each sector in every year.

- In the fourth step, we take the product of the sectoral shares of imported intermediate goods constructed in the second step and the value of imported intermediate goods in the third step for each of the sectors for every year. This gives us the values for imported inputs.

In the third and final stage of our analysis, we estimate the direct and indirect import requirement ratios for each sector, as in Loschky and Ritter (2006) and Saygılı et al. (2012). The ratio of imported intermediate goods to the production value for a given sector is called the direct import requirement. The indirect import requirement takes into account the import content of domestic inputs as well, through the imported raw materials involved in the former stages of their production. The ratios represent the imports required by total production, for both domestic demand (consumption and investment) and foreign demand (exports), as in the "open" Leontief model formulated by Leontief (1944). In other words, it is assumed that the products for domestic use and for foreign markets are homogenous and have similar production structures, in terms of the import content.

In the model, the intermediate consumption of sector i from sector j is a certain ratio of the total production of sector i.

$$X_{ij} = a_{ij}X_j \text{ such that } 0 < a_{ij} < 1 \quad (1)$$

The sectoral production vector (X) is the total of intermediate product consumption and final product consumption (Y) of all sectors.

$$X = AX + Y \quad (2)$$

X can be solved as

$$X = (I - A)^{-1}Y \quad (3)$$

Here, X is a $nx1$ dimensioned vector that comprise the output of n sectors. I is an nxn dimensioned identity matrix. Y is a $nx1$ dimensioned vector that comprise the final product consumption of n sectors. A represents the Leontief technical coefficients matrix that reflects production technologies that determine the unit-output input requirements for each sector. In other words, the elements of the matrix A, (a_{ij}) show the ratio of intermediate consumption of sector i directly used for the production of one unit domestic output of sector j. Accordingly, matrix A reflects the direct intermediate consumption structure within the sectors. On the other hand, $(I - A)^{-1}$ is called the

Leontief inverse matrix. The elements of the Leontief inverse matrix contain the production of one unit output for final uses (unit matrix I), the production of domestic intermediate inputs directly used in the production process for final uses (input coefficients A) and the necessary production of domestic intermediate inputs on former stages of the whole domestic production process. Yet, the sum of the columns of the Leontief inverse matrix comprises all direct and indirect relations for each sector.

The technical coefficient matrix A can be disaggregated into two parts: domestic (A_d) and imported (A_m):

$$A = A_d + A_m \tag{4}$$

In this case, the import inverse matrix can be written as:

$$R = A_m(I - A_d)^{-1} \tag{5}$$

In Equation 5, the elements of the matrix R are the total direct and indirect import requirement coefficients. The sum of each column of the import inverse matrix gives the import requirement ratio for the corresponding sectors, influenced by the changes in both the domestic and the foreign demand. In accordance, the amount of imports required by the change in total demand (Y) can be written as:

$$M = RY \tag{6}$$

Here, total demand is the sum of domestic (consumption and investment) (Y_d) and foreign demand (exports) (Y_f).

$$Y = Y_d + Y_f \tag{7}$$

And total imports are the sum of imports required by the domestic (M_d) and foreign demand (M_d):

$$M = M_d + M_f \tag{8}$$

which can be separately written as below:

$$M_d = RY_d \quad \text{and} \quad M_f = RY_f \tag{9}$$

The import dependency of production in the Turkish economy as a whole is calculated as the weighted average of import requirement ratios of each sector based on the sectors' shares in total production. Similarly, the import dependency of Turkish exports as a whole is calculated as the weighted average of import requirement ratios of each sector based on the sectors' shares in total exports.

4. Findings

To show the accuracy of our findings, we first present the import contents that are calculated directly from the input-output tables of 2002 in comparison to those that are estimated by our methodology in Figure 4.1. According to the figure, the estimated import contents for the sectors successfully approximate the ones that are obtained from the official input-output tables. If we call the calculations from the official tables as the real import contents, the percentage difference of our estimates from their real counterparts are the estimation errors from our methodology. In this context, the average percentage error over the industry sectors is found to be 7.8 percent. The errors vary from 1.9 percent to 18.8 percent with a standard deviation of 4.7 percent. Although there are visually discernable differences between the real ratios and the estimated ones, our approximations seem to be good proxies especially when the variety of the data sources used during the calculation process is considered.

Figure 4.1: Import Requirement Ratios from 2002 IOT and the Estimates (By Sector, Percent)

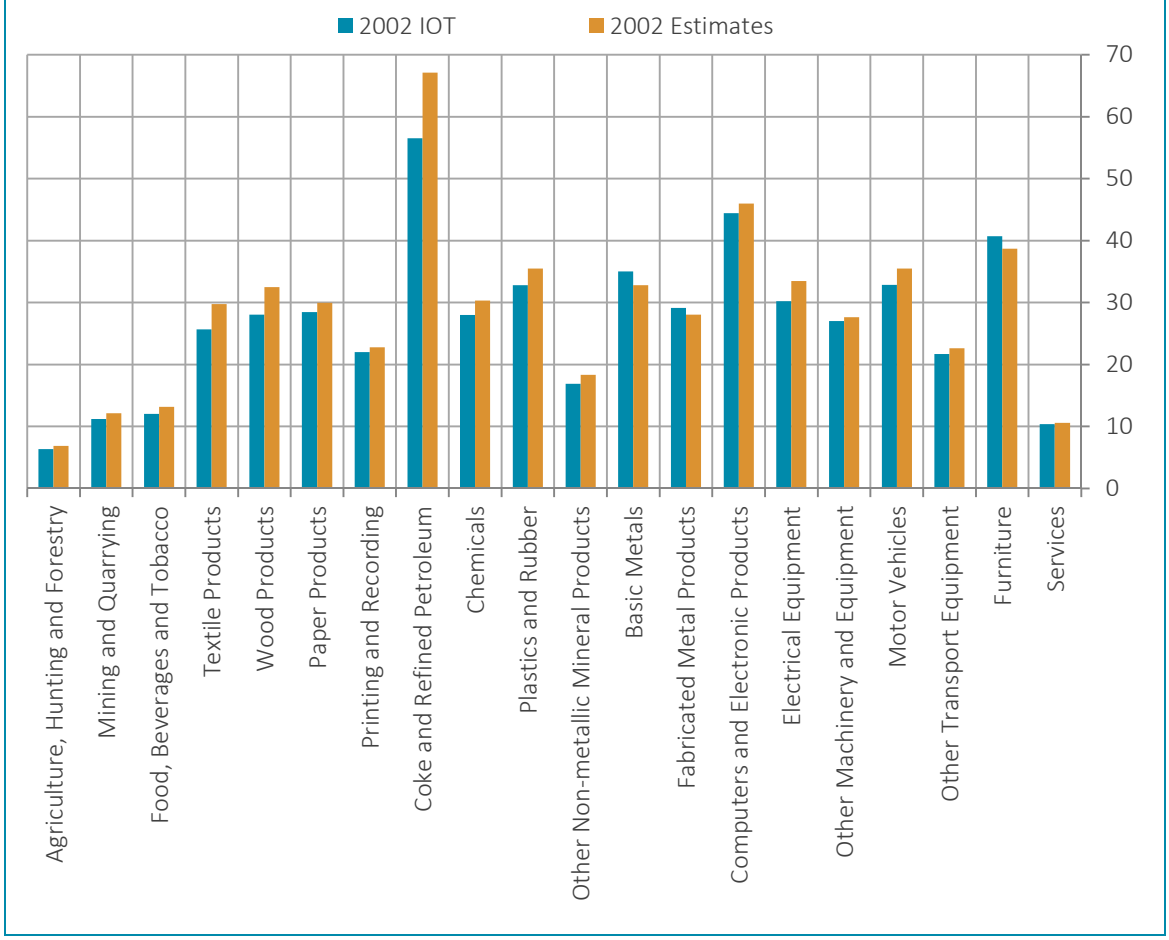
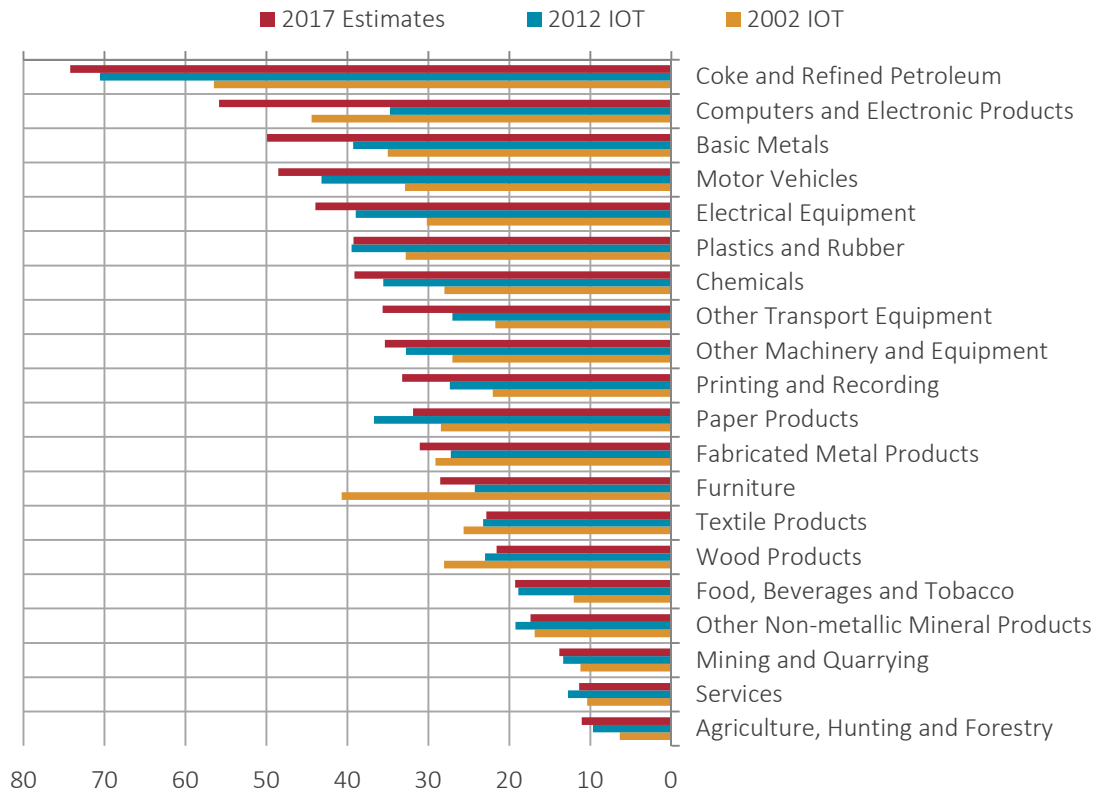


Figure 4.2 provides import requirement ratios by sector from 2002 and 2012 official IOTs, together with 2017 estimates. The figure portrays the degree of heterogeneity among the sectors in terms of the import requirement ratios. The sectors with the highest import requirements are the ones that are characterized by high capital intensity and advanced technology usages such as coke and refined petroleum products, basic metals and motor vehicles. Agriculture, forestry and fishing sector, service sector and mining sector have the lowest import requirements within each sector and at the aggregate level. The lack of official IOTs after 2012 leaves the questions about the current level of import dependency unanswered. Nevertheless, our estimates shed some light on the issue and point out that they have generally gone up as compared to 2012 figures from the official IOT. It is also worth noting that the ordering of only a few sectors did change from 2012 to 2017.

Figure 4.2: Import Requirement Ratios from 2002 and 2012 IOTs and the Estimates for 2017 (By Sector, Percent)



In order to better evaluate how import dependency in each sector has evolved over the fifteen year period, the sectors are separated into three groups with respect to whether their import contents exhibit increasing, decreasing or constant trends. According to our findings, the import content ratio is marked with an increasing trend in 10 out of the 20 sectors. 5 sectors have falling trends while import content ratio remains almost unchanged in the other 5 sectors. Here we present plots of 4 sectors per each category, and the plots of the remaining sectors are given in Appendix B.

Figure 4.3 shows the evolution of the import content of production in the first four sectors that show the highest rise from 2002 to 2017.[12] The amount of increase changes from 14 to 18 percentage points across the sectors. One interesting observation is that these are among the sectors with the highest ratios of import content in the initial year. In other words, these findings indicate that the sectors with the largest import dependency become even more reliant on imported intermediate goods over time. Although the reasons behind this transformation are not within the scope of our paper, it may be informative to briefly touch on some possible explanations. One possible explanation would be that some firms may have started to produce entirely new products, which rely on imported inputs at substantially higher rates than the sectoral average. Or, firms may have upgraded their existing products so that their production required more imported inputs than before. The list of possible factors can easily be extended but it requires a meticulous analysis to figure out the right answer, which may be the subject of another research paper.

Figure 4.3: Sectors Where the Import Content Has a Rising Trend*
(Percent)

* Yellow lines represent linear trends of the series.

[12] Other sectors where the import requirement ratios has a rising trend are chemicals; other transport equipment; printing and recording; food, beverages and tobacco; agriculture, forestry and fishing; mining and quarrying, for which the graphical presentations are provided in Appendix B.

The development of import content is displayed in Figure 4.4 for the sectors with a declining trend.[13] Here, only the four sectors with the biggest fall are presented. Furniture sector experiences the largest decline in import content ratio amounting to roughly 12 percentage points in fifteen years. It is followed by the wood products sector with a drop of 7 percentage points. The decreasing trend is found to be less pronounced in the remaining two sectors. These findings imply that the firms switched from the imported to locally-produced inputs. This might be either because those inputs started to be produced locally as the necessary technology and knowledge are adapted, or because domestically-produced inputs provided cost advantages throughout the period of analysis.

Figure 4.4: Sectors Where the Import Content Has a Declining Trend*
(Percent)

* Yellow lines represent linear trends of the series.

[13] Since we make the classification with respect to their trend movements, the final value of import content may be greater than its starting value in some sectors.

In total, there are 5 sectors in which the import content remains almost constant throughout the entire period when their trends are considered. Figure 4.5 illustrates the time path of import content for four of those sectors. Plastics and rubber products, and computer and electronic products sectors have trends around 40 percent while the trend is placed around 11 and 18 percent in services and other non-metallic products sectors, respectively. The fact that the share of the imported inputs in the total value of production remains almost unchanged in these sectors implies that imported inputs were not replaced with their domestically-produced inputs or vice versa.

Figure 4.5: Sectors Where the Import Content Has a Constant Trend*
(Percent)

* Yellow lines represent linear trends of the series.

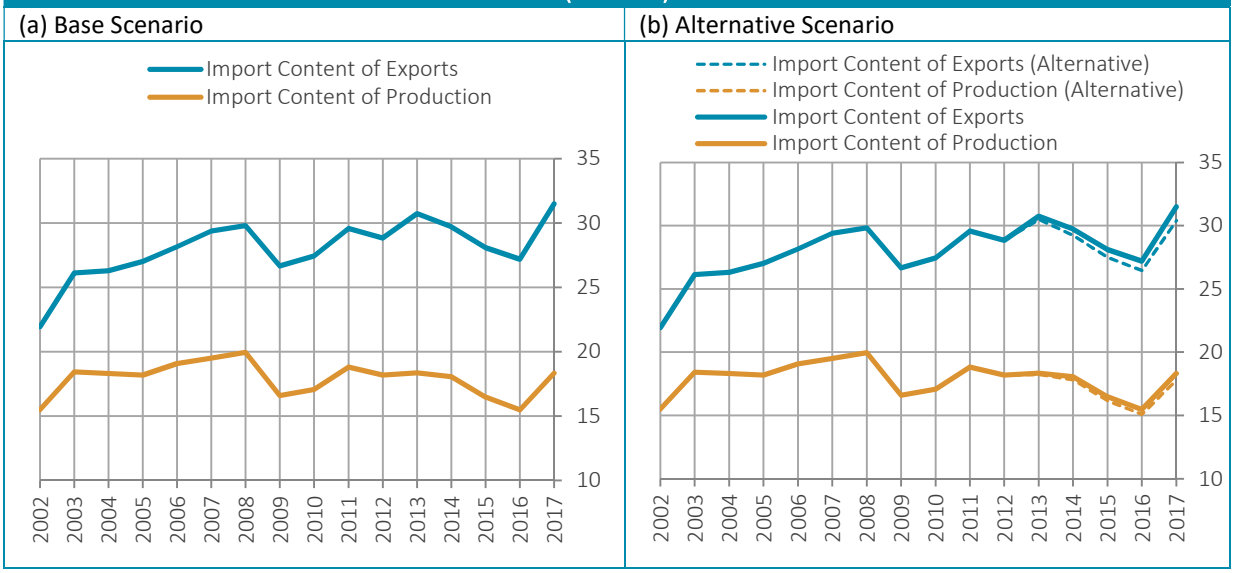
Finally, we calculate the import content of Turkey`s production and exports by using the sectoral import requirement ratios and the corresponding shares of the sectors in total production and exports, respectively. It is worth noting that the share of each sector in production and in exports can be considerably different. To give an idea on the extent of the divergence, the shares of each sector in 2012 is provided in Table 4.1. While the services sector constitutes the highest share in total production, main export sectors are textiles and apparel, basic metal and motor vehicles in the manufacturing industry.

Table 4.1: Sector Shares in Production and Exports in 2012 (Percent)		
Sectors	Production	Exports
Agriculture, forestry and fishing	6,05	3,13
Mining and quarrying	1,11	1,62
Food, beverages and tobacco products	5,86	5,91
Textiles, wearing apparel, leather, and related products	5,15	17,86
Wood and of products of wood and cork, except furniture	0,41	0,38
Paper and paper products	0,63	0,92
Printing and recording services	0,31	0,00
Coke and refined petroleum products	1,48	4,02
Chemicals and chemical products	1,78	4,07
Rubber and plastic products	1,48	3,56
Other non-metallic mineral products	1,73	2,25
Basic metals	4,01	10,55
Fabricated metal products, except machinery and equipment	1,68	3,88
Computer, electronic and optical products	0,40	1,69
Electrical equipment	1,28	5,48
Machinery and equipment n.e.c.	1,19	4,78
Motor vehicles, trailers and semi-trailers	1,85	9,19
Other transport equipment	0,21	0,94
Furniture and other manufactured goods	1,37	2,41
Services (Other Sectors)	62,04	17,35

Figure 4.6 (a) displays our calculations under the base scenario. We estimate the average import content of production and exports as 18.3 and 31.5 respectively during the 2002-2017 period. Our findings reveal that the import content of exports is on average 10 percentage points larger than the import content of production, which reflects both the significant import-content heterogeneity across sectors and different sectoral compositions of exports and total production. The difference can mainly be attributed to the services sector, which has relatively low import content, but a significant share in production. Despite the considerable level difference, the two series exhibit almost the same movement pattern over the period of analysis. For both series, there are periods of ups and downs which mostly overlap. The import content shows gradual ascent before the global financial crisis, then makes a small dip in 2009 and returns to its pre-crisis levels in 2011. Afterwards, it remains almost unchanged until 2014 and sets off a gradual decline which ends with a relatively big upturn in 2017. Nonetheless, the import content of exports increases around 10 percentage points from 2002 to 2017 while the rise remains around 3 percentage points for the production. It seems

that Turkey`s exports are highly concentrated in the sectors where the use of imported inputs is relatively more pervasive during the period of interest. In the case of domestic production, those sectors have relatively smaller shares and their impact is mostly offset by the sectors with declining import usage.

Figure 4.6: Import Content of Domestic Production and Exports
(Percent)



To check the robustness of our main findings, we create an alternative scenario by altering our assumption that the import use ratios and the shares of domestic inputs in the value of production remain unchanged in sectors after 2012. Instead, we assume that the average course of change between the two official input-output tables for those shares and ratios are maintained in the subsequent years. To save space, we refrain from displaying the change in the import content for each sector and comparing them with their benchmark counterparts. Hence, only the aggregate import contents of exports and domestic production are plotted in Figure 4.6 (b) in comparison to our findings from the base scenario. Under the alternative scenario, the resulting paths of the import content for both exports and domestic production exhibit negligible deviations from patterns of change in the base scenario. So, this exercise serves as a robustness check for our main results. Our findings about the gap between import content ratios of exports and domestic production and their temporal movements still remain valid after the alteration of the assumption.

One last point that attracts attention in these results is the hike in import content ratios in 2017. Here, Figure 4.7 provides some explanation. The change in the import content ratios with respect to previous year seems to be closely related to the annual GDP growth rate and the annual percentage change in average Brent oil price. According to Figure 4.7 (a), the import content ratios rise in those years in which the annual GDP growth rate realizes above its medium term average. 2011, 2013 and 2017 are the years that the Turkish economy recorded higher growth rates than its average of 6.8

percent after the global financial crisis. These also correspond to the years that the change in the import content ratio is positive. Therefore, it can be inferred that when the economic activity is considerably high, the need for imported raw materials increases, probably because domestic input suppliers fall short of meeting the excessive demand.

Figure 4.7: Import Content Ratios, GDP and Oil Price
(Change from Previous Year)

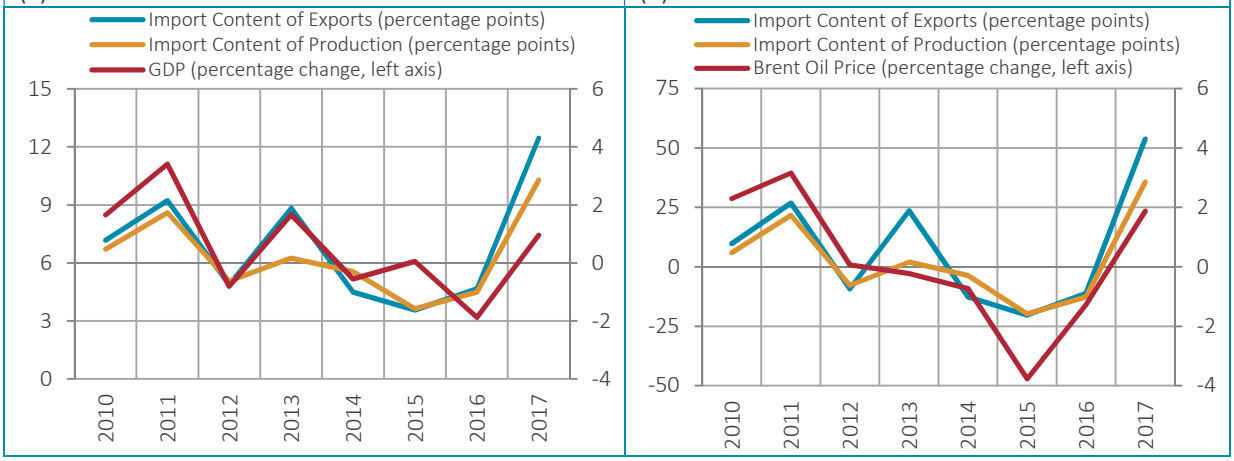


Figure 4.7 (b) suggests that the increase in oil prices is another factor that contribute to the rise in import dependency in the Turkish economy. The rise in the oil and other commodity prices raises the prices of imported raw materials, which in return expands the share of imported inputs in the production value. Oil price increases seem to accentuate the rise in import content ratios, especially when coupled with higher than average GDP growth rates, such as in 2011 and 2017.

5. Conclusion

The degree of import dependency, which has increased at a global scale due to growing integration to global value chains in recent decades, is especially important for developing countries with relatively high current account deficits, such as Turkey. High import requirement ratios are among the structural factors that result in excessive current account deficit during high growth periods and limit external trade gains.

This study explores the evolution of import content of production and exports in Turkey for the 2002-2017 period. Based on the 2002 and 2012 input-output tables, we estimate the values of production and imported input use for 20 sectors in the remaining years by using foreign trade, and industry and services statistics. Import requirement ratios, comprising both direct and indirect linkages, for each sector are calculated using the Leontief inverse matrix. Our findings are broadly in line with former empirical evidence on the import dependency of the Turkish economy. They indicate that the average import content is around 18 percent for production and 31 percent for exports in the examined period. This difference can mainly be attributed to the services sector, which has relatively

low import content, but a large share in production. There exists considerable heterogeneity among sectors in terms of the import content. Sectors with the highest import requirements are found to be those with higher capital and technology intensity such as coke and refined petroleum products, basic metals and motor vehicles. Agriculture, forestry and fishing sector, service sector and mining sector are found to have the lowest import requirements. The import dependency is estimated to increase in exports, but to stay almost the same for production over time. Our results are consistent with the intuition that Turkey`s exports are highly concentrated in the sectors where the use of imported inputs expands during the period of interest. In the case of production, those sectors have relatively smaller shares and their impact is mostly offset by the sectors with declining import usage.

Our analysis contributes to the literature by shedding some new light on how import dependencies in sectors have evolved in the recent period. One key policy implication that can be drawn from this study is that, by implementing structural reforms to increase the local input content of production, the Turkish economy can not only better harness the benefits of foreign trade, but also contribute to financial stability through decreasing the current account deficit and reducing external financing needs in the medium term. In this context, our findings support the importance of implementing structural reforms to reduce import dependency.

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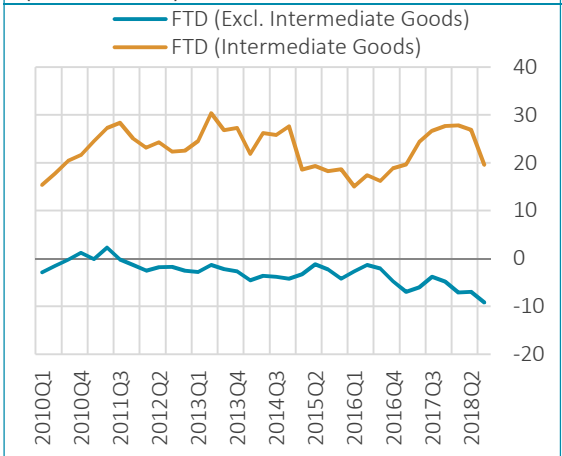
Appendix A

From a macro perspective, the amount of imported inputs is closely linked to the foreign trade deficit which drives the current account deficit of Turkey. Figure A (a) shows the foreign trade deficit of intermediate goods trade and the trade excluding intermediate goods. We observe that import of intermediate goods is the main component of the foreign trade deficit in Turkey. In fact, excluding the intermediate goods, there is an increasing trade surplus.

Figure A: Intermediate Good Imports and Economic Activity

(a) Foreign Trade Deficit
(Billions of USD)



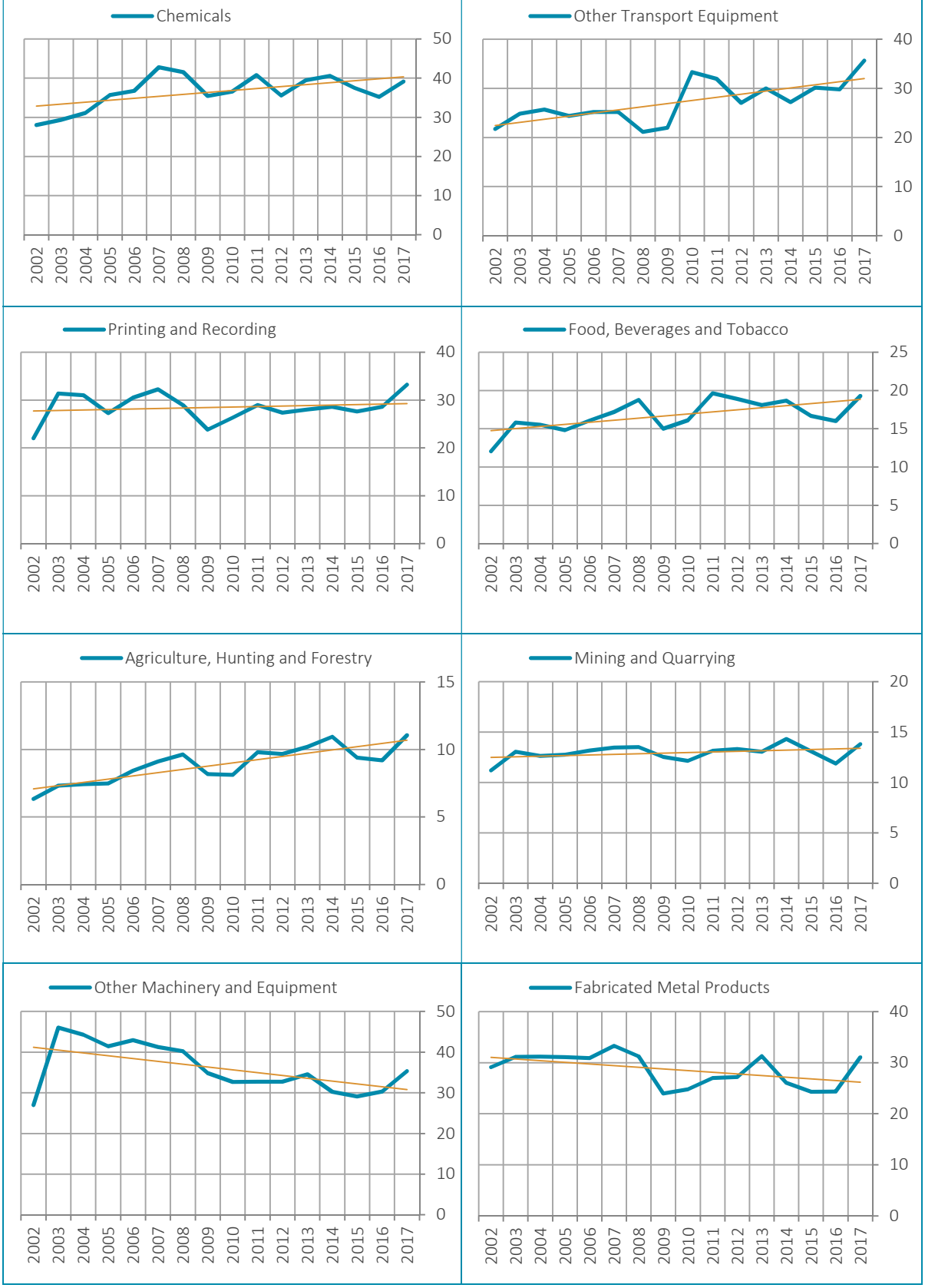
(b) Intermediate Goods Imports and GDP*
(Volume, Deviation from Trend)

Source: TurkStat and authors' calculations.
* The correlation coefficient between two variables in the period is 0.51.

In general, the imports of intermediate goods are directly related to economic activity. Figure A (b) shows imports of intermediate goods and gross domestic product, both in volumes and as deviation from trends. Even though it is not very strong, the correlation coefficient for two series (0.51) indicates a positive relationship between domestic production and imports of intermediate goods. Without making implications regarding the direction of causality, we infer that strong growth outlook of Turkey is related to strong import volumes of intermediate goods. Both its driving characteristic in the current account deficit and its relation to domestic economic activity make it critical to estimate the import content of production in Turkey.

Appendix B

Figure B: Import Content of Remaining Sectors
(Percent)



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