

Current Account Deficit and Automotive Sector Nexus in Turkey: An Input-Output Analysis

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Türkiye’de Otomotiv Sektörü ve Cari İşlemler Açığı İlişkisi: Bir Girdi Çıktı Analizi

Abstract

The automotive sector plays a significant role in the Turkish economy in creating relatively high added value and employment and accelerating the country's global trade share. The sector is so substantial that it has become the leader in Turkish exports in the last decade. There are plenty of papers in the literature regarding the automotive sector and economic growth nexus and implementing various methods. Still, hardly any studies focus merely on the current account deficits the sector generates, incorporating an input-output analysis. This paper examines the automotive sector and current account deficit nexus through input-output analysis. The results highlight that the automotive sector is highly dependent on imports.

Keywords : The Automotive Sector, Current Account Deficit, Input-Output Analysis, Import Dependency, Leakage Coefficients.

JEL Classification Codes : C67, D57, L62.

Öz

Otomotiv sektörü görece yüksek katma değer ve küresel ticarettten aldığı pay ile Türkiye ihracatı açısından büyük önem taşımaktadır. Öyle ki son yıllarda Türkiye ihracatının (%17-18) lokomotifini konumuna ulaşmıştır. Literatürde sektörünün ekonomiye katkısını regresyon ve benzeri analizlerle ortaya koymayı amaçlayan birçok çalışma bulunmaktadır. Ancak sektör üretiminin cari işlemler açığına etkisini girdi çıktı analizi kapsamında değerlendiren az sayıda çalışma bulunduğu gözlemlenmiştir. Bu bağlamda bu çalışmada girdi çıktı analizi kapsamında, sektör üretiminin cari işlemler hesabına etkisinin ortaya konulması amaçlanmıştır. TÜİK tarafından yayınlanan 2012 yılına ait girdi-çıkıtı tablolarından sektöre yönelik sızıntı ve bağlantı katsayıları hesaplanmıştır; sektörün üretim aşamasında ithalata bağımlı olduğu tespit edilmiştir.

Anahtar Sözcükler : Otomotiv Sektörü, Cari İşlemler Açığı, Girdi Çıktı Analizi, İthalat Bağımlılığı, Sızıntı Katsayıları.

1. Introduction

Developing countries, including Turkey, have commenced adopting the export-led growth model for development and sustainable economic growth mainly since 1980. In this respect, production - particularly in sectors that have relatively high comparative advantage- is fostered via various government incentives, mainly for the export drive. The automotive sector (AS hereafter) is one of the sectors under consideration. AS, primarily comprised of multinationals, has an essential place in government budgets with its relatively high value-added structure, contribution to employment and the balance of payments and tax revenue from the sale of products in the sector. Besides, the AS contributes significantly to the countries' economic growth with its relatively high potential that meets the demands of tourism, defence, construction, agriculture, transport, and infrastructure sectors. Moreover, the AS contributes to the economic growth via the huge volume of business it generates in the finance and insurance sectors. The AS is a moderately labour-intensive sector, and relatively low labour costs attract the multinationals¹ to invest in Turkey. What's more, Turkey's integration to Customs Union of the European Union and its strategic position to reach the domestic markets of the European community are the other motivations for the global companies to operate in Turkey. In this regard, these multinationals hold a crucial place for the development of the Turkish economy. Furthermore, the AS has become the leader sector in Turkish exports for more than fifteen years thanks to these multinationals. According to the "Turkey's Top Ten Industrial Enterprises / 2019" report, issued by Istanbul Chamber of Industry, five global companies operating in the AS are located among Turkey's top ten exporter companies.

On the other hand, as stated by the said report, we can see that total export of the companies is approximately 15,5 billion and 15 billion dollars in 2018 and 2019, respectively. Nevertheless, the total import of the companies is almost 11 billion and 10 billion dollars, respectively in the given years. In other words, we can say that these global companies cause 4,5 billion and 5 billion dollars of current account deficit for Turkey.

As well as the AS, production in the manufacturing industry in Turkey has become more dependent on imported intermediate goods to such an extent that the imported intermediate goods constitute approximately 75 percent of Turkey's total imports. Lack of innovation, technology, and capital accumulation are the main reasons for accelerating the volume of imported inputs. Besides, price and quality advantages are the other factors that lead the manufacturing industry to utilizing imported inputs. Consequently, imported inputs dependency has become a structural characteristic of the Turkish economy (Erduman et al., 2019).

High import dependency in production triggers high current account deficits, exposing the economy to fluctuations in exchange rates. High import requirement is among

¹ *The list of multinationals operating in AS can be seen: Home Page - ISO 500 | Türkiye'nin 500 Büyük Sanayi Kuruluşu, <iso500.org.tr>, 16.04.2021.*

the structural factors that bring about current account deficit during high growth periods and decrease the foreign trade incomes (Erduman et al., 2019).

Moreover, high import dependency, by means of increasing the need for foreign financing, puts pressure on the Turkish economy's fragile structure. Subsequently, Turkey's relatively permanent nature of the economic crises has its roots in the production structure of the Turkish economy (Senesen & Senesen, 2003), which is highly dependent on imported inputs. Essentially, high import dependency is not considered a critical phenomenon for a developed economy with a competitive advantage in the global markets. In those developed economies, huge incomes generated from exports can finance the imports. However, as a developing economy, this high dependency on imported intermediate goods induces a less stable pattern for the growth of the economy in the case of Turkey.

In this context, through input-output (I-O hereafter) analysis, this paper sets out to highlight the dependence on imports of the Turkish AS and its interaction with other sectors that provide input. With I-O analysis, linkages between sectors and changes in the economy can be calculated. The I-O analysis began with Leontief (1936), who used *Tableau Economique* first by Quesnay (1894). Leontief created an analytical model that can be applied to any economic system. In addition to Leontief, Rasmussen (1956) and Hirschman (1958) developed the concept of the "key sector" making a significant contribution to I-O analysis. However, examining the literature, we can see that less attention has been paid to the distinction between imported and domestically produced inputs, especially on AS via I-O analysis. In particular, investigating the impact of international trade on the linkages and finding out how it influences an economy's overall interdependence plays an essential role in finding out if higher import dependence may result in lower linkages among domestic production. Smith and Sarabi (2020) provided an analysis of the UK's role in the automotive sector, focusing on the UK's trading relationship within and between regions, in which they found out a high level of integration with Europe and Central Asia. They have also revealed that outside the region, there appears to be a trend towards sourcing inputs from East Asia and Pacific and the Middle East and North Africa acting as an export destination. In their paper investigating the Portuguese sectoral interdependence, Reis and Rua (2009) found out that an increase in the coefficient of interdependence seems to be associated with a decrease of the coefficient of leakage and vice versa. Moreover, they underlined that a sector's multiplier effect is higher when the linkages are more spread out over the economy. Timmer et al., (2015) evaluated the geographical and factorial distribution of value-added in global automotive production and revealed increasing fragmentation, both within and across regions. They also calculated the global value chain income in AS, where they found that Turkey's share is less than 1 percent² of the world. The paper also calculated the regional value-added distribution of the final output of automotive by country of completion. Besides, they also found out that Turkey has a final output of 12,371 million US dollars in 2008 where value-added shares in 2008 are (i) domestic (ii) regional (iii) global are as follows 0,64, 0,20

² 0,64, 0,40, 0,70 and 0,66 in 1995, 2002, 2008 and 2011 respectively.

and 0,16 and change in shares (2008 minus 1995) are as follows -0.17, 0.07 and 0.09 respectively. On the other hand, Ünal (2021) highlighted the trade deficits, whereas İnançlı and Konak (2011) emphasized the high import dependency of AS in Turkey. Besides, there are many papers focusing merely on high import dependency in the Turkish economy by I-O analysis. Among these, Şenesen and Şenesen (2001) revealed the interconnections between the origins and destinations of intermediate input import dependency induced by final demands within the methodology they proposed. Şenesen and Şenesen (2003) also highlighted the high import dependency in Turkey and mentioned the production structure contributing to the relatively permanent nature of economic crises, exerting pressure on foreign exchange availability. Ersungur and Kızıltan (2007) revealed that the high import-dependent structure of the Turkish economy reduces the correlation between the key sectors of the manufacturing sectors rendering the effect of industrialization and production increase inadequate. Analysing the structural changes in exports of an emerging economy, Saygılı and Saygılı (2011) affirmed that structural change in the composition of exports determines the recent changes in parameters of the export equation in Turkey. They also noted that the sectors with high income and imports, but low exchange rate elasticities of exports tended to increase their shares in total Turkish exports.

Within this context, this paper aims to examine the AS and current account deficit nexus through input-output analysis. This paper also seeks to fill the literature gap, primarily focusing on the Turkish AS's imported inputs. For this reason, the linkage coefficients, leakages, power and sensitivity, and key sectors of the Turkish economy from the input-output tables of 2012, published by TURKSTAT³, are calculated. In the second and third parts of the paper, methodology and results are reported. In the third part of the paper, the findings are discussed.

2. Methodology

I-O analysis is a general equilibrium analysis that examines the mutual dependence of the sectors in an economy. For economic planning, the determination of the relation between sectors plays a significant role. In this respect, revealing the relations between the sectors in a specific country's whole economic structure, I-O analysis plays a significant role in economic planning (Küçükkiremitçi, 2013). As an analytical tool, the I-O analysis is utilized by governments when implementing economic policies. The advantage of I-O analysis is that it reveals how changes in the economy affect a specific sector and how changes in one or more sectors affect the entire economy. In this context, it provides the tools to assess structural changes in the economy in terms of linkages between economic sectors. In a free-market economy, the I-O analysis is not concerned with the causes of final demand changes, for these changes are considered "given". Within this framework, since they have been estimated, the I-O analysis will show the activity levels that will have to be met within the endogenous sectors to sustain the final demand level (Miernyk, 2020: 49). While the I-O analysis has been developed within the framework of a market economy, it

³ Sectors are classified by NACE Rev. 2.

has been understood that the analysis could be applied to other types of economic systems (Miernyk, 2020: 49). The I-O analysis represents the economy to be studied in terms of aggregated industrial commodity groups or sectors, particularly in assessing how changes in one or more sectors within an economy will affect the entire economy.

The I-O table is a matrix indicating the input requirements of each sector from other sectors to produce one unit of output. The columns consist of (i) each sector's production factors (inputs from other sectors), (ii) the sum of each sector's output, (iii) the total imports (as final good). Namely, the columns indicate the total supply. Moreover, the rows consist of intermediate usage of other sector's output (as input) and the final demand for that sector (including domestic consumption, inventory changes, and exports). In other words, the rows indicate the total utilization.

The I-O table provides a brief and systematic composition of all economic activities within an economy. It reveals the inter-sectoral flows in monetary terms for a particular period where the flows represent intermediate goods /services. The I-O table traces the transactions between the sectors -inter-sectoral flows in a given period in dollar term. The sectors sell goods and services to other sectors and final users or final demand and buy inputs from other sectors and primary sources (Jensen et al., 2017: 18). A hypothetical and much-simplified transaction table for a 3-sector economy is shown in Table-1. Each row indicates the flows from one sector to other sectors and final demand.

Table: 1
Hypothetical Transaction Table (dollar)

Selling Sectors	Purchasing Sector			Final Demand	Total Output
	1	2	3		
	Quadrant I			Quadrant II	
1	25	20	15	40	100
2	14	6	10	20	50
3	20	12	43	25	100
	Quadrant III			Quadrant IV	
Primary Inputs	41	12	32	12	97
Total Outlet	100	50	100	97	347

Source: Jensen et al., 2017: 18.

Examining the Table-1, we can see that "sector 1" sells 25 dollars of its output operating in the same sector; 20 dollars in "sector 2"; 15 dollars of its output to "sector 3" and 40 dollars to final users. Examining the Table-1, we can also see that the columns reveal the purchasing pattern of each sector. Thus "sector 3" buys 15 dollars of goods/ services from "sector 1"; 10 dollars from "sector 2"; 43 dollars from "sector 3" and 32 dollars of goods / services in the form of primary inputs. Quadrant I is termed the processing or intermediate quadrant, and it reveals the flows of transactions between the sectors, whereas quadrant II reveals the sales of each sector to final demand -namely consumption, investment, government expenditure, and exports (Jensen et al., 2017: 19). Quadrant III - including rows for depreciation, indirect taxes, wages and salaries, gross operating surplus imports, and other value-added items- shows the primary inputs into each sector and mainly

represents the value-added in production. In contrast, quadrant IV reveals primary inputs which are absorbed by final demand. In general, all endogenous sectors of the economy are included within quadrant I, where the transactions table provides a descriptive snapshot / essential information on particular aspects of a particular economy at a point of time (Jensen et al., 2017: 19). The final demand (minus imports) is considered to indicate GNP on the expenditure side.

The I-O analysis began with Leontief (1936), who used "Tableau Economique" first by Quesnay (1894). Leontief created an analytical model that can be applied to any economic system during the growth period and characterized by two simplifying assumptions: (i) a standard classification is used for goods and production units: the "sector classifies the economy" (ii) although sectors may utilize a variety of goods as inputs, their inputs are not mixed. Each sector is identified with the goods that it produces. By definition, a technical coefficient measures the need for some input per unit of some output (Raa, 2006: 14).

According to the I-O analysis, since one sector uses other sectors' output during production, inter-sector transactions play an essential role in the economy. In other words, the output of a sector is an input of the other sector to produce its output. The primary assumption of the I-O analysis is that each sector has a unique output and homogeneous production function. Another basic assumption of the I-O analysis is that there is a linear correlation between the demand of inputs and outputs.

In addition to Leontief, Hirschman (1958), Rasmussen (1956), Chenery and Watanebe (1958) focused on the linkages between the sectors and developed the I-O analysis, in which Rasmussen (1956) and Hirschman (1958) developed the theory of the "key sector" to make a significant contribution to I-O analysis. The most fundamental challenge of the I-O analysis is calculating the necessary output levels of each sector required to achieve a final output (Hewings, 2020: 7).

The transactions table can be represented by series of equation as follows:

$$X_1 = X_{11} + X_{12} + \dots + X_{1n} + Y_1$$

$$X_2 = X_{21} + X_{22} + \dots + X_{2n} + Y_2$$

$$X_n = X_{n1} + X_{n2} + \dots + X_{nm} + Y_n$$

where,

X_i = total output of intermediate sector i (row or column totals)

X_{ij} = output of sector i purchased by sector j (elements of quadrant I)

Y_i = total final demand for the output of sector i

Dividing the elements of the columns of the transactions table by the respective column totals, we derive coefficients representing plainly the purchasing form of each

sector. These coefficients are named "direct" or "input- output" coefficients (Lind, 2014). They are notated as a_{ij} and represent the direct requirement / inputs from each sector i following an increase in unit output of any sector j (Lind, 2014).

This can be shown in matrix as follows.

$$X = AX + Y$$

$$n \times 1 \quad n \times n \quad n \times 1 \quad n \times 1$$

where $A=[a_{ij}]$, the matrix of input- output coefficients

by transposition we obtain

$$X = (1-A)^{-1} Y$$

By solving the above system, we derive the general solution:

$$X = (1-A)^{-1} Y$$

$(1-A)^{-1}$ is termed as Leontief inverse matrix.

Linkage Coefficients

The direct backward linkage coefficient (DBLC) reveals the sum of a sector's intermediate inputs requirement during the production phase. In other words, DBLC indicates the ratio of a sector's input requirement during production. If the production increase in the sector with a high coefficient (X), this increase raises other sectors' production providing inputs (Y, Z)⁴, and the sectors with high DBLC positively affect the level of production of other sectors. In this context, these sectors can also be defined as locomotive sectors within an economy. The direct forward linkage coefficient (DFLC) is the ratio of the total intermediate sales of one sector to other sectors (total sales of the sector for using other sectors as intermediate goods) to the sector's total production. According to Hirschman (1958: 102), the size of the DFLC informs about the characteristic of each sector. If the DFLC of the sector is relatively high, we can say that the sector's input is utilized as raw material or intermediate goods. If the DFLC of the sector is relatively low, we can consider the related sector as a final goods.

Calculations of DBLC in Equation 1 and DLFC 1 in Equation 2 keep up with Chenery and Watanabe (1958) method as follows:

$$DBLC_i = \sum_{i=1}^n \frac{x_{ij}}{x_j} = \sum_{i=1}^n a_{ij} \quad (1)$$

$$DLFC_j = \sum_{j=1}^n \frac{x_{ij}}{x_i} = \sum_{j=1}^n b_{ij} \quad (2)$$

⁴ If X production increases $\Rightarrow Y, Z$ production also increases, since X uses Y & Z during production.

The total increase in production in the economy caused by a 1 unit increase in demand in a particular sector is the total backward linkage coefficient (TBLC). The sum of the Leontief inverse matrix columns reveals the TBLC (Miller & Blair, 2009: 557). On the other hand, TBLC also reveals the production multiplier. In this sense, TBLC refers to the total increase in production in the economy triggered by demand change. The increase in the production of a particular sector by increasing the one-unit increase in all sectors is defined as the total forward linkage coefficient (TFLC). With TFLC, when there is an increase in one-unit demand for all sectors' final products in the economy, the increase in each sector's production is calculated. Rasmussen (1956) adds another methodology to use the column (or row) sums of the Leontief inverse (L), which can be calculated with $L = (I - A)^{-1}$ in where A is I-O table, to calculate inter-sectoral linkages. TBLC in Equation 3 and TLFC 2 in Equation 4 referring to L are calculated as below:

$$TBLC_i^L = \sum_{j=1}^n g_{ij} \quad (3)$$

$$TFLC_j^L = \sum_{i=1}^n z_{ij} \quad (4)$$

Within an open economy, imported goods are used not only as final goods but also as input. Therefore, increase in production generates an increase in imports, which is called "economic leakage" (Guo & Planting, 2001). Generally, the I-O table's intermediate transactions are made of the sector's consumption of goods and services regardless of the origin, whether foreign or domestic (Guo and Planting, 2001:8). Within the I-O analysis, the economic leakages are forecasted by separate tables: (i) merely domestic inputs and (ii) merely of imports (Guo & Planting, 2001: 9).

According to Hirschman, a key sector is the one which has a high forward as well as backward linkage coefficient (Hazari, 1970: 302). On the other hand, key sectors are mainly determined using Rasmussen's power and sensitivity index (Rasmussen, 1957). These are calculated respectively as the average ratio of the sector's DBLC to the average ratio of the DBLC of the economy and the average ratio of the sector's sales to the average economic sales ratio.

Leakage in Equation 8 coefficients that indicate the import dependency of a sector are also calculated below, where A_m denotes Import I-O Table, A_d is domestic I-O Table, Y_d is the final demand of certain sector for Turkey:

$$X_i = (I - A_d)^{-1} Y_{id} \quad (5)$$

$$A_m X_i = A_m (I - A_d)^{-1} Y_{id} \quad (6)$$

$$M_i = A_m (I - A_d)^{-1} Y_{id} \quad (7)$$

$$LI = A_m (I - A_d)^{-1} \quad (8)$$

$$Leakage_i^{LI} = \sum_{j=1}^n l_{ij} \quad (9)$$

The interaction of the sectors with other sectors and their dependence on imports was calculated by using I-O tables issued by TURKSTAT 3 for 2012.

To classify a sector by considering its power (P) in Equation 10 and sensitivity (S) in Equation 11 coefficients, followings are calculated:

$$P_j = \frac{\frac{1}{n}g_{ij}}{\frac{1}{n^2}\sum_{i=1}^n g_{ij}} \quad (10)$$

$$S_i = \frac{\frac{1}{n}z_{ij}}{\frac{1}{n^2}\sum_{j=1}^n z_{ij}} \quad (11)$$

Then each sector is classified if it has $P_j > 1$ and $S_i > 1$, it is classified as key sector. If it has $P_j > 1$ and $S_i < 1$, then is called backward linkage dependent. Alternatively, if it has $P_j < 1$ and $S_i > 1$, forward linkage dependent. Lastly, if it satisfies $P_j < 1$ and $S_i < 1$, is classified as independent.

3. Results

The linkage coefficients, leakages, power and sensitivity, and key sectors of the Turkish economy are calculated from the input-output tables of 2012. The data obtained from TURKSTAT's I-O tables⁵. We can see the (i) original I-O tables, (ii) import I-O tables, and (iii) the domestic import I-O tables, within the tables at basic prices. The tables mainly cover 64 sectors, and each of the I-O Tables assess them together based on these sectors.

DBLC is calculated by the sum of intermediate inputs used from other sectors within the production of AS. The calculations - also shown in Table 7 in appendix- reveal that the DBLC of AS - which has ranked relatively higher⁶ among 64 sectors - is "0,4962". In other words, the AS uses almost 50 units of input from other sectors in its 100-unit production. So, it is appropriate to remark that, due to the relatively high DBLC of AS, a rise in production in AS increases the total production in the economy, respectively. However, it is not correct to state that a sector with a high DBLC affects the production of many sectors. In other words, the critical point to be determined is how many sectors are triggered by an increase in AS production. So, at this point, it is worth determining which sectors' production specifically goes up due to the increase in AS's production. Therefore, the partial DBLCs of AS are calculated. As a result, it has been observed that AS -with the highest coefficient of "0,1671"- mostly uses inputs from its own sector during production. *Basic metals* (with "0,0871") and *machinery and equipment* (with "0,0350") follow AS, respectively (Table-2). Therefore, we can reveal that the AS does not have a production structure that affects many sectors. During the production of 100 units of output, most inputs used are from its (own) sector (approximately 17 percent). The other sectors are as follows: the *basic metals* (approximately 9 percent), and *machinery and equipment* (approximately 4

⁵ <http://www.tuik.gov.tr/PreTablo.do?alt_id=1021>.

⁶ Twenty -first among 64 sectors.

percent), *wholesale and retail trade and repair services of motor vehicle* (approximately 3 percent) and *wholesale trade services, except motor vehicles and motorcycles* (approximately 3 percent).

Table: 2
The Partial DBLCs of AS

Sector	Coefficient
Motor vehicles, trailers and semi-trailers (AS)	0,1671
Basic metals	0,0871
Machinery and Equipment	0,0350
Wholesale and retail trade and repair services of motor vehicle	0,0293
Wholesale trade services, except motor vehicles and motorcycles	0,0269

Source: Author's own elaboration.

Besides, the DFLC⁷ of the AS is "0,2854", ranked thirty- second out of 64 sectors (Table 7). In other words, we can reveal that the AS's output is mostly used as a "final good." However, in order to determine the sectors that utilize AS as input, we calculated the partial DFL coefficients of the AS. The results of the calculations reveal that the AS is ranked first with the value of "0,1671"; wholesale and retail trade and repair services of motor vehicles and motorcycles is ranked second with the value of "0,0851" and machinery and equipment is ranked third out of 64 sectors with the value of "0,0126" (Table 3).The subsequent sectors are as follows: land transport services, and transport services via pipelines and other transport equipment. Namely, the sectors shown in Table 3 are the ones that primarily use AS as input.

Table: 3
The Partial DFLCs of AS

Sector	Coefficient
Motor vehicles, trailers and semi-trailers (AS)	0,1671
Wholesale and retail trade and repair services of motor vehicles and motorcycles	0,0851
Machinery and Equipment	0,0126
Land transport services and transport services via pipelines	0,0054
Other transport equipment	0,0045

Source: Author's own elaboration.

On the other hand, the calculations in Table 7 reveal that the TBLC of AS ranked eighteenth among 64 sectors with a value of "1.9061". In other words, when the final demand for AS increases by 1-unit, total production in the economy increases by approximately 2 units. The relatively high TBLC indicates that AS has a critical position to trigger the economy's production capacity and value chain. Besides, to determine which sectors compose "1.9061" units increase⁸, the partial TBLCs have been calculated. It has been seen that when the final demand for AS increases by 1-unit, total production increase occurs mostly AS's production -with the highest coefficient of "1.2057". Besides *basic metals* (with "0.1450") and *land transport services and transport services via pipelines* (with "0.0484") follow AS, respectively (Table 4). Thus, it is understood that after AS the highest production

⁷ Revealing information about the qualification of the sector's output.

⁸ Which sectors were mostly affected due to production increase in AS.

increase occurs in the basic metals and *land transport services and transport services via pipelines*. The subsequent sectors are as follows: *machinery and equipment and wholesale trade services, except of motor vehicles and motorcycles*.

Table: 4
The Partial TBLCs of AS

Sector	Coefficient
Motor vehicles, trailers, and semi-trailers (AS)	1,2057
Basic metals	0,1450
Land transport services and transport services via pipelines	0,0484
Machinery and Equipment	0,0462
Wholesale trade services, except of motor vehicles and motorcycles	0,0446

Source: Author's own elaboration.

Additionally, the calculations reveal that TFLC ranked thirty-fifth among 64 sectors with a value of "1.4167". Accordingly, when the final demand for whole sectors of the economy increase one unit, AS production will increase by "1.4167" units. This "1.4167" unit increase is composed of increased AS production due to an increase in final demand (in all sectors) and total production increase in the AS to meet demand in other sectors. As a result of the calculation, we see that "1.2057" of the "1.4167" units, which is the total production increase of the AS, is due to the sector's (own) demand. The distribution of other coefficients making up "1.4167" is as follows: *wholesale and retail trade and repair services of motor vehicles and motorcycles* (0,1068) and *machinery and equipment* (0,0170) (Table 5). The subsequent sectors are as follows: *land transport services and transport services via pipelines* and *other transport equipment*.

Table: 5
The Partial TFLCs of AS

Sector	Coefficient
Motor vehicles, trailers and semi-trailers (AS)	1,2057
Wholesale and retail trade and repair services of motor vehicles and motorcycles	0,1068
Machinery and Equipment	0,0170
Land transport services and transport services via pipelines	0,0107
Other transport equipment	0,0066

Source: Author's own elaboration.

Leakages

On the other hand, leakage represents the increase in imported inputs due to the increase in production. Examining the leakages, we understood that AS is ranked fifth with the value of (0,3185) among 64 of all Turkish economy sectors. TBLC of AS is "1.9062", the increase in AS production causes an increase in import due to the import dependency of AS. Besides, due to the imported inputs used in production by the sectors providing input to AS, the increase in production of AS causes a "0,3185" increase in imported inputs. In other words, when the production for AS increases by "1.9062" due to the increase in final demand and this causes an increase in the import of the intermediate goods and raw materials worth of "0,3185". So, we calculated the coefficients to find out the sectors that make up the import increase of "0,3185", due to the increase in AS's production. As a result, we see that AS

with the highest coefficient of "0,2302" mostly uses imported inputs from its own sector during production. Basic metals (with "0,0304") and rubber and plastic products (with "0,0087") follow AS, respectively. The subsequent sectors are as follows: electricity, gas, steam and air conditioning and *machinery and equipment*. Therefore, we can conclude that the 1.9062 unit of increase in AS production causes "0,3185" leakages (Table 6) which is highly dependent on imported inputs.

Table: 6
Leakage of AS

Sector	Coefficient
Motor vehicles, trailers and semi-trailers (AS)	0,2302
Basic metals	0,0304
Rubber and plastic products	0,0087
Electricity, gas, steam, and air conditioning	0,0071
Machinery and equipment	0,0047

Source: Author's own elaboration.

On the other hand, according to leakage coefficients (Rasmussen categories), it has been understood that AS is "BL dependent". We also calculated power coefficients to determine the effect of the sectors. According to the power coefficient (normalized total backward linkage) of AS, other sectors will produce approximately 1.1 times higher than their current level if the final demand for it increases. Similarly, given the sensitivity that the economy rises to 1 unit, AS's demand will increase by 0,8 times.

4. Conclusion

High import dependency, which increases the need for foreign financing, puts pressure on the Turkish economy's fragile structure. Subsequently, Turkey's relatively permanent structure of the economic crises has its roots in the production framework of the economy, which is highly dependent on intermediate imported goods.

This paper aims to examine the automotive sector and current account deficit nexus through input-output analysis. Evaluating the linkage and leakage, we see that the sector generates leakage and current account deficit, underlining the sector's high import dependency.

The automotive sector plays a significant role in the Turkish economy in creating relatively high added value and employment and accelerating global trade share. The sector has become the leader in Turkish exports in the last decade, thanks to the global companies invested in Turkey. According to the "Turkey's Top Ten Industrial Enterprises / 2019" report, issued by Istanbul Chamber of Industry, five global companies operating in the sector are located among Turkey's top ten exporter companies. Examining the foreign trade figures of these leader exporters, we see that total export of the companies is approximately 15,5 billion dollars, while total import is approximately 11 billion dollars in 2018. They generated 4,5 billion dollars of foreign trade deficit in 2018. Likewise, 2018, the foreign trade deficit increased to 5 billion dollars, while the total export of companies was approximately 15

billion dollars and total import is approximately 10 billion dollars in 2019. In other words, they increase not only the export but also the import volume.

The calculations from the input-output tables of 2012 indicate that the automotive sector uses almost 50 units of input from other sectors in its 100-unit production. Due to the relatively high direct backward linkage coefficient, one unit increase in production in the sector increases the total production in the economy. During the production of 100 units of output, most inputs are from its own sector (mainly automobile motors and spare parts, which is approximately 17 percent). The other sectors are as follows: (i) the basic metals (approximately 9 percent), and (ii) machinery and equipment (approximately 4 percent).

Taking the direct forward linkage coefficient into account, we see that the automotive sector's output is a "final good" in the economy. Calculating the sectors that mainly utilize the automotive sector as input are as follows: (i) its own sector, (ii) wholesale and retail trade and repair services of motor vehicles and motorcycles and (iii) machinery and equipment.

Taking the total backward linkage coefficient into account, we see that when the final demand for the automotive sector increases by 1-unit, total production in the economy increases by approximately 2 units. In other words, the automotive sector has a significant potential to trigger the production capacity of economy and value chain. When the final demand for the automotive sector increases by 1-unit, total production increase occurs mainly in its own production sector, where (i) basic metals and (ii) land transport services and transport services via pipelines follow, respectively.

When the final demand for the whole sectors of the economy increase 1 unit, the automotive sector production will increase by approximately 1,5 units, which is mainly due to the sector's (own) demand. The subsequent sectors are as follows: (i) wholesale and retail trade and repair services of motor vehicles and motorcycles and (ii) machinery and equipment.

Examining the leakages, we see that the automotive sector is ranked fifth among all sectors. In other words, the increase in the automotive sector production causes an increase in imports due to the import dependency of the sector. Putting it another way, when the production in the automotive sector increases by approximately 100 units, this increase causes an increase in the import of the intermediate goods and raw materials of 20 units. The sectors that make up the import increase are as follows (i.) its own sector (ii) basic metals, (iii) rubber and plastic products (iv) electricity, gas, steam and air conditioning and (v) machinery and equipment.

Import dependence on production factors creates adverse conditions for economic growth, especially for the developing countries. In this context transforming the automotive sector into a technologically competitive one will support the growth of the economy. The imported inputs (mainly the automobile motors and spare parts) need to be motivated to be produced domestically via different government incentives. In other words, along with the

incentives addressed solely to the automotive sector, deploying the said incentives to the input providers will create a robust automotive sector inducing a stable pattern for the economy's growth. Thus, the added value created will remain in Turkey, supporting the current account deficit, and the targeted production increase will be realized.

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Appendix

Table: 7
I-O analysis of Turkey

Sector	DBLC	DFLC	TBLC	TFLC	Leakage	Power	Sensitivity	Classification
1	0.3271	0.6124	1.5381	2.1793	0.0994	0.9087	1.2875	FL* Dependent
2	0.1398	0.1327	1.2350	1.2067	0.0356	0.7296	0.7129	Independent
3	0.2285	0.0316	1.4015	1.0385	0.0761	0.8279	0.6135	Independent
4	0.1147	1.0067	1.1912	3.9273	0.0440	0.7037	2.3202	FL Dependent
5	0.6575	0.5929	2.1374	1.9575	0.1933	1.2627	1.1564	Key Sector
6	0.5888	0.6195	2.1359	2.0677	0.2303	1.2619	1.2216	Key Sector
7	0.5203	0.3443	1.8857	1.4945	0.2039	1.1140	0.8829	BL* Dependent
8	0.5005	0.6834	1.8844	2.2120	0.3178	1.1132	1.3068	Key Sector
9	0.6013	0.4757	2.0915	1.7000	0.3188	1.2356	1.0043	Key Sector
10	0.4380	1.0436	1.5422	2.7754	0.3933	0.9111	1.6396	FL Dependent
11	0.3150	1.2259	1.4958	3.4050	0.2118	0.8837	2.0116	FL Dependent
12	0.3056	0.1729	1.4971	1.2087	0.1622	0.8845	0.7140	Independent
13	0.5892	0.4716	1.9977	1.8096	0.3776	1.1802	1.0690	Key Sector
14	0.5746	0.3818	1.9725	1.6729	0.1955	1.1653	0.9883	BL Dependent
15	0.5300	1.1612	1.8752	2.9787	0.3115	1.1078	1.7597	Key Sector
16	0.5098	0.3430	1.9368	1.5422	0.2540	1.1442	0.9111	BL Dependent
17	0.2047	0.2732	1.3245	1.3825	0.1235	0.7825	0.8167	Independent
18	0.5236	0.3857	1.9470	1.5776	0.2952	1.1502	0.9320	BL Dependent
19	0.3171	0.2361	1.5686	1.3409	0.1774	0.9267	0.7922	Independent
20	0.4962	0.2854	1.9062	1.4168	0.3185	1.1261	0.8370	BL Dependent
21	0.2345	0.0913	1.4033	1.1154	0.1224	0.8290	0.6590	Independent
22	0.5186	0.1920	1.9504	1.2325	0.2195	1.1523	0.7281	BL Dependent
23	0.4524	0.2385	1.7919	1.3672	0.2164	1.0586	0.8077	BL Dependent
24	0.7816	1.2543	2.7032	4.3601	0.4790	1.5970	2.5758	Key Sector
25	0.3273	0.0947	1.6985	1.1369	0.1217	1.0035	0.6717	BL Dependent
26	0.2701	0.3412	1.4365	1.8367	0.1158	0.8486	1.0851	FL Dependent
27	0.6047	0.6457	2.1397	2.0222	0.1917	1.2641	1.1946	Key Sector
28	0.4177	0.2818	1.7393	1.4676	0.1623	1.0275	0.8670	BL Dependent
29	0.3919	1.1061	1.6780	2.8149	0.0944	0.9913	1.6630	FL Dependent
30	0.3477	0.3564	1.5915	1.5872	0.0834	0.9402	0.9377	Independent
31	0.4478	1.2172	1.7549	3.3346	0.1651	1.0367	1.9700	Key Sector
32	0.4930	0.2680	1.8101	1.4675	0.1639	1.0694	0.8670	BL Dependent
33	0.5832	0.1967	1.9634	1.2513	0.2932	1.1599	0.7393	BL Dependent
34	0.3602	0.6667	1.5943	2.1420	0.0921	0.9418	1.2654	FL Dependent
35	0.4509	0.1662	1.7460	1.2496	0.1113	1.0315	0.7382	BL Dependent
36	0.4594	0.5088	1.8707	1.6762	0.1244	1.1052	0.9902	BL Dependent
37	0.4158	0.1650	1.7895	1.2737	0.1357	1.0572	0.7525	BL Dependent
38	0.4955	0.5467	1.9516	2.0974	0.1547	1.1530	1.2391	Key Sector
39	0.3894	0.3601	1.6719	1.5528	0.0637	0.9877	0.9174	Independent
40	0.1825	0.3252	1.3055	1.4934	0.0359	0.7712	0.8823	Independent
41	0.2884	0.6918	1.4632	2.1922	0.0411	0.8644	1.2951	FL Dependent
42	0.6330	0.2736	2.0644	1.4161	0.1601	1.2196	0.8366	BL Dependent
43	0.2883	0.3234	1.4760	1.4724	0.0506	0.8720	0.8699	Independent
44	0.1791	1.0137	1.3167	2.6025	0.0638	0.7779	1.5375	FL Dependent
45	0.0000	0.0000	1.0000	1.0000	0.0000	0.5908	0.5908	Independent
46	0.2331	0.5783	1.3908	1.9007	0.0516	0.8217	1.1229	FL Dependent
47	0.3798	0.2359	1.6571	1.3484	0.0839	0.9790	0.7966	Independent
48	0.1503	0.0000	1.2603	1.0000	0.0485	0.7446	0.5908	Independent
49	0.6561	0.5979	2.3431	2.0285	0.1522	1.3843	1.1984	Key Sector
50	0.5006	0.2147	1.8630	1.2932	0.1536	1.1006	0.7640	BL Dependent
51	0.2123	0.2650	1.3536	1.4181	0.0674	0.7997	0.8378	Independent
52	0.1883	0.0567	1.3187	1.0833	0.0348	0.7790	0.6400	Independent
53	0.6133	0.1024	2.1589	1.1248	0.1754	1.2754	0.6645	BL Dependent
54	0.2310	0.8189	1.3808	2.2143	0.0704	0.8157	1.3081	FL Dependent
55	0.3463	0.0783	1.6067	1.1123	0.0966	0.9492	0.6571	Independent
56	0.1542	0.0836	1.2752	1.1156	0.0386	0.7533	0.6591	Independent
57	0.4142	0.0720	1.6978	1.0788	0.1173	1.0030	0.6373	BL Dependent
58	0.3567	0.0000	1.6288	1.0000	0.0967	0.9622	0.5908	Independent
59	0.2761	0.1203	1.5124	1.1625	0.0463	0.8935	0.6868	Independent
60	0.5123	0.1075	2.0020	1.1597	0.1254	1.1827	0.6851	BL Dependent
61	0.3483	0.1159	1.7125	1.1522	0.0856	1.0117	0.6807	BL Dependent
62	0.4233	0.0430	1.7444	1.0638	0.1814	1.0305	0.6285	BL Dependent
63	0.5374	0.0157	1.9516	1.0199	0.1800	1.1529	0.6025	BL Dependent
64	0.0000	0.0000	1.0000	1.0000	0.0000	0.5908	0.5908	Independent

* BL: Backward Linkage, FL: Forward Linkage.

20: Motor vehicles, trailers and semi-trailers.

Sector codes, NACE Rev. 2 sections seq no and Description can be seen: [L_2010210EN.01000101.xml](#) (europa.eu)

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