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A Structural Decomposition Analysis (SDA) of the Turkish Economy and Structural Change Between 2003 and 2019

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Türkiye Ekonomisinin Yapısal Ayrıştırma Analizi (SDA) ve 2003-2019 Arasındaki Yapısal Değişim

Abstract

This study investigates the structural dynamics of Türkiye's economic growth from 2003 to 2019 using Structural Decomposition Analysis (SDA) and Input-Output methods. Findings show that growth was primarily driven by final demand (105.96%), with limited contributions from value-added production (1.23%) and a negative impact from structural change (-7.19%). Sectoral analysis reveals weak performance in high-tech sectors and a reliance on imports over exports. Results highlight the need for more profound structural transformation to support sustainable growth and escape the middle-income trap.

Keywords : Economic Growth, Growth Quality, IO Table, Structural Change.

JEL Classification Codes : O11, O14.

Öz

Bu çalışma, 2003-2019 döneminde Türkiye ekonomisinin yapısal dinamiklerini Girdi-Çıktı (Input-Output) yöntemleri ve Yapısal Ayrıştırma Analizi (SDA) kullanarak incelemektedir. Bulgular, ekonomik büyümenin büyük ölçüde nihai talepten (%105,96) kaynaklandığını; katma değer üretiminin (%1,23) sınırlı katkı sağladığını ve yapısal değişimin (%-7,19) olumsuz etkide bulunduğunu göstermektedir. Sektörel analiz, yüksek teknoloji sektörlerinin zayıf performansını ve ihracat yerine ithalata dayalı bir büyüme yapısını ortaya koymaktadır. Sonuçlar, sürdürülebilir büyüme ve orta gelir tuzağından çıkış için daha derin bir yapısal dönüşüme ihtiyaç duyulduğunu vurgulamaktadır.

Anahtar Sözcükler : Ekonomik Büyüme, Büyüme Kalitesi, IO Tablosu, Yapısal Değişim.

1. Introduction

While economic growth remains a central objective for developing countries, the quality and structure of that growth are equally crucial for achieving sustainable development. Growth that is merely quantitative may conceal underlying weaknesses in production capacity, technological progress, and sectoral resilience. In contrast, structural change - the reallocation of economic activity across sectors toward higher productivity and value-added industries- plays a pivotal role in sustaining long-term development and advancing toward high-income status.

Analysing the composition of economic growth through structural decomposition methods provides valuable insights into the sources of growth. It allows policymakers to distinguish between expansion driven by mere demand-side dynamics and growth rooted in real productivity or transformative change. In this sense, decomposition analysis is a methodological tool and a strategic framework for identifying bottlenecks and guiding structural reforms, particularly important for countries striving to escape the middle-income trap.

In Türkiye, the period following 2002 marked a notable political and economic transformation, frequently described as a turning point in the country's development trajectory. While macroeconomic indicators during the early 2000s showed remarkable improvement, especially in the 2008 global financial crisis, debates persist over this growth's sustainability and structural foundations. A growing body of literature suggests that despite gains in GDP, limited progress in high-technology production, export sophistication, and sectoral upgrading undermined the long-term transformative potential of this period.

This study is motivated by the growing need to unpack the nature of Türkiye's post-2002 growth path, especially considering persistent vulnerabilities such as external imbalances, productivity stagnation, and structural rigidities. While headline GDP figures may suggest a success story, there remains a critical gap in understanding whether this growth has translated into genuine structural advancement. Addressing this gap is essential not only for academic discourse but also for informing effective policy responses aimed at ensuring long-term economic resilience.

Despite the extensive literature on Türkiye's economic growth, there remains a lack of in-depth empirical investigation into the underlying structural factors shaping this trajectory, particularly using a formal Structural Decomposition Analysis (SDA) framework. Most existing studies emphasise macroeconomic indicators or policy narratives without systematically quantifying the contributions of final demand, value added, and input-output linkages to growth. Furthermore, relatively few papers apply SDA in the context of developing economies grappling with structural transformation and external vulnerabilities. This study fills this gap by offering a granular, component-level assessment of the drivers of growth in Türkiye between 2003 and 2019, helping to clarify whether observed expansion was rooted in internal transformation or driven by external, possibly unsustainable, factors.

A critical question, therefore, is whether Türkiye’s economic success post-2002 stemmed from deliberate, sustainable institutional reforms or was primarily a consequence of favourable external conditions, notably, the global liquidity surge and accommodative monetary policies in advanced economies like the United States. Disentangling these drivers is essential to understanding the country’s development path and addressing vulnerabilities that may hinder progress beyond middle-income status.

This study contributes to the ongoing debate on the quality of economic growth by examining the structural dynamics of Türkiye’s economic performance between 2003 and 2019. Employing Structural Decomposition Analysis (SDA) alongside sectoral share analysis, the research investigates whether Türkiye’s economic expansion during this period was underpinned by meaningful internal transformation or primarily driven by external demand and macro-financial conditions. The article is structured as follows: The first section introduces the concept of structural change and its central role in long-term economic development, providing background on Türkiye’s production structure. The methodology section outlines the technical framework and formalisation of the Input-Output (IO) analysis. The results are presented in linkage analysis and decomposition outcomes to enhance clarity and readability. Finally, the conclusion offers a macroeconomic interpretation of the findings and proposes policy recommendations to support structural transformation and sustainable growth.

2. Structural Change

Structural change is generally defined as a sustainable and long-term transformation of an economy's internal components. More specifically, it refers to a systematic shift in sectors and production systems that increases aggregate output and contributes to sustainable economic growth (Kruger, 2008: 330). Kuznets (1973) reinforces this definition by arguing that structural change is typically driven by technological progress in the production sector, which leads to increased productivity. Such progress also confers a comparative advantage for countries sustaining structural change.

Swiecki (2017) views structural change as one of the most defining features of economic development. In his model, four key channels facilitate this transformation:

- *Sector-biased technological progress*: This occurs when resources and consumption shift toward sectors with slower productivity growth, due to complementarities in consumer preferences across sectors.
- *Non-homothetic preferences*: As incomes rise, consumer demand tends to favour services over agricultural goods. This elasticity in preferences drives resource reallocation, encouraging structural evolution.
- *International trade*: Open and liberalised markets can accelerate structural change. Comparative advantages, particularly in labour-intensive sectors, allow economies to realign production toward more dynamic sectors.

- *Relative labour costs across sectors*: Swiecki assumes homogeneous labour as the sole production factor, highlighting that discrepancies in effective labour costs across sectors can distort resource allocation and affect sectoral shifts.

From this model, Swiecki (2017) concludes that sectoral technological change is one of the strongest drivers of structural transformation, which also influences the other three channels. However, the remaining factors are crucial for sustaining long-term structural progress.

In the empirical literature, value-added production is often used as a proxy to measure structural change. Although structural change and value added are distinct concepts, they are closely related. Improvements in production technology and sectoral shifts are usually associated with increased value added (Enongene, 2024: 327). Productivity gains and technological progress are therefore fundamental to any meaningful structural transformation.

Promoting technology-intensive industries and upgrading traditional sectors are fundamental strategies for sustainable growth in developing countries. Structural change must be supported by coherent industrial policies, targeted investment in innovation, human capital development, and infrastructure - all of which can help increase productivity and expand forward and backward linkages within the economy. Moreover, a critical sign of structural change is the reallocation of resources from labour-intensive to capital-intensive sectors, signalling technological upgrading and productivity enhancement. This transition typically accompanies broader economic development, as economies move toward more sophisticated and higher-value production systems. Figure 1 below shows the production shift within three basic sectoral classifications, agriculture, manufacturing and services, in Türkiye between 2003 and 2019.

Figure: 1
Sectoral Production of Türkiye Between 2003-2019

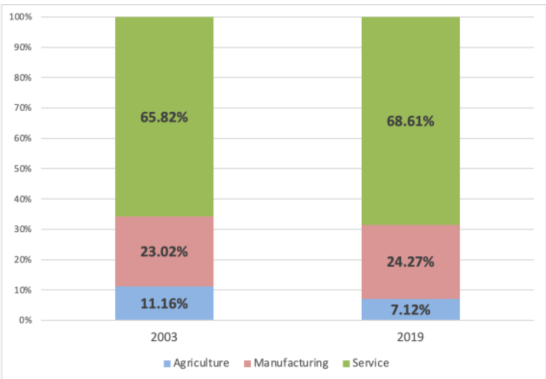
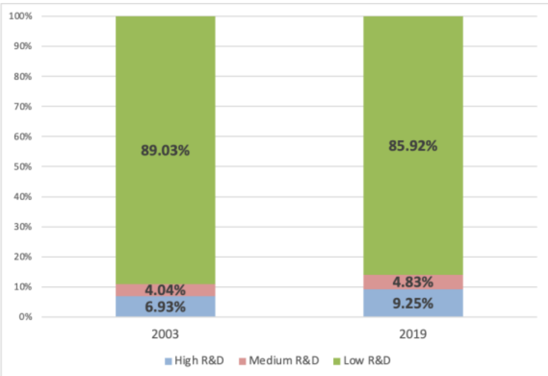


Figure 1 shows that the change in the contribution of value added to GDP from 2003 to 2019 will increase by 4.24% in the services sector and 5.46% in the manufacturing sector. The share of agriculture in added value will decrease by 36.24%. Despite the significant decrease in the share of agriculture in GDP, the increases in manufacturing and services are limited. However, we can get a clearer picture of the progress of structural change components between related years by looking at the sectoral contributions to GDP with classifications of sectors according to the technological intensity of production[1]. Figure 2 is a stacked chart of the sectoral shares of high, medium and low technology-intensive sectors in GDP in 2012 and 2019.

High R&D intensive sectors accounted for almost 7% of GDP in Türkiye in 2003. In 2019, the contribution of the high R&D intensive sectors to the total GDP increased to 9.25%, which means a 33% growth in the share. Although this increase can be considered progress, the limited decrease of low R&D dependence in 16 years, only a 3.5% decrease in production and a high rise in medium R&D intensive sector role with 19%, shows that the structural change has not reached expectations between related years.

In this context, Türkiye's experience provides a critical case. One of the most significant barriers to its long-term development has been the slow pace of structural transformation, especially in high-technology and innovation-driven sectors. Although the country experienced high growth after 2002, much of this expansion was consumption-driven and not accompanied by a decisive shift toward more productive, knowledge-intensive industries. As a result, Türkiye has struggled to escape the middle-income trap. In this development deadlock, economies cannot transition from resource or labour-intensive industries to high-tech, innovation-based production.

Figure: 2
Sectoral Shares of GDP Based on Technology Intensity



1 *This classification was made by Galindo-Rueda and Verger (2016) considering the sector's R&D intensity.*

The middle-income trap is characterised by stagnant productivity, limited technological innovation, and a failure to increase the share of high-value-added sectors in GDP significantly. To overcome this, countries must pursue long-term, strategic interventions to enhance industrial complexity, diversify exports, and foster institutional environments that support research and development (R&D), entrepreneurship, and labour flexibility.

This study, therefore, aims to examine the structural change in the Turkish economy between 2003 and 2019, a period marked by rapid growth, global economic shifts, and domestic policy reforms. Analysing this transformation through the lens of Input-Output (IO) tables provides an empirical foundation for assessing whether Türkiye has initiated a sustainable structural transformation or if growth has remained shallow and sectorally unbalanced.

3. Literature Review

In literature, although the economic composition of Türkiye is not a famous subject, the analysis of economic components with the structural decomposition of other economies can be considered sufficient to investigate. One of the most recent studies on the evaluation of structural change in Türkiye was made by Tahsin and Börü (2023) with structural decomposition analysis in the framework of 12 basic sectors. Their research covers the period 2003-2016, with the focus on the productivity of the sectors. As a result of this research, the Turkish economy has experienced limited progress in structural transformation in the corresponding period. The highest structural transformation was in the real estate sector, which was classified as the least technology-intensive sector based on the OECD classification. Similar findings are reported by Filho, dos Santos, and Ribeiro (2021) for the Brazilian economy, which, like Türkiye, faces persistent challenges associated with the middle-income trap and exhibits comparable macroeconomic characteristics. Their study, which applies Structural Decomposition Analysis (SDA) over the 1995-2015 period, concludes that Brazil's economic growth remains structurally fragile and heavily reliant on demand-side dynamics. This pattern closely mirrors the Turkish case, reinforcing the broader concern that in both economies, growth has not been sufficiently underpinned by productivity gains, technological upgrading, or transformative structural change.

Pamukçu and Boer (2000) examined the import of Türkiye between 1968-1979 and 1979-1990 with structural decomposition analysis. They concluded that the import substitution strategy that Türkiye is following in this period has an adverse effect on imports as planned. Still, the technical change in the intermediate demand structure causes an increase in imports due to the failure to reduce import dependence on mining, heavy intermediate goods and capital goods. Thus, the objective of the import substitution strategy has not been achieved as planned, unlike the research on import substitution of the Brazilian economy between 2003 and 2008, which Magacho (2013) concluded with a structural decomposition analysis. Brazil, another developing country, managed to reduce the increase in imports of inputs by a total of 8.6% for all sectors. However, after imposing the contribution of exports to GDP in the calculation, the net contribution of the import substitution policy is negative for high-technology sectors. Plank et al. (2018) investigated the changes in raw material consumption between 1990 and 2010 using multi-regional input-output tables (MRIO) by performing a structural decomposition analysis. Based on the regional results, the international trade pattern was highly correlated with global raw material consumption (RMC). This result suggests that industrialised countries extend their supply chains to less industrialised countries and regions, making their impact on RMC relatively high.

The Leontief multiplier, which basically depends on the elasticity of the price inducement, represents the sectoral changes in the production and supply structure and provides an opportunity to observe the input-output and input-price components. In addition, technological and structural changes in the economy can be interpreted based on Leontief multiplier results (Milana, 2001: 2). Structural decomposition analysis and the Leontief multiplier have been used by Milana (2001) to study the production system by comparing traditional decomposition techniques and a new decomposition technique called Törnqvist, which allows researchers to study a more general structure of technology and compare the US and Japanese economies by using multiplicative SDA such as Plank (2018) and Pamukçu and Boer (2000). Examining the case of China in terms of its export structure is a well-known and important one for the global economy. Lianling and Cuihong (2017), Doan and Long (2019), and Pei et al. (2011) implement structural decomposition analysis to study the structural change of exports of the Chinese economy. Lianling and Cuihong (2017) focus on the structural change of domestic value-added exports in 2002-2010 and conclude that the increase in export capacity caused the expansion of domestic value-added products related to exports. The growth of domestic value added was the main reason for expanding trade volume. Between 2002 and 2007, 93% of the export increase was related to the rise in value added. Although this percentage fell to 81.5% between 2007 and 2010, it remained at the same level. In another decomposition analysis of the contribution of exports to employment in the Chinese economy, Doan and Long (2019) identified the period between 1981 and 2010. Considering the results of the growth of export value added in the research of Lianling and Cuihong (2017) above, as expected, Doan and Long (2019) argue that the contribution of export to employment, especially in the manufacturing sector, has increased.

The expansion of China's export activity cannot be viewed in isolation from imports. China's import structure has been studied using structural decomposition analysis by Pei et al. (2011) for 1997-2005. According to the results, vertical specialisation, i.e. importing goods to produce export goods, plays a vital role in China's foreign trade. However, although 38% of import growth is based on vertical specialisation and export growth, 62% is related to the change in economic structure. The 235% increase in the gas production and supply sector is the most significant contributor to import growth at the sectoral level. In this regard, Doan and Long (2019) investigate the contribution of exports to employment in the manufacturing sector at 23.2%, which is relatively higher than in other sectors. Similar results to those of Pei et al. (2011) on energy-related import growth were also evaluated by Cho (2002) from the structural decomposition analysis of Korea between 1975 and 1995.

With the conclusion of import composition in this result, it can be concluded that energy dependence for developing countries is increasing. At the same time, economic growth is based on structural changes in the economy over many decades. The study of Pamukçu and Boer (2000) also examined the share of mining and petroleum products in investment, which increased from 1968 to 1990. This increasing energy-related import structure is reviewed by Wang et al. (2019) in the context of one of the largest cities in China, Guangdong economy, between 2002 and 2012, with structural decomposition analysis. The main reasons for the increase in energy consumption are population growth and economic structure. The research also shows that the factors that affect energy consumption changes are mainly related to final demand.

Structural decomposition analysis presents various components related to economic structure and provides quantitative linkages at the global, sectoral or household level. On the other hand, the Leontief multiplier also ensures essential and significant quantitative information on supply and output components, such as backward and forward linkages. In the study of Figueiredo and Oliveira (2016) and Gonçalvez et al. (2021), the elements of the Brazilian economy are examined by sectors. While Oliveira and Figueiredo (2016) concluded that forward linkage does not obtain a significant change between 1995 and 2009, and the biggest change in backward linkage among sectors is the increase of natural resources, Gonçalvez et al. (2021) claim that the textile sector obtains an undeniable importance for the Brazilian economy by backward and forward linkage. A similar result was obtained for the Turkish economy in 2012, in which the energy and agricultural sectors also have strong backward linkage, according to the work of Karkacier and Bölük (2017).

In addition to providing the general structure of the economy with linkages and sectoral assessments, the Leontief multiplier also offers components for specific economic issues, such as water stress, carbon emissions, unemployment, imports, etc. Another field-based study on structural decomposition analysis was established by Nakamoto (2019) on the investigation of carbon footprints, one of the most famous SDA topics of the last decades. The author divides 1995-2009 into 4 periods and examines each period for Japan, the USA and Germany, focusing on carbon emissions generated by final car demand. The basic drivers of change in CO footprints are determined by technological changes in the emission intensities of suppliers directly and indirectly. Also, the fuel intensity and petroleum use affect the CO2 emissions by increasing, with the same results as the study that Papagiannaki and Diakoulaki (2009) made with SDA for Greece and Denmark between 1990 and 2005. Nakamoto (2019) also found that new car sales have a limited effect on the increase of CO2 emissions in each country he studied. However, it is interesting to note that after the 2008 crisis, depending on the decrease in car sales, the CO2 footprints of the US and Japan decreased. However, in Germany, the government's green car policy caused an increase in Germany's carbon footprint.

4. Data and Research Methods

This study utilises Türkiye's Input-Output (IO) tables from the OECD database to investigate the structural characteristics and transformation of the Turkish economy between 2003 and 2019. Two core analytical approaches are employed: Leontief multiplier analysis, which includes backwards and forward linkages, and Structural Decomposition Analysis (SDA). These methods provide insights into sectoral interdependencies, the relative positioning of industries within the economy, and the evolution of their roles over time. In particular, the analysis captures how sectoral contributions to the supply chain have changed and identifies key drivers of economic growth during the period under consideration.

The choice of the 2003-2019 period is deliberate. It reflects a timeframe of relative macroeconomic continuity, avoiding distortions in economic indicators caused by the COVID-19 pandemic. Although the pandemic's formal emergency status was lifted in 2022, its lingering economic effects render post-2019 data less reliable for measuring long-term structural dynamics.

In addition to assessing sectoral linkages, the SDA component of the analysis quantifies the relative contributions of final demand, value-added production, and structural change to GDP growth. Moreover, the analysis distinguishes the role of imported intermediate inputs in GDP expansion, offering a more comprehensive understanding of domestic production capabilities and vulnerabilities.

4.1. Leontief Multiplier, and Backwards and Forward Linkages

An IO table is constructed for a specific period and country or region by collecting data for each sector or region. Some organisations and public agencies release IO tables within periodic time frames and give researchers access. In this research, IO tables are obtained from the OECD database. Table 1 shows the theoretical framework of an IO table, which includes the matrices.

Table: 1
The Structure of Traditional IO Table

Sectors	Consumer Sector	Final Demand	Total Output
Agriculture			
Mining	Z_{ij}	F_i	X_i
…			
Value Added	V_j	V_{fj}	V_i
Imports	I_j	I_{Fj}	I_i
Total Input	X_j	F_j	

Source: Chuenchum et al., 2018: 96.

The producer's output is shown in the row, and the sector's input demand to produce that output is represented in the column.

$$X_i = Z_{ij} + F_i \tag{1}$$

Equation 1 represents each sector i output (X_i) is the summation of each consumer sector (Z_{ij}) purchases with final demand (F_i) of that sector, and the same interpretation is valid for each row. It can also be constructed with an equation as;

$$x_i = \sum_{j=1}^{j=n} x_{ij} + y_i \tag{2}$$

The Leontief IO model indicates that the economy's total production is a summation of quantitative inter-sectoral relations and final demand. x_{ij} is the trade value of intersectoral relations for each sector i to j and y_i is the final demand of products in each sector (Chuenchum et al., 2018: 97). For the Leontief multiplier calculation, the weighted effects of each sector on the total input of that sector. This relationship can be demonstrated as;

$$a_{ij} = \frac{x_{ij}}{x_j} \tag{3}$$

a_{ij} can be explained as a technical coefficient value, and direct input required by sector j can be explained shortly. When we arrange this equation for all economy, the total equation will become,

$$x_i = \sum_{j=1}^{j=n} a_{ij}x_j + y_i \tag{4}$$

Also, it can be explained as;

X = AX + Y and,

X - AX = Y,

(I-A) * X = Y, it can be reformulated by moving (I-A) to the right-hand side, and because all these notations are matrices, the result will be,

$$X = (I - A)^{-1} * Y \tag{5}$$

This equation is the main form of economic impact calculation using Leontief's multiplier. The Leontief multiplier determines the correlation of transmission of the effects of changes in final consumption. In this research, the economic growth composition of Türkiye was investigated by equation (Cho, 2002: 188):

$$GDP_t = (I - A)^{-1} * V_t * F_t \tag{6}$$

where V_t is the value added production fraction for each sector in the column, which means the value added production in each sector *i* per unit ($) of its output, which is $v_i = \frac{V_i}{X_i}$, where V_i is the total value added in sector *i* and X_i is the total output. This matrix is also an important tool and component of gross domestic product to assess the sectoral value-added production fractions in total output.

If we assume the Leontief multiplier, which is $(I - A)^{-1}$ equal to B matrices, the backward multiplier can be calculated by summing each column of matrices B and can be written as,

$$BACKWARD_j = \sum_j b_{ij} \tag{7}$$

Forward multiplier can also be calculated with the same logic, that is, summing all rows of the matrices B and written as;

$$FORWARD_i = \sum_j b_{ij} \tag{8}$$

By definition, the forward multiplier represents the part of a particular sector in the supply chain that contributes to total output by providing products and services to other sectors. In addition, the sectors with high backward multipliers mean their production activity is more effectively transmitted to other upstream industries.

4.2. Structural Decomposition Analysis

Structural Decomposition Analysis (SDA) offers a robust macroeconomic framework for examining the underlying drivers of economic growth, sectoral transformation, and the distribution of value added within an economy, using Input-Output (IO) tables. Its key strength lies in its ability to disentangle the contributions of final demand, structural change, and value-added production to overall economic performance. This makes it especially useful for evaluating the quality of economic growth, not just quantity.

SDA's methodological flexibility enables simultaneous analysis of demand-and supply-side dynamics, while relying on national-level data reduces estimation bias and enhances consistency. Unlike models that require strong theoretical assumptions, SDA uses empirically grounded input-output relationships, making it well-suited for long-term structural assessments. Its applicability has expanded in recent years, including external components such as environmental factors, labour market indicators, and trade flows.

This study employs SDA due to its analytical clarity, multidimensional scope, and policy relevance. It provides a comprehensive foundation for assessing Türkiye's economic transformation and offering evidence-based recommendations.

After considering the growth components in the previous sections, the GDP difference between the two years can be written as equation (9).

ΔGDP= V_t*B_t*F_t - V_0*B_0*F_0 where B_t is Leontief inverse, and, (9)

To show the decomposition equations, we will consider the change in each end, starting with value added, *v*, Leontief inverse, *B*, and final demand, *F*.

$$\Delta GDP = (V_1B_1F_1 - V_0B_1F_1) + (V_0B_1F_1 - V_0B_0F_1) + (V_0B_0F_1 - V_0B_0F_0) \tag{10}$$

and finally;

$$\Delta GDP = \Delta V^* B_1^* F_1 + V_0^* \Delta B^* F_1 + V_0^* B_0^* \Delta F \quad (11)$$

It is important to understand that if there are n number of components in the equation, of which we have three, there should be n! decomposition forms are generated separately. In our research, there are six forms of decomposition equation (L→v→f, L→f→v, v→f→L, f→v→L, f→L→v, v→L→f) because we have three components, but we have only found two of them (v→L→f, f→L→v) and took the average. In this context, the average of two alternative decompositions (or paths) equals the average of all other n! decomposition forms. This means taking the midpoint weights that yield the identical result (Vazquez et al, 2008: 376).

5. Results

This chapter presents the findings on the components of structural change in the Turkish economy from 2003 to 2019. The analysis is structured around two key dimensions: forward and backward linkages, and the results of Structural Decomposition Analysis (SDA). These elements are examined separately, as they are derived through distinct methodologies and offer unique insights. Each provides valuable implications for understanding economic transformation dynamics and formulating effective policy recommendations.

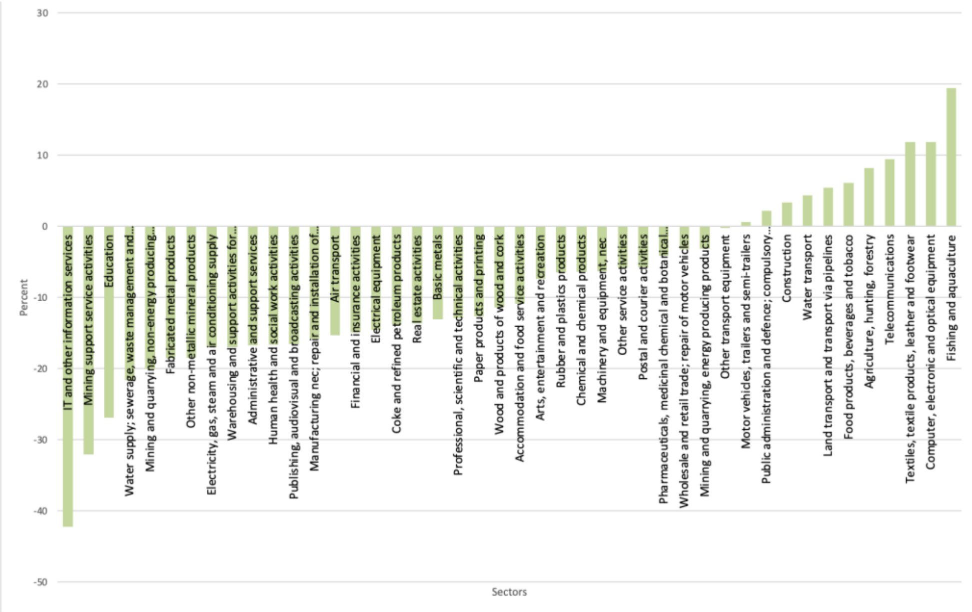
5.1. Forward and Backward Linkages of Sectors

Backward Linkage: The backwards multiplier/linkage measures how much a sector stimulates demand for inputs from other domestic sectors. Suppose a sector has a high backward multiplier. In that case, its production creates a strong demand for upstream industries, such as the manufacturing sector's demand for raw materials from other sectors.

Figure 3 illustrates the changes in the backward multipliers of all sectors in the Turkish economy between 2003 and 2019, reflecting shifts in intersectoral demand. A positive change in the backward multiplier indicates that a sector has become more integrated into the production network by increasing its demand for intermediate inputs from other sectors. The most significant increases in backward linkages are observed in sectors such as Fishing and Aquaculture, Computers, Electronics and Optical Equipment, Textiles, and Telecommunications. These changes suggest that these sectors have increasingly relied on inputs from broader industries, indicating growing interdependence within the production system.

Conversely, the most notable declines in backward multipliers are found in IT and Other Information Services, Mining Support Service Activities, and Education. This suggests a relative decrease in their upstream integration, potentially reflecting a shift towards more self-contained production or less reliance on domestic intermediate inputs.

Figure: 3
The Change of Backwards Multiplier of Sectors Between 2003 and 2019



Notably, most sectors with increased backward linkages are traditionally classified as low-technology or resource-based industries, such as fishing, textiles, and agriculture, indicating a structural pattern where these sectors deepen their domestic input usage. In contrast, many high-technology intensive sectors, including IT services, Air Transport, and Machinery and Equipment, show weaker or declining backward linkages. This may reflect either a reliance on imported intermediate goods, outsourcing, or a shift towards more capital- or knowledge-intensive modes of production with fewer domestic input demands.

These findings raise important considerations regarding Türkiye’s structural transformation. While deeper intersectoral integration in low-tech sectors may contribute to short-term economic activity, it also highlights the persistent challenges in embedding high-tech industries more broadly within the domestic production network. This underlines the need for policy measures that strengthen domestic supply chains, foster innovation spillovers, and support the integration of high-tech industries into the broader economy.

Forward Linkage: The value of the forward multiplier represents how much an industry provides inputs to other industries by facilitating productivity and value added downstream, like micro-chip production for various industries. So, the forward multiplier shows how much a sector's output is utilised by input from other sectors.

The forward multiplier is significant for developing countries for several reasons. The middle-income trap is a common economic phenomenon in developing countries: since they cannot increase their productivity and shift to a technology-intensive production system, most developing countries are destined to remain stuck below a certain level of economic development. This sustainability issue has become more important in recent decades as the economic development gap between advanced and other countries has widened due to technological externalities in the production structure. Policies to increase high forward multipliers aim to produce critical inputs for multiple industries and increase economic complexity with technology and productivity spillovers. This will also help industries to integrate the country into the global value chain and enhance competitiveness. The demand for skilled labour is also expected to increase, mainly because of the structural change that forwards multiplier-focused policy regulations.

Figure: 4
The Change of Forward Multiplier of Sectors Between 2003 and 2019

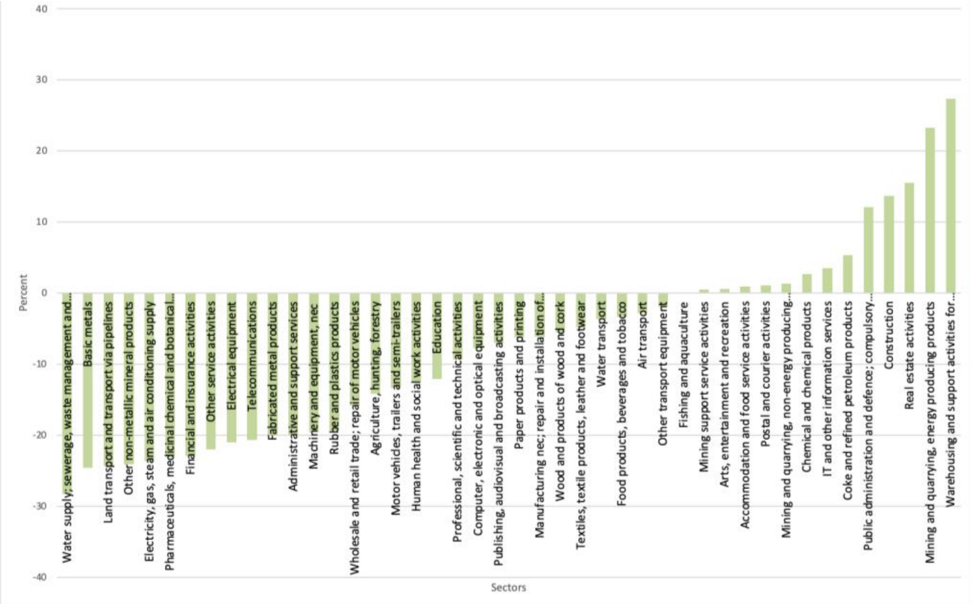


Figure 4 presents the changes in the forward multipliers of all sectors in the Turkish economy between 2003 and 2019. Forward multipliers reflect the extent to which a sector contributes to the production activities of other sectors by providing intermediate inputs. A rising forward multiplier suggests growing sectoral importance as a supplier in the broader production network.

During this period, the most notable declines in forward linkages were observed in water supply, sewerage, waste management and remediation activities, and basic metals, electricity, gas, steam, and air conditioning supply. These reductions suggest that these sectors have become less central as input providers, potentially due to structural shifts, efficiency gains, or substitution with imported alternatives.

Conversely, sectors such as Warehousing and Support Activities, Mining and Quarrying, Real Estate Activities, and Construction experienced the most significant increases in their forward multipliers. The sharp rise in forward linkage values in Real Estate and Construction, both characterised by low R&D intensity, raises concerns regarding the strategic direction of economic transformation. Despite their growing intersectoral influence, these sectors do not typically drive innovation or productivity growth. Their expansion, therefore, may reflect demand-driven booms rather than meaningful structural change.

Most critically, the forward linkages of high-technology-intensive sectors, such as IT services, Machinery, and electronics, have shown limited improvement, with several even registering declines. Given that forward linkages are essential for diffusing technological gains across the economy, this stagnation points to a missed opportunity to enhance these sectors' transformative potential.

These findings suggest that the Turkish economy’s structural change process between 2003 and 2019 was skewed toward low-productivity and low-innovation sectors. For structural transformation to support sustainable and inclusive growth, forward linkages from high-technology and knowledge-intensive industries must be strengthened through targeted industrial and innovation policies.

Please find forward and backward linkage values for each sector for 2003 and 2019 in Appendix, Table 5, as the result of the calculation with equations (7) and (8).

As a result of the forward and backward multiplier calculations, three basic policy recommendations can be made;

- High-technology-intensive sectors should be better integrated into industrial value chains to increase their efficiency overall in the economy. Low forward and backward linkages of high-technology-intensive sectors indicate their weak completion and interaction with the production chain.
- The economy still heavily relies on traditional sectors, rather than knowledge-based, high-technology-intensive sectors that can boost the structural change.
- A higher forward multiplier should focus on technology-intensive sectors to avoid the risk of slower productivity growth and more robust structural change.

5.2. GDP Levels and Economic Growth in Türkiye Between 2003-2019

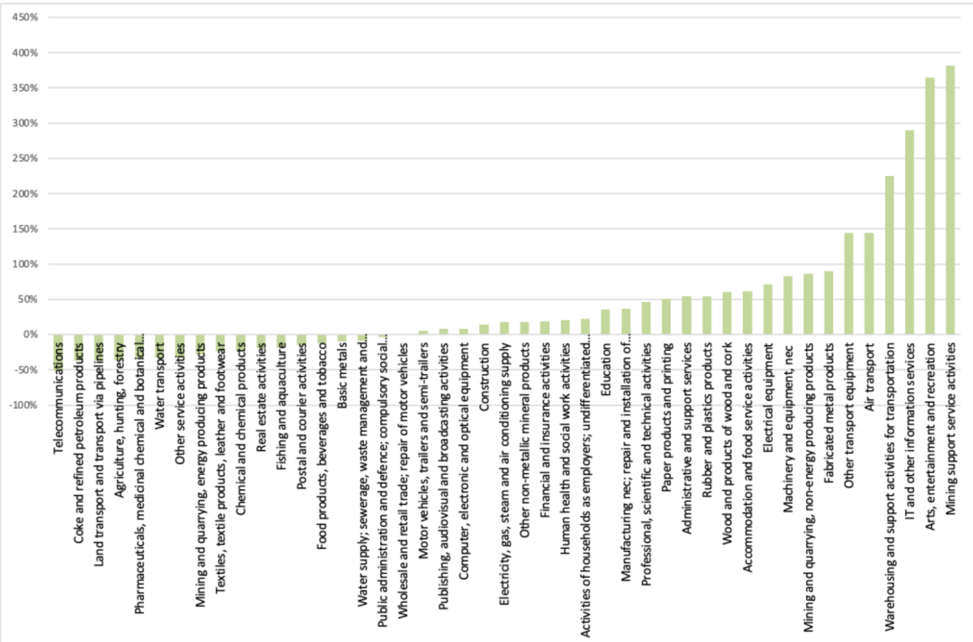
The total current GDP level of Türkiye ($) in 2003 and 2019 was calculated using equation (6) based on the IO tables in the corresponding years. The results are presented in Table 2.

Table: 2
2003 and 2019 Current GDP Levels in Türkiye

2003	2019	Growth Between 2003-2019
$276,035.8 Million	$685,316.6 Million	148.3%

As a result of the calculation based on equation (6), the current GDP of Türkiye is $276,035.8 Million in 2003 and $685,316.6 Million in 2019. Based on these GDP levels, we can calculate that the economic growth in Türkiye has a positive value, and the economy grew by 148.3% from 2003 to 2019. The SDA analysis and evaluations consider this economic growth between related years.

Figure: 5
Sectoral Share Changes Between 2003-2019



In Figure 5, although the relative increase in the GDP share of specific sectors appears substantial - for example, Mining Support Service Activities recorded a 381% rise - this growth stems from a very low initial base (from 0.009% to 0.05%). Such changes, while statistically striking, remain economically modest in absolute terms. Therefore, it is essential to interpret these shifts with caution to avoid overstating their macroeconomic significance. Similarly, IT and Other Information Services experienced a notable increase of 290%, expanding from 0.4% to 1.4% of GDP[2].

Most high-technology-intensive sectors—including Pharmaceuticals, Computers, Electronic and Optical Products, and Machinery and Equipment—either experienced a decline in GDP share or grew below the average sectoral growth rate. This divergence suggests a structural shift favouring non-high-tech or service-oriented sectors regarding value-added contributions[3].

Overall, Figure 5 reveals a structural pattern in which sectors with lower technological intensity and service-oriented activities have experienced the most significant gains in GDP share, while many high-technology manufacturing sectors have either declined or stagnated, underscoring a potential mismatch between economic transformation and technological upgrading.

5.3. Structural Decomposition Analysis of Türkiye Between 2003-2019

The most straightforward and comprehensive approach to assessing the quality of Türkiye's economic growth is SDA, as we can observe the components of economic growth, which are final demand, structural change or value-added production, and identify the source of growth between 2003 and 2019.

As we have already calculated the economic growth of 148.3% between 2003 and 2019, the components are interpreted according to their contribution to this economic expansion. Table X below presents the result of SDA by decomposing the growth components using equation (11).

Table: 3
SDA Results of Türkiye Between 2003-2019

Total	Final Demand Change	Structural Change	Value-Added Production Change
100%	105.96%	-7.19%	1.23%

The Structural Decomposition Analysis (SDA) results, presented in Table X, reveal that Türkiye's economic expansion of 148.3% between 2003 and 2019 was driven overwhelmingly by final demand growth, which accounted for 105.96% of the total. In contrast, structural change negatively contributed -7.19%, indicating that shifts in the economy's sectoral composition either failed to support or actively hindered growth. The value-added coefficient effect contributed a mere 1.23%, suggesting limited improvements in domestic value generation capabilities. These findings highlight a growth trajectory

[2] *Sectoral shares of GDP in 2003 and 2019 are presented in Table 6 in the Appendix.*
[3] *Value-added production per output is presented in Appendix, Table 4.*

primarily led by demand-side dynamics, with insufficient structural upgrading or productivity deepening at the sectoral level.

6. Conclusion and Recommendations

This article contributes to the growing literature on structural change and sustainable economic growth by providing a comprehensive empirical analysis of the Turkish economy between 2003 and 2019 using Structural Decomposition Analysis (SDA). By decomposing the drivers of GDP growth into final demand, structural transformation, and value-added production, the study reveals critical insights into the qualitative dimensions of Türkiye’s economic expansion. Unlike traditional growth analyses focusing solely on output levels, this study highlights the underlying structural weaknesses hindering Türkiye’s progress beyond the middle-income trap. The findings offer valuable policy implications for developing economies seeking to align their growth trajectories with long-term, innovation-driven, and structurally resilient development.

The findings of this research reveal that economic growth over the period, totalling 148.3%, was predominantly driven by final demand, which accounted for 105.96% of the observed expansion. In contrast, structural change contributed negatively (-7.19%), and value-added coefficient improvements played only a marginal role (1.23%).

These results suggest that the Turkish economy's growth has mainly been demand-led, with limited support from supply-side restructuring or productivity enhancements. The negative contribution of structural change implies that sectoral shifts either did not align with productivity improvements or reflected a reallocation of resources toward relatively less productive activities.

The analysis of sectoral GDP share dynamics further supports this interpretation. As illustrated in Figure 5, the sectors exhibiting the most significant increases in GDP share - such as Mining Support Services and IT-related services - began from a very low base. Although their relative gains appear substantial (381% and 290%, respectively), the absolute increases are economically minor, limiting their overall impact on structural transformation. More critically, many high-technology manufacturing sectors have either contracted or stagnated in GDP share, underscoring a disconnect between macroeconomic growth and technological upgrading.

In this context, the findings align with persistent concerns about Türkiye’s vulnerability to the middle-income trap. In this condition, an economy achieves a certain income level but struggles to transition to a high-income status due to insufficient productivity growth, weak innovation systems, and limited structural diversification. The stagnation of high-tech manufacturing and the weak contribution of value-added improvements point directly to this challenge.

These findings indicate that meaningful structural modernisation has not matched Türkiye's economic growth trajectory. For sustained and inclusive development, future policy should aim to:

- Promote high-productivity sectors, particularly those with strong forward and backward linkages.
- Foster technological upgrading by incentivising innovation, R&D, and high-tech exports.
- Facilitate productive structural change through industrial policy and targeted investment in strategic sectors.
- Enhance domestic value-added generation by strengthening supply chains and reducing import dependency in critical sectors.

A shift toward a more production-oriented and innovation-driven growth model is essential to complement demand-side momentum with durable structural competitiveness.

While the findings of this study provide valuable insights into the structural dynamics of Türkiye's economic growth, several limitations must be acknowledged. First, the analysis is constrained by the availability of input-output data and the aggregation level, which may obscure intra-sectoral productivity shifts or informal sector dynamics. Second, the study focuses solely on the 2003-2019 period; future research could extend this timeframe to include post-pandemic developments or explore comparative cases from other middle-income countries. Finally, although the SDA framework offers a robust decomposition of growth sources, it does not fully capture institutional, political, or micro-level drivers of structural change. Future studies could complement this macro-level analysis with qualitative assessments or firm-level data to deepen the understanding of transformation pathways. The results underscore policymakers' need to move beyond demand-side stimuli and pursue long-term industrial upgrading, innovation capacity, and sectoral diversification strategies.

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APPENDIX

Table: 4
Ratio of Value-Added Production Per Output

SECTORS	2003	2019	ΔV
Agriculture, hunting, and forestry	0.790	0.460	-0.330
Fishing and aquaculture	0.892	0.549	-0.344
Mining and quarrying, energy-producing products	0.773	0.419	-0.354
Mining and quarrying, non-energy producing products	0.321	0.587	0.266
Mining support service activities	0.127	0.656	0.529
Food products, beverages and tobacco	0.303	0.253	-0.050
Textiles, textile products, leather and footwear	0.480	0.365	-0.115
Wood and products of wood and cork	0.189	0.317	0.127
Paper products and printing	0.275	0.374	0.099
Coke and refined petroleum products	0.109	0.147	0.038
Chemicals and chemical products	0.493	0.413	-0.080
Pharmaceuticals, medicinal chemical and botanical products	0.811	0.392	-0.419
Rubber and plastic products	0.203	0.336	0.133
Other non-metallic mineral products	0.261	0.359	0.098
Basic metals	0.195	0.315	0.120
Fabricated metal products	0.222	0.444	0.222
Computer, electronic and optical equipment	0.575	0.564	-0.011
Electrical equipment	0.186	0.245	0.059
Machinery and equipment, nec	0.224	0.391	0.167
Motor vehicles, trailers and semi-trailers	0.278	0.303	0.025
Other transport equipment	0.440	0.763	0.323
Manufacturing nec repair, and installation of machinery and equipment	0.291	0.407	0.116
Electricity, gas, steam and air conditioning supply	0.179	0.173	-0.006
Water supply, sewerage, waste management and remediation activities	0.400	0.467	0.067
Construction	0.237	0.360	0.123
Wholesale and retail trade; repair of motor vehicles	0.651	0.646	-0.005
Land transport and transport via pipelines	0.685	0.405	-0.280
Water transport	0.739	0.575	-0.164
Air transport	0.179	0.480	0.301
Warehousing and support activities for transportation	0.296	0.748	0.452
Postal and courier activities	0.478	0.486	0.008
Accommodation and food service activities	0.384	0.573	0.189
Publishing, audiovisual and broadcasting activities	0.330	0.447	0.117
Telecommunications	0.874	0.425	-0.450
IT and other information services	0.341	0.898	0.557
Financial and insurance activities	0.549	0.629	0.080
Real estate activities	0.751	0.626	-0.125
Professional, scientific and technical activities	0.415	0.590	0.175
Administrative and support services	0.492	0.668	0.176
Public administration and defence; compulsory social security	0.752	0.663	-0.089
Education	0.677	0.877	0.200
Human health and social work activities	0.473	0.534	0.061
Arts, entertainment and recreation	0.320	0.580	0.260
Other service activities	0.573	0.466	-0.107
Activities of households as employers; undifferentiated goods and services	1.000	1.000	0.000

Table: 5
Backwards and Forward Multipliers

SECTORS	Backward Linkage		Forward Linkage	
	2003	2019	2003	2019
Agriculture, hunting, and forestry	1.37	1.49	2.50	2.15
Fishing and aquaculture	1.17	1.40	1.03	1.03
Mining and quarrying, energy-producing products	1.17	1.13	2.03	2.51
Mining and quarrying, non-energy producing products	2.01	1.61	1.41	1.42
Mining support service activities	2.61	1.77	1.06	1.06
Food products, beverages and tobacco	2.03	2.15	1.69	1.64
Textiles, textile products, leather and footwear	1.89	2.11	1.96	1.86
Wood and products of wood and cork	2.36	2.09	1.42	1.35
Paper products and printing	2.32	2.03	2.14	2.01
Coke and refined petroleum products	1.99	1.72	2.21	2.33
Chemicals and chemical products	1.68	1.57	2.74	2.82
Pharmaceuticals, medicinal chemical and botanical products	1.58	1.52	1.51	1.16
Rubber and plastic products	2.17	2.03	2.10	1.70
Other non-metallic mineral products	2.49	2.04	1.94	1.47
Basic metals	2.52	2.19	3.95	2.98
Fabricated metal products	2.54	2.07	2.01	1.61
Computer, electronic and optical equipment	1.27	1.42	1.45	1.34
Electrical equipment	2.41	2.06	1.86	1.47
Machinery and equipment, nec	1.89	1.77	1.80	1.45
Motor vehicles, trailers and semi-trailers	2.15	2.17	1.67	1.45
Other transport equipment	1.55	1.55	1.27	1.25
Manufacturing nec repair, and installation of machinery and equipment	2.39	2.01	1.66	1.56
Electricity, gas, steam and air conditioning supply	3.31	2.75	5.05	3.86
Water supply, sewerage, waste management and remediation activities	2.48	1.95	2.07	1.48
Construction	2.35	2.43	1.94	2.21
Wholesale and retail trade; repair of motor vehicles	1.58	1.53	5.59	4.71
Land transport and transport via pipelines	1.58	1.67	3.42	2.58
Water transport	1.37	1.43	1.41	1.36
Air transport	2.28	1.93	1.27	1.24
Warehousing and support activities for transportation	1.92	1.59	1.48	1.88
Postal and courier activities	2.00	1.89	1.14	1.15
Accommodation and food service activities	2.05	1.83	1.37	1.38
Publishing, audiovisual and broadcasting activities	2.24	1.87	1.50	1.39
Telecommunications	1.59	1.74	1.67	1.32
IT and other information services	2.14	1.24	1.40	1.45
Financial and insurance activities	1.76	1.50	2.92	2.25
Real estate activities	1.60	1.39	1.52	1.76
Professional, scientific and technical activities	1.95	1.70	2.49	2.26
Administrative and support services	1.95	1.62	2.79	2.23
Public administration and defence; compulsory social security	1.54	1.57	1.14	1.28
Education	1.69	1.24	1.22	1.08
Human health and social work activities	1.99	1.66	1.22	1.07
Arts, entertainment and recreation	1.76	1.63	1.18	1.19
Other service activities	1.91	1.80	1.40	1.09
Activities of households as employers; undifferentiated goods and services	1.00	1.00	1.00	1.00

Table: 6
Sectoral Share in Total GDP

SECTORS	Share	
	2003	2019
Agriculture, hunting, and forestry	10.90%	6.90%
Fishing and aquaculture	0.27%	0.22%
Mining and quarrying, energy-producing products	0.55%	0.39%
Mining and quarrying, non-energy producing products	0.43%	0.81%
Mining support service activities	0.01%	0.04%
Food products, beverages and tobacco	3.39%	2.97%
Textiles, textile products, leather and footwear	5.19%	3.93%
Wood and products of wood and cork	0.16%	0.26%
Paper products and printing	0.55%	0.83%
Coke and refined petroleum products	0.35%	0.22%
Chemicals and chemical products	1.48%	1.15%
Pharmaceuticals, medicinal chemical and botanical products	0.61%	0.40%
Rubber and plastic products	0.63%	0.97%
Other non-metallic mineral products	0.96%	1.13%
Basic metals	1.34%	1.21%
Fabricated metal products	0.79%	1.51%
Computer, electronic and optical equipment	0.40%	0.44%
Electrical equipment	0.54%	0.92%
Machinery and equipment, nec	0.57%	1.04%
Motor vehicles, trailers and semi-trailers	1.19%	1.25%
Other transport equipment	0.23%	0.57%
Manufacturing nec repair, and installation of machinery and equipment	1.11%	1.52%
Electricity, gas, steam and air conditioning supply	1.56%	1.84%
Water supply, sewerage, waste management and remediation activities	0.96%	0.87%
Construction	5.25%	6.01%
Wholesale and retail trade; repair of motor vehicles	13.81%	13.83%
Land transport and transport via pipelines	9.73%	6.12%
Water transport	0.89%	0.60%
Air transport	0.30%	0.73%
Warehousing and support activities for transportation	0.55%	1.79%
Postal and courier activities	0.27%	0.23%
Accommodation and food service activities	2.32%	3.75%
Publishing, audiovisual and broadcasting activities	0.36%	0.39%
Telecommunications	2.10%	1.01%
IT and other information services	0.38%	1.47%
Financial and insurance activities	2.91%	3.46%
Real estate activities	9.02%	7.28%
Professional, scientific and technical activities	1.76%	2.58%
Administrative and support services	2.15%	3.32%
Public administration and defence; compulsory social security	6.09%	5.85%
Education	3.59%	4.88%
Human health and social work activities	2.43%	2.93%
Arts, entertainment and recreation	0.27%	1.25%
Other service activities	1.60%	1.08%
Activities of households as employers; undifferentiated goods and services	0.04%	0.05%