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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

INDUSTRIAL STRUCTURAL TRANSFORMATION IN TURKEY

TÜRKİYE'DE ENDÜSTRİYEL YAPISAL DÖNÜŞÜM

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Abstract

This study investigates and presents some facts about the characteristics of industrial structure adjustment in Turkey. These characteristics are examined by the measures of industrial structure upgrading and industrial structure optimization. The analyses are performed both at the country and regional levels. The results show that the industrial structure upgrading decreases during 1991-2019 in Turkey. The index of industrial structure optimization has a downward trend signaling a reduction in the imbalances in sectoral development. The findings also show the regional differences in the transformation of industrial structure.
Keywords: Industrial Structure Upgrading, Industrial Structure Optimization
JEL Codes: L60, O14

Öz

Bu çalışma, Türkiye'deki endüstriyel yapının özelliklerini inceleyerek birtakım tespitler sunmaktadır. Endüstriyel yapının yükseltilme ve optimizasyonu endeksleri Türkiye geneli için ve bölgesel düzeyde hesaplanmıştır. 1991-2019 dönemi için yapılan analiz sonuçları, endüstriyel yapının yükseltilme endeksinin zamanla azaldığını göstermektedir. Endüstriyel yapının optimizasyonunu gösteren endeks ise sektörler arasındaki dengesizliklerde azalmaya işaret etmektedir. Bulgular, endüstriyel yapının dönüşümündeki bölgesel farklılıkları da göstermektedir.
Anahtar Kelimeler: Endüstriyel yapının yükseltilmesi, endüstriyel yapının optimizasyonu
JEL Sınıflandırması: L60, O14

1. Introduction

The capacity of firms to attain high levels of productivity and to increase productivity over time are important aspects of improving the standard of living in a country. Sustained productivity growth requires a constantly upgrading economy. Companies must develop essential capabilities by improving product quality, creating desirable attributes, raising product technology, or increasing production efficiency. This is crucial to compete in new sophisticated industries (Porter, 1990).

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One meaning of upgrading in the literature is relative innovative performance (Kaplinsky and Readman, 2005). Kaplinsky and Readman (2005) and Humphrey and Schmitz (2002) widened the interpretation of this term and specified four types of upgrading (process upgrading, product upgrading, functional upgrading, and intersectoral upgrading) in a conceptual framework. Gereffi (2005: 171) defines industrial upgrading as "…the process by which economic actors—nations, firms, and workers—move from low-value to relatively high-value activities in global production networks. Different mixes of government policies, institutions, corporate strategies, technologies, and worker skills are associated with upgrading success." Taglioni and Winkler (2016) define economic upgrading and densification as getting more value-added from a country's productive factors.

Structural transformation or structural change implies the shift of a country's productive resources from low-productive to high-productive economic activities. Structural change can be most beneficial for developing countries as their economies are typically characterized by some inter-sectoral productivity gaps. The lack of high-productivity activities slows down the development in these countries (UNCTAD, 2018). As mentioned by Kuznets, "It is impossible to attain high rates of growth of per capita or per worker product without commensurate substantial shifts in the shares of various sectors (Kuznets, 1979: 130)." In other words of Kuznets (1957: 56), "…Industrial structural aspects of economic growth carry with them wide and far-reaching implications for other aspects of the economic structure of nations in the process of their growth." The shift implies switching to large-scale productive units and larger economic management units, urbanization, and several other changes in the mode of lives, changes in the structure of final use of the national product including its allocation between consumption and investment, and a more complex economic structure which gives rise to expanding economic activities (Kuznets, 1957).

Syrquin (1988) points out that the changes in the sectoral composition of production are the most important characteristic of structural transformation. When the factor returns are not equal across sectors, which is a state of disequilibrium, the reallocation of resources from low-productivity to high-productivity sectors triggers economic growth. This situation is especially beneficial for developing countries which are more likely to experience the disequilibrium. Therefore, the disparity in factor returns across sectors make structural change a crucial component of economic growth (Syrquin, 1988). The allocation of production factors between industries influences the evolution of industrial structure and then has effects on economic growth by means of the optimization of industrial structure (Shi, 2021). The optimization of the industrial structure represents the balance between the parts of the industry (Zhao et al., 2022).

The transformation of the industrial structure of an economy encompasses two aspects: industrial structure upgrading and industrial structure optimization. Industrial upgrading is defined as the process of moving towards higher value-added and more productive activities. The reallocation of labor and other productive resources such as capital, natural resources, land, and know-how can be at the firm and the country level. This process of structural transformation gives rise to economic growth. Empirical evidence shows that countries which upgrade their productive structures export more sophisticated goods, thereby contributing to their economic growth (UNIDO, 2016; Monga and Lin, 2019).

The analyses of industrial structures in developing countries have attracted much attention in recent years. Several studies focus on the relationship between industrial structure upgrading and carbon emission reduction. The transformation of industrial structure from secondary to tertiary industry is crucial for policymakers to lower carbon emissions for green economic development. The optimization and upgrading of the industrial structure save energy and reduce the greenhouse effect. Most of these studies related to industrial structure upgrading and optimization are analyses of the Chinese economy (Zhou et al., 2013; Zhang et al., 2014; Wang et al; 2019; Wu et al., 2021; and Zhao et al., 2022, among others). In addition, Dong et al. (2021) provide evidence of the effect of industrial structure upgrading on global carbon dioxide emissions by using a group of countries. Jiang et al. (2018) investigate the impact of industrial structure on energy consumption in China. Wang et al. (2019) evince the effect of capital markets on industrial structure upgrading in China. Some studies dwell on the increased benefits of participating in gross value chains. Among these, Tian et al. (2019) adopt the gross value chains method to measure industrial upgrading, reflecting its multidimensionality. They also provide quantitative elements of industrial upgrading such as process upgrading, skill upgrading, and product upgrading (Tian et al., 2019).

The purpose of this study is to investigate the characteristics of industrial structure adjustment in Turkey. These characteristics are examined by using the measures of industrial structure upgrading and optimization indices for Turkey. To the best of my knowledge, this study is the first attempt to calculate these measures for Turkey. The analysis exploits data of employment and gross value added for the three main industries of Turkey both at the country and regional levels. The study aims to present a general overview toward a better understanding of developments underlying the process of industrial structure transformation in Turkey. To this end, it is expected to be a preliminary analysis and pave the way for further examinations of industrial structural transformation.

The study is organized as follows. Section 2 presents some basic facts about the industrial structure in Turkey. Section 3 delineates the concepts of industrial structure upgrading and industrial structural optimization and presents the results of the analyses at both the country and regional levels. The last section recapitulates the results.

2. Overview of Industrial Structure

To shed some light on the transformation of industrial structure in Turkey, this section reveals some facts about how the shares of three main sectors have evolved in the last two decades. [2] Figures 1 and 2 illustrate the sectoral shares of employment and the value added per worker in Turkey, respectively. The employment share of services has the highest share and exhibits an upward trend during the period 1991-2020. While the employment shares of industry and agriculture have almost the same until 2003, the share of agriculture diverges by falling under that of industry thereafter. During that period, the industry is relatively stable. Sectoral shares of services and agriculture move in opposite directions, suggesting a reallocation between them (Figure 1).

2 For the literature about the structural change in Turkey, see Cecen et al., (1994) and Atiyas and Bakis (2015), among others.

Figure 2 shows that the share of value added per worker in the service sector has the highest share until 2014. As of 2015, the ongoing increase in industry and decrease in services result in a higher share in the industry value added per worker. The average growth rate in industry value added per worker is 4.2%, while the corresponding rate for services is 2% during the period 1992-2019. Comparing the 1990s and the 2000s reveals that the growth in industry value added per worker declines from 4.7% to 4%, whereas the related rate for the services sector changes from 3% to 1.5%. Although average growth rates decline during the period, the fall in the services sector is more pronounced.

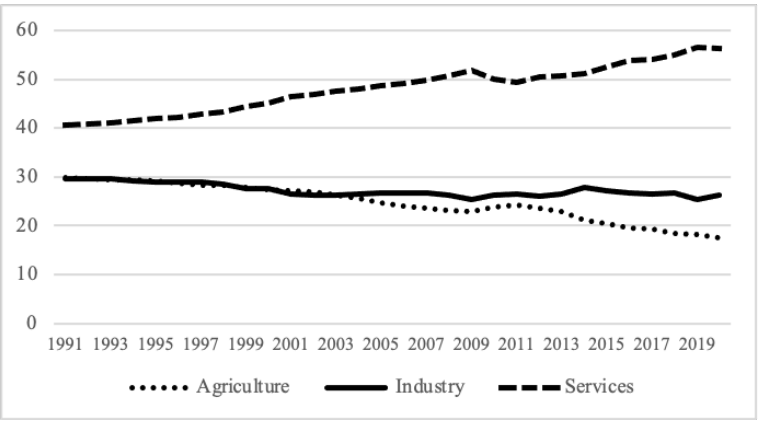

Figure 1: Sectoral Shares of Employment (% of total employment) (1991-2020)
Source: World Development Indicators (2022)

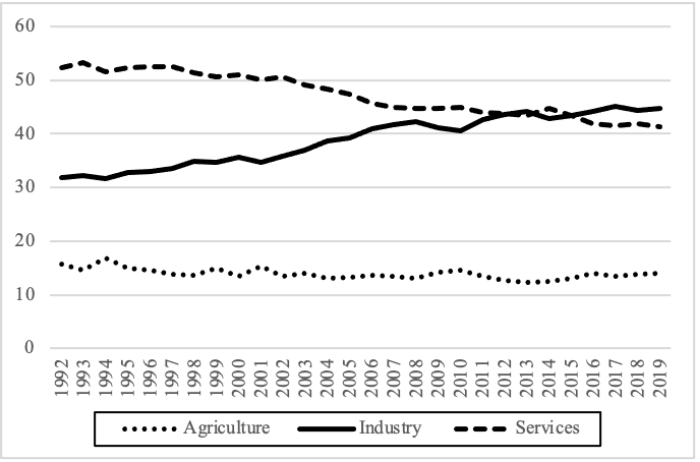

Figure 2: Sectoral Shares of Value Added per worker (constant 2015 US$) (1992-2019)
Source: World Development Indicators (2022) 3

3 "Value added per worker is a measure of labor productivity-value added per unit of output. Value added denotes the net output of a sector after adding up all outputs and subtracting intermediate inputs." See https://databank.worldbank.org/metadataglossary/world-development indicators/series/NV.AGR.EMPL.KD, Retrieved by: 1 August 2022.

Zhao et al. (2022), referring to Yu (2015) and Li and Su (2016), suggest that industrial structure adjustment involves the key concepts of industrial structure upgrading and industrial structure optimization. [4] They also mention that previous studies on industrial structure adjustment dwell on industrial structure upgrading and disregard industrial structure optimization. It is essential to scrutinize the industrial structure of the economy to understand the dynamics of the structural transformation. To this end, the following section presents and analyzes the upgrading and optimization of industrial structure indices in Turkey.

3. Industrial Structure Upgrading and Industrial Structural Optimization

Industrial structure upgrading is defined as the shift from low-productivity activities to high-productivity activities in the economy. Some studies measure the upgrading of the industrial structure by using the proportion of the output value of the tertiary industry to the secondary industry (Zhou et al., 2013; Li and Su, 2016; Zhao et al., 2022). However, Wu et al. (2021) argue that the traditional measurement cannot reflect the upgrading of industrial production factors. Therefore, they use the ratio of labor productivity of the tertiary industry to that of the secondary industry to measure the upgrading of industrial production factors.

Upgrading of industrial production factors is computed with the following ratio:

$$\text{Industrial Upgrading (ISU)} = \frac{Y_3/L_3}{Y_{2/L_2}} \qquad [1]$$

where Y_2 and Y_3 represent the output value of the secondary and tertiary industries, respectively. [5] L_2 and L_3 are the employment in the secondary and tertiary industries, respectively. A ratio greater than 1 indicates higher labor productivity in the tertiary sector and the industrial structure upgrading is increasing towards the overall efficiency (Wu et al., 2021). This process is usually accompanied by the development of high-technology industries.

In this section, the two measures of industrial structural upgrading (ISU) are computed and presented in Figure 3. ISU1 is calculated by the ratio of value added in the tertiary industry to the secondary industry. ISU2 is computed by using Equation [1] based on the labor productivity of two sectors. Economic output is represented by value added (constant 2015 US$) in the analysis. The data for the value added of each industry and the number of employees is obtained from World Development Indicators.

4 Zhao et.al (2022) refer to Yu (2015) and Li and Su (2016), which are in Chinese. This study uses these references as cited by Zhao et.al (2022).

5 Secondary industry denotes the industry sector (including construction), and tertiary industry denotes the service sector.

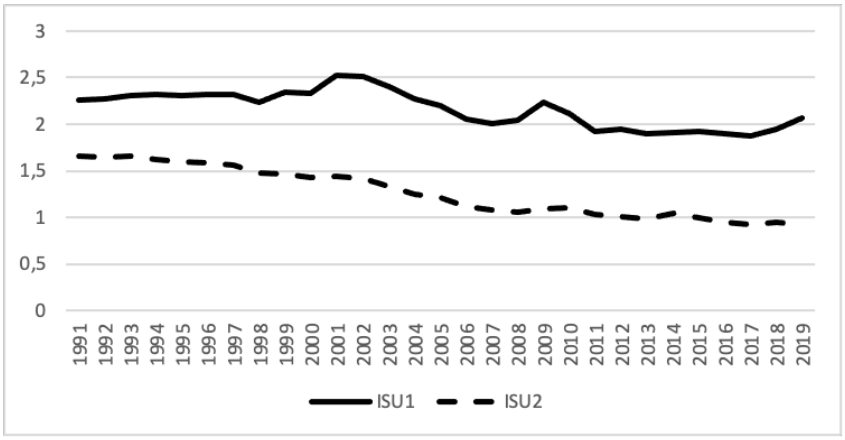

Figure 3: Industrial Structure Upgrading

Source: Calculated by the author by using data from World Development Indicators (2022).

As Figure 3 demonstrates, both ISU1 and ISU2 have declining trends. ISU1 value is 2.52 in 1968, attains its highest value of 2.65 in 1982 and is 2.05 in 2020. [6] The highest ISU2 value occurs in the early 1990s and continues to decline over time. ISU2 value is 1.65 for 1991 and 0.92 for 2019. The upswing in the values of ISU1 in 2001-2002 and 2008-2009 can be explained by the fact that the decrease in the industry value added is more than the decrease in the services sector.

As Wu et al. (2021) point out, the measure of ISU2 reflects the upgrading of industrial production factors. One of the most prominent differences between ISU1 and ISU2 arises in the year 2009, right after the economic crisis. Although there is a jump in industrial upgrading in terms of ISU1, there is almost no change in the value of ISU2. ISU2 reflects the degree of industrial upgrading considering labor productivity. Therefore, it is a more comprehensive measure.

2012 is the year where the productivity of the industry sector (Y_2/L_2) is equal to that of the services sector Y_3/L_3 (i.e., ISU value is 1) (Figure 3). Since then, the value is below 1. This is clearly consistent with Figure 2 which shows the rising industry value added per worker and falling services value added per worker coincide in 2012.

Furthermore, the allocation of production factors across industries has an important role in the advancement of industrial structure and fostering economic growth (Shi, 2021). The optimization of the industrial structure represents the balance between different parts of the industry and indicates the degree of coordinated development of various industries (Zhao et al., 2022).

Based on the study of Yu (2015), this study employs the Theil index (Theil, 1967) to analyze "the level of balanced growth among various parts of the industry" (cited by Zhao et al., 2022: 5). This

6 ISU1 value is 2.06 in 2019.

measure considers the heterogeneity of various industries by using weights that are assigned to different industries in an economy (Zhou et al., 2013). [7]

The index of industrial structure optimization (ISO) can be measured with the following equation:

$$ISO = \sum_{i=1}^{n} (\frac{Y_i}{Y}) In(\frac{Y_i}{L_i} / \frac{Y}{L}) \quad [2]$$

where i represents the i^{th} industry, and n indicates the number of industries, Y indicates total output value, L denotes total employment in the economy. If the economy is at equilibrium, the index value is equal to 0, otherwise the industrial structure deviates from equilibrium. The higher the value of the Theil index, the greater the existence of imbalances among various segments of the industry (Zhao et la., 2022). When the value of the ISO index is close to 0, this means that the industrial structure is close to the equilibrium state and the industrial structure is more reasonable (Shi, 2021).

In the calculation of the index, the number of industrial sectors n is set to three to reflect the primary, secondary and tertiary industries in the economy. Figure 4 illustrates the industrial structure optimization index before and after the year of 2004 in Turkey. [8] The most striking fact is that the industrial upgrading index has a downward trend both before and after 2004. Declining in the value of the index implies a reduction in the imbalances among the sectors. Another fact that draws attention is that the index is more volatile before 2004 than after 2004. Also, the 2001 crisis seems to affect the optimization towards a more imbalanced condition among sectors.

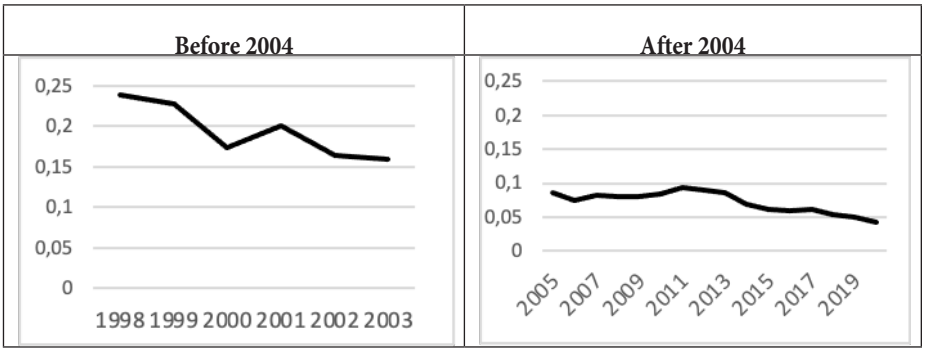

Figure 4: Industrial Structure Optimization

Source: Calculated by the author by using data from TURKSTAT (2022).

After examining the upgrading and optimization indices for Turkey, the relevant index values are computed at the regional level in Turkey. The data is at NUTS2 level, including the 26 regions of Turkey for the period 2004-2020 (Table 1). [9] The regions are ranked according to the annual

7 The Theil index, which is mainly used for measuring regional income inequality.

8 The GDP calculations were revised by TURKSTAT in 2004. Since the data is not comparable, two separate graphs are drawn. The year 2020 is not included due to the possible economics effects of the Covid-19 pandemic.

9 Industrial structure upgrading is calculated by using Equation [1]. The year 2020 is not included due to the possible economics effects of the Covid-19 pandemic.

average indices of industrial structure upgrading and industrial structure optimization. The results show the differences across various regions. [10]

Table 1: The Industrial Structure Upgrading and Optimization Indices (2004-2019)

Industrial Structure Upgrading		Industrial Structure Optimization	
Region	Value	Region	Value
TRB2 Van, Muş, Bitlis, Hakkari	1.879	TR90 Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	0.277
TRA2 Ağrı, Kars, Iğdır, Ardahan	1.641	TR81 Zonguldak, Karabük, Bartın	0.247
TR10 İstanbul	1.481	TRA1 Erzurum, Erzincan, Bayburt	0.219
TR83 Samsun, Tokat, Çorum, Amasya	1.322	TRA2 Ağrı, Kars, Iğdır, Ardahan	0.172
TR82 Kastamonu, Çankırı, Sinop	1.127	TRB2 Van, Muş, Bitlis, Hakkari	0.151
TR52 Konya, Karaman	1.068	TR83 Samsun, Tokat, Çorum, Amasya	0.142
TR62 Adana, Mersin	1.068	TR82 Kastamonu, Çankırı, Sinop	0.134
TR81 Zonguldak, Karabük, Bartın	1.066	TRB1 Malatya, Elazığ, Bingöl, Tunceli	0.133
TR90 Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	1.05	TR22 Balıkesir, Çanakkale	0.086
TR61 Antalya, Isparta, Burdur	1.049	TR33 Manisa, Afyonkarahisar, Kütahya, Uşak	0.084
TR32 Aydın, Denizli, Muğla	1.041	TR42 Kocaeli, Sakarya, Düzce, Bolu, Yalova	0.08
TR41 Bursa, Eskişehir, Bilecik	1.014	TR72 Kayseri, Sivas, Yozgat	0.078
TR72 Kayseri, Sivas, Yozgat	1.011	TR63 Hatay, Kahramanmaraş, Osmaniye	0.062
yiTRC2 Şanlıurfa, Diyarbakır	1.01	TR32 Aydın, Denizli, Muğla	0.061
TR31 İzmir	1.007	TR61 Antalya, Isparta, Burdur	0.059
TRB1 Malatya, Elazığ, Bingöl, Tunceli	1.003	TRC1 Gaziantep, Adıyaman, Kilis	0.059
TRC1 Gaziantep, Adıyaman, Kilis	0.996	TR21 Tekirdağ, Edirne, Kırklareli	0.046
TRC3 Mardin, Batman, Şırnak, Siirt	0.974	TR71 Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0.044
TR63 Hatay, Kahramanmaraş, Osmaniye	0.896	TRC2 Şanlıurfa, Diyarbakır	0.038
TR22 Balıkesir, Çanakkale	0.864	TR62 Adana, Mersin	0.033
TR33 Manisa, Afyonkarahisar, Kütahya, Uşak	0.831	TR41 Bursa, Eskişehir, Bilecik	0.029
TR42 Kocaeli, Sakarya, Düzce, Bolu, Yalova	0.815	TRC3 Mardin, Batman, Şırnak, Siirt	0.027
TRA1 Erzurum, Erzincan, Bayburt	0.788	TR52 Konya, Karaman	0.022
TR71 Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0.77	TR10 İstanbul	0.021
TR51 Ankara	0.763	TR31 İzmir	0.016
TR21 Tekirdağ, Edirne, Kırklareli	0.703	TR51 Ankara	0.012

Source: Author's own calculations by using data from TURKSTAT (2022).

The highest three ISU indices are in TRB2 Van, Muş, Bitlis, Hakkari, TRA2 Ağrı, Kars, Iğdır, Ardahan, and TR10 İstanbul. This implies that these regions are characterized by their relatively higher labor productivities in the service sector. TRA2 and TRB2 are classified in the group of non-industrialized regions in Turkey (Karahasan, 2021). Furthermore, they have scores far beyond in the regional competitiveness index (Didin Sönmez, 2018). [11] Since they are relatively more service – oriented regions,

10 There are several studies examining the disparities between regions in Turkey from different perspectives (Doğruel and Doğruel (2020), Karahasan (2021), Eriş Dereli and Düzgün Öncel (2021), among others).

11 See OECD (2016) for detailed information about the components of regional competitive index.

they are expected to have relatively higher ISU index values. Shi (2021) emphasizes that a service-oriented industrial structure is an important characteristic of industrial upgrading Also, Zhou et al. (2013) point out that the measurement of ISU indicates whether an industrial structure is upgrading with an expanding service sector.

The regions TRB2 Van, Muş, Bitlis, Hakkari, TRA2 Ağrı, Kars, Iğdır, Ardahan, and TR82 Kastamonu, Çankırı, Sinop are characterized by both relatively high ISU and high ISO index values. However, it is worth mentioning that there is no correlation between upgrading and optimization indices when all regions are considered. The three regions with the lowest index values of ISU are TR21 Tekirdağ, Edirne, Kırklareli, TR51 Ankara, and TR71 Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir.

The first three regions with the highest index values of industrial structure optimization are TR90 Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane, TR81 Zonguldak, Karabük, Bartın, and TRA1 Erzurum, Erzincan, Bayburt. Therefore, there is still potential for balanced growth among the industries in these regions. (Zhao et.al, 2022)

Figures A1 and A2 in Appendix show the ISU and ISO indices at the regional level. The regions with relatively high GDP per capita such as TR51 Ankara, TR31 İzmir, TR10 İstanbul, and TR41 Bursa, Eskişehir, Bilecik have lower industrial structure optimization index values indicating that they have relatively balanced growth among various parts of the industry. TRC3 Mardin, Batman, Şırnak, Siirt is among the regions with the lowest GDP per capita, but it has also a low ISO value. In this region, the share of the service sector increased rapidly along with a rising share of employment in that sector. The regions with high ISU index values have more service-oriented regions than industry-oriented.

Özerkek and Didin Sönmez (2021) analyze that there are prominent shifts between service and agriculture sectors in Turkey, except for the regions with relatively high GDP per capita such as TR51 Ankara, TR31 İzmir, TR10 İstanbul, and TR41 Bursa, Eskişehir, Bilecik. In the regions with high income and high shares of industry and services sectors, employment shifts occur between industry and services sectors.

In a nutshell, the findings show that the index of industrial structure upgrading slowly decreases or follows a steady course in many regions (in particular, with the exceptions of regions TRA2 and TRB2). On the one hand, the index of industrial structure optimization follows a fluctuating course for several regions (Figure A2 in Appendix)

4. Concluding Remarks

Upgrading and optimization of the industrial structure have been key concepts in the discussion of industrial structural transformation literature in recent years. With structural transformation, the production factors shift from low productivity sectors to high productivity sectors which improves the productivity level of the whole economy. These, in turn, have important effects

on the process of economic growth and development. This study aims to highlight the basic facts about this process in Turkey by measuring the indices of industrial structure upgrading and optimization. The results indicate that the industrial structure upgrading decreases during 1991-2019 in Turkey. The index of industrial structure optimization has a downward trend signaling a reduction in the imbalances among the parts of the industries. The findings also signal the regional differences in the transformation of industrial structure. This is an initial analysis to fathom the overview of the industrial structure and its evolution with available data. These findings are expected to serve as a preliminary analysis and pave the way for further examinations of industrial structure upgrading and optimization with a more comprehensive perception. These concepts can be analyzed together with the components of sustainable development to help policymakers in implementing policies.

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Appendix

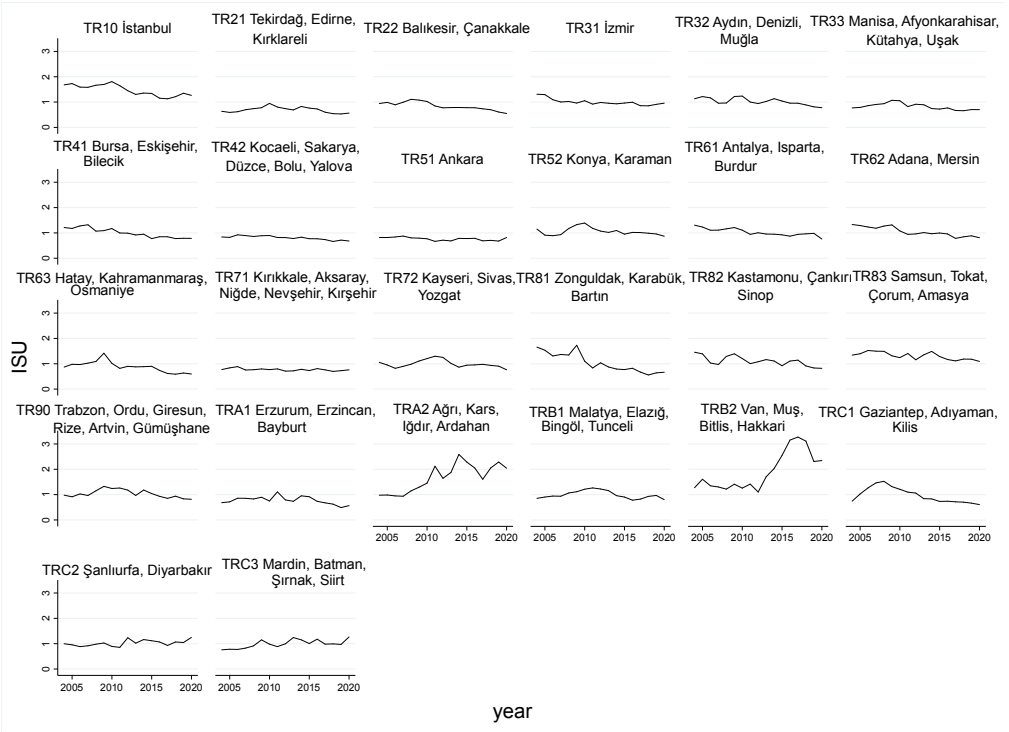

Figure A1: Industrial Structure Upgrading by Regions

Source: Author's own calculations by using data from TURKSTAT (2022).

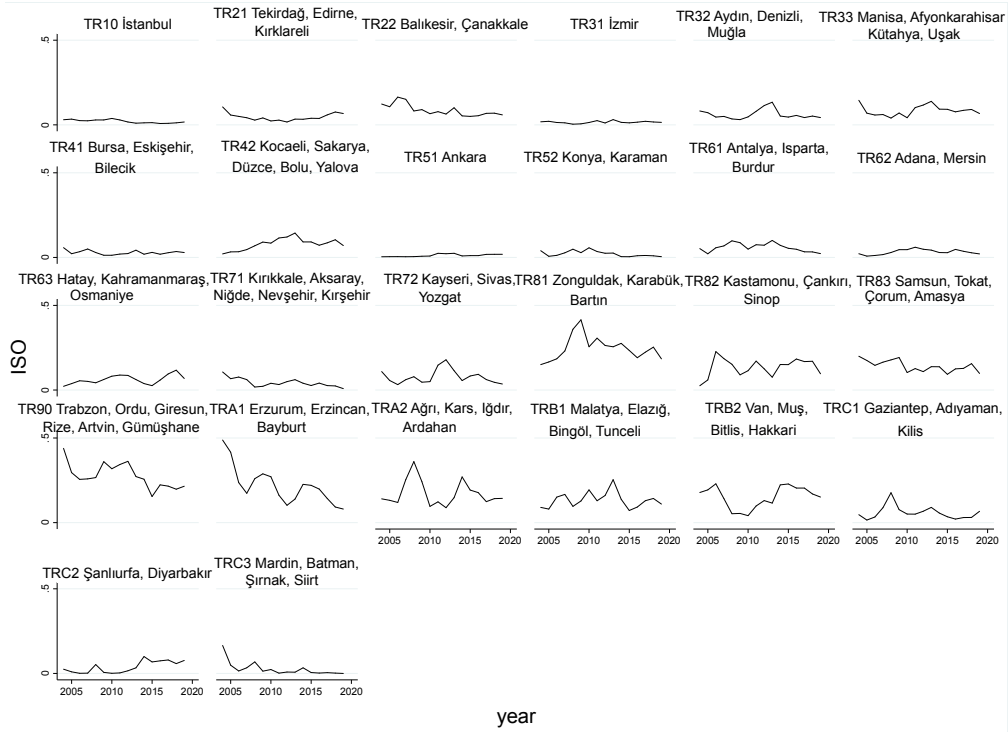

Figure A2: Industrial Structure Optimization by Regions

Source: Author's own calculations by using data from TURKSTAT (2022).