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Article

Identifying the manufacturing industrial clusters in the districts of Türkiye

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ABSTRACT

This article identifies the manufacturing industry clusters in Türkiye and contributes to the literature by identifying clusters at the district level. The literature background of this study is based on the concept of cluster and cluster identification. The study uses the sales and purchases between manufacturing industries via the input-output tables of 24 manufacturing industries and the number of employment and workplaces in each industry at the district level for 2019 as data. The methodology consists of three steps: the study first identifies the purchase and sales relations between industries, then groups related industries using principal component factor analysis, and lastly determines the spatial concentration of industries using the location quotient. The study's findings show manufacturing industries to be grouped into six cluster templates. The districts where industries are clustered are mostly located in the western Türkiye. The textile industry differs because it is clustered in southeast Türkiye. The geographical distributions of the furniture industry clusters and non-metallic industry clusters also differ due to having different location criteria. The packaged food industry is clustered in more districts compared to all other industries except the non-metallic industry, and the districts are located in highly populated provinces. These results place a comprehensive framework across the country and can enable policymakers to direct cluster policies.

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INTRODUCTION

In Türkiye, industry clusters started becoming one of the main policies for regional development after the 2000s in relation to the application process for European Union (EU) membership (Bulu & Yalçıntaş, 2015; Dulupçu et al., 2015). This approach has been supported in the national development plans. The Ninth Development Plan (2007-2013) was the first national plan to use the concept of clusters and to support clustering as one of its strategies (State Planning Organization, 2007). The emphasis on cluster policies was increased in the Tenth Development Plan (2014-2018) and Eleventh Development Plan (2019-2023). The Tenth Development Plan supported clusters by aiming for innovation, competitiveness, collaboration, and better infrastructure (Ministry of Development, 2014), while the Eleventh Development Plan updated the previous aims, increased strategies regarding clusters, and also defined specific sectoral clusters (Presidency of the Republic of Turkey- Presidency of Strategy and

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Budget, 2019). These national strategies and global trends regarding clusters have directed regional and local policies. For example, development agencies have an important role in cluster policy (Bulu & Yalçıntaş, 2015; Dulupçu et al., 2015). Türkiye has 26 development agencies that were established within the EU membership process at the Nomenclature of Territorial Units for Statistics-2 (NUTS-2) level. These agencies' main objectives are to accelerate regional growth based on national aims and targets, organize economic development, develop the coordination of different agents, and diminish regional disparities. On the other hand, development agencies organize regional incentives (Official Gazette, 2006) and also make regional plans in line with the national development plans. Development agencies use these plans to define clusters in the region, determine objectives for clusters, and organize clusters. For example, supporting industrial clusters is one of the main objectives of the İstanbul Development Agency's (2014) regional plan for 2014-2023. The Bursa Eskişehir Bilecik Regional Plan for 2014-2023 also defines objectives for clusters regarding specific sectors (Bursa Eskişehir Bilecik Development Agency, 2014). In addition to regional plans defining clustering objectives, development agencies also organize and finance clusters. For example, the İzmir Development Agency is an agent in the İzmir organic food cluster, the İnoviz health cluster, the İzmir Atatürk Organize Sanayi Bölgesi (İAOSB) machinery metal cluster, and the aeronautics and space cluster (Günaydın, 2013). The Dicle Development Agency (2018) covers the provinces of Batman, Mardin, Siirt, and Şırnak and coordinates and designs the textile cluster project in Batman. Both in the regional plans and projects, development agencies focus on cluster policies, but these policies are bordered by region due to area of authority. Therefore, the need exists for a general framework across the country regarding clusters. Türkiye has some studies that have analyzed the manufacturing industry clusters across the country, and these are mentioned in the literature review. However, these studies analyzed clusters at the provincial level as the lowest unit of size. This study analyzes manufacturing clusters at the district level using updated data, which is the contribution this study makes to the practical aspect of the literature.

After the introduction, this paper presents information on the concept of cluster and both national and international studies on identifying clusters in the literature review in Section 2. Section 3 explains the three-stage methodology and data used in the study. Section 4, discusses the findings using the maps made in ArcGIS Pro. The last section makes general evaluations and provides suggestions for policymakers and further research.

LITERATURE REVIEW: CLUSTER AND CLUSTER IDENTIFICATION

The concept of cluster has a long historical background. Marshall (1920) asserted that firms agglomerate because of positive externalities that he called agglomeration. After the mass production crises in the 1970s, the spatial pattern of production changed (Harvey, 1990), and agglomeration started being discussed again, with the rapid growth of some districts compared to others increasing the interest in this concept. During this period, studies analyzed agglomeration in terms of industrial districts and industrial regions (Becattini, 1990; Lazzeretti et al., 2013). These studies focused on both the economic and non-economic dimensions (e.g., cultural, social, and institutional) of industrial districts (Scott, 2000; Cainelli, 2008; Becattini et al., 2009). Michael Porter (1990; 1998) developed another approach in the literature based on competitiveness and asserted competitive firms to be agglomerated, which he defined as a cluster. The diamond model has been used to describe the dimensions and relations of clusters (Martin & Sunley, 2003; Porter & Ketels, 2009), and this model makes clusters applicable for policies.

Different approaches and relatedly different definitions exist for the concept of cluster. The United Nations Industrial Development Organization (UNIDO, 2001) defined cluster as a sectoral and spatial concentration of complementary entrepreneurs. According to the Organization of Economic Co-operation and Development (OECD, 1999) a cluster is a production network in which strongly connected agents provide added value. Porter (1998) defined the spatial concentration of firms and institutions in a particular field as a cluster. Gordon and McCann (2000) also stated a similar definition with regard to the spatial concentration of related firms.

Even though small differences exist in these definitions, they have two important common points: related industries and spatial concentration. Studies on identifying clusters focus on these two points.

Feser and Bergman (2000) conducted an important study on identifying clusters. They suggested a methodology in which they first defined the relation of industries by analyzing an input-output (I/O) table showing industries' purchases and sales, then they used principal component factor analysis to group the related industries. They analyzed 478 industries in the USA in their study using data from 1987 and found 23 clusters. After defining these industrial clusters, they used a location quotient (LQ) analysis to reveal spatial distributions. Kelton et al. (2008) updated this study using the same method with data from 2002. They found 62 industrial clusters but did not analyze the spatial dimension. Lopes et al. (2010) also followed the same method to analyze the 55 manufacturing industries in Portugal and found nine industrial clusters. Delgado et

al. (2014) again identified industrial clusters in the USA. However, they used similarities in site selection and labor pool in addition to I/O tables. Argüelles et al. (2014) used an I/O table of 65 industries in Spain as well as a hierarchical clustering regarding the principal components. They identified three clusters but did not associate their findings spatially. To analyze the correlation between cluster growth and cluster specialization in Eastern Cape Province, Zeelie and Lloyd (2013) first identified the industrial clusters in South Africa using an I/O table of 90 industries in 2002 and identifying 12 clusters using Ward's hierarchical cluster algorithm. Duque et al. (2009) used the Colombian I/O table and identified 12 clusters, while also benefitting from the network-based approach to analyze the networks among the clusters.

Türkiye has had some studies on identifying clusters across the country. Akgüngör et al. (2003), Akgüngör (2006), and Çelik et al. (2019) used the model Feser and Bergman (2000) had developed. All these studies first identified the relations among industries using an I/O table, then used principal component factor analysis to identify the industrial clusters templates, and finished by calculating the LQ to analyze the clusters spatially. Akgüngör et al. (2003) identified seven industrial clusters at the geographic regional level using data on 64 industries in 1990. Akgüngör (2006) used the same method at the provincial level using data from 1996. Çelik et al. (2019) followed the same method at the NUTS-2 level using data from 2012. Meanwhile, Kaygalak and Reid (2016) used a different methodology to identify industrial clusters at the provincial level, in which they first used the global Moran's I method to analyze global clustering at the national level, then they used the Getis-Ord Gi* statistic to identify local spatial autocorrelations. Kirankabeş and Arik (2014) used the 3-star analysis that is frequently used in the EU. Their study analyzed and compared clusters at the NUTS-2 scale for the years 2008 and 2011.

Of these studies in Türkiye, the lowest geographical scale was at the provincial level. The current study identifies manufacturing industrial clusters at the district level and includes the importance of industries' spatial proximity in the analysis by focusing on a lower geographical scale. This approach is the study's contribution to the empirical area of the literature.

METHODOLOGY AND DATA

The methods for identifying clusters can be categorized as top-down and bottom-up, as in the studies mentioned above. Bottom-up methods are qualitative and cluster-specific, such as surveys and expert opinions. On the other hand, top-down methods analyze a region, a country, or a sector quantitatively based on secondary data to identify clusters, and these methods involve I/O analyses, network analyses, and LQ analyses (Cortright, 2006; Gwosdz & Micek, 2010; Brenner, 2017; Cho, 2014; Duca & Gribincea, 2019; Bergman & Feser, 2020). This study analyzes the manufacturing clusters in Turkish districts and thus applies the top-down method.

The study follows the methodology developed by Feser and Bergman (2000) and used by Akgüngör et al. (2003), Akgüngör (2006), and Çelik et al. (2019). This methodology allows both related industries and spatial concentrations, which are the main characteristics of industrial clustering, to be analyzed.

The methodology consists of three steps. The study first identifies the relations among industries using the I/O table, then groups related industries using principal component factor analysis, and finally defines the LQs of related industries spatially at the district level.

To identify the related industries, the I/O table of the purchases and sales between industries is used. Feser and Bergman (2000) suggested the two metrices of purchases (X) and sales (Y). These are derived as follows:

$$X_{ij} = \frac{a_{ij}}{p_j} \; ; \quad X_{ji} = \frac{a_{ji}}{p_i} \; ; \quad Y_{ij} = \frac{a_{ij}}{s_i} \; ; \quad Y_{ji} = \frac{a_{ji}}{s_j} \qquad (1)$$

where X_{ij} and X_{ij} are the respective purchases by *j* from *i* and by *i* from *j* as a percentage of *j*'s and *i*'s total purchases, and Y_{ij} and Y_{ij} are the respective sales from *i* to *j* and from *j* to *i* as a percentage of *i*'s and *j*'s total sales.

After defining the tables, four correlations are calculated among industries. $r(X_i.X_j)$ is the correlation coefficient between the purchase patterns of *i* and *j*, $r(X_i.Y_j)$ is the correlation between the purchases of *i* and sales of *j*, $r(Y_i.X_j)$ is the correlation between the sales of i and the purchases of *j*, and $r(Y_i.Y_j)$ is the correlation between the sales of *i* and of *j*. Finally, the largest is taken as the relation coefficient between industries *i* and *j*.

Principal component factor analysis is used to group the related industries according to the largest correlation coefficient between industries. Principal factor analysis is a method for grouping those industries in an industrial cluster according to their selling and purchasing similarities (Chu et al., 2010; Cho, 2014). This study performs the principal component factor analysis using the program Statistical Package for the Social Sciences (SPSS). Using varimax rotation as in Feser and Bergman's (2000) study, groups with an eigenvalue greater than 1.0 are evaluated as an industrial cluster template. Taking the eigenvalue greater than 1.0 allows for the optimal number of factors/clusters (Kanyongo, 2005). Feser and Bergman (2000), Akgüngör et al. (2003), Akgüngör (2006), Argüelles et al. (2014), and Çelik et al. (2019) evaluated industries with a loading factor greater than 0.60 as the primary industry in their cluster templates. Similarly, this study evaluates industries with a loading factor greater than 0.60 as the primary industry and others as secondary industries.

After defining the industrial cluster templates, the LQ is used to analyze the spatial agglomeration. LQ analysis is a method for analyzing the regional specialization of an industry. It is the ratio of the regional industry employment's share of the total regional employment to the national industry employment share in the total national employment (Isaksen, 1997; Brachert et al., 2011; Crawley et al., 2012). Besides LQ's common usage, it has two important points with regard to interpreting the results. The first one is that the cut-off value indicates which value shows the clustering or specialization of an industry. The literature has no common cut-off value, it instead varies by case (O'Donoghue & Gleave, 2004; Gwosdz & Micek, 2010; Crawley et al., 2012; Brenner, 2017). For example, it is 3.0 in Malmberg and Maskell (2002) and Isaksen (1996), 1.0 in Held (1996) and Bishop et al. (2003), and 2.0 in Sölvell et al. (2003). This study employs a cut-off value of 1.25, similar to the studies of Feser and Bergman (2000), Akgüngör et al. (2003), Akgüngör (2006), Argüelles et al. (2014), and Çelik et al. (2019). The second important point of the LQ involves the risk in evaluating small regions as being specialized. Small regions with a low number of employees can have a higher LQ, so the cut-off value should have a condition regarding employment (Gwosdz & Micek, 2010; Brenner, 2017; Pominova et al., 2021). In this study, the LQ values are calculated by employment at the district level. Also, this study assumes the districts with less than 50 employees in each industrial cluster template to be non-clustered, and their LQ values are shown to be less than 1.25 in the map legends.

This study uses two datasets. The first is the I/O table for manufacturing industries in 2019. There are 24 industries with NACE Rev.2 2-coded values like C24 - Manufacture of basic metals and the I/O table consists of a 24X24 cell of these industries. The table is available from the Republic of Türkiye's Ministry of Industry and Technology - Entrepreneur Information System. The second dataset involves the employment and number of workplace data of each industry with NACE Rev.2 2-coded values at the district level in 2019. This set was obtained from the Social Security Institution (SSI).

Findings

In 2019, more than 83 million people were living in Türkiye. According to data obtained from SSI, Türkiye had 16.332.069 employees and 1,.20.019 workplaces in 2019. The manufacturing industry took up 25.6% (4.84.756) of the total employment and 14.6% of the total workplaces (281.266). The manufacturing industry also was responsible for 16% of the gross domestic product (GDP) (48.988 million $ / 307.659 million $) in 2019 (Central Bank of Türkiye [TCMB], 2022).

To define the cluster templates, the principal component factor analysis is used for 24 industries according to the purchase and sale relations between two coded industries. The results revealed six factors (i.e., clusters). The six clusters are identified in Table 1 according to the primary and secondary industries. The primary industries have a loading factor greater than 0.60, and secondary industries have a loading factor less than 0,60.

The metal industry and electrical equipment have the most employees and workplaces. The manufacture of electrical equipment is one of the primary industries in this cluster, in addition to metal products and machinery equipment. The textile industry is also another dominant industry cluster template in the Turkish manufacturing industry. The non-metallic industry template, which is mainly a stone-based industry, has the lowest number of employees and workplaces (Table 2).

The maps for the industrial cluster template regarding LQ at the district level were mapped using Arc-GIS Pro. Türkiye has 970 districts. In order to interpret the clusters, the provinces are coded on the maps. The provinces and codes are given in Appendix 1.

For the metal industry and electrical equipment, 108 of 970 districts (11%) are specialized. Three regions are prominent, and they are close to the most populated and industrialized provinces. The first one is a corridor from Bursa (Province #16) to Sakarya (#54) through Kocaeli (#41). These provinces alongside İstanbul (#34) are among the most populated provinces. Automotive and related industries are agglomerated in this region, which has different types of transportation modes, including ports. This corridor also has a connection to the corridor starting from Eskişehir (#26). The second region includes the districts in İzmir (Province #35) and Manisa (#45). İzmir (#35) is the third most populated province, and Manisa (#45) is mostly linked economically to İzmir (#35). They may be described as a pole of manufacturing industries along the western edge. The third region is Ankara (#6) the capital of Türkiye and the second most populated province. Alongside Ankara (#6), the districts around Çankırı (#17) and Kırıkkale (#71) are also specialized in metal industry and electrical equipment. Especially in Ankara (#6) high population, wide labor pool, main transportation connections, historical development process, and having universities, and techno parks are the main dynamics of the metal industry and electrical equipment firms (Ankara Development Agency, 2014) (see Figure 1).

Of the 970 districts, 246 (25%) are specialized in the packaged food industry. The number of specialized districts in the packaged food industry is much higher than in the metal industry and electrical equipment. The specialized districts are generally dispersed, but some are located near highly populated provinces due to the high rate of consumption.

Table 1. Summary of the Principal Component Analysis Results

Cluster Definition	Industries	Industry type	Eigenvalue	Variance (%)	Cumulative variance (%)
Metal industry and	C24 - Manufacture of basic metals	Primary	7.4528	22.4845	22.4845
electrical equipment (1)	C25 - Manufacture of fabricated metal products, except machinery and equipment	Primary			
	C27 - Manufacture of electrical equipment	Primary			
	C28 - Manufacture of machinery and equipment n.e.c.	Primary			
	C29 - Manufacture of motor vehicles, trailers and semi-trailers	Primary			
	C26 - Manufacture of computer, electronic and optical products	Secondary			
	C30 - Manufacture of other transport equipment	Secondary			
	C33 - Repair and installation of machinery and equipment	Secondary			
Packaged food industry (2)	C10 - Manufacture of food products	Primary	3.6563	15.9295	38.4140
	C12 - Manufacture of tobacco products	Primary			
	C17 - Manufacture of paper and paper products	Primary			
	C18 - Printing and reproduction of recorded media	Primary			
	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	Secondary			
Textile industry (3)	C13 - Manufacture of textiles	Primary	3.5933	14.1860	52.6001
	C14 - Manufacture of wearing apparel	Primary			
	C32 - Other manufacturing	Primary			
Chemical industry (4)	C19 - Manufacture of coke and refined petroleum products	Primary	2.0764	11.2148	63.8148
	C20 - Manufacture of chemicals and chemical products	Primary			
	C22 - Manufacture of rubber and plastic products	Primary			
	C15 - Manufacture of leather and related products	Secondary			
Furniture industry (5)	C16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Primary	1.8590	9.8163	73.6311
	C31 - Manufacture of furniture	Primary			
Non-Metallic industry (6)	C11 - Manufacture of beverages	Primary	1.1940	9.0016	82.6327
	C23 - Manufacture of other non-metallic mineral products	Primary			

The region that includes Edirne (#22), Kırklareli (#39), Tekirdağ (#59), Çanakkale (#17), and especially Balıkesir (310) shows the clustering of the packaged food industry. This also applies to the region that includes Bursa (#16) and Bolu (#14). This same pattern can be seen in İzmir (#35), Manisa (#45), and Aydın (#9). Besides being near

Table 2. Employment and Workplace Distributions Based on Clusters, 2019

Clusters	Employment		Workplace	
	Number	Rate (%)	Number	Rate (%)
Metal industry and electrical equipment (1)	1.488.716	35.57	91.390	32.49
Packaged food industry (2)	658.403	15.74	57.086	20.30
Textile industry (3)	1.165.161	27.84	61.070	21.71
Chemical industry (4)	398.804	9.53	25.413	9.04
Furniture industry (5)	241.376	5.77	31.559	11.22
Non-Metallic industry (6)	232.296	5.55	14.748	5.24
Total	4.184.756		281.266	

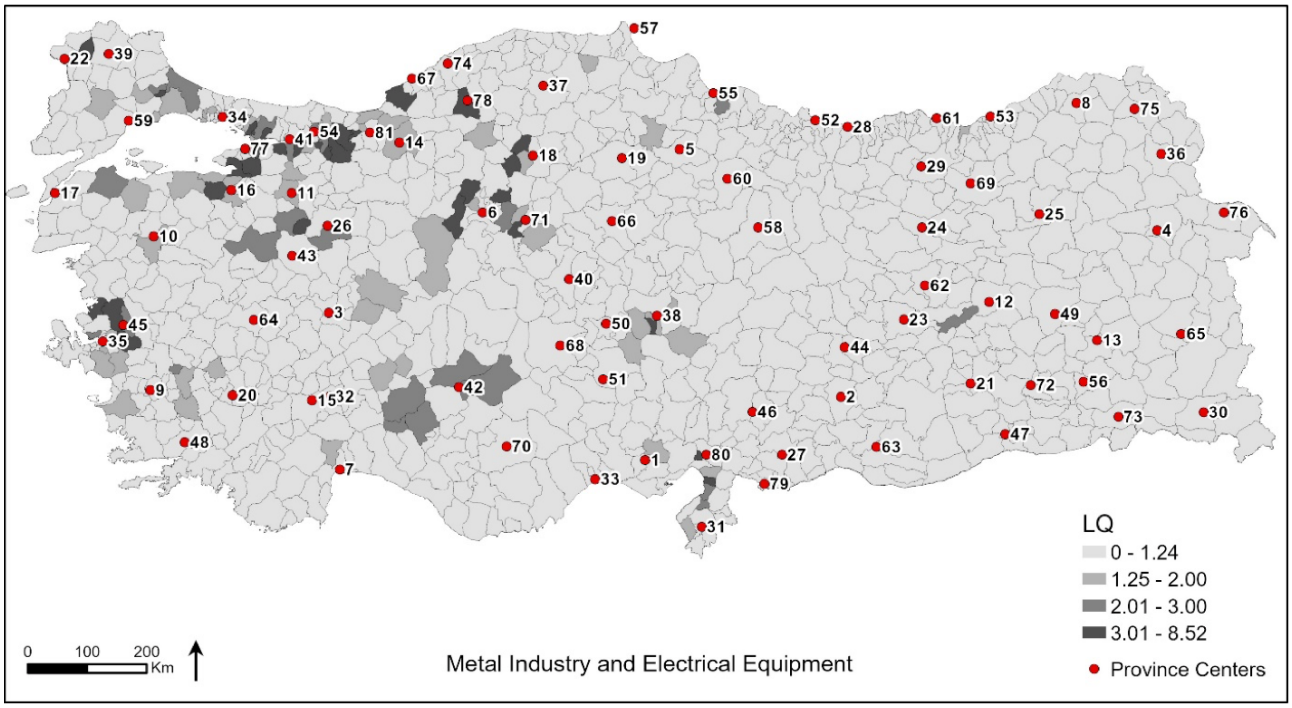

Figure 1. LQ map of metal industry and electrical equipment (Created by the author based on data from SSI- 2019).

highly populated provinces, plenty of fertile agricultural land, livestock, and demand for organic food are important for firms to locate in these provinces (İzmir Development Agency, 2014; South Marmara Development Agency, 2014; Trakya Development Agency, 2014). The map shows an additional two important regions. The first one started from the south in Karaman (#70) going north to Samsun (#55). This region has fertile soil, and agricultural production is converted to a final product through agricultural industries (agro-industries). The second region is in the north, going from Samsun (#55) to Artvin (#8). The industrial districts in this region occur primarily along the shoreline. The specific agricultural product like tea, hazelnut, and agriculture production from forestry called agroforestry attracts packaged food industry firms (Eastern Black Sea Development Agency, 2014) (see Figure 2).

Of the 970 districts, 166 (17%) are specialized in the textile industry. Unlike the packaged food industry, the textile industry clusters are not related spatially to the most populated provinces. Another difference is that the textile industry clusters are especially distinct in the southeast. Districts around Kahramanmaraş (#46), Gaziantep (#27), and Malatya (#44) are specialized in this region. The region including these provinces has high cotton production that attracts the firm to locate in this region (Eastern Mediterranean Development Agency, 2014; Silkroad Development Agency, 2014). Also, the region including Diyarbakır (#21), Batman (#72), and Mardin (#47) shows specialization. These provinces have relatively low industry employment, so having relatively high employment in the textile industry makes it specialized. The textile industry requires relatively low-skilled labor (Yülek et al. 2019), therefore this industry

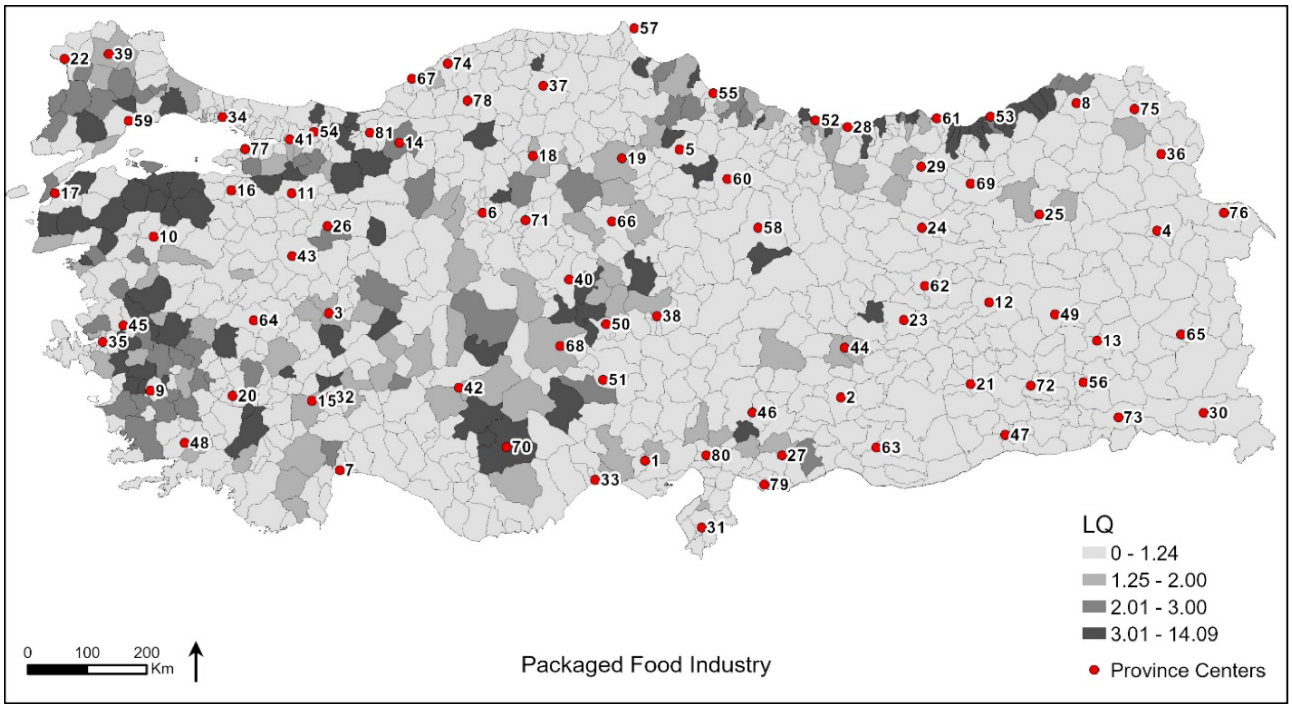

Figure 2. LQ map of packaged food industry (Created by the author based on data from SSI- 2019).

can be specialized in regions with comparatively low industrial development. Specialized districts are dispersed in northern Türkiye. Western Türkiye can be seen to have two regions. The first one includes Denizli (#20) and Uşak (#64). The textile industry has a historical background in these provinces, especially in Denizli (#20). The second region includes districts in Edirne (#22), Kırklareli (#39), and Tekirdağ (#59). The development of the textile industry is mainly related to the deindustrialization of İstanbul (#34) (see Figure 3).

The chemical industry is specialized in 112 (12%) of the 970 districts. The clusters of this industry show spatially similar patterns to the metal industry and electrical

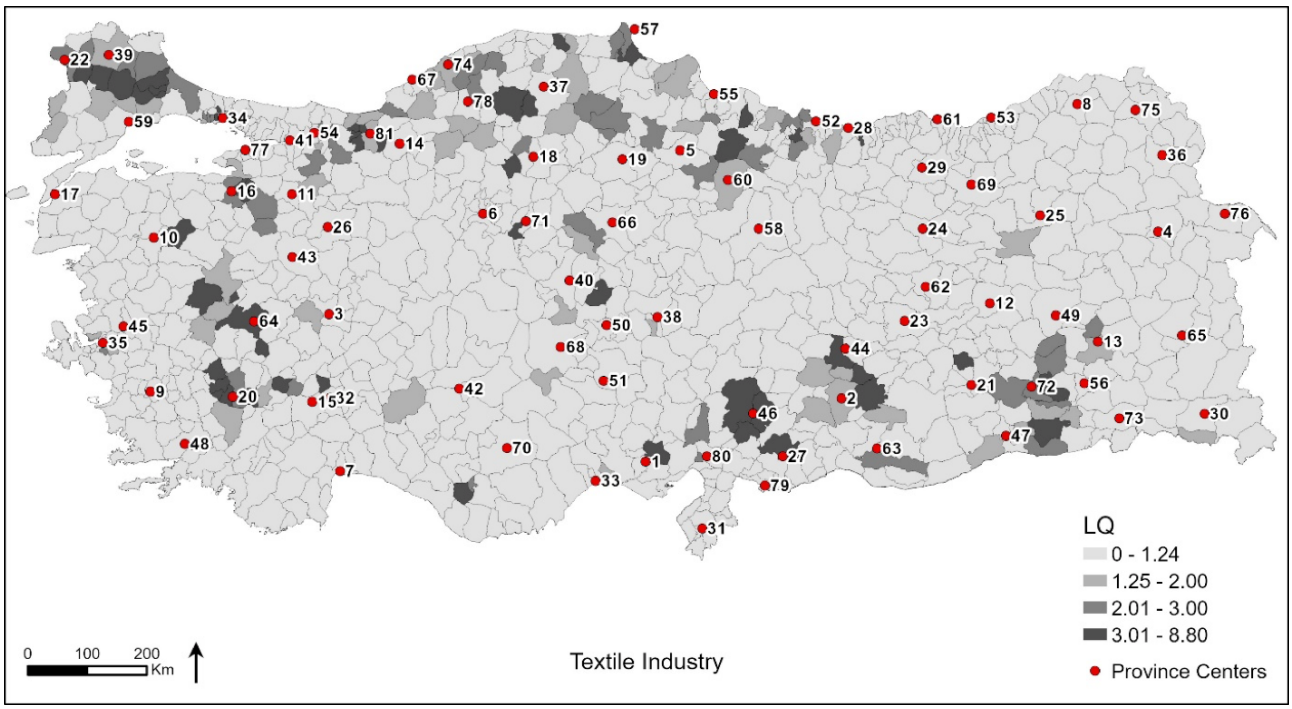

Figure 3. LQ map textile industry (Created by the author based on data from SSI- 2019).

equipment. The region from Kocaeli (#41) to Düzce (#81) as well as the region including İzmir (#35) and Manisa (#45) are specialized. Both these regions have refineries and related industries. Another region includes the districts between İstanbul (#34) and Tekirdağ (#59). This region is also specialized in the textile industry and, in relation to this, has textile dyeing industries. As with textile industry, southern Türkiye has chemical industry clusters in the districts around Kahramanmaraş (#46) and Gaziantep (#27). As in Tekirdağ (#59) these provinces has dyeing industry related to textile (Eastern Mediterranean Development Agency, 2014; Silkroad Development Agency, 2014). As well as other local clusters around Konya (#42) because of dyeing, rubber, and plastic for supplying the automotive industry (Mevlana Development Agency, 2014); and it is similar for Eskişehir (#26) in which the chemical industry supplies the automotive and military industries in the region (Bursa Eskişehir Bilecik Development Agency, 2014) (see Figure 4).

Of Türkiye's 970 districts, 161 (17%) are specialized in the furniture industry. The location criteria of firms in this industry are mostly related to being near raw material sources. Therefore, regions in northern Türkiye where forests cover a large percentage of land in particular are prominent. The districts around Kastamonu (#37), Zonguldak (#67), Karabük (#78), and Sakarya (#54) are where the clusters of the furniture industry are found. The corridor from Antalya (#7) to Balıkesir (#10) through Uşak (#64) also shows clustering characteristics for the furniture industry. On this corridor, the forest asset is distinctive, so the forest industries select this corridor to be near the raw material sources (West Mediterranean Development Agency, 2014; South Marmara Development Agency, 2014) (see Figure 5).

The non-metallic industry has the greatest number of specialized districts at 275 (28%) of the 970 districts. This cluster is spread out across the country. As in the furniture industry, the non-metallic industry that is generally stone based has a tendency to be located near raw material sources. The specialized districts are mostly located in western Türkiye. The corridor starting from Afyon (#3) and finishing at Bilecik (#11) and connected to İzmir (#35) and Muğla (#48) through Uşak (#64) has a strong non-metallic industry presence. Central Türkiye has specialized districts going south to north. The most important difference between the non-metallic industry cluster and the other five industries is eastern Türkiye has many districts specialized in non-metallic industry (see Figure 6).

CONCLUSION

This study has attempted to meet the need for identifying the manufacturing industry clusters across Türkiye and differs from other studies in Türkiye by analyzing these clusters at the district level.

The results show that manufacturing industries can be grouped into six cluster templates with respect to their buying and selling relations. These clusters differ spatially. In general, the manufacturing industry clusters are seen to

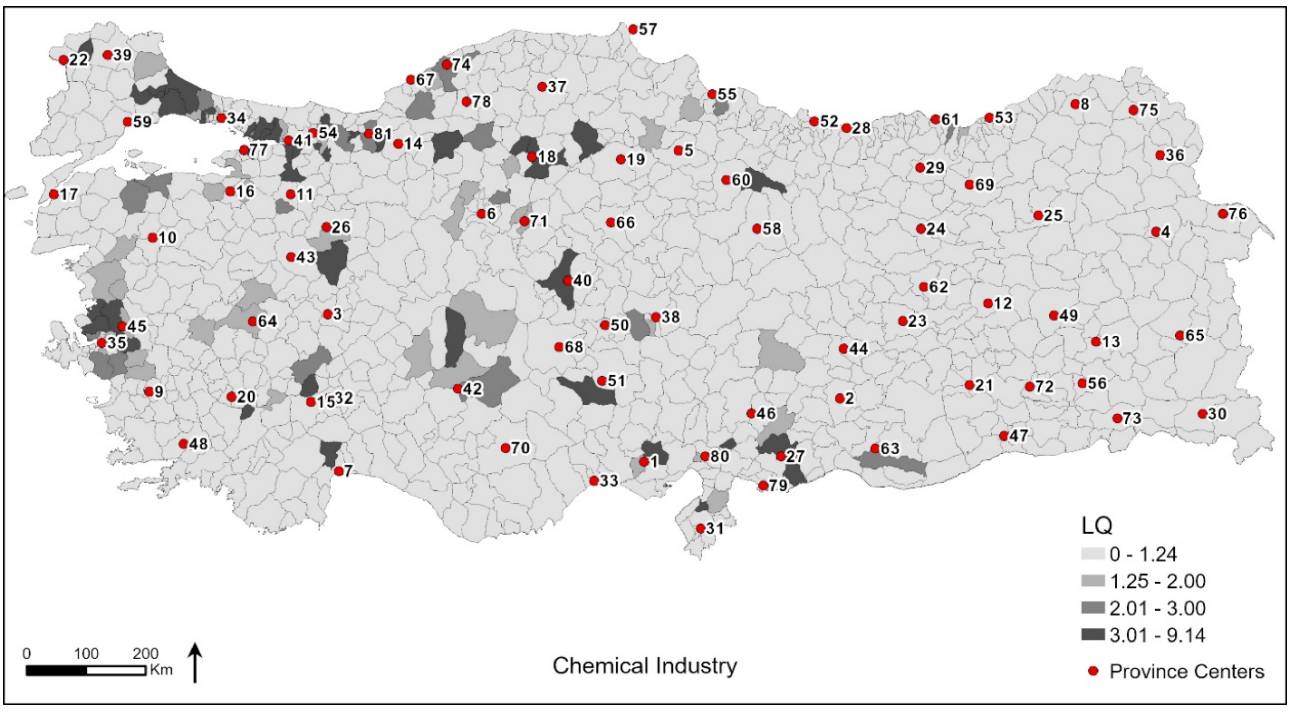

Figure 4. LQ map chemical industry (Created by the author based on data from SSI- 2019).

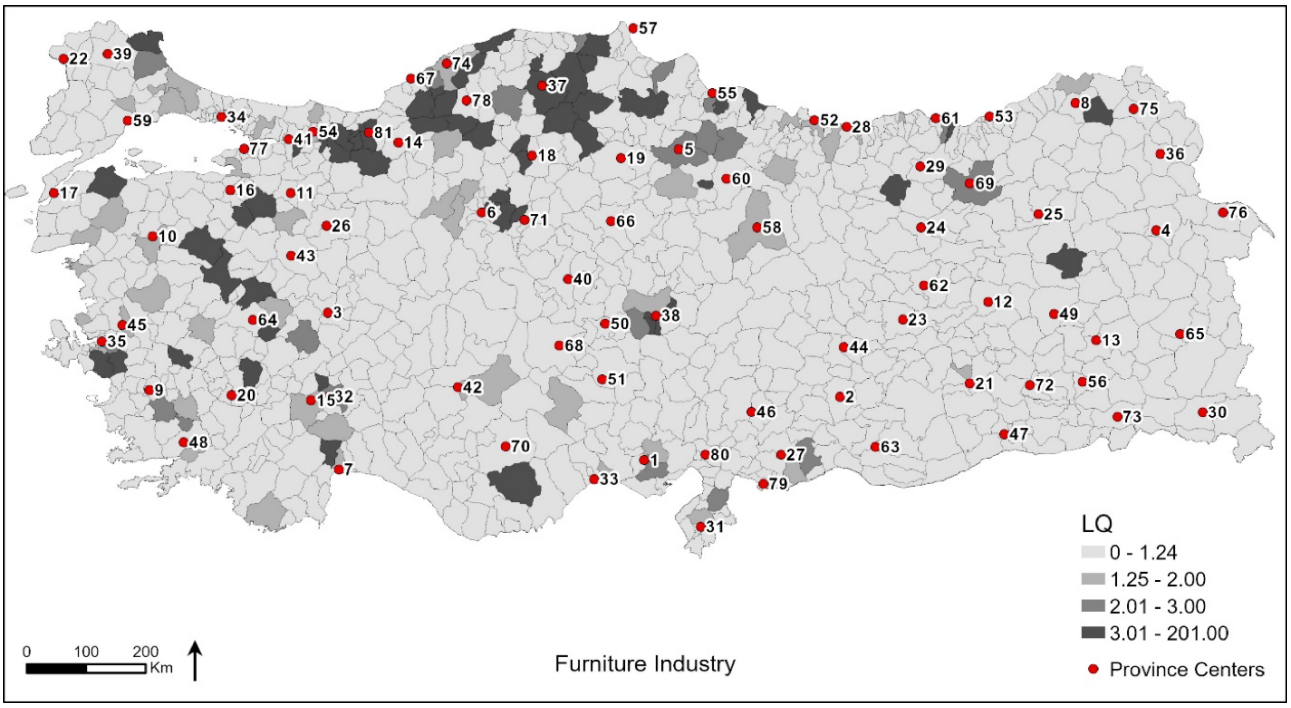

Figure 5. LQ map furniture industry (Created by the author based on data from SSI- 2019).

be mostly located in western Türkiye. Figure 7 shows the number of industries clustered in districts, with districts in western Türkiye, especially around Sakarya (#54), Kocaeli (#41), Bursa (#16), İstanbul (#34), İzmir (#35), and Manisa (#45) to be specialized in more than one industry. The same applies to the districts around Antalya (#7), Konya (#42), Adana (#1), Gaziantep (#27), Kahramanmaraş (#46), Ankara (#6), and Samsun (#55), with 107 districts (11%) that are specialized in more than two industries; these districts are located generally around these provinces, which are the more populated and industrialized provinces in Türkiye.

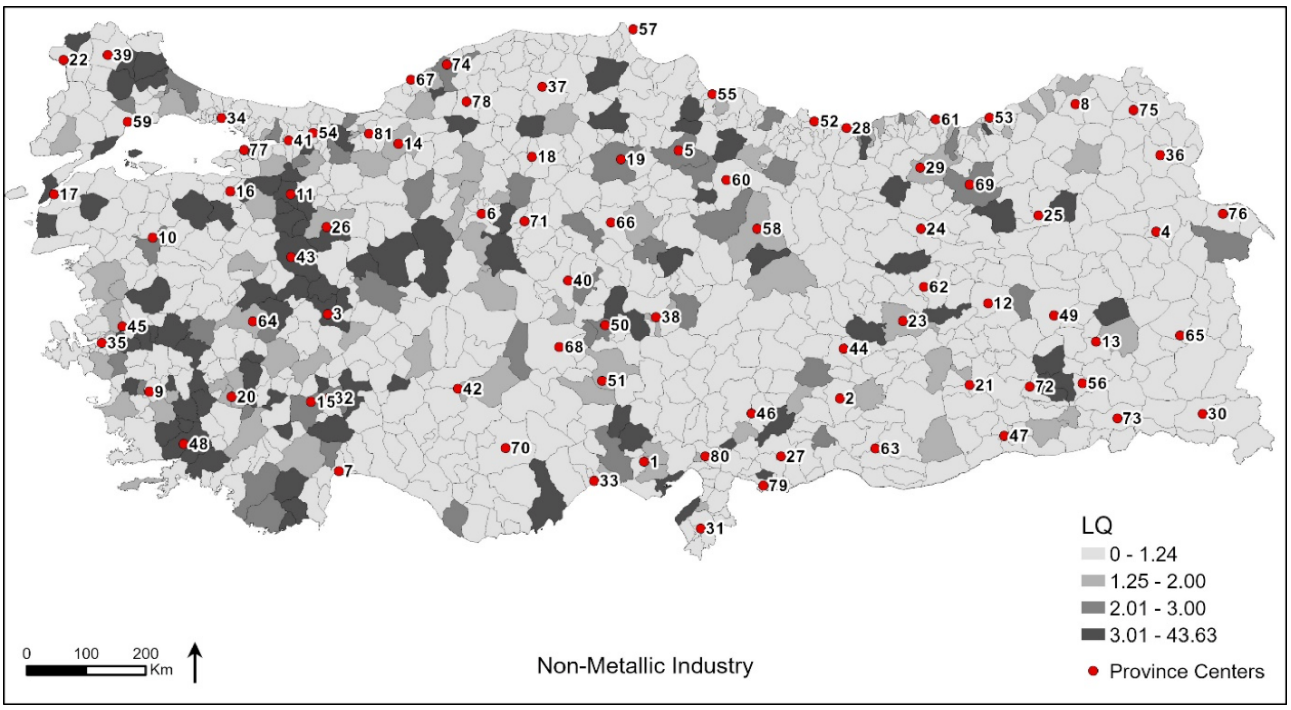

Figure 6. LQ map of non-metallic industry (Created by the author based on data from SSI- 2019).

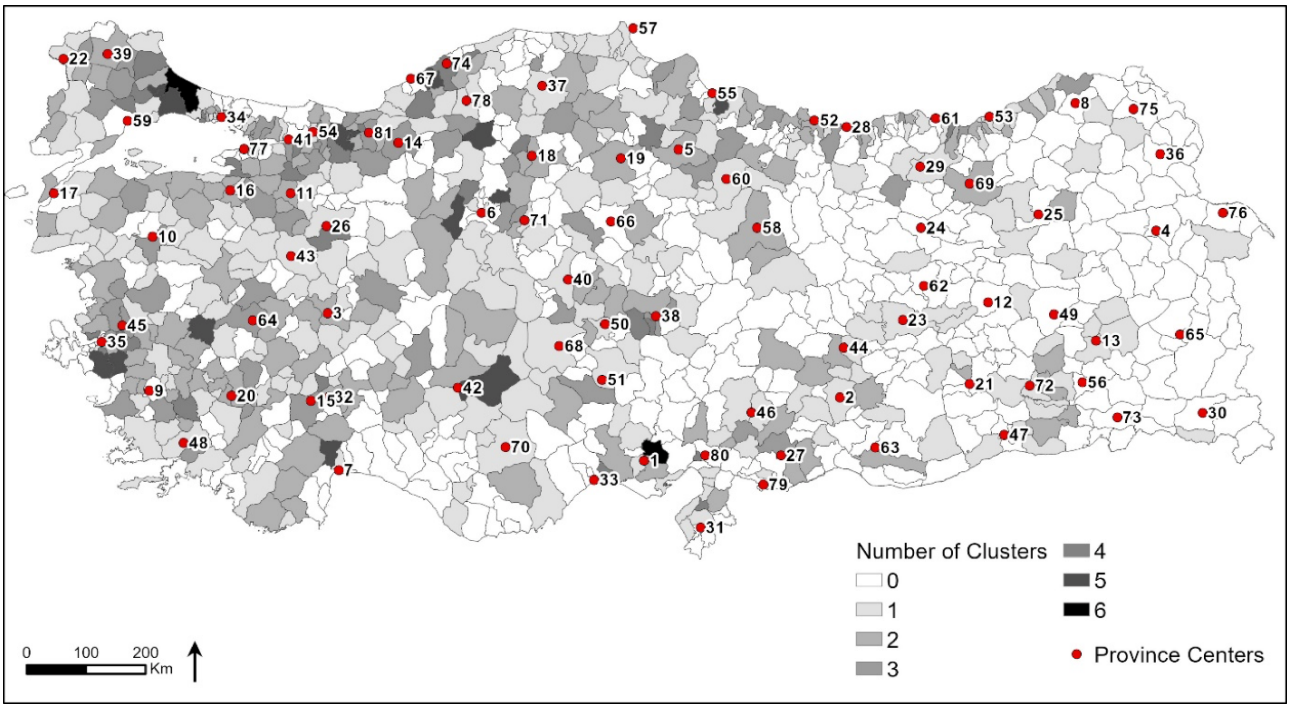

Figure 7. The number of industries clustered in the districts of Türkiye (Created by the author on data from SSI- 2019).

The spatial distribution of the metal industry and electrical equipment clusters show a similar pattern to that of the chemical industry clusters. The furniture industry clusters are generally near the raw materials. This is also the same for the non-metallic industry clusters, but more districts are specialized in this industry, and these districts are spread throughout the country. The packaged food industry clusters are near highly populated provinces to be near market area. The textile industry differs from other industries in that it has more clusters in southeastern Türkiye, because as mentioned before, the production of material used in textile industry is high in this region, and having relatively lower industrial employment makes the textile industry which does not require high-skilled labor, specialized in this region.

This study draws a picture of the manufacturing industrial clusters at the district level across Türkiye. This may help institutions, including development agencies, rethink their cluster policies and can provide a framework for organizing new cluster policies and projects. This picture may also provide a basis for where to direct incentives and investments with respect to the industries.

The results of the study differ from the studies made for Türkiye. This study gives a detailed spatial distribution because of focusing on the district level. For example, for the textile industry, Kaygalak and Reid (2016) found the spatial concentration around İstanbul (#34), Manisa (#45) and Kahramanmaraş (#46), Gaziantep (#27). This study shows that the textile industry does not concentrate on all districts in these provinces. For example, in İstanbul (#34) Kahramanmaraş (#46), and Gaziantep (#27) the districts that are the center of the provinces are dominant (Figure 7). Also, it was revealed that there are districts that have textile industry clusters in the northern part. For another example, Çelik et al. (2019) define the cluster at the regional level, and this study shows that the region TR 50 including Konya (#42) and Karaman (#70) has automotive clusters that have C28 (Manufacture of machinery and equipment n.e.c.) and C29 (Manufacture of motor vehicles, trailers, and semi-trailers) industries. These industries are in the metal industry and electrical equipment industries cluster in this study. Figure 7 shows that the center districts of the Konya (#42) have metal industry and electrical equipment industries clusters, and the other districts do not have the same pattern. Also, the districts in this region have packaged food industry clusters.

The findings from this research should be supported by cluster-specific studies using the bottom-up methodologies mentioned in the methodology section. This research has used inter-industry relations and spatial proximity for identifying the cluster, as has been done in studies that use a top-down methodology; however, clusters have more dimensions, such as social networks, traded and untraded interdependencies, cooperation, competition, factor conditions, demand conditions, and institutions. These can also be analyzed through cluster-specific studies by applying bottom-up methodologies in future research.

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Appendix 1. The provinces and codes.

Province	Code	Province	Code	Province	Code
Adana	1	Giresun	28	Samsun	55
Adıyaman	2	Gümüşhane	29	Siirt	56
Afyon	3	Hakkari	30	Sinop	57
Ağrı	4	Hatay	31	Sivas	58
Amasya	5	Isparta	32	Tekirdağ	59
Ankara	6	Mersin	33	Tokat	60
Antalya	7	İstanbul	34	Trabzon	61
Artvin	8	İzmir	35	Tunceli	62
Aydın	9	Kars	36	Şanlıurfa	63
Balıkesir	10	Kastamonu	37	Uşak	64
Bilecik	11	Kayseri	38	Van	65
Bingöl	12	Kırklareli	39	Yozgat	66
Bitlis	13	Kırşehir	40	Zonguldak	67
Bolu	14	Kocaeli	41	Aksaray	68
Burdur	15	Konya	42	Bayburt	69
Bursa	16	Kütahya	43	Karaman	70
Çanakkale	17	Malatya	44	Kırıkkale	71
Çankırı	18	Manisa	45	Batman	72
Çorum	19	Kahramanmaraş	46	Şırnak	73
Denizli	20	Mardin	47	Bartın	74
Diyarbakır	21	Muğla	48	Ardahan	75
Edirne	22	Muş	49	Iğdır	76
Elazığ	23	Nevşehir	50	Yalova	77
Erzincan	24	Niğde	51	Karabük	78
Erzurum	25	Ordu	52	Kilis	79
Eskişehir	26	Rize	53	Osmaniye	80
Gaziantep	27	Sakarya	54	Düzce	81