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Research article

Contribution of small and medium enterprises to economic development and quality of life in Turkey

Ceren Erdin, Gokhan Ozkaya *

Yildiz Technical University, Faculty of Economics and Administrative Sciences, Department of Business Administration, Turkey

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ABSTRACT

All successful cities are the most developed and productive cities in their regions and countries in terms of economy and quality of life. In addition, it is observed that there are strong industries and enterprises in these regions and cities. Therefore, this study tries to evaluate the quality of life and the development of the industry together. The proposed method can be considered as a combination of operational research and GIS (Geographical Information System). The results of both approaches support each other. In addition, the innovative approaches of the sectors are evaluated by TOPSIS (Technique for Order Preference by Similarity to Ideal Solution). Also, the article recommends SMEs (Small and Medium-Sized Enterprises) for sustainable economic growth. According to the results, the quality of life and socio-economic development has a very close relationship with the existence of investments and manufacturing companies. If the current development policy continues, the regions with low quality of life will continue to lag behind the other cities in terms of development. The study indicates that there are remarkable differences between eastern and western Turkey in terms of living standards and the contribution of SMEs to economic development.

1. Introduction

The share of industrial activities in the economy increased with the improvements in production infrastructure and capacity after the industrial revolution. As a result, the focus of the economy has shifted from rural to urban areas. It has also radically changed the structure and content of urban economic activities. This new economic system in cities created a new form of social life and relationship. Cities have become settlements with greater populations than ever before. This has caused inequalities, social conflicts, and poor living conditions. The word "city" has started to be defined with these negative concepts. Therefore, governments and politicians have prepared new arrangements and urban projects to improve the living conditions in the cities. Urbanization has become a new branch of politics and science.

CNBC-e-Business Magazine has investigated the quality of life of Turkey's 81 cities and ranked them between 2008 and 2011. The first study was conducted using 28 criteria in 2008 and the last study was conducted using 37 criteria in 2011 (Mavi, 2011). The article tries to evaluate the criteria of this study and the data of TurkStat (2016) by using multi-criteria decision making methods.

SMEs are the catalyzer of the economy of Turkey as well as in other developed and developing countries. As they have more flexible production opportunities compared to large enterprises, they adapt to the changes in demand in a short time and reach full competition conditions quickly. Thus they contribute to national income, employment, productivity and entrepreneur training. The unemployment rate in Turkey is 14.1% (TurkStat, 2019a). SMEs are the main actor in increasing employment. Therefore, SMEs are seen as a key element in achieving the “growth” and “employment” targets. Approximately 26 million SMEs operating within the EU provide employment for 109 million people and constitute 2/3 of the European Gross National Product. In addition, SMEs contribute greatly to the improvement and usage of new technologies

* Corresponding author.
E-mail address: gozkaya@yildiz.edu.tr (G. Ozkaya).

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due to their innovative and flexible structures. SMEs have special importance for the EU's economy. Therefore, the European Union supports SMEs in order to preserve its flexible and innovative structures and use them as a competitive element (EuroStat, 2019).

Determining the development of a region and comparing it with others is a multi-criteria decision making (MCDM) problem. Thus, it requires evaluation of many conflicting criteria (Erdin and Özkaya, 2017; Forman and Selly, 2001). When MCDM methods are classified according to their different purposes, the TOPSIS method is recommended in order to determine the best option and rank (Erdin and Özkaya, 2017; Ozkaya, 2017). As a result of the analyzes performed over the years, the most appropriate MCDM methods were determined according to the type of problem (Erdin and Ozkaya, 2019). Also, there are many studies using GIS to evaluate the location of investment. Some of these are summarized as follows: Safian et al. (2018) recommended a GIS-based decision--making approach in order to evaluate the sustainable business location for purpose-built offices in Malaysia. Fisher, Glaeser, and Su (2016) o offered an empirical methodology and application to decide the optimal retail location. Fraser, Chester, and Eisenman (2018) suggested a decision approach based on GIS to determine the strategic location of refuges for extreme heat events (or heat waves). Church and Murray (2009) proposed a GIS and optimization approach to select suitable locations for business. Dodson, Agadjanian, and Driessen (2017) used a method including descriptive statistics, PCA, location-allocation analysis, and GIS in order to decide the location of health services. Gwak, Lee, Lee, and Sohn (2017) used GIS to select the optimal location for the installation of urban green roofs considering honeybee habitats.

In addition, there are many similar articles in terms of the subject. Kubickova, Croes, and Rivera (2017) investigated the relationship between tourism competitiveness and quality of life in developing economies. Craglia, Leontidou, Nuvolati, and Schweikart (2004) reviewed the comparable indicators of the quality of life to monitor development and policy implementation. Morais, Miguéis, and Camanho (2013) provided an assessment of the urban quality of life (QoL) of European cities from the perspective of qualified human resources. Also, they stated that the competitiveness of cities relies on their potentials that attracts highly educated workers. Because they are important assets for firms when choosing a location. Turkoglu (2015) evaluated the sustainability and quality of life concept based on quality of life (QoL) researches. Environmental, economic, social, physical and health-related indicators were discussed to contribute to the sustainable development strategies. Arifwidodo and Perera (2011) explore whether Quality of Life (QOL) corresponds to the spatial pattern of urban system as a result of compact development policy practice in Bandung city. Therefore, it examined the connection between QOL and selected attributes of compact development. Easterlin and Angelescu (2012) resented a survey and an empirical relation between quality of life and modern economic growth. Peterson and Ekici (2007) tried to understand the relationship between Consumer Attitude toward Marketing (CATM) and the quality of life (QOL) in a developing country.

In this study, regions, and cities are analyzed in terms of quality of life. The existing investment and industrial capacities of the regions are compared with these results. It also seeks to determine whether there is a significant difference between cities in terms of development and quality of life. In addition, the innovation performance of the sectors is evaluated by the TOPSIS method.

The rest of the study is organized as follows: Section 2 gives some information about SMEs. Section 3 explains the proposed methods. Section 4 presents the obtained results. Section 5 presents discussions and section 6 presents the conclusion.

2. SMEs (small and medium-sized enterprises)

The great unemployment crisis in the 1980s led policymakers to concentrate on small and medium-sized enterprises in the member countries. It was thought that large enterprises' production, employment, and investment problems could be solved by taking advantage of SMEs. SMEs were handled with sensitivity in all economic arrangements, incentive policies and legislative implementations made after 1990. In the European Research Area (ERA) framework programs, SME support and grant funds were increased every four years. They were € 3.6 billion in the 6th Framework Program, € 7.0 billion in the 7th Framework Program, approximately € 9.5 billion in the 8th Framework Program and € 12 billion in the 9th Framework Program ((ERA), 2018). In addition, every European country has its own incentive and support programs for SME enterprises.

The contribution of SMEs to the economy is generally gathered under five main topics: employment creation; fast adaptation to new situations with its flexibility feature; encouraging entrepreneurship; product differentiation through boutique production; working as sub-industry in

Table 1. Distribution of firms by cities (KOSGEB, 2016) (created by authors).

Cities	Number of firms		Number of employees	
	Number	%	Number	%
Istanbul	558.285	19,3	4.234.002	28,7
Ankara	211.165	7,3	1.312.983	8,9
Izmir	196.701	6,8	1.135.952	7,7
Bursa	124.384	4,3	767.136	5,2
Antalya	109.921	3,8	501.159	3,4
Konya	98.351	3,4	354.063	2,4
Adana	75.209	2,6	354.126	2,4
Mersin	72.317	2,5	295.052	2
Balıkesir	57.853	2	280.300	1,9
Manisa	60.746	2,1	265.547	1,8
Muğla	52.068	1,8	236.042	1,6
Aydın	54.961	1,9	235.993	1,6
Kocaeli	54.960	1,9	235.993	1,6
Gaziantep	54.960	1,9	368.815	2,5
Samsun	52.068	1,8	265.166	1,8
Denizli	49.175	1,7	221.289	1,5
Hatay	53.390	1,5	177.031	1,2
The other cities	971.941	33,6	3.573.933	24,2
Total	2.892.670	100	14.752.620	100

Table 2. Goals in total fixed capital investments of public (Development, 2019) (created by authors).

Sectors	11th Development Plan Period (2019–2023)	
	Million Turkish Lira	(%) Share
Agriculture	46.032	6,1
Mining	24.008	3,2
Production	5.989	0,8
Energy	39.772	5,2
Transportation	262.343	34,8
Tourism	1.921	0,3
Housing	8.521	1,1
Education	144.280	19,1
Health	32.229	4,3
Other Public Services	188.973	25,1
Technological research	35.176	4,7
Total	754.068	100

Table 3. Science, Technology and Innovation Goals (Development, 2019) (created by authors).

	2018	2023
Ratio of R & D Expenditures to GDP (%)	0,98	1,8
Number of Full Time Equivalent (FTE) R&D Staff	153.552	300.000
Number of PhD and Over FTE R & D Personnel per Million	352	863

large enterprises. Among all these features, the most important feature of SMEs is their contribution to employment. In general, SMEs using labor-intensive production techniques are extremely important in terms of social as well as economically. According to the statistics of employment in EU countries (in 2016, %), although SMEs constitute 9.63% of total enterprises, they provide 45.18% of employment. SMEs have a share of 48.54% in the manufacturing industry and constitute 46.09% of the employment. In 2016, the total number of employment of SMEs was 83.6 million. The share of this sector in the total manufacturing industry is 42.5% (Statista, 2017). Therefore, SMEs in the manufacturing industry have an important place in terms of employment.

Distribution of firms by cities and their employment rates are given in Table 1. The cities that have the highest number of firms are Istanbul, Ankara, Izmir, Bursa, Antalya, and Konya. While 43.9% of total enterprises operate in these six cities, 56.3% of total employees are also employed in these cities (KOSGEB, 2016).

Small and medium-sized industrial enterprises constitute 99.4% of the enterprises operating in the manufacturing industry. The share of SMEs in production is 56.2%. While SMEs employee 61.5% of employment, they only contribute 27.6% of the added value. The number of employees per SME enterprise is 8.8 (KOSGEB, 2016).

When Table 2 and Table 3 are analyzed, Turkey's public fixed capital investments, R&D and innovation investments, and budgets are far behind the EU countries and developed countries. The share of SMEs in exports was 56.2% in 2018 and the goal for 2023 is 60%. Moreover, the share of SMEs in R&D expenditures is 19.6% and the goal for 2023 is 25% (Development, 2019). In this context, the distribution of project applications by cities is shown in Figure 1 (TUBITAK, 2018).

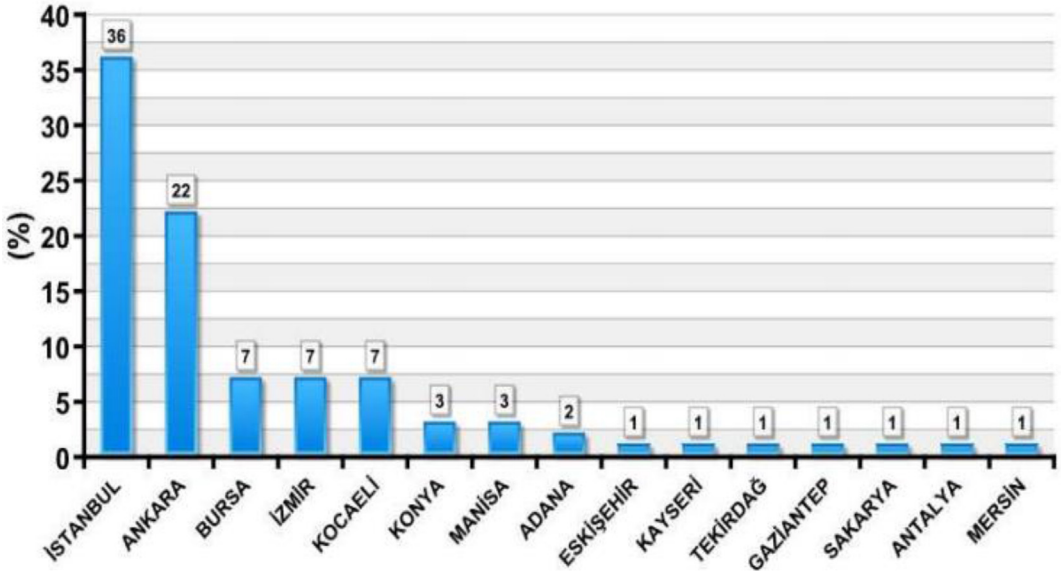

Figure 1. Distribution of project applications by cities (1995–2017) (TUBITAK, 2018).

Table 4. Export shares of SMEs in selected countries (%) (WTO, 2016).

Countries	Share in Exports (%)	Direct Export Share (%)	Indirect Export Share (%)
United States of America	36	22	14
Germany	35	18	17
Denmark	33	18	15
France	27	15	12
Italy	30	20	10
Greece	22	12	10
India	42	22	10
Japan	38	28	10
England	27	13	14
South Korea	26	13	13

According to the export rates of SMEs, India and Japan are the leading countries.

The European Union's umbrella programs include support, grants, and loans for SMEs, and these are distributed to countries (including Turkey). These funds are allocated to SMEs through KOSGEB (Small and Medium Enterprises Development Organization of Turkey) and/or investor banks. The loans are given as low interest, long term investment loans. It is difficult for micro-enterprises to benefit from these funds. Medium-sized enterprises employing 50–250 workers often benefit from these loans. They can monitor legislation and credit incentive channels due to their advanced institutional structures. They can provide counter-guarantees for investment banks. Some of them have also R&D infrastructures that have the possibility of designing original products.

Few SMEs in Turkey (up 8% of total business) are able to export directly. Research shows that SMEs have a share of only 15% of total exports. Also, SMEs have a share of 15% of total imports. The share of SMEs in exports in some countries is given in Table 4 (WTO, 2016).

R&D has critical importance, especially in the machinery manufacturing industry. As seen in Table 5, firms do not feel any responsibility to make innovation. This is one of the main reasons why value-added products are not produced. Unfortunately, the private sector does not make the necessary investments for innovation and R&D by using its own capital.

According to Table 6, R & D, information and communication, industry and manufacturing, advertising and market research are Turkey's most preferred investment sectors in innovation. Unfortunately, there are not any R&D centers or Techno parks in 19 of the 24 cities in Eastern and Southeastern Anatolia. It is seen that almost all of these investments are made in the Marmara, the Central Anatolia, the Aegean, and the Mediterranean regions.

3. Proposed multi criteria decision making method (GIS and TOPSIS)

In Turkey, the seven regions vary dramatically in terms of development. This study investigates the similarities of investment data with the development and quality of life scores of the regions. GIS method is used in order to provide a visual output for the reader. The GIS software used

Table 5. Reasons not to innovation activities in non-innovative enterprises, 2014–2016 (TurkStat, 2016).

Economic activity and size group	Non-innovators	Reasons not to innovation activities	
		No compelling reason to innovate	Considered innovating, but barriers to innovation too large
General (%)	38,5	82,2	17,8
Industry	35,5	81,7	18,3
Mining and quarrying	47,7	84,6	15,4
Manufacturing	34,7	81,3	18,7
Electricity, gas steam and air conditioning supply	58	91,6	8,4
Water supply; sewerage, waste management and remediation activities	48,2	86,2	13,8
Service	42,3	82,8	17,2
Wholesale trade, except of motor vehicles and motorcycles	38,9	83,4	16,6
Transportation and storage	52,5	81,2	18,8
Information and communication	24,4	82,2	17,8
Financial and insurance activities	42,1	84,9	15,1
Architectural and engineering activities, technical testing and analysis	43,9	84,3	15,7
Scientific research and development	14,8	66,7	NA
Advertising and market research	31,4	87,8	12,2
Size group			
Enterprises with 10 employees or more	38,5	82,2	17,8
10–49	39,6	82,2	17,8
50–249	35	81,9	18,1
250+	29,6	83,5	16,5

Table 6. Comparison of sectors with TOPSIS method according to their innovative enterprise performance in Turkey.

Sectors	Ranking Scores
Scientific research and development	1
Information and communication	0,64322
Industry	0,42048
Manufacturing	0,42048
Advertising and market research	0,40896
Wholesale trade, except of motor vehicles and motorcycles	0,30623
Financial and insurance activities	0,28128
Service	0,2623
Architectural and engineering activities, technical testing and analysis	0,20353
Water supply; sewerage, waste management and remediation activities	0,17842
Mining and quarrying	0,1626
Transportation and storage	0,10105
Electricity, gas steam and air conditioning supply	0,03858

in this article is ArcGIS-ESRI 9.1 version software. Then the TOPSIS scores of cities are compared with GIS results. In addition, the innovation performance of the sectors is compared with the TOPSIS method.

3.1. Geographic information systems (GIS)

Geographic information systems (GIS) can be applied for many purposes including resource management, land review, and business planning. GIS is defined as a method of collecting, storing, managing, analyzing and displaying the data introduced to the system geographically (Cheng et al., 2007). The GIS provides data management, integration, data query, analysis and visualization through permitting the evaluation of spatial and non-spatial data together (Li et al., 2003). Then these data are used on different layers. Figure 2 shows the multilayered structure of an exemplary GIS (Cheng et al., 2007; Li et al., 2003).

As shown in Figure 2, each layer shows a particular theme in the same area, such as customers, streets, buildings. Especially, a GIS uses database control procedures to build its individual data indexing scheme where inquiries may be initiated by retrieving values of saved data. Data is saved according to their location in space, and then it is arranged in numerical or alphabetical form. GIS is designed with a network-based

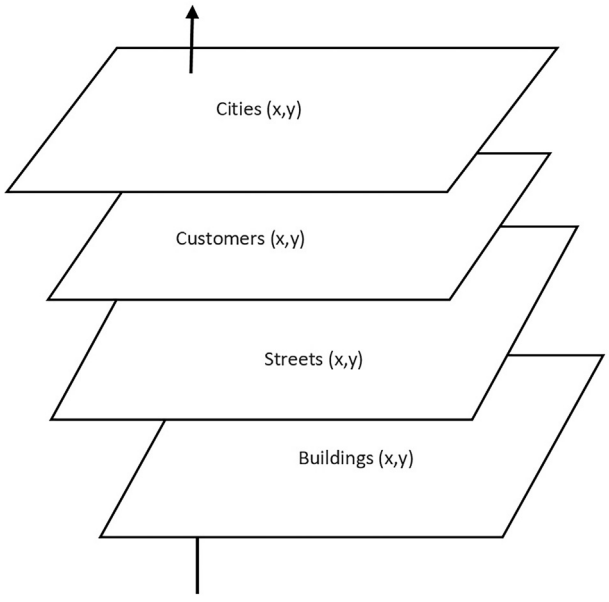

Figure 2. Multilayered structure of an exemplary CBS (Cheng et al., 2007; Li et al., 2003).

structure. A network may describe as a set of points called nodes and a set of arcs in which a pair of nodes are linked in every branch.

Figure 3(a) presents a basic network of travel, including six nodes (marked by A, B, C, D, E, and F) and nine arcs (not to scale) (marked by two capital letters, such as AB, BE, DC,etc.). A path on the network is an array of arcs. It stipulates that no nodes can be used more than once. Figure 4 (b) shows a tree design consisting of five paths: A – B–F, A – B – E – F, A – D – E – F, A – D – C–F and A – C–F. When the length of each arc is known exactly, the distance of each path can also be determined. The GIS can identify the shortest path from A to F by following these steps: (1) nodes are placed on a map, (2) the length of each arc is determined, (3) the lengths of the linked arcs for each path are calculated in order to measure the distance of per path, and (4) the distances of the roads are compared and the shortest one is decided (Burrough et al., 2015; Cheng et al., 2007; Maguire, 1991).

In addition, a GIS can transform available digital knowledge or data, such as a census, into a map-like scheme, thereby creating thematic layers of information (Bahaire and Elliott-White, 1999; Kraak and Ormeling, 2013). GIS is only able to utilize digital data. Otherwise, the data cannot be processed by the computer. Hence, firstly every non-digital data need to be digitized (Pundt, 2002). Data can be obtained with numerous methods. For instance, electronic scanning tools may assist transform map marks and points to digits (Maguire, 1991). A GIS can connect and combine many data types. GIS combines data such as street and building names and their associated latitude and longitude with a programmed method called geocoding (Claramunt et al., 2000). A digital height model is designed to display surface heights by indicating different heights in different colors in order to demonstrate outputs (Andrienko et al., 2003). Projection transformation may be required for digital data before analysis. This procedure is a standard math-based process in which the transformation of map data from a three-dimensional real world to a two-dimensional image (Sondheim et al., 1999). Different methods of collecting and storing digital data can result in different structures. GIS transforms data from independent forms to compatible forms in order to prevent this problem (Goodchild, 1987). Data models are divided into two classes: vector and raster. The vector offers discrete properties, whereas the raster offers continuous quantitative values (Faust, 1995). Raster data records are helpful for creating land usage maps, and vector data records can capture the digital data as points, lines, and areas (Goodchild, 1992). When a GIS is created, layers are able to graphically display on a computer or print on paper. It is possible to make inquiry settings to help decision making. Also, a GIS allows users to see and simulate possible answers by creating wall maps and similar graphics (Burrough et al., 2015; Krygier and Wood, 2016).

The purpose of this research is to compare all cities of Turkey in terms of economic, development and quality of life. The research is based on data derived from "Life Quality Research - 2011" presented by Mavi

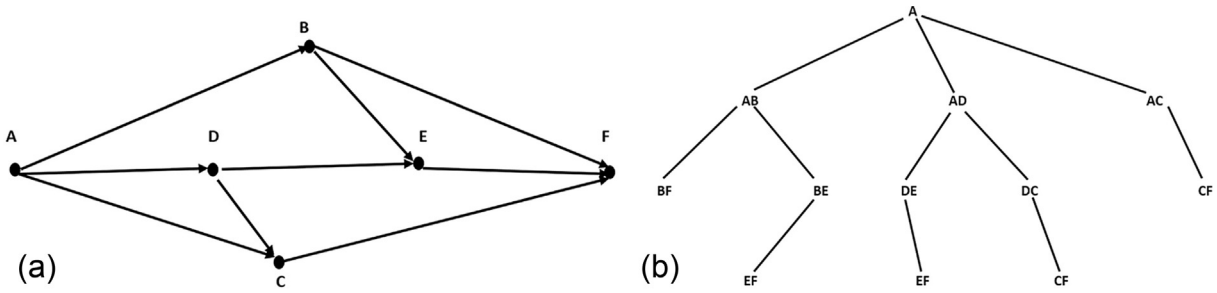

Figure 3. (a) Nodes and arcs of a network, and **(b)** Paths as shown in a tree structure (Cheng et al., 2007; Li et al., 2003).

(2011) and "Research on Socio-Economic Development Order of Cities and Regions SEGE - 2011" introduced by the Ministry of Development (2013). This research, which includes data of 81 cities, covers the subjects of economy, education, health, urban life, security, cultural art. We obtained the data of 81cities from that study. These data were used in GIS and TOPSIS analyzes. We arranged the data in a matrix to be used in the analysis. The evaluation results of GIS are initially presented as a two-dimensionally map. Also, the regions were assessed by GIS analysis employing 7 criteria related to SME performance. Shares in the total SMEs enterprises (%), SMEs government incentives (%), SMEs bank loans (%), SMEs direct investments (%), SMEs export (%), SMEs employment (%) and SMEs R&D investments (%) were used in order to analyze the contribution of SMEs to economic development by regions. The three-dimensional evaluation results are also presented to ensure that the decision maker can easily understand.

In methods such as TOPSIS and GIS, experts in the relevant field are consulted and these coefficients are decided as a result of their opinions. There are no restrictions on the number of experts. We got the opinion of three experts. The biggest limitation on this subject is to find experts in the field. The experts we consulted found these coefficients appropriate. The scientific explanation of this expert opinion and the coefficients used are as follows:

The Boolean method is used to indicate whether each of the criteria to be used in mapping is either favorable or unfavorable for the existence of what the researcher is looking for. Also, the knowledge-driven approach tries to decide the appropriate criterion in a field of study based on expert knowledge and experience. Methods such as fuzzy logic or Dempster-Shafer belief functions are used and modelling is done. The data-driven approach is based on measuring the relationships between these criteria and known data. Some of these are statistical methods, regression, weights of evidence (WofE), neural networks, and data mining. The hybrid expert-guided data-driven approach combines two of the above approaches to take advantage of both methods. Therefore, an evaluation and scoring method is implemented based on the identified favorability (weights of evidence "WofE) so that we can analyze the criteria in order to identify areas of high quality of life. Various evidence themes are used (in GIS's specific language, an evidence theme is a vector or raster format map or area layer used for estimating objects to be identified): highly favorable = 3; favorable = 2; less favorable = 1; and unfavorable = 0. The coefficients were determined by considering this hybrid method. These favorability scores are then added to a compilation (predictive) map. The third stage is the development of the predictive map. The predictive map is a combination of the spatial criteria values established and quantified during the preceding stages (Roy et al., 2006). Its aim is to provide a better understanding of the factors that control the quality of life distribution and to provide a picture of the potential of the cities and regions. In practice, this predictive map was obtained by adding up the various favorability scores for the criteria. In theory, it should enable us to find out the percentage of quality of life. Then location scores are calculated and illustrated on the last column as shown in Table 8. Based

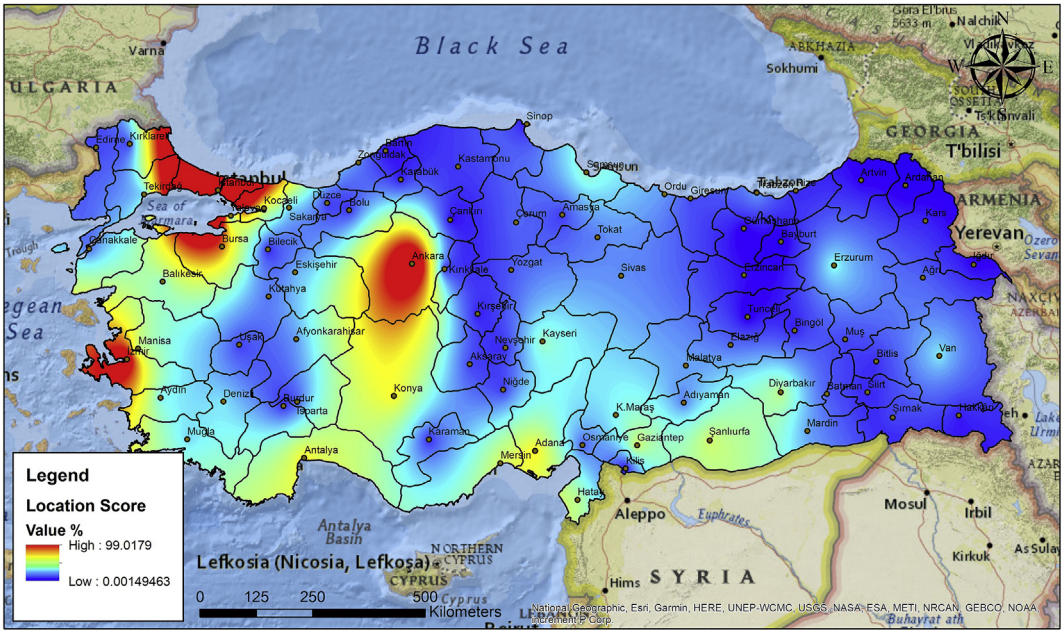

Figure 4. Two dimensional geographic demonstration of location scores.

on these variables, formula 1 is used for location scores, regardless of the type of sectors for each city.

$$[\text{Populations Density of City} + 2*\text{Population \% in City Center} + \text{Internal Revenue} + 2*\text{Economy} + 3*\text{Education} + 3*\text{Health} + 3*\text{Safety} + 2*\text{Urban Life} + 2*\text{Culture and Art} + 3*\text{Life Quality} + 2*\text{Development}] / 24 \quad (1)$$

The essential statistical information about the importance of SMEs in the economy of Turkey and other countries are presented in the second section. In this context, the regions are evaluated in terms of SMEs. Seven regions were analyzed in the GIS program using formula 2 below. The most current values of these indicators for each region are taken into account in the calculations and analysis. Experts weighted all indicators equally. Therefore, the scores of the regions are obtained by calculating the arithmetic mean of the indicator values of each regions.

[Share in the total SME enterprises (%)+Share in the total SME Government incentives (%)+Share in the total SME bank loans (%) + Share in the total SME direct investments (%)+Share in the total SME export (%) + Share in the total SME employment (%)+Share in the total SME R&D investments (%)]/7 (2)

3.2. TOPSIS (Technique for Order Preference by similarity to ideal solution)

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) was developed by Yoon (1980). It involves a 6-step solution process. The steps of the TOPSIS method are described below (Yoon, 1980).

Step 1. In the rows of the decision matrix, there are decision points whose superiorities are to be listed, and in the columns, there are evaluation factors to be used in decision making. Matrix A is the initial matrix created by the decision maker. The decision matrix is shown as formula 3:

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \quad (3)$$

In matrixA_{ij}, m represents the number of decision points, n represents the number of evaluation factors.

Step 2. Creating the Standard Decision Matrix (R)

The Standard Decision Matrix is calculated by using the elements of matrix A and the following formula 4:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}} \quad (4)$$

The matrix R is defined by the matrix shown below:

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix} \quad (5)$$

Step 3. Creating the Weighted Standard Decision Matrix (V) First, the weight values (w_i) of the evaluation factors are determined ($\sum_{i=1}^{n} w_i = 1$). Then the elements in each column of the R matrix are multiplied by the corresponding w_i value to form the V matrix. The V matrix is shown below:

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix} \quad (6)$$

Step 4. Creating ideal (A^*) and negative ideal (A^-) solutions:
Finding the ideal solution set is shown in the following formula 7:

$$A^* = \left\{ \left(\max_i v_{ij} \middle| j \in J\right), \left(\min_i v_{ij} \middle| j \in J'\right) \right\} \quad (7)$$

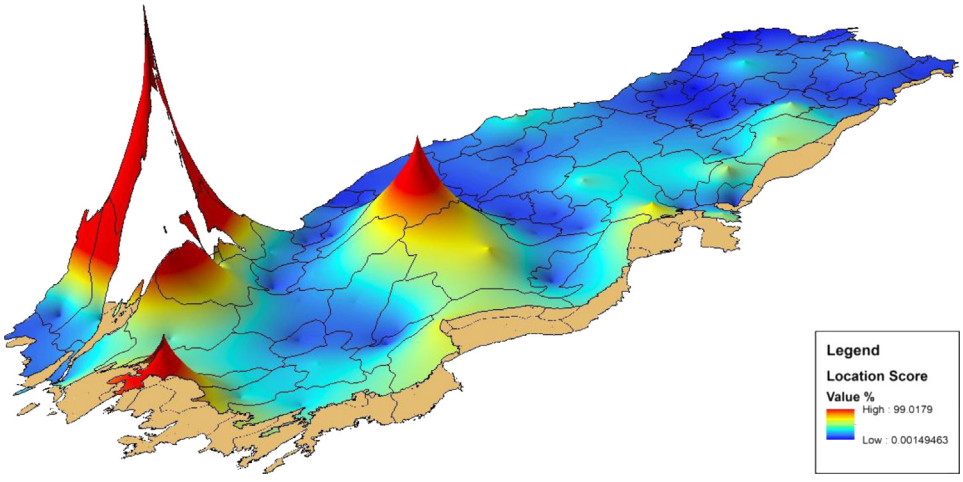

Figure 5. Three dimensional graphical representation of the location scores.

Table 7. Geographical (spatial) and socio-economical (semantic) data of marmara region.

Name of City	Geographical Coordinates (X) X	Geographical Coordinates (Y) Y	Area (km^2)	Populations of City (Persons)	Populations Density of City ($/km^2$)	Population % in City Center	Closest City	Distance (km)	Internal Revenue	Rented Areas ($x10^3$ m^2)	Economy (Scores)	Education (Scores)	Health (Scores)	Safety (Scores)	Urban Life (Scores)	Culture - Art (Scores)	Life Quality (Scores)	Development (Scores)	GIS Location Scores
Balikesirir	27.8823	39.6484	14442	1152323	81	19	**Manisa**	137	4841	40	87	85	75	31	78	48	68	78	**48.3**
Bilecik	29.9817	40.1414	4181	225381	52	15	**Eskişehir**	80	2380	15	76	79	26	43	79	57	49	73	**34.1**
Bursa	29.0651	40.1833	11087	2605495	250	88	**Bilecik**	95	5325	200	74	55	70	36	63	92	60	94	**62.2**
Çanakkale	26.4154	40.1483	10201	508769	54	22	**Tekirdağ**	188	3987	20	89	95	68	25	93	54	80	86	**43.4**
Edirne	26.5548	41.6778	6241	390428	64	31	**Kirklareli**	62	5174	20	77	92	89	30	65	50	88	88	**44.6**
Istanbul	28.9867	41.0375	5170	13255685	2551	83	**Tekirdağ**	132	19252	2910	98	80	50	85	98	95	94	99	**100.0**
Kirklareli	27.2281	41.7322	6056	332791	53	16	**Edirne**	62	5342	10	81	75	56	90	74	81	79	85	**45.2**
Kocaeli	29.9044	40.7643	3635	1560138	432	19	**Sakarya**	37	5238	80	97	65	60	40	71	82	77	96	**50.3**
Sakarya	30.4047	40.7742	4895	872872	180	33	**Kocaeli**	37	2441	50	47	43	36	81	75	90	51	82	**46.7**
Tekirdağ	27.5125	40.9762	6345	798109	126	13	**Kirklareli**	121	4459	50	86	49	22	68	43	41	42	91	**47.6**
Yalova	29.2423	40.6539	847	203741	241	34	**Kocaeli**	65	4494	20	80	91	30	34	96	91	62	87	**51.1**
		Average	66455.45	1991430	371.27	33.83		92.36	5721.18	308.18	81.09	73.55	52.91	51.18	75.91	71	68.18	87.18	**52.23**

The set calculated from formula (7) can be shown as$A^* = \{v_1^*, v_2^*, ..., v_n^*\}$.

The set of negative ideal solutions is formed by selecting the smallest of the weighted evaluation factors in the V matrix. Creating the negative ideal solution set is shown in the following formula 8.

$$A^- = \left\{ \left(\min_i v_{ij} \middle| j \in J\right), \left(\max_i v_{ij} \middle| j \in J'\right) \right\} \tag{8}$$

The set calculated from formula (8) can be shown as$A^- = \{v_1^-, v_2^-, ..., v_n^-\}$. In both formulas, J represents the benefit (maximization) and J' indicates the loss (minimization).

Step 5. In the TOPSIS method, Euclidian Distance Approach is used to find the deviations of the evaluation factor value for each decision point from the ideal and negative ideal solution set. The calculation of the ideal discrimination (S_i^*) measure is shown in formula (9) and the calculation of the negative ideal discrimination (S_i^-) measure is shown in formula (10):

$$S_i^* = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^*\right)^2} \tag{9}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2} \tag{10}$$

Step 6. The ideal and negative ideal separation measures are used to calculate the proximity (C_i^*) of each decision point relative to the ideal solution. The calculation of the proximity to the ideal solution is shown in the following formula 11:

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \tag{11}$$

The value C_i^* is in the range $0 \leq C_i^* \leq 1$and $C_i^* = 1$indicates the absolute proximity of the corresponding decision point to the ideal solution, and $C_i^* = 0$indicates the absolute proximity of the corresponding decision point to the negative ideal solution.

4. Results

GIS location scores for each city were calculated by using formula 1 to generate visual outputs. All values are shown in the appendix. The GIS location scores are presented as two and three-dimensional graphics. These graphs are shown in Figure 4 and Figure 5.

Table 7 shows the values of the Marmara region where has the highest quality of life score.

When Figures 4 and 5 are evaluated, Istanbul, Bursa and Kocaeli in the Marmara, Izmir in the Aegean, Ankara and Konya in Central Anatolia, Antalya, Mersin and Adana in the Mediterranean have higher scores compared to other cities. The cities with the highest scores are Istanbul and its neighboring cities. It is seen that the scores decrease from the center of the country to the east. High scores are seen in the ten most populous cities of the country. The remaining 71 cities have very low scores. Almost all of these cities are in the Black Sea, Eastern Anatolia, and Southeast Anatolia.

The two and three dimensional presentation of the Marmara region produced by GIS is shown in Figure 6 and Figure 7:

When we compare the regions with each other, Marmara is the one that has the highest score. When Figures 6 and 7 are evaluated, the main reason is that Istanbul has a quite high score than other cities. In addition, neighbor cities of Istanbul have high scores.

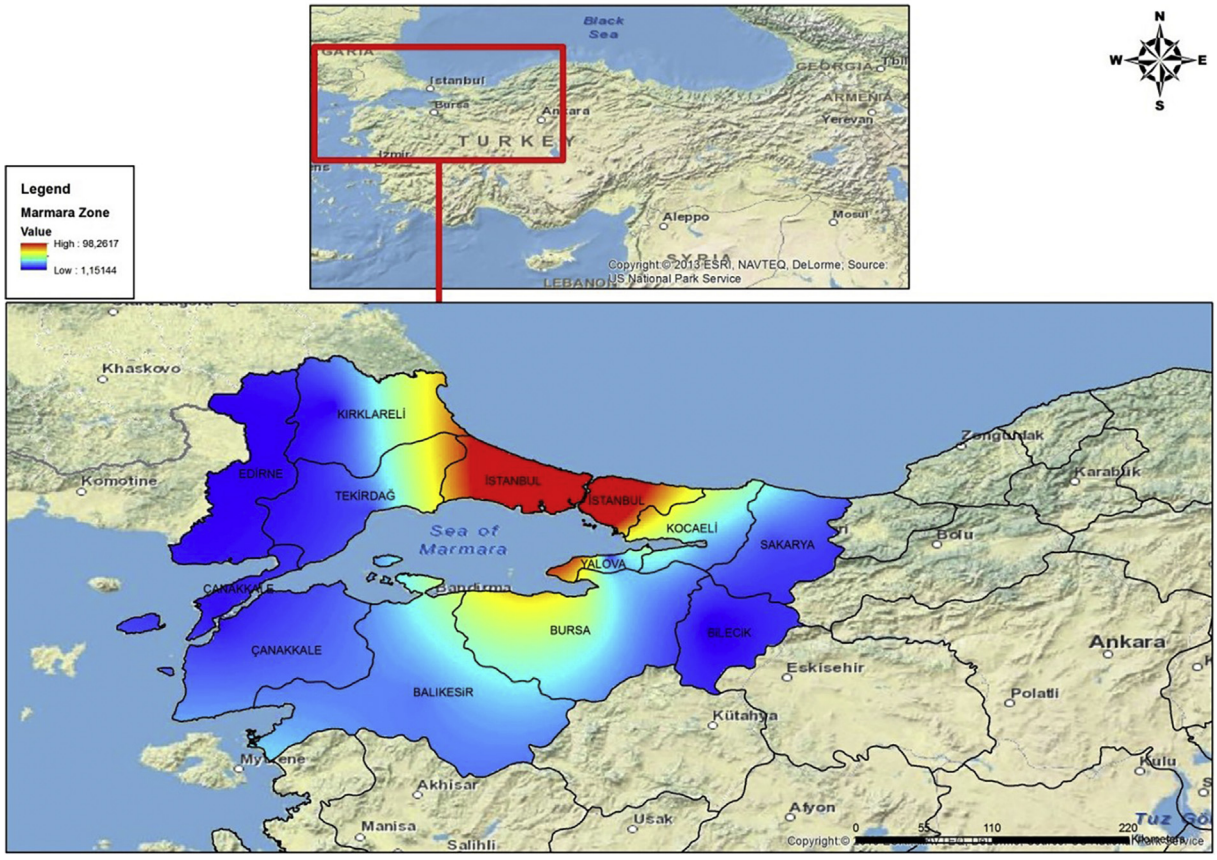

Figure 6. The location of the Marmara Region in Turkey (above) and the two-dimensional geographic demonstration of location scores.

The same criteria (economic, development and quality of life) and data were evaluated by using the TOPSIS method. The scores of cities and ranking are shown in Table 8.

The criteria used in TOPSIS analysis are location score of closest city, location score of city, economy score, education score, health score, safety score, urban life score, culture – art score, life quality score, development score and population % in city center.

Table 9 presents the results of TOPSIS and GIS analysis related to the quality of life by the cities. It also shows the industrial share of the cities in each region (see Table 10).

According to the map, as shown in Figure 8, only two of the 14 cities in the Eastern Anatolia Region (Elazig and Erzurum) are on the list. In addition, Siirt is the only city on the list among the cities of Southeast Anatolia.

The indicators used in the analysis of SMEs, and their values for each region (KOSGEB, 2015, 2018; Özdemir, ERSÖZ, & SARIOĞLU, 2007; TMMOB, 2017a, 2017b; Trade, 2019; TurkStat, 2019b) and GIS location scores calculated with formula 2 are as follows:

Figure 9 presents the two-dimensional map of GIS location scores regarding the contribution of SMEs to economic development by regions.

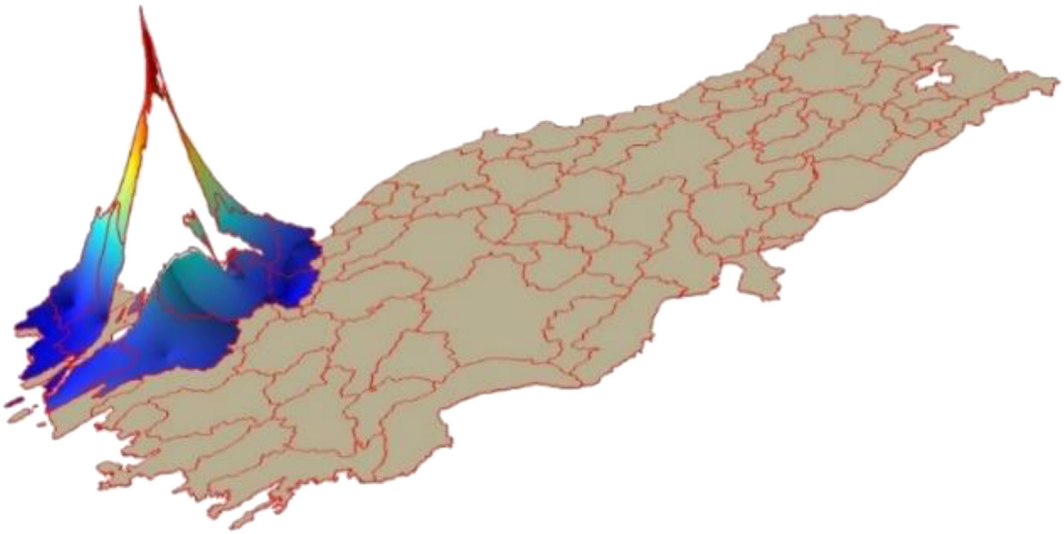

Figure 7. Three-dimensional graphical representation of the location scores in Marmara Region.

Table 8. Comparison of cities with TOPSIS method in terms of economic, development and quality of life in Turkey.

1. Istanbul	0.657718	**28. Samsun**	0.28635	**55. Diyarbakir**	0.217085
2. Ankara	0.457107	**29. Trabzon**	0.284523	**56. Sanliurfa**	0.215797
3. Izmir	0.43269	**30. Rize**	0.278782	**57. Corum**	0.210244
4. Bursa	0.42083	**31. Afyonkarahisar**	0.278736	**58. Bartın**	0.208764
5. Konya	0.370138	**32. Karaman**	0.276788	**59. Yozgat**	0.203684
6. Antalya	0.356207	**33. Aydin**	0.276355	**60. Van**	0.201485
7. Yalova	0.343389	**34. Nevsehir**	0.27569	**61. Kahramanmaras**	0.198739
8. Adana	0.336922	**35. Giresun**	0.274539	**62. Aksaray**	0.197412
9. Kocaeli	0.335513	**36. Amasya**	0.273733	**63. Hatay**	0.19052
10. Eskisehir	0.333784	**37. Kirsehir**	0.273326	**64. Osmaniye**	0.185854
11. Balikesir	0.323942	**38. Sinop**	0.260154	**65. Bayburt**	0.177658
12. Bolu	0.319493	**39. Cankiri**	0.260003	**66. Mardin**	0.174302
13. Mersin	0.317811	**40. Zonguldak**	0.258811	**67. Adiyaman**	0.17209
14. Tekirdag	0.314982	**41. Ordu**	0.25543	**68. Erzincan**	0.171853
15. Sakarya	0.31411	**42. Sivas**	0.252109	**69. Kilis**	0.163412
16. Isparta	0.310468	**43. Gaziantep**	0.250362	**70. Kars**	0.160634
17. Manisa	0.309692	**44. Kastamonu**	0.247483	**71. Bitlis**	0.156191
18. Kirklareli	0.309642	**45. Tokat**	0.244686	**72. Batman**	0.154081
19. Denizli	0.306992	**46. Burdur**	0.243527	**73. Tunceli**	0.151431
20. Kayseri	0.303797	**47. Malatya**	0.240709	**74. Siirt**	0.148642
21. Duzce	0.302901	**48. Artvin**	0.240486	**75. Igdir**	0.14525
22. Mugla	0.300756	**49. Gumushane**	0.240196	**76. Hakkari**	0.13348
23. Usak	0.298298	**50. Bilecik**	0.237522	**77. Ardahan**	0.127065
24. Edirne	0.294995	**51. Erzurum**	0.227859	**78. Bingol**	0.125983
25. Kutahya	0.294231	**52. Nigde**	0.227145	**79. Sirnak**	0.113046
26. Kirikkale	0.292933	**53. Karabuk**	0.223992	**80. Agri**	0.0716531
27. Canakkale	0.289223	**54. Elazig**	0.221483	**81. Mus**	0.0713005

5. Discussion

Quality of life assessment is an interesting and difficult issue. As stated in the literature review, many factors have been tried to explain by the quality of life. The study tries to show industrial investments in regions with a low quality of life. It also demonstrates that eastern cities have not been governed fairly in terms of industrial, innovation and R & D investments. Moreover, when the 11th development plan (2019–2023) is assessed, it is understood that this management style will continue. Large enterprises have not preferred to invest in the East, Southeast, Black Sea and the eastern parts of Central Anatolia so far. They also demand great support and incentives to make an investment there. This situation sharpens and deepens the current inequalities. Small and medium-sized enterprises may be an important source of development and employment for these undeveloped regions. We stated that the success of SMEs in competitive markets, the creation of added value, and the ability to play a role in increasing employment depend on the cooperation with large companies. Therefore, the presence of large-scale companies is required in these regions. Policies and action plans are necessary to encourage them to invest in these regions.

In Turkey, 80 percent of the businesses are gone bankrupt in their first 5-year period, while 96 percent of them are gone bankrupt in their first decade. This period of time is 18 years in Germany and 9 years in France (Group, 2018). Furthermore, starting a new project or opening a business requires a significant amount of initial and long-term capital investment, so their closure in a short period of time causes economic damage for both government and private investors (GDP) (Park, 2002).

There are 370 140 SMEs in the manufacturing industry in Turkey. These account for 61.5% of manufacturing industry employment. It has a share of only 26.9% of the value-added. On the other hand, large enterprises (2,460) account for 0.7% of the total number of enterprises and 39.5% of employment. They contribute 73.1% to the value-added. These data show that the SME legend does not provide a sufficient economic contribution in Turkey. In medium-sized enterprises, the added value is $ 1,860,013 per facility and $ 10,274 per person. These values increase in large enterprises. The added value is $ 41,222 per facility, while it is $ 4,703 per employee. When European countries are considered, these values increase by 4–6 times (KOSGEB, 2016). Hence, it is observed that SMEs generally produce low value-added products in Turkey. Therefore, large-scale enterprises producing high value-added products are also required for the development of the regions and cities.

The share of SMEs in total loans is 19% in Turkey. These rates are 39.8% in the USA; 37.1% in Germany; 25.3% in India; 54.1% in Japan; 28% in the UK; In South Korea, 51%; 50.3% in France; 37% in Italy and 52.3% in Greece (OECD, 2019). These countries mostly have low-interest rates and long term loans. In Turkey, the interest rates are high, and the maturity period is too short compared to these countries.

One of the biggest limitations of the study is to reach the experts who decide the coefficients in the formula used in GIS analysis. Because it takes a long time to find experts in the field of subject and get their opinions. Another limitation is that statistical data cannot be obtained from only one source. Statistical information of the regions was obtained from 7 different sources for GIS analysis of SMEs. Unfortunately, TurkStat and KOSGEB have not provided an effective portal for easy access to appropriate data yet.

Turkey's sustainable growth and regional development of the cities have not been considered together by assessing the quality of life and the contribution of SMEs so far. Even though Turkoglu (2015) has proposed indicators, there is not still any study providing evaluation and suggestions. Our study presents an important novelty in this respect. There is no study examining the quality of life and SME activities in eastern Turkey. In this context, the study proposes a significant novelty with the comparative method of GIS and TOPSIS. By visualizing the results on maps, it also aims to facilitate reader understanding. Also, the paper offers a detailed analysis of Turkey's economy and demographic structure.

Table 9. Comparison of cities with TOPSIS, GIS, and industry share (%).

Cities	Industry share (%) in its region	Ranking in Turkey by TOPSIS	GIS Location Scores	Region	Cities	Industry share (%) in its region	Ranking in Turkey by TOPSIS	GIS Location Scores	Region	Cities	Industry share (%) in its region	Ranking in Turkey by TOPSIS	GIS Location Scores	Region
Istanbul	65	1	100	**Marmara**	**Samsun**	19	28	43.1	**Black Sea**	**Ankara**	45	2	67.7	**Central Anatolia**
Bursa	17	4	62.2		**Duzce**	10	21	44.7		**Konya**	24	5	55.2	
Kocaeli	5	9	50.3		**Trabzon**	10	29	42.9		**Kayseri**	10	20	44.8	
Tekirdag	3	14	47.6		**Corum**	10	57	31.2		**Eskişehir**	5	10	50.2	
Balikesir	3	11	48.3		**Bolu**	7	12	47.8		**Sivas**	3	42	37.9	
Sakarya	2	15	46.7		**Kastamonu**	6	44	36.6		**Karaman**	2	32	41.3	
Canakkale	1	27	43.4		**Ordu**	5	41	38.2		**Kirikkale**	2	26	43.5	
Kirklareli	1	18	45.2		**Rize**	5	30	41.9		**Aksaray**	2	62	28.1	
Edirne	1	24	44.6		**Amasya**	4	36	40.4		**Nevsehir**	2	34	40.8	
Bilecik	1	50	34.1		**Tokat**	4	45	36.4		**Yozgat**	2	59	30.3	
Yalova	1	7	51.1		**Zonguldak**	4	40	38.4		**Nigde**	1	52	32.8	
Izmir	37	3	64.3	**Aegean**	**Karabuk**	4	53	32.6		**Cankiri**	1	39	38.9	
Denizli	18	19	45		**Sinop**	3	38	39		**Kirsehir**	1	37	40.3	
Manisa	11	17	45.4		**Giresun**	3	35	40.7		**Malatya**	29	47	35.9	**Eastern Anatolia**
Usak	9	23	44.1		**Bartin**	3	58	30.8		**Elazig**	18	54	32.3	
Afyon	7	31	41.8		**Gumushane**	1	49	35.6		**Erzurum**	13	51	33.2	
Aydin	7	33	41.1		**Artvin**	1	48	35.8		**Erzincan**	9	68	24.3	
Mugla	6	22	44.6		**Bayburt**	1	65	25.6		**Van**	9	60	30.1	
Kutahya	5	25	43.9		**Gaziantep**	65	43	37.5	**Southeast Anatolia**	**Agri**	5	80	11.5	
Adana	25	8	50.1	**Mediterranean**	**Sanliurfa**	10	56	31.4		**Kars**	3	70	23.7	
Mersin	19	13	47.7		**Diyarbakir**	9	55	31.6		**Bingol**	3	78	19.3	
Antalya	16	6	52.8		**Adiyaman**	6	67	24.8		**Bitlis**	3	71	22.4	
Hatay	13	63	27.9		**Batman**	4	72	22.1		**Ardahan**	2	77	19.7	
Kahramanmaras	11	61	28.3		**Mardin**	3	66	25.4		**Mus**	2	81	10.4	
Burdur	6	46	36.1		**Kilis**	1	69	23.9		**Igdir**	2	75	20.8	
Isparta	6	16	46		**Siirt**	1	74	21.6		**Hakkari**	1	76	20.3	
Osmaniye	4	64	27.6		**Sirnak**	1	79	17.1		**Tunceli**	1	73	21.8	

Table 10. Contribution of SMEs to Economic Development and GIS location scores by region.

	Marmara	Aegean	Central Anatolia	Mediterrenean	Black Sea	Eastern Anatolia	Southeastern Anatolia
Share in the total SME enterprises (%)	32.8	15.25	18.62	12.42	11.32	3.65	5.87
Share in the total SME Government incentives (%)	27.72	14.58	21.52	12.03	12.39	5.11	6.65
Share in the total SME bank loans (%)	44.9	13.4	19.1	13.1	4.1	1.2	4.2
Share in the total SME direct investments (%)	36.41	17.43	17.7	11.63	10.7	1.56	4.57
Share in the total SME export (%)	65.9	11.8	7.8	5.6	5.9	0.7	2.3
Share in the total SME employment (%)	40.5	14	15.2	11.3	9	3.9	6.1
Share in the total SME R & D investments (%)	42.6	14.2	16.8	13.7	8.4	1.83	2.47
GIS Scores	100	76.08	40.14	27.44	21.25	6.16	11.05

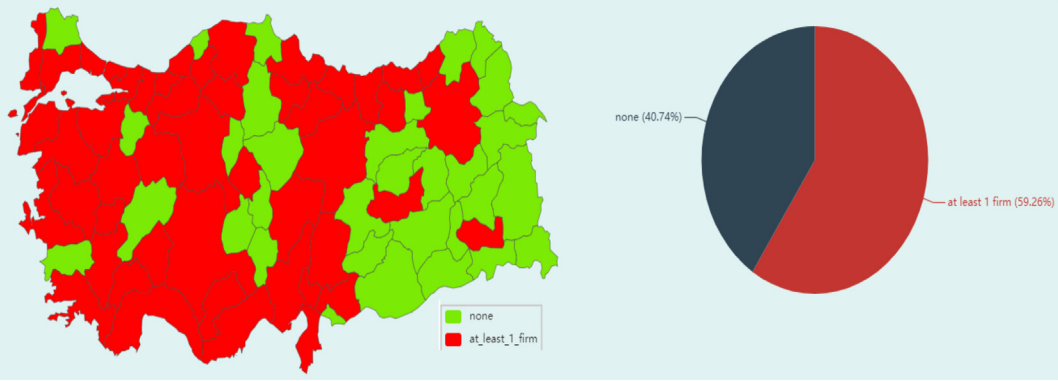

Figure 8. The Map of Turkey's Top 500 Industrial Enterprises (created by authors).

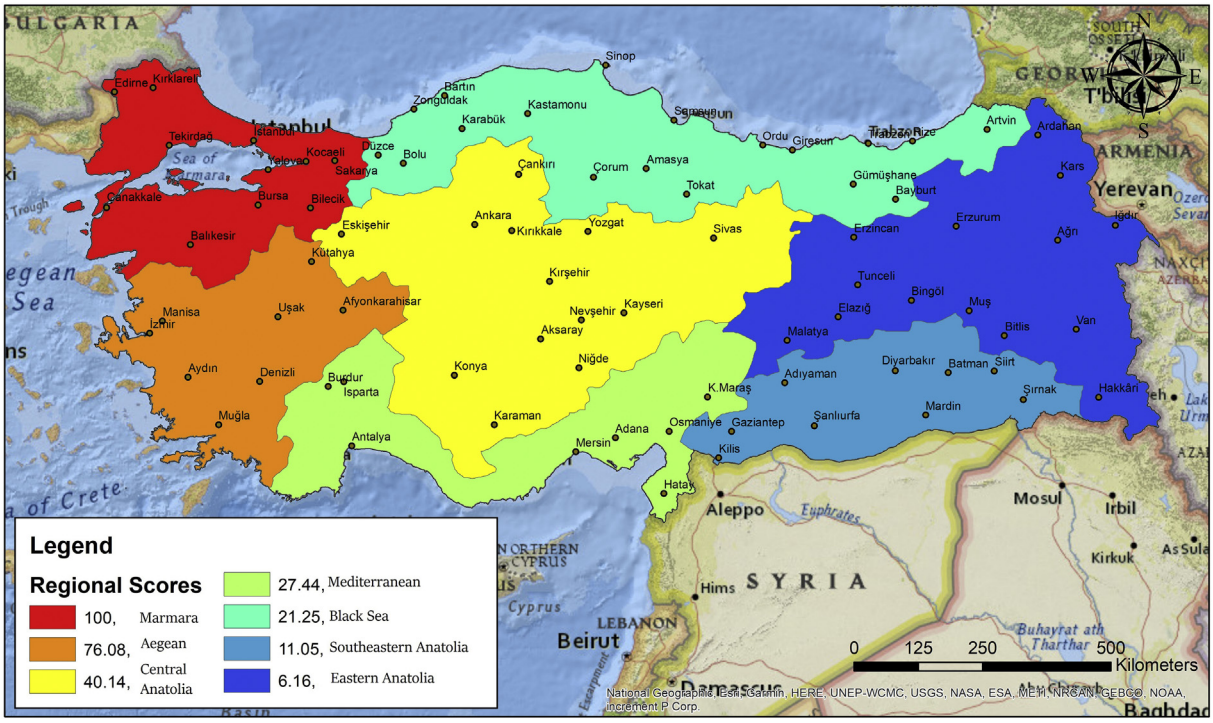

Figure 9. Two-dimensional map of GIS scores regarding the contribution of SMEs to economic development by regions.

6. Conclusion

The paper presents informations about Turkey's economic goals and opportunities by considering the 2023 strategic plan and statistics in the second section. The study also aims to inform all local or foreign investors related to many sectors. The development level and life quality of the city are very important issues for both investors and human resources. If a city has a bad score or impression on these issues, they prefer other alternative developed cities.

One of the objectives of this study is to make recommendations to country managers and researchers who will make similar studies for other countries by using TOPSIS and GIS in selection and ranking studies. There are 7 geographical regions and 81 cities in Turkey. Location scores of the nearest city, location scores of the city, economy scores, education scores, health scores, security scores, urban life scores, culture and art scores, quality of life scores, development scores, percentage of the population in the city center were utilized in order to assess the quality of life for cities. The data were obtained from the TurkStat Quality of Life Index for Cities (2015). Marmara Region is the best geographical region according to GIS - TOPSIS analyses. The ranking is Marmara, Central Anatolia, Aegean, Mediterranean, Black Sea, Southeast Anatolia, and Eastern Anatolia respectively. Istanbul (0.657718), Ankara (0.457107), Izmir (0.43269), Bursa (0.42083), Konya (0.370138), Antalya (0.356207), Yalova (0.343389), Adana (0.336922), Kocaeli (0.335513), and Eskisehir (0.333784) are the top ten cities with the highest quality of life scores. While Istanbul has the highest score with a significant difference, Ankara, Izmir, and Bursa have similar scores. There is a significant difference between these cities and the last 20 in terms of scores. 16 of the last 20 cities are in Eastern and Southeastern Anatolia.

Also, the regions were assessed by GIS analysis. Shares in the total SMEs enterprises (%), SMEs government incentives (%), SMEs bank loans (%), SMEs direct investments (%), SMEs export (%), SMEs employment (%) and SMEs R&D investments (%) were used in order to evaluate the contribution of SMEs to economic development of regions. As a result of the analysis, Marmara (100) had the highest score again and Southeast Anatolia (11,05) and Eastern Anatolia (6,16) had the lowest score. The ranking of the seven regions in terms of the contribution of SMEs to their economies is as follows: Marmara (100), Aegean (76,08), Central Anatolia (40,04), Mediterranean (27,44), Black Sea (21,25), Southeastern Anatolia (11,05) and Eastern Anatolia (6,16). This ranking is the same as the results of GIS and TOPSIS analysis of quality of life except that the second and third place of Aegean and Central Anatolia regions change among themselves. The results of this analysis show that Eastern and Southeastern Anatolian economies are the least benefited regions from SMEs.

The indicators used to evaluate the innovative enterprise performances of the sectors are as follows: innovative enterprises, product and/or process innovative enterprises (including abandoned/suspended and ongoing activities), product innovative enterprises, process innovative enterprises, enterprises with abandoned/suspended innovation activities, enterprises with on-going innovation activities, organization and/or marketing innovative enterprises, organization innovative enterprises, and marketing innovative enterprises. According to the TOPSIS results, the ranking and scores of the sectors are as follows: scientific research and development (1); information and communication (0,64322); industry (0,42048); manufacturing (0,42048); advertising and market research (0,40896); wholesale trade, except of motor vehicles and motorcycles (0,30623); financial and insurance activities (0,28128); service (0,2623); architectural and engineering activities, technical testing and analysis (0,20353); water supply; sewerage, waste management and remediation activities (0,17842); mining and quarrying (0,1626); transportation and storage (0,10105); electricity, gas steam and air conditioning supply (0,03858). In Turkey, the most innovative sectors are scientific research and development, information and communication, industry, manufacturing, advertising, and market research. The number of companies operating in these sectors is not satisfactory in Eastern and Southeastern Anatolia. Unfortunately, there are not any R&D center and Technopark in 19 out of 24 cities in Eastern and Southeastern Anatolia. It is seen that almost all of these investments are made in Marmara, Central Anatolia, Aegean, and Mediterranean regions. There are remarkable inequalities between the eastern cities that make up %20 of the population and other western cities in terms of quality of life and SMEs' contribution to development. Policymakers need to put forward more efforts and attention to solving the social and economic problems of these cities. Improving the education system and living standards and increasing efforts for equal distribution of welfare will make more possible to reach Turkey's future goals. These efforts are essential for more sustainable economic growth and prosperity.

In these two regions, there are only 3 industrial companies that are on the list of Turkey's top 500 industrial companies. SMEs can contribute to development, economy, and employment through the presence and cooperation of large companies. Lack of large-scale enterprises in the eastern regions affects the development of SMEs in the regions and their contribution to regional and country development. SMEs are one of the most important solution alternatives that will increase the employment and quality of life in these regions. All developed economies mentioned in the article have accomplished their current economic and welfare goals by taking advantage of SMEs. Therefore, Turkey should determine and implement a systematic action plan that is appropriate for its potential in order to accomplish its 2023 goals.

Declarations

Author contribution statement

Ceren Erdin, Gokhan Ozkaya: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

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