

HOW INNOVATIVE ARE THE CITIES? A MULTI-VARIABLE APPROACH TO MEASURING INNOVATION IN TURKEY

Ebru KERIMOGLU, Delal EKINCI
Istanbul Technical University, Istanbul, Turkey

Abstract: There are a couple of essential indicators of an innovative city. Besides technological and economic developments, there are qualities such as institutional capacity, strong collaborative dispositions, and an excellent physical and social infrastructure which make a city genuinely innovative and they create a push for the rest of the region and, in some cases, for the entire country. This study aims to measure the innovation level of the cities in Turkey with a multi-variable approach. In total, 27 variables were used for 81 cities of Turkey, with a 0-100 scale. The results showed that 68 cities are below the average value of innovation (1.23%). Overall, most of the cities in Turkey performed poorly in the analysis, and this reveals that using innovation as a means to achieve regional development is yet not fully acknowledged by the public authorities in Turkey.

Key Words: innovative city, regional development, policy development, Turkey.

Introduction

Innovation is the new panacea of urban development and economic growth and it found audience in disciplines such as planning and economic geography. Starting in the late 2000s, innovation has been seen as the main driver of policies and interventions for urban development (Vanolo 2013, Fang et al. 2014). It is regarded as the vital factor for economic growth and it is treated as a valuable characteristic that every city should attain (OECD 2009, Rutkowska-Gurak 2010). The questions, however, of what makes a city genuinely innovative, and of how does one city attract innovative people or businesses, remain mostly unanswered. An innovative city is a place where science and technology are the main drivers of the leading sectors. It relies heavily on human capital and on a culture that highly values innovation as a developmental tool (Hall 1998, Marceau 2008, Fang et al. 2014). While cities provide an ideal environment for innovation, as they offer proximity, density and variety and they are hosts for innovation by people, firms and organizations (Athey et al. 2008), innovative cities are places where knowledge-intensive industries and skilled labor are concentrated. To be able to attract these critical components of innovative economic growth, the cities must offer suitable housing and reliable physical infrastructure and, on top of that, an open and lively social environment. The innovative cities also have a highly productive and robust private sector with a high Gross Value Added (Crowley 2011). Besides attracting new businesses from around the world, cities should work as an incubator for innovative local businesses to flourish, which is only possible when authorities see innovation as a critical factor in urban economic growth (Rutkowska-Gurak 2010). On the other hand, innovation is not a quality that is measured if either one city has it or not. The level of innovation of cities may differ in terms of their economic structuring, environment, and social fabric. The geographical and cultural context also acts as a determinant factor. Some cities set innovation as a goal; however, they are reluctant to engage in the necessary activities, which would make the real difference. There are cities where public authorities

could be miles ahead than the economic sectors, while in others, companies are on the driver seat of innovation, and the authorities are pushed to comply.

The cities that already have a strong base for sustainable development, technological investment, and skilled labor in knowledge-intensive industries have more advantages than the cities that mostly rely on traditional mechanisms for urban economic development. Whereas mainstream economics sets development at the scale of the firm, the entrepreneur and the national economy, Jacobs (1969) put cities at the center of the processes of innovation, entrepreneurship and economic growth (Florida et al. 2017). However, even if there is a lack of technological infrastructure, having young and skilled labor sometimes boost the cities' competitive potential before the services could keep up. Dynamically efficient and productive cities are essential for national economic growth and strong urban economies are essential for generating the resources needed for public and private investment in infrastructure, education and health, improved living conditions and poverty alleviation (Johnson 2008). According to Jacobs (1969), Hall (1998), Johnson (2008) and Botero (2012), the conditions for production and growth are better in cities than in less urbanized areas because the factors of production (capital and labor) are relatively available, abundant, efficient and complementary and because cities offer relatively good infrastructure for productive activities (Johnson 2008).

Cities come in all shapes and sizes. In most cases, if not all, cities do not have a physical and even visible border. Labor, goods, and economic relations flow back and forth between cities, and innovative economic activities are no exception. The economic footprint of companies is usually not confined in one city's administrative borders. They focus on wider areas that contain two or more cities, mostly one large city and its surroundings. These structures create a lively economic environment (Marceau 2008). The large city is the place where economic development, knowledge generation, skilled people, important transport nodes and good-quality housing concentrate. The additional components such as special incubator zones or science parks and many of the other supply-side elements that are generally agreed by companies and public institutions to be essential for innovation are also located here (Marceau 2008). Last but not least, cities with the potential for innovation act as a trigger and thus they play a strategic role in constructing a more innovative country, producing new forms of economic and urban development (Fang et al. 2014).

As a developing country, Turkey seems to be eager to jump on the innovation bandwagon; however, there is a lack of policies that support this and substantial studies that will measure how and why a city becomes innovative and how this affects a city's development and economic development. In recent years, with the rise of the interest on innovation and innovative cities, several studies have been conducted that focus on how to rank cities according to their competitiveness and innovation level (Crowley 2011, Baer 2014, PWC et al. 2014, ICP 2018, Kelly 2018). According to the Global Competitiveness Report published by the World Economic Forum (Schwab 2019), the countries that ranked high are the countries that are innovation-intensive (Germany and Nordic Countries), while the ones which are located at the end of the list are the countries that rely more on foreign investment rather than on technology production or on knowledge generation (Isik and Kilinc 2012, Şahinli and Kiliç 2013). Turkey is also among the countries that ranked low on this list. The quality of the scientific research organizations, university and industry collaborations for R&D and the numbers of patents show that in Turkey the level of awareness is not enough for an innovation-driven national and regional development (Isik and Kilinc 2012). After the 1980s, Turkey shifted from a closed economic model to a more globalized one. This leap from traditional to modern, i.e., open, understanding of development required a series of new tools to keep up with the global agendas. A renewed look towards regional policies is one of them. Innovative regional policies gained speed with the start of the approval of the EU candidate status (1999), and Turkey took some radical steps during the negotiations in the early 2000s (Keskin and Sungur 2010). In 2002, the concept of regional innovation gained ground and it found its way to regional development plans and policies (Akpınar

2013). Following the developments in EU countries, Turkey made similar attempts, such as extending the scope of the information and communication technologies (ICT) and taking them out of the narrow zone of technology companies and applying them to urban policies and strategies (Uçar et al. 2017). In the last couple of years, the term 'innovation' started to be mentioned in the cities' vision statements.

However, the detailed studies on what makes a city innovative and how to measure the level of innovation are still missing, leaving innovation only as a highly quoted, fancy word in the urban literature and in the one-time-only planning documents. To avoid this common pitfall, the local authorities in Turkey must commit a deeper understanding of the concept of innovation. Also, a better definition of the parameters to measure innovation is a much-needed step. By prioritizing well-rounded research on innovation parameters and local data availability, the local authorities will be able to develop long lasting strategies for urban economic growth and policies for a better future for everyone.

Thus, to measure the innovation level of the 81 cities in Turkey, the study defined a range of variables in parallel to the studies in the innovative city literature. With the selected set of variables, the study aims to determine the innovation level of cities and to find out their potentials, as well as their shortcomings, in order to pave the way for a better strategy development in the future. The following section summarizes the approaches of similar studies in the literature; it outlines the selected group of variables and the methodology, and it presents the findings of the study. In the discussion part, the existing innovation policies and the findings of this study are detailed in terms of future policy developments.

Methodology

This study uses a large group of variables, selected in parallel to similar previous studies and basic indexing to determine the innovation level of cities in Turkey. However, due to the unavailability of city-scale (NUTS 3) data in Turkey, the study faced a limitation in terms of variables. The innovative city variables are listed from cultural assets, human capital, network structures (ICP 2018) to the number of patents per capita, the number of business towers, the transport infrastructure, economic diversity, energy, smart systems, and technology (Baer 2014), creative activities and commercialization, R&D expenditures, technology transfer awards, number of small business innovation research, and venture capital per capita (Şahinli and Kiliç 2013).

There are many studies on innovative cities that determine the innovative city typologies. There are also some indexing studies that rank cities according to their innovation level and they publish the results annually (ICP 2018, Kelly 2018). On the other hand, some studies prefer to analyze countries instead of cities on a much larger scale (Isik and Kilinc 2012, Şahinli and Kiliç 2013, Ersöz et al. 2016, Yilmaz and İncekaş 2018).

Even though this study aims to reveal the innovative potential of cities in Turkey, it is easier to find data on the national scale than it is on the city scale. Due to the wider availability of large-scale data, the focus of the studies conducted in Turkey has been mostly the country-level innovation. Additionally, the policy development processes have been concerned with the national innovation level and they disregard the potential of cities in particular, which indicates a literature gap in terms of city-level innovation research. There is, however, one study that evaluated the cities of Turkey according to their potential of being a 'knowledge city' and it used a similar set of variables (Kacar and Gezici 2016).

To summarize, the variables of city-scale studies can range from economic and human capital indicators to those that show the level of social and physical infrastructures such as cultural values, institutional structures, networks and collaborations. Considering the broad range of variables of similar studies and the lack of city-specific data in Turkey, this study

suggests the following set of variables for the evaluation of the innovation level of cities in Turkey.

In total, 27 variables are used to measure the innovation level of the 81 cities of Turkey, with a 0-100 scale. The variables are categorized as (i) economy and human capital (14 variables), (ii) physical and social infrastructures (10 variables), and (iii) institutional structure and collaborations (3 variables) (Table 1).

Table 1

List of variables in the three categories

Variables	Source/year*
1. Economy and Human Capital	
Economy	
Number of patents	Turkish Patent and Trademark Office/2018
Employment rate	TurkStat/2013
High-tech export (USD)	TurkStat/2019
GDP per capita	TurkStat/2017
Number of techno-parks	Ministry of Industry and Technology/2018
Number of R&D centers	Ministry of Industry and Technology/2018
Number of foreign companies	TOBB/2019
Number of companies established	TurkStat/2019
Number of companies liquidated	TurkStat/2019
Number of entrepreneurship	TurkStat/2016
1.2. Human Capital	
Number of people with master's degrees	TurkStat/2018
Number of people with doctoral degrees	TurkStat/2017
Number of international students	TurkStat/2017-2018
Share of young population	TurkStat/2018
2. Physical and Social Infrastructure	
Number of academics/students	Council of Higher Education/2017-2018
Number of green buildings	Turkish Green Building Council/2018
Number of theaters	TurkStat/2017
Number of museums	TurkStat/2017
Number of opera houses	MCT/2018
Number of art galleries	Municipalities/2018
Number of libraries	TurkStat/2017
Number of internet subscribers	BTK/2017
Number of festivals	Ministry of Culture and Tourism/2018
Number of foreign visitors	Ministry of Culture and Tourism/2019
3. Institutional Structure and Collaborations	
Number of NGOs	Ministry of Interior/2019
Number of KUSI projects	KUSIP/2019
Number of SANTEZ projects	Ministry of Industry and Technology/2009

*The used data are the most recently available.

Abbreviations: TurkStat – Turkish Statistical Institute; TOBB – the Union of Chambers and Commodity Exchanges of Turkey; MCT – Ministry of Culture and Tourism, Directorate General of State Opera and Ballet; BTK – Information and Communication Technologies Authority; KUSI – projects supported by the Ministry of Science, Industry and Trade with the aim of increasing synergy between stakeholders through public-university-industry cooperation; SANTEZ – projects supported by the Scientific and Technological Research Council of Turkey, covering products and production methods based on new technologies realized with industry-university-public cooperation; KUSIP – public-university-industry cooperation portal.

The first category, economy and human capital, consists of two sub-categories, economy and human capital. The variables in the economy category are as follows: the number of companies established or liquidated, the number of entrepreneurships, the employment rate, the high-tech export, the GPD per capita, the number of R&D centers, the number of technology parks, the total number of patents obtained, and also the number of foreign companies. The first three variables are selected to measure if the current economic system is trusted or not. The last variable, the number of foreign companies, is included in the list to evaluate how well the cities' economies are integrated into the global economic flows. The second sub-category, human capital, has three variables, which are: the number of international, postgraduate, and PhD students in the city. The second category, physical and social infrastructure, has ten variables such as the number of cinemas, libraries, opera houses, museums, theatres, art galleries and festivals and also the number of internet users, foreign visitors and the number of university students per academics. Obtaining city-level institutional data was a challenging task, which makes it even harder to digitalize and measure institutional development. The third category, the institutional structure and collaborations, therefore, includes only the number of SANTEZ projects, which is an indicator of public-private project partnerships and the KUSI projects that is an indicator of university-industry-government partnerships, and the number of active NGOs.

Also, due to the strong relationship between knowledge-intensive industries and the development of cities (Koç and Mente 2007, Crowley 2011, Ozbek and Atik 2013, Şahinli and Kiliñç 2013, PWC et al. 2014), if available, the number of companies established or liquidated, the number of entrepreneurships and the number of NGOs serving in knowledge-intensive industries are considered. The knowledge-intensive industries are ICT, finance, insurance, education, health and social services, other service activities and activities of international organizations, and international registrations. The relevant NGOs are categorized according to the purpose of the foundation such as education and research, urban planning and urban development, culture, art and tourism, international organizations, and partnerships.

The study used the basic indexing method to convert the different units of all variables into a percentile to make data easily comparable. After conversion, the scores of individual variables are summed up, and the total values of cities for each group of variables are determined. No variable is assigned more weight than the other, so each variable is accepted to have an equal effect on the cities' total value. The basic indexing offers a simple calculation to determine the relative value of a variable (or a set of variables) that is subject to change in time or that might differ among cities. In other words, this method measures the change, not as an absolute value but as a relative value. In this index, there are two values; the first one is the base value, and the second one is the value that is compared to the base value. In this model, the base value is always the denominator (the value that is compared), and the second value is the numerator. The aim is to observe the change of the second value in relation to the base value. Finally, to be able to easily compare the results, the end value is multiplied by 100 (Fig. 1).

$$\frac{\text{Compared Value}}{\text{Base Value}} 100 = I_{i/o} = \frac{X_i}{X_o} 100$$

Fig. 1 – Basic indexing formula

Based on the values that each city gets, a map was created to see the overall situation of Turkey. The cities, whose values are similar or close to each other, were grouped under the same group in the legend of the map.

Results

The innovation level of cities is analyzed with data on NUTS 3 level. However, to be able to see the place of the city among other cities in the same region, the NUTS 2 level is also utilized, if considered significant. Due to data limitations at city level, if available, either the data on NUTS 1 and NUTS 2 or the descriptive data, in particular on knowledge intensive industries etc., are also used whenever logically applicable for some cities.

Economy and Human Capital

According to the city values in the economy sub-category, Istanbul ranks as the highest valued city in Turkey, which gets above-average values in every variable. Especially the city stands out with its values in the total number of patents (45.48%), the number of companies established (46.91%), and the number of foreign companies (61.71%) variables.

On the ten groupings, there are seven cities in the first six groups (Fig. 2). Ankara, occupying the second place, also has above average values in the same categories as Istanbul, the total number of patents (12.67%) and the number of companies established (9.70%). Even though Ankara does not stand out in terms of the number of foreign businesses and investors (3.64%), it scores high in the number of technology parks. Istanbul and Ankara have similar values in the number of companies in knowledge-intensive industries, and the number of established companies is higher than the number of liquidated companies in these industries. However, the number of companies established in knowledge-intensive industries is considerably lower in the total number of companies in these cities (Table 2).

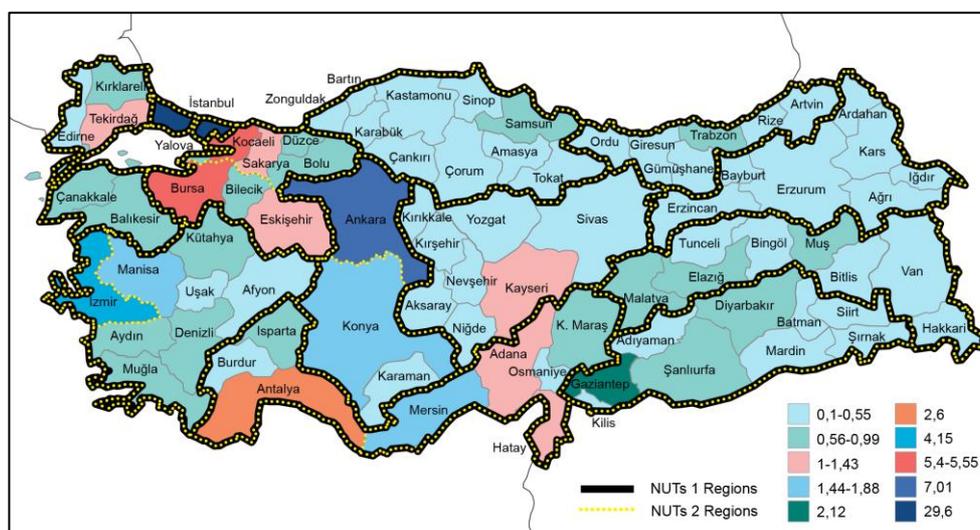


Fig. 2 – Innovation level of cities in the economy sub-category

According to the economy sub-category, Kocaeli and Bursa are the third and the fourth cities, respectively. In both cities, the values of the high-tech export are way above average, and also, the number of R&D centers is another variable that renders these cities economically strong. Izmir, as one of the prominent metropolitan cities of Turkey, on the other hand, could not score as high as these two cities due to its lower values in the total number of patents, the employment rate, the hi-tech export and the number of R&D centers.

Table 3 shows the R&D expenditures in GDP on the NUTS 1 regions of Turkey. The three leading cities are Istanbul, Kocaeli, and Ankara in the GDP per capita. The Marmara Region is ahead of other regions in the GDP per capita, as it is in the R&D expenditures. Ankara (in West Anatolia) and Izmir (in Aegean Region) are situated near the cities in the Marmara Region.

Table 2

The number of companies

Cities	Total number of companies established	Total number of companies established in KI*	Total number of companies liquidated	Total number of companies liquidated in KI
Ankara	1,713	84	545	20
Istanbul	8,919	529	3270	76

*Knowledge Intensive Industries

Source: the Union of Chambers and Commodity Exchanges of Turkey (TOBB 2019)

In the economy category, Antalya, Gaziantep and Konya also stand out. The cities that are relatively developed and located in the west show a better performance. Tekirdag and Sakarya are on the eighth place, while Kirklareli, Balikesir, Canakkale, Bilecik, and Yalova are on the ninth, and Edirne is in the tenth group. The reason that Edirne is at the weak end of the ranking is that the city values very low on more than one variable. The low values in patent numbers (0.12%), in the number of companies established (0.01%), the number of entrepreneurship (0.60%), the number of foreign companies (0.08%) and the almost non-existent high-tech export and R&D centers, and the quite low personal investment levels are the reasons of Edirne's poor performance on this category. The cities around Ankara are not in a good condition, except Konya. Eskisehir and Kayseri are on the eighth group. In the Aegean region, Mugla, Aydin, Denizli, Isparta and Kutahya are on the ninth group. Northeast and eastern regions' values are very low, with the one exception of Gaziantep, which is on the sixth rank. With the number of patents (1.93%), the high-tech export (2.00%), the number of technology parks (2.47%), the number of companies established (3.30%), and the number of foreign companies and entrepreneurship (4.05%), the city values above the average. However, contrary to the Gaziantep's position, other cities in the same region (TRC1), Kilis and Adiyaman, are located at the end of the list. The northwest regions of Turkey (TR10-TR21-TR22- TR41-TR42) have higher innovation values on the economy category.

Table 3

R&D in GDP (NUTS 1)

Regions	R&D expenditures (1,000 TL)	R&D employment
TR1 Istanbul	7,701,448	70,251
TR2 West Marmara	728,299	8,473
TR3 Aegean	2,863,997	31,675
TR4 East Marmara	4,664,387	35,696
TR5 West Anatolia	9,751,434	57,517
TR6 Mediterranean	1,201,681	16,371
TR7 Central Anatolia	668,710	9,991
TR8 West Black Sea	557,668	9,146
TR9 East Black Sea	332,608	6,358
TRA Northeast Anatolia	394,774	5,936
TRB Central Anatolia	490,819	7,351
TRC Southeast Anatolia	499,651	7,713

Source: Turkish Statistical Institute (TurkStat 2017)

In the human capital sub-category, Istanbul has the leading position. Even though Ankara is on the second rank, the values of Istanbul are almost twice as much of Ankara's. Izmir is the third, and Eskisehir and Konya are the followers. It is interesting to see that the cities surrounding Istanbul have considerably lower values, and the same situation is observed for Izmir as well. Edirne, even though its economic values are quite low, as an exception, shows a better performance in human capital values (Fig. 3).

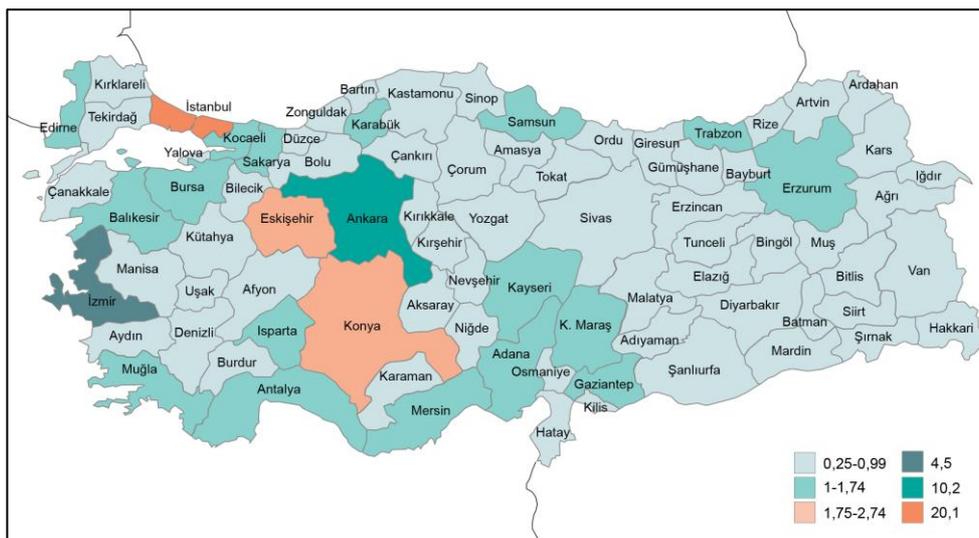


Fig. 3 – Innovation level of cities in the human capital sub-category

In the human capital sub-category, 76 of Turkey's cities are on the fifth and sixth groups. The Mediterranean coastal cities are mostly on the fifth group, including Sakarya, Samsun and Trabzon from the Black Sea. The cities in East and Southeast part, except Gaziantep and Erzurum, are on the last group. The reason for their differentiation is the relatively higher values of the number of international students that they have.

Physical and Social Infrastructure

In the physical and social structure category, Istanbul, again, is the highest-ranking city and Ankara takes the second place. However, the difference between the values of the cities is even higher than the previous category, Istanbul's value being 3.5 times higher than the one of Ankara. This time, instead of Izmir, Antalya takes the third place due to the high numbers of foreign visitors (29.26%), and Izmir becomes the fourth. Bursa, Mersin and Mugla have similar values and therefore similar rankings, however, again the cities that are in the surroundings of the highest-ranking cities perform quite poorly, with Bursa being an exception (Fig. 4).

In this category, 73 of Turkey's cities are accumulated at lower groups, between the seventh and the tenth. When compared to the economy sub-category, the physical and social infrastructure category varies quite a lot. In Marmara Region, the city of Bursa follows Istanbul instead of the cities in northeast Marmara. This time, the second-ranking Ankara is followed by the nearby city of Konya. However, Konya's values are dramatically lower than of Ankara. West Anatolia and Central Anatolia NUTS 1 regions are equally far from innovation as East and West Marmara NUTS 1 regions are. In East Black Sea, West Black Sea, Southeast Anatolia, Central East Anatolia, and Northeast Anatolia NUTS 1 regions, the innovation level in this category is quite low, reflecting the characteristics of the other parts of the country. There is, however, one city, Samsun, that stands out in the West Black Sea

Region with its relatively higher values. The reason for these higher values is that Samsun has an active opera house, which gives Samsun an advantage over its counterparts, as the number of opera houses in Turkey is quite low. The number of university students (1.30%), museums (1.51%), opera houses (9.09%), libraries (1.31%), festivals (2.31%) and internet subscribers (1.55%) are the other areas on which Samsun values higher than the cities in its region. There is also one more city, Yalova, which captures attention. Even though it is located very close to Istanbul, in the Marmara Region, the values of Yalova are way below the Turkey average in almost every category.



Fig. 4 – Innovation level of cities in the physical and social infrastructure category

Institutional Structure and Collaborations

In this category, unsurprisingly, Istanbul, again, took the first place and it is followed by Ankara, this time with a small difference in their values. Izmir takes the third place and Bursa the fourth. However, Adana, the fifth city in this category, is on the same level as the fourth ranking of Bursa (Fig. 5).

In this category, where there are 7 groups in total, most of the cities (64 cities) are on the sixth and seventh group. The three leading cities are Istanbul, Ankara and Izmir. Ankara is closer to Istanbul than it was in the other two categories. This is due to the numbers of KUSI (12.20%), and SAN-TEZ (28.65%) projects, which are high in Ankara. In the Northwest part, other cities with relatively higher values are Bursa, Kocaeli, and Sakarya. In Central Anatolia, Ankara is followed by Eskisehir and Konya. In the Aegean Region, there are no other cities that come to the fore, except Izmir. Even though most of the cities in TR81, TR82, TR83, and TR90 NUTS 2 regions are on the seventh group, in the Northern region, the cities of Trabzon and Samsun, and in the East Mus, Gaziantep and Sanliurfa, have relatively higher values. The NGOs in knowledge-intensive industries constitute only 12% of the total NGOs in Turkey. In Istanbul, Ankara, and Izmir, the number of NGOs in knowledge-intensive sectors is 10%, 7%, and 14%, respectively.

The Innovation Level of the Cities in Turkey

With the highest values in all three categories, Istanbul is the most innovative city in Turkey. Overall, it scores three times higher than the second-ranking of Ankara. Izmir is the third

city; however, in some categories, the third rank is occupied by other cities. On the final list, Antalya takes the fourth place, while Bursa takes the fifth place (Fig. 6).

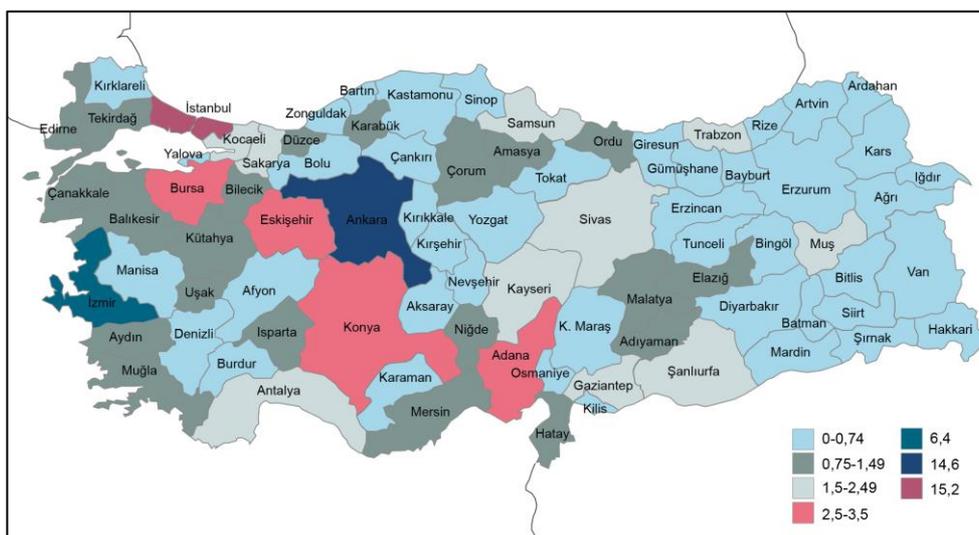


Fig. 5 – Innovation level of cities in the institutional structure and collaborations category

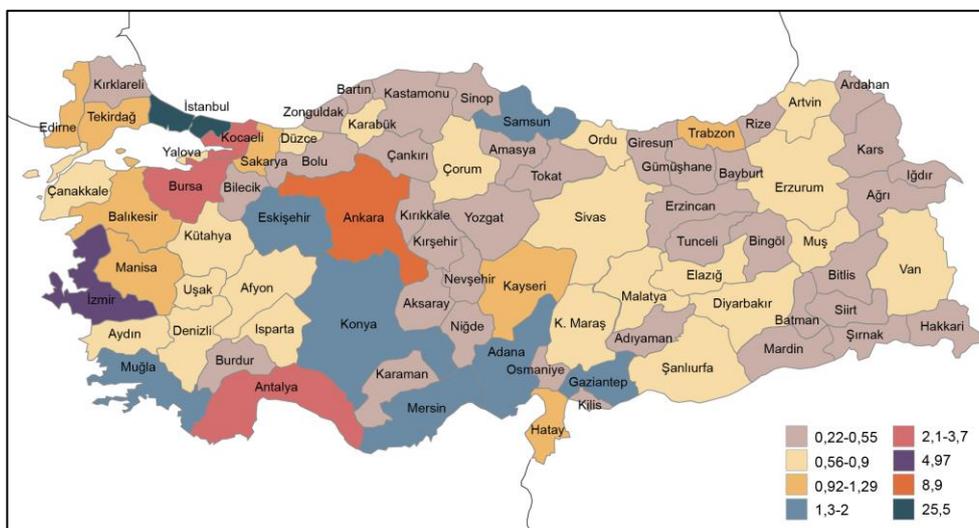


Fig. 6 – Innovation level of cities in Turkey

The Northwest part of Turkey is more innovative than the other regions. In this region, Bursa and Kocaeli follow Istanbul. In Central Anatolia, Ankara is followed by Konya and Eskisehir. Nevertheless, the values of Konya and Eskisehir are lower than those of Bursa and Kocaeli. These values suggest that the West and Central Anatolia NUTS 1 regions are not as innovation-driven as Istanbul and East Marmara regions. In the Aegean NUTS 1 region, where the third ranking city Izmir is located, there is one city, Mugla, that catches attention. In the overall ranking, Mugla shares the same position with Konya and Eskisehir. In the Mediterranean Region, where the fourth city Antalya is located, there is again one more city,

Adana. Furthermore, it is also on the same group as the rest of the mid-level cities such as Mugla, Konya, and Eskisehir. The cities in West Black Sea, East Black Sea, Southeast Anatolia, Central East Anatolia and Northeast Anatolia NUTS 1 regions have noticeably lower values in all categories, except Samsun in West Black Sea and Gaziantep in Southeast Anatolia. The general innovation consideration has 8 groups. However, in the first four groups, there are only 6 cities. The rest of the 75 cities in Turkey spread over the fifth and eighth groups, with 37 of the 75 cities accumulated on the eighth group.

While Istanbul, Bursa, and Kocaeli have above average values in their high-tech export, Izmir, Antalya, Mugla, Mersin, and Adana have higher values in physical and social infrastructures. Furthermore, Gaziantep has relatively higher values in the economy category (Table 4).

Table 4

The highest-ranking cities in Turkey

	Economy and Human capital		Physical and Social Infrastructure	Institutional structure and collaborations	Overall
	Economy	Human capital			
1	Istanbul 29.6%	Istanbul 20.1%	Istanbul 28.1%	Istanbul 15.2%	Istanbul 25.5%
2	Ankara 7.1%	Ankara 10.2%	Ankara 7.6%	Ankara 14.6%	Ankara 8.9%
3	Kocaeli 5.5%	Izmir 4.5%	Antalya 6%	Izmir 6.4%	Izmir 4.97%
4	Bursa 5.5%	Konya 2.3%	Izmir 5.3%	Bursa 3.2%	Antalya 3.7%
5	Izmir 4.2%	Antalya 2.1%	Mersin 2.5%	Adana 2.9%	Bursa 3.4%
6	Antalya 2.6%	Samsun 1.6%	Bursa 2.5%	Konya 2.6%	Kocaeli 3%
7	Gaziantep 2.1%	Kocaeli 1.6%	Mugla 2.3%	Eskisehir 2.6%	Konya 2%
8	Konya 1.4%	Bursa 1.6%	Samsun 1.9%	Gaziantep 2.4%	Mersin 1.9%

Antalya, even though it has the fourth place in overall, is not on the first eight cities in the institutional structure and collaborations category. Similarly, the sixth number – Kocaeli – is not located among the first eight cities in the social and physical infrastructure, and the institutional structure and collaborations categories. Also, Mersin is another city that is only in the physical and social infrastructure category on the number eight, and, however, it still values higher than the rest of the cities in Turkey, while it found its place to the most innovative eight cities in Turkey.

Even though their positions change in different categories, the cities with the eight lowest values are the same (Table 5). There are 68 cities below the average of innovation level (1.23%) in Turkey. 69 cities in the economy category, 64 cities in human capital, 67 cities in physical and social infrastructure, and 60 cities in the institutional structure and collaboration category are below the national average.

Table 5

The lowest-ranking cities in Turkey

	Economy and Human capital		Physical and Social Infrastructure	Institutional structure and collaborations	Overall
	Economy	Human capital			
1	Siirt 0.22%	Tunceli 0.4%	Siirt 0.2%	Tunceli 0.04%	Bayburt 0.25%
2	Hakkari 0.23%	Bilecik 0.4%	Yalova 0.23%	Bayburt 0.05%	Siirt 0.25%
3	Mus 0.24%	Artvin 0.42%	Bayburt 0.24%	Ardahan 0.05%	Gumushane 0.27%
4	Bitlis 0.24%	Ardahan 0.43%	Bingol 0.25%	Hakkari 0.07%	Bingol 0.27%
5	Gumushane 0.25%	Iğdir 0.43%	Bartın 0.25%	Iğdir 0.08%	Bartın 0.28%
6	Bayburt 0.26%	Mus 0.43%	Kirikkale 0.25%	Siirt 0.09%	Tunceli 0.29%
7	Agri 0.27%	Amasya 0.43%	Gumushane 0.26%	Kilis 0.09%	Kilis 0.3%
8	Sirnak 0.27%	Bartın 0.44%	Kilis 0.29%	Sirnak 0.12%	Ardahan 0.3%

Discussion

The concept of 'innovation' first appeared in the 8th Five Years Development Plan of Turkey (2001-2005); however, there were no policies that support and develop what the concept suggests (State Development Agency 2000). The 9th development plan (2007-2013) stresses the importance of new theoretical regional development tools and innovative approaches (State Development Agency 2006). In the 9th plan, R&D, university-industry partnerships, and entrepreneurship capital are seen as the drivers for innovation-based regional development (Keskin and Sungur 2010). The plan emphasizes that the most effective way to kick-start the innovation as a developmental tool is to support the key sectors that are inherently innovative, competitive, technology-driven, dynamic, and have a high added-value. Similarly, the 10th development plan of Turkey (2014-2018) focused on the innovation approach and innovative cities (Ministry of Development 2013). It drew attention to innovative production and production capacity, entrepreneurship, sectorial development, knowledge-based competition, the use of technology, R&D, skilled labor force, and education.

In policy documents, innovation was almost always concerned with sectorial development, and an innovative city or region is seen mostly through its innovative economic structure. Therefore, it can be said that, in Turkey, innovation is only seen through the lenses of economic variables. Therefore, the economy and human capital category under this research is the most covered area for the innovation policies of Turkey. However, counterintuitively, the case for an innovative development cannot be built on an economic-only approach and without the supporting role of social, physical, and institutional structures. Development and maintenance of an appropriate urban order requires both private and collective action, and administrative and institutional innovativeness, as well as technological development (Johnson 2008).

In the 10th development plan of Turkey, under the 'Livable Places, Sustainable Environment' section, there are some evaluations and propositions (Ministry of Development 2013). With this particular section, the physical and social environment found its way to the definition of innovation. The 11th development plan (2019-2023) resolved to set up a Specialization Commission; however, the terms of reference are not published yet (Directorate of Presidential Strategy and Budget 2019). But, in general, there are some strategies on productivity and innovation for developing economy in particular industries. In the last couple of years, Turkey adopted the new regionalism approach (Keskin and Sungur 2010), and it supported studies and applications in R&D, technological developments, innovation, and partnerships. The new regional policies are designed to foster the development of internal dynamics and capacities of regions. By doing so, it tries to secure a developmental model that builds upon the competitive capacity, basic infrastructure and technology, and knowledge infrastructures, the quality of physical spaces, human resources, entrepreneurship culture, sectoral clusters, internationalization, innovation, governance, institutional capacity, specialization and the social capital a region has. However, the questions of if and when the results of these positive approaches in the policy documents will manifest themselves in implementations remain unanswered (Keskin and Sungur 2010).

This study found that the country average of Turkey in innovation is 1.23%, and 68 cities are below the national average. There seems to be a positive relation between the innovation level and the socio-economic development level (SEGE 2011). When the results of this study are compared with the 2016 study of Kacar and Gezici (2016), which also used similar variables to measure the cities' knowledge capacity, it is seen that the first five cities in the economy category are precisely the same. Similarly, in another variable – the institutional structure, the first four cities are the same; however, after that, different other cities, such as Adana, Konya, Eskisehir, and Gaziantep, join the competition. When we compare the results, over the past 5-6 years, the differentiation of Antalya, Konya and Mersin is remarkable.

Although cities are simultaneously a place where skilled workers assemble and interact, there existing an organizational technology for that interaction (Florida et al. 2017), human capital is a weaker category for most cities in Turkey. Cities that usually occupy the higher ranks, such as İstanbul, Ankara, İzmir, Antalya, Mersin, Adana, Konya, Mugla, Samsun, Eskisehir, valued higher in terms of social and physical infrastructures. Bursa, Kocaeli, Gaziantep have higher values in the economy category. Most of the cities in Central East Anatolia and North East Anatolia NUTS 1 regions obtained higher values in the physical and social infrastructures. On the other hand, the cities in the Southeast NUTS 1 region stand out in the social and physical infrastructure and economy categories.

Since 2000, the number of studies on technology and innovation in Turkey is on the rise, and the technology and R&D penetrated the five-year development plans. Also, the efforts to create science and technology policies picked up speed. Between 2014 and 2023, the regions where İstanbul, Ankara, and İzmir are located seem to travel the extra mile to integrate innovation into their regional plans (Ankara Development Agency 2013). In the TR61 NUTS 2 region's plan, where the fourth city of Antalya is located, the term innovation does not stand out, however, in the regional plans of the region TR41 of the fifth city of Bursa, the term innovation and related policies were heavily emphasized (BEBKA 2014). Antalya is a tourism city, whereas Bursa is an industrial city. In Turkey, innovation is regarded as connected with industry more than with any other sector. Thus, the plans unsurprisingly reflect the sectorial differences between cities and whether or not they include innovation in their policies. Similarly, in the TR42 NUTS 2 region, another industrial city – Kocaeli – scores high, where the plans include innovation-driven policies (MARKA 2014). Likewise, in the TRC1 NUTS 2 region, the plan has aims, objectives, and policies on innovation, and Gaziantep, one of the cities in this region, got higher values in the overall innovation level in this study (Silkroad Development Agency 2014). Also, Mugla, another city located in the TR32 NUTS 2 region, has an above average value and it has innovation-related policies in its regional development plan (GEKA 2014). It is likely that if the city or the region plans to develop with a special focus on innovation and with rational strategies, it will also have higher values on innovation in the future.

Conclusions

According to Bayrac (2003), the 'new economy' is heavily connected to innovation. The technological capacity and innovation capacity often go hand in hand. As the former develops, the latter follows (Hoeckman et al. 2005). There are a couple of keywords like innovation, entrepreneurship, and university that define the common characteristics of innovative cities. Koçer and Karakayaci (2018) argue that institutional, political, and economic relationships are the main contributing factor in the process of developing an innovative environment. Most of the thriving, innovative cities have remarkably sophisticated infrastructures in terms of economy (high-tech export, the number of patents, the number of entrepreneurs), and the social and physical environment (the number of libraries, art galleries, festivals, opera houses, green buildings, foreign visitors).

Their pioneering development policies also play an important role in their success. It would not be wrong to say that innovative cities are also well-developed cities. This is also true for regions and even for countries. For innovative cities, human capital, institutional structure and partnerships, and the physical and social environment are highly valued attributes among technological and economic developments. However, the solution does not include tracing the steps of these cities/regions. On the contrary, the shortest path to innovation requires enhancing the local conditions and generating unique ways that lead to urban growth and development. A rational approach is a much-needed quality in the decision-making process.

In Turkey, the cities with higher innovation levels are located in the Marmara Region, while the coastal cities in the Aegean and Mediterranean regions are accompanying them. The

lowest-scoring cities are the cities in the Eastern part of the country. The massive difference between Istanbul and the rest of the cities' values is not an unexpected outcome. The rankings are almost carbon copies of each other in similar development scales. In Turkey, the level of innovation is way below the world average. Istanbul is on the fifth third ranking between 500 cities in a global index created by ICP (2018). But, Istanbul, even though it is the locomotive power of Turkey, does not score very high in the global indexes. And the capital city of Ankara scores way lower than Istanbul does.

The reason that this picture did not change in the long run is that there are some shortcomings in the policies and their implications. More work is needed to change the existing structure as, in almost every scale that measures development, İstanbul, Ankara and İzmir are the only cities that stand out. Innovation indicators could be seen as an opportunity to promote alternative cities. This study, therefore, has a vital role in determining the strengths and weaknesses of all cities in Turkey. This study could act as a springboard for other studies that would like to delve deep into innovation research.

The surrounding cities of Istanbul and Ankara demonstrate higher potentials than the rest of the NUTS 2 regions. Furthermore, other cities stand out on the Ankara-Konya-Antalya axis towards the Southern part of the country. In the economy category, after Istanbul and Ankara, Bursa and Kocaeli stand out, leaving Izmir behind. In the human capital category, Konya and Eskisehir follow Istanbul, Ankara, and Izmir. In the physical and social infrastructure category, Antalya comes as the third city, after Istanbul and Ankara. Finally, in the institutional structure and collaborations category, Ankara gets a higher point, closer to Istanbul for the first time, while Izmir, Kocaeli, Bursa, Eskisehir, Konya, Kayseri, Adana, and Gaziantep follow respectively. In the light of these findings, cities that have higher values above the country average, such as Ankara, Izmir, Antalya, Bursa, Kocaeli, Konya, Mersin, Eskisehir, Adana, Gaziantep, Samsun, Mugla, could be supported in order to promote a multi-centered growth model for Turkey.

Knowledge-intensive and industry-based cities always rank higher in similar indexes. Due to the prioritization of national and regional development over urban development, as policy documents and academic studies indicate, the existing strategies are not sufficient for cities to reach higher levels of innovation. The cities in NUTS 2 regions demonstrate quite different characteristics from each other. Therefore, the policies should be tailored according to the needs of each particular city rather than applying the same solution to the whole region. The current approach in this sense results in misleading policy developments that do not meet the needs of a specific region or do not support its strengths and potentials.

The driving force of innovation is represented by the increasing collaborations between the private sector, the public institutions, universities and NGOs. The main objective of innovation policies should be creating an eco-system that would enable the promotion, application, and dissemination and it would also facilitate the commercialization of new ideas. The government funds are an essential factor in this process (Ersoy and Sengul 2008). A better analysis of the production infrastructure is needed in order to develop more precise solutions. Under the current circumstances, it is evident that policies do not overlap with the dynamics of each specific city. In the last few years, competitiveness is recognized as an essential factor of innovation; however, the competitiveness of individual cities is still overlooked and understudied.

Patent and R&D expenditures, technology transfer and business development are important aspects of innovation. The potentials of larger cities in terms of institutional structure and human capital are much higher than their smaller counterparts. At this point, the allocation of public resources should be thoroughly discussed. The resources of each city, small or large, should be well analyzed and prioritized, and the innovation-driven sectors should be supported. Also, the human (labor politics, entrepreneurship) and social capital (capacity building, organizational skills) should be strengthened. Successful innovation in cities, as

elsewhere, requires specific packages of policies (Johnson 2008). However, before designing the policies and taking actions, a sustainable and detailed dataset should be produced. Due to the data limitations and the incomparability of the available data, many studies, including this one, cannot fully comprehend the issues of individual cities and they therefore fail to develop effective strategies.

References

- AKPINAR R. (2013), *Changing Regional Development Policies in Turkey*, Karadeniz Sosyal Bilimler Dergisi 4 (6), 29-46.
- ANKARA DEVELOPMENT AGENCY (2013), *Ankara Regional Plan 2014-2023*, Retrieved from: www.ankaraka.org.tr.
- ATHEY G., NATHAN M., WEBBER C., MAHROUM S. (2008), *Innovation and the City*, Innovation: Management Policy & Practice 10 (2-3), 156-169.
- BAER D. (2014), *The 18 Most Innovative Cities on Earth*, Business Insider, Retrieved from: www.businessinsider.com.
- BAYRAC H. N. (2003), *Social, Economic and Technological Dimensions of New Economy*, Osmangazi Üniversitesi Sosyal Bilimler Dergisi 4 (1), 41-62.
- BEKKA (2014), *Bursa Eskişehir Bilecik Regional Plan 2014-2023*, Retrieved from: www.bebka.org.tr.
- BOTERO G. (2012), *On the Causes of the Greatness and Magnificence of Cities*, University of Toronto Press, Toronto.
- CROWLEY L. (2011), *Streets Ahead: What Makes a City Innovative?*, The Work Foundation, Lancaster University, Retrieved from: www.reglab.dk.
- DIRECTORATE OF PRESIDENTIAL STRATEGY AND BUDGET (2019), *11th Development Plan of Turkey (2019-2023)*, Retrieved from: www.sbb.gov.tr.
- ERSOY B., SENGUL C. (2008), Government Applications towards Innovation and Comparison with European Union, *Yönetim ve Ekonomi* 15 (1), 59-74.
- ERSÖZ F., BAYRAKTAR T., ERSÖZ T. (2016), *An Analysis of Innovation on World and Turkey*, Yeni Türkiye Dergisi - Bilim ve Teknoloji 2, 1-5.
- FANG C., MA H., WANG Z., LI G. (2014), The Sustainable Development of Innovative Cities in China: Comprehensive Assessment and Future Configuration, *Journal of Geographical Sciences* 24, 1095-1114.
- FLORIDA R., ADLER P., MELLANDER C. (2017), *The City as Innovation Machine*, *Regional Studies* 51 (1), 86-96.
- GEKA (2014), *2014-2023 Muğla Regional Plan*, Retrieved from: www.geka.gov.tr.
- HALL P. G. (1998), *Cities in Civilization*, Weidenfeld and Nicolson, London.
- HOECKMAN B. M., MASKUS K. E., SAGGI K. (2005), Transfer of Technology to Developing countries: Unilateral and Multilateral Policy Options, *World Development* 33 (10), 1587-1602.
- INNOVATION CITIES PROGRAM (ICP) (2018), *Innovative cities index 2018*, Retrieved from: www.innovation-cities.com.
- ISIK N., KILINC E. (2012), *Innovation-Driven Development: An Examination on the European Union Countries and Turkey*, *Journal of Entrepreneurship and Innovation Management* 1 (1), 31-68.
- JACOBS J. (1969), *The economy of cities*, Vintage, New York.
- JOHNSON B. (2008), *Cities, systems of innovation and economic development*, *Innovation: Management Policy & Practice* 10 (2-3), 146-155.
- KACAR S. M., GEZICI F. (2016), *Knowledge-based urban development potential of Turkish provinces*, *International Journal of Knowledge-Based Development* 7 (2), 160-183.
- KELLY J. (2018), *These are the world's most innovatively cities, and here's why*, World Economic Forum, Retrieved from: www.weforum.org.
- KESKIN H., SUNGUR O. (2010), Transformation in Regional Policy: Changes in Regional Policies in the Development Plans in Turkey, *SDÜ Fen Edebiyat Fakültesi Sosyal Bilimler Dergisi* 21, 271-293.

- KOÇ K., MENTE A. (2007), *Inovasyon Kavramı ve Üniversite-Sanayi-Devlet İşbirliğinde Uçlu Sarmal Modeli* (The Concept of Innovation and the Three Spiral Model in the University-Industry-State Cooperation), Hacettepe Üniversitesi Sosyolojik Araştırmalar Dergisi, 1-18.
- KOÇER K., KARAKAYACI Ö. (2018), Space as Determining of Innovation Process in Small-scale Cities: The Case of Iznik City, *Artium* 2, 24-37.
- MARCEAU J. (2008), *Introduction: Innovation in the city and innovative cities*, Innovation: Management, Policy & Practice 10 (2-3), 136-145.
- MARKA (2014), *Doğu Marmara 2014-2023 Regional Plan*, Retrieved from: www.marka.org.tr.
- MINISTRY OF DEVELOPMENT (2013), *10th Development Plan of Turkey (2014-2018)*, Retrieved from: www.sbb.gov.tr.
- OECD (2009), 2009 Interim Report on the OECD Innovation Strategy: an agenda for policy action on innovation, Retrieved from: www.oecd.org.
- OZBEK H., ATIK H. (2013), The Place of Turkey within the European Union Countries in Terms of Innovation Indicators: A Statistical Analysis, *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 42, 193-210.
- PRICEWATERHOUSECOOPERS (PWC), EUROPEAN INSTITUTE FOR COMPARATIVE URBAN RESEARCH (EURICUR), INSTITUTE FOR HOUSING AND URBAN DEVELOPMENT STUDIES (IHS) (2014), *iUrban: Innovative City Strategies for Delivering Sustainable Competitiveness*, Retrieved from: www.pwc.com.
- RUTKOWSKA-GURAK A. (2010), *The innovative city: the Impact of Innovation on City Development*, *Badania Fizjograficzne R. I – Seria D – Gospodarka Przestrzenna*, 77-87.
- ŞAHİNLİ M. A., KİLİNÇ E. (2013), *Innovation and Innovation Indicators: Compare of EU Countries and Turkey*, *The Journal of Social and Economic Research* 25, 329-355.
- SCHWAB K. (2019), *The Global Competitiveness Report 2019*, World Economic Forum, Geneva.
- SEGE (2011), *The Research of Socio-economic Development Rankings of Cities and Regions in Turkey-2011*, Ministry of Development Publishing, Ankara.
- SILKROAD DEVELOPMENT AGENCY (2014), *Gaziantep Adiyaman Kilis 2014-2023 Regional Plan*, Retrieved from: www.ika.org.tr.
- STATE DEVELOPMENT AGENCY (2000), *8th Development Plan of Turkey (2001-2005)*, Retrieved from: www.sbb.gov.tr.
- STATE DEVELOPMENT AGENCY (2006), *9th Development Plan of Turkey (2007-2013)*, Retrieved from: www.sbb.gov.tr.
- UÇAR A., ŞEMŞİT S., NEGİZ N. (2017), *Smart City Implementations in the EU and Reflections in Turkey*, *The Journal of Faculty of Economics and Administrative Sciences* 22, 1785-1798.
- VANOLO A. (2013), Smartmentality: The Smart City as Disciplinary Strategy, *Urban Studies* 51 (5), 883-898.
- YILMAZ Z., İNCEKAŞ E. (2018), *Innovation and Regional Development in Turkey*, *Kırklareli Üniversitesi Sosyal Bilimler Dergisi* 2 (1), 154-169.

Initial submission: 01.04.2020
Revised submission: 27.11.2020
Final acceptance: 23.12.2020

Correspondence: Department of Urban and Regional Planning, Faculty of Architecture, Istanbul Technical University, Taskisla, 34437 Taksim, Istanbul, Turkey.

Email: kerimoglu@itu.edu.tr