REGIONAL STATISTICS

JOURNAL OF THE
HUNGARIAN CENTRAL
STATISTICAL OFFICE

EDITORIAL BOARD

ANNA BANDLEROVA (SK), LAJOS BÁLINT, JÓZSEF BENEDEK (RO), JÁN BUČEK (SK),
GYÖRGY CSOMÓS, LÓRÁNT DÁVID, ZOLTÁN DÖVÉNYI, TAMÁS DUSEK, ALAN FYALL (UK),
ÁKOS JAKOBI, RANDALL JACKSON (USA), PETER JORDAN (AT), ÉVA JUHÁSZ-HANTOS,
ANDRZEJ KALETA (PL), ÁRON KINCSES, GYÖRGY KOCZISZKY, ZSOLT KOCSIS-NAGY,
ZOLTÁN KORMOS, BALÁZS KOTOSZ, ZOLTÁN KOVÁCS, METIN KOZAK (TR),
LÁSZLÓ KULCSÁR, LÁSZLÓ J. KULCSÁR (USA), IMRE LENGYEL,
PARIKSHAT SING MANHAS (IN), GÁBOR MICHALKÓ, TAMÁS MOLNÁR,
ARMANDO MONTANARI (IT), ZOLTÁN NAGY, ZOLTÁN NÉDA (RO),
NÁNDOR NÉMETH, ZOLTÁN NOVÁK, GYÖRGYI NYIKOS, JOHN PICKLES (USA),
BALÁZS SZÁNTÓ, MARK THISSEN (NL), FERENC TIPOLD, KYRA TOMAY,
GÉZA TÓTH (Editor in Chief), ATTILA VARGA, JUDIT VIDA, MÁRIA-MAGDOLNA VINCZE (RO)

VOLUME 8, No 1 2018

CONTENTS

STUDIES

Migration to Germany: Structures, processes, and discourses – *Birgit Glorius* 3
Migration to Europe and its demographic background – *Marcell Farkas – Zoltán Dövényi* 29
The spatial peculiarities of economic and social convergence in Central and Eastern Europe – *Zoltan Egri – Tamas Tanczos* 49
New trends in the development of Hungarian clusters: The case of the Southern Great Plain region – *Lívia Berkecz-Kovács* 78
Spatial inequalities of disadvantage accumulation and their impact on employability in Hungary – *Levente B. Alpek – Róbert Tésits – Gábor Hoványi* 96
Evidence-based designation of development regions in Romania – *József Benedek – Ibolya Török– Csongor Máthé*..... 120
The impact of the 2008 financial crisis on household income and wealth in Visegrad countries – *György Kocziszky – József Benedek – Dóra Szendi* 141
Dwelling services, with an emphasis on imputed rent in the European Union – *Magdolna Komolafe* 168
Ranking of provinces by entrepreneurship, innovativeness, and human capital indicators, using the PROMETHEE method – The case study of Turkey – *Onur Sungur – Yağmur Zararci*..... 187
Jarred baby food purchasing habits among mothers of infants in Hungary, and the features of baby food labels – *Katalin Lipták – Noémi Hajdú* 202

Peer-reviewed scientific periodical

Abstracted & indexed in:
SCOPUS, EBSCO, Google Scholar, Current Geographical Publications (CGP), CEEOL, Index Copernicus International, Infobase Index, European Reference Index for the Humanities and Social Sciences, AcademicKeys.com, Primo Central, Harvard Dataverse

HU ISSN 2063-9538 (Print) HU ISSN 2064-8243 (Online)

Editorial Office: H-1024 Budapest II, Keleti Károly u. 5–7
Editor in Chief: Géza Tóth
Proofreader: Cosette Kondora
Design: Ilona Csilla Bada; Technical Editor: Eva Bartha
Published by the Hungarian Central Statistical Office
Internet: www.ksh.hu
The publication can be purchased at the Information Service of the Hungarian Central Statistical Office:
H-1024 Budapest II, Fényes Elek u. 14–18. Phone: +36 (1)345-6560

Printed by Xerox Magyarország Kft. – 2018.096

Ranking of provinces by entrepreneurship, innovativeness, and human capital indicators, using PROMETHEE – The case study of Turkey

Onur Sungur
Mehmet Akif Ersoy University
Department of Economics,
Turkey
E-mail:
onursungur@mehmetakif.edu.tr

Yağmur Zararci
Mehmet Akif Ersoy University
Department of Economics,
Turkey
E-mail: yagmur.zararci@gmail.com

Keywords:
entrepreneurship,
innovation,
human capital,
PROMETHEE,
ranking

In the study, the authors aim to rank Turkey's provinces through the lens of innovativeness, entrepreneurship, and human capital. They use company establishment and liquidation statistics, industrial capacity report statistics, intellectual property statistics, national education statistics, and higher education statistics for this purpose. The presented 16 variables are grouped into 3 categories: entrepreneurship, innovativeness, and human capital. As a ranking technique, the preference ranking organization method for enrichment evaluation (PROMETHEE) is used. The 81 provinces of Turkey are ranked in terms of innovativeness, entrepreneurship and human capital performance, and their advantages are shown relative to one another. According to the results, Istanbul takes the first place followed by Ankara, İzmir, Konya, and Kocaeli provinces, while Sinop, Iğdır, Tunceli, Ardahan, and Bayburt provinces perform the worst.

Introduction

Many extant studies focus on ranking cities, provinces, or regions using various indicators in both developed and developing countries (Azar–Gholamrezaei 2006, Amini et al. 2006, Murias et al. 2006, Mehrjardi et al. 2012, Rostampour 2012, Csomos 2015). Regional (or provincial) statistics include economic accounts, demography, labour market, education, health, agriculture, business, tourism, science and technology, transport, digital economy and society, poverty, crime, social connections, social exclusion, governance, environment, among others (Brandmueller et al. 2017, p. 8., Bartha–Tóthné 2015, p. 127.). In Turkey, various institutions (especially the Ministry of Development [MoD]) have conducted studies to determine the socio-economic level of development of provinces and regions in certain periods. These studies use a large number of economic and social variables. Some examples of these studies are 'Socio-economic development ranking of prov-

inces and regions' (SEGE) prepared by the MoD, 'Well-being index of provinces' prepared by TurkStat (TUIK), and 'Provincial competitiveness index for Turkey' conducted by the Centre for Economic and Foreign Policy Studies (EDAM). They are important references to determine policies and strategies in many other areas as well as to allocate public resources and orientate private sector investments.

In addition to ministerial/institutional studies, there are academic papers that rank the provinces based on selected variables. Each paper has different indicators, time interval, and methods to determine provinces' socio-economic development level. To rank and classify the provinces, several techniques can be used such as clustering analysis, discriminant analysis, principal component analysis (PCA), multidimensional scaling analysis, etc. (Filiz 2005). For example, Erilli et al. (2009), Erilli–Gundogdu (2013), and Yılancı (2010) used fuzzy clustering analysis; Kaygısız et al. (2005) used path analysis and clustering analysis; Özdemir and Altıparmak (2005) used factor analysis; Gul and Cevik (2014, 2015), Albayrak (2005), and Baday Yıldız et al. (2010, 2012) used PCA; Koç (2001) and Karabulut et al. (2004) used clustering analysis; Kılıç et al. (2011) used multidimensional scaling analysis; and Filiz (2005) used multivariate statistical techniques.

Albayrak (2005) examined the determinants of Turkish provinces' socio-economic development levels. The author used 48 variables from a large number of distinct fields, such as geography, demography, education and culture, health, employment, social security, finance, manufacturing industry, agriculture, export, energy, housing, and infrastructure. Based on the results, Istanbul, Izmır, Ankara, Kocaeli and Bursa rank as the most developed provinces. Baday Yildiz et al. (2010) determined the provinces' socio-economic development ranking by using up-to-date data from the year of the publication. They selected 41 variables from social (demographic, employment, education, health, infrastructure, and other welfare) and economic (manufacturing, construction, agriculture, financial) indicators for the 81 provinces, and used PCA. In their study, Sakarya and Ibısoglu (2015) prepared a socio-economic development index with a geographically weighted regression model for 2011. The authors used eight out of the 61 indicators from the socio-economic development index prepared by the MoD and investigated how these indicators explained the development rates geographically. Dikmen and Dursun (2016) examined the well-being and quality of life in Turkish provinces and ranked the provinces by 40 indicators. They used multi-objective optimization on the basis of ratio analysis (MOORA) and MOORA plus full multiplicative form (MULTIMOORA) methods. The results revealed that Istanbul, Ankara, Izmır, Trabzon and Yalova ranked as the top five provinces. Gulel et al. (2017) calculated a human development index for Turkey's provinces for 2013. Their study concludes that Ankara ranks first and Mus ranks last.[1]

[1] For more studies on ranking provinces, see DPT (2003), EDAM (2009), Gul–Cevik (2014, 2015), Kalkınma Bakanlığı (2013), Karadeniz Yılmaz et al. (2016), Ozaslan et al. (2006), TEPAV (2013), and TUIK (2015).

This study aims to create a similar ranking through the lenses of characteristics such as innovativeness, entrepreneurship, and human capital. In this context, the number of patents, utility models, trademark registrations, established/closed companies and higher education students as well as other relevant human capital indicators are employed. We use the multi-criteria decision making (MCDM) method and the PROMETHEE II full ranking method as ranking techniques. As far as we know, this is the first study that uses PROMETHEE to rank provinces in Turkey as an alternative ranking technique. In the study, 81 provinces are ranked in terms of innovativeness, entrepreneurship and human capital performance, and the advantages of these provinces are compared with one another.

The study consists of four sections. After an introduction and a brief literature review, we describe PROMETHEE in the first section. In the second section, we present the dataset used in the study. The analysis results are presented in tables and figures in the third section. The last section concludes the study.

Methodology

In this study, PROMETHEE is used to rank provinces in terms of the entrepreneurship, innovativeness, and human capital criteria. This method was developed by Brans et al. (1984, 1986) and Brans and Vincke (1985). The main purpose of PROMETHEE is to ensure the most suitable choice among alternatives depending on multiple criteria.

According to PROMETHEE, an evaluation table, which includes both criteria and alternatives, must first be composed. The evaluation table is a $m \times n$ matrix, where $m = 1,2,3...$ indicates the number of alternatives, and $n = 1,2,3...$ denotes the number of criteria (Bagci–Rencber 2014, p. 42.). Table 1 presents an example of such an evaluation table.

Table 1

Evaluation table (example)

Alternative/Weight	Criterion 1	Criterion 2	Criterion n
Alternative a	$f_1(a)$	$f_2(a)$	$f_n(a)$
Alternative b	$f_1(b)$	$f_2(b)$	$f_n(b)$
Alternative c	$f_1(c)$	$f_2(c)$	$f_n(c)$
....	...	...	...
Alternative m	$f_1(m)$	$f_2(m)$	$f_n(m)$
Weight	w_1	w_2	w_n

Source: Fernandez (2014, p. 11.).

As the first step, the preference function is defined for the relevant criteria. A preference function for a and b alternatives for criterion C_j is described as follows:

$$\Omega_j(a,b) = H_j\left(d_j\right);\ C_j(a) > C_j(b), \tag{1}$$

where d_j stands for the difference of evaluations (alternatives *a* and *b*), and H_j denotes the criterion function. In the second step, we calculate the preference indices reflecting the weights for criteria *k* depending on the preference function:

$$c(a,b) = \sum_j w_j \Omega_j(a,b);\ w_j\left(j = 1,2,...,k\right). \tag{2}$$

In the next step, positive ($\Phi^+(a)$) and negative ($\Phi^-(a)$) priorities (flows) are determined for the alternatives. A positive flow for alternatives *a* and *b* measures how good alternative *a* is compared with alternative *b*. On the contrary, a negative flow expresses how weak alternative *a* is compared with alternative *b*.

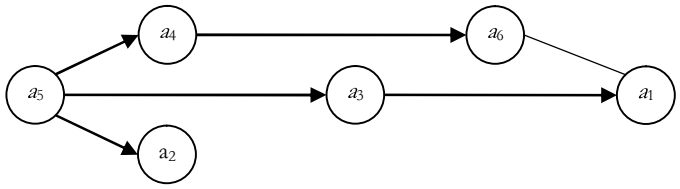
$$\Phi^+(a) = \sum c(a,b) \tag{3}$$

$$\Phi^-(a) = \sum c(a,b) \tag{4}$$

Finally, the partial priorities of alternatives are set using the PROMETHEE I, then full priorities are calculated by the PROMETHEE II (see Figures 1 and 2).

Figure 1

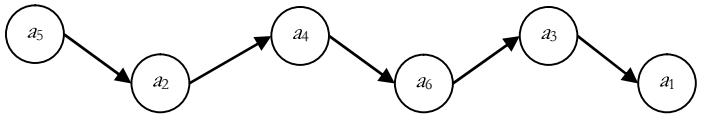
Partial priorities of six alternatives by PROMETHEE I (example)



Source: Brans–Vincke (1985, p. 655.).

Figure 2

Full priorities of six alternatives by PROMETHEE II (example)



Source: Brans–Vincke (1985, p. 656.).

The main difference between PROMETHEE I and PROMETHEE II is that while the former provides a partial ranking (priorities) of alternatives, the latter gives a final ranking (full priorities) of alternatives from best to worst, using net flow values (Macharis et al. 2004, pp. 308–309.).

Dataset

We used company establishment and liquidation statistics, industrial capacity report statistics, intellectual property statistics, national education statistics, and higher education statistics in this study. The 16 variables presented are grouped into three categories (entrepreneurship, innovativeness, and human capital). The variables are shown in Table 2.

Table 2

Research variables for the reference year of 2016

Category	Variable
Entrepreneurship	Number of companies established
	Number of companies closed
Innovativeness	Number of patents
	Number of utility models
	Number of trademarks
Human capital	Literacy rate (of people aged 15 and over)
	Number of students (associate's and bachelor's degrees)
	Number of students (master's and doctoral degrees)
	Number of graduate students (primary education)
	Number of graduate students (secondary education)
	Number of graduate students (associate's and bachelor's degrees)
	Number of graduate students (master's degree)
	Number of graduate students (doctoral degree)
	Number of academicians
	Number of engineers
	Number of technicians

Our data is obtained from various sources such as the Union of Chambers and Commodity Exchanges of Turkey (TOBB), the Council of Higher Education (YOK), TUIK, the Turkish Patent and Trademark Office (TPE), and the Ministry of National Education (MEB). The number of established and closed companies, and the engineers' and technicians' statistics are from the TOBB; patent, utility model and trademark statistics are from the TPE; statistics on primary, secondary and higher education as well as on human capital are from MEB and YOK databases. The 'Visual PROMETHEE' software was used to analyse data and rank the provinces. During the analysis, all the preference functions of variables were selected as V-shaped since all the variables are quantitative. In addition, for all the variables, the maximum preference was selected, except for the 'Number of companies closed' variable; and no thresholds were selected.

Results

Table 3 shows the descriptive statistics for each variable. Since there are 81 provinces, each variable has 81 observations. As can be seen in Table 3, about 1,305 companies were established and 378 companies were closed in 2016, on average, across the provinces of Turkey. In terms of innovativeness, 22 patents, 29 utility models, and 1,033 trademarks were registered on average. The human capital indicators given in Table 3 are the literacy rate of the population aged 15 and over (the total number of the population aged 15 and over who can write and read), the number of higher education students, the number of graduates from primary, secondary and tertiary education, the number of academicians, the number of engineers, and the number of technicians.

Table 3

Descriptive statistics

Variable	Minimum	Maximum	Mean	Standard deviation
Number of companies established	31.0	40,924.0	1,304.7	4,659.2
Number of companies closed	9.0	11,639.0	378.4	1,342.9
Number of patents	0.0	956.0	22.1	108.9
Number of utility models	0.0	985.0	29.0	116.7
Number of trademarks	5.0	40,212.0	1,032.9	4,546.3
Literacy rate (of people aged 15 and over)	64,014.0	10,865,370.0	706,752.0	1,316,345.9
Number of students (associate's and bachelor's degrees)	2,370.0	2,914,115.0	76,370.5	327,994.2
Number of students (master's and doctoral degrees)	0.0	150,721.0	6,212.1	18,631.1
Number of graduate students (primary education)	744.0	202,282.0	14,344.5	24,501.1
Number of graduate students (secondary education)	816.0	174,411.0	12,255.2	21,365.0
Number of graduate students (associate's and bachelor's degrees)	685.0	204,029.0	9,300.0	24,918.3
Number of graduate students (master's degree)	8.0	17,226.0	541.1	2,007.6
Number of graduate students (doctoral degree)	1.0	1,547.0	93.1	259.1
Number of academicians	246.0	27,634.0	1,802.9	3,661.8
Number of engineers	10.0	21,926.0	1,458.5	3,600.4
Number of technicians	4.0	24,868.0	1,560.6	3,743.1

Table 4 shows the provinces' net flows of priorities and ranking based on PROMETHEE analysis results. As the table shows, Istanbul took the first place

based on the mentioned 16 variables. Istanbul has a positive flow of 0.921, a negative flow of 0.065 (only for the 'Number of companies closed' variable), and thus, a net flow of 0.856. Istanbul is the most populous province having about 15 million people. Nearly one-third of Turkey's universities are located in Istanbul, and 27 thousand academics work at these universities. In addition, 10% of associate and undergraduate students and 30% of graduate and doctoral students are educated in the province. Moreover, there are 127 R&D centres in Istanbul, and 30% of Turkey's enterprises are also located there. Hence, 956 patents, 985 utility models, and more than 40 thousand trademarks were registered in Istanbul in 2016.

Table 4

Ranking of Turkish provinces by net flow of priorities

Rank	Province	Φ	Rank	Province	Φ
1	İSTANBUL	0.856	28	KÜTAHYA	0.251
2	ANKARA	0.838	29	ELAZIĞ	0.234
3	İZMİR	0.806	30	AFYON	0.222
4	KONYA	0.745	31	ÇANAKKALE	0.207
5	KOCAELİ	0.721	32	SİVAS	0.205
6	BURSA	0.709	33	VAN	0.111
7	GAZİANTEP	0.651	34	ŞANLIURFA	0.067
8	ADANA	0.644	35	DÜZCE	0.035
9	SAKARYA	0.616	36	ZONGULDAK	0.013
10	KAYSERİ	0.611	37	EDİRNE	–0.003
11	ESKİŞEHİR	0.609	38	TOKAT	–0.018
12	ANTALYA	0.557	39	BOLU	–0.035
13	MANİSA	0.541	40	AKSARAY	–0.052
14	SAMSUN	0.521	41	RİZE	–0.082
15	MERSİN	0.505	42	GİRESUN	–0.096
16	DENİZLİ	0.466	43	UŞAK	–0.112
17	AYDIN	0.402	44	KIRIKKALE	–0.116
18	TRABZON	0.392	45	ADIYAMAN	–0.134
19	HATAY	0.354	46	KIRKLARELİ	–0.138
20	KAHRAMANMARAŞ	0.349	47	KARABÜK	–0.173
21	BALIKESİR	0.347	48	NİĞDE	–0.176
22	ERZURUM	0.340	49	ORDU	–0.176
23	ISPARTA	0.331	50	BURDUR	–0.183
24	TEKİRDAĞ	0.326	51	KASTAMONU	–0.193
25	MALATYA	0.291	52	ÇORUM	–0.208
26	MUĞLA	0.281	53	AMASYA	–0.244
27	DİYARBAKIR	0.267	54	NEVŞEHİR	–0.250

(Continued on the next page)

(Continued)

Rank	Province	Φ	Rank	Province	Φ
55	YALOVA	–0.254	69	BARTIN	–0.481
56	MARDİN	–0.255	70	SİİRT	–0.482
57	BATMAN	–0.262	71	ŞIRNAK	–0.503
58	KARAMAN	–0.281	72	GÜMÜŞHANE	–0.545
59	OSMANİYE	–0.284	73	HAKKARİ	–0.581
60	BİLECİK	–0.327	74	BİTLİS	–0.581
61	YOZGAT	–0.375	75	KİLİS	–0.640
62	KARS	–0.383	76	ARTVİN	–0.647
63	KIRŞEHİR	–0.384	77	SİNOP	–0.666
64	ERZİNCAN	–0.414	78	IĞDIR	–0.676
65	AĞRI	–0.414	79	TUNCELİ	–0.689
66	ÇANKIRI	–0.469	80	ARDAHAN	–0.735
67	BİNGÖL	–0.470	81	BAYBURT	–0.760
68	MUŞ	–0.473			

Istanbul is followed by Ankara (with a net flow of 0.838), İzmir (0.806), Konya (0.745), and Kocaeli (0.721). Ankara is Turkey's capital and the second most populous city in the country. There are 17 universities in Ankara, where more than 18 thousand academicians work. Ankara has 46 R&D centres specialised in fields such as computer, software, and defence industries. Izmir is a port city located in the west and Turkey's third most populous city. It is highly developed in terms of R&D, innovation, and human capital. In the province, there are eight universities as well as an Innovation Centre, and various regional innovation systems are carried out in many areas. Konya, which is Turkey's largest city by land area, is located in central Anatolia, close to Ankara. It stands out with its industrial sector, especially with its machinery and equipment, and automotive industries. There are four universities and five R&D centres in Konya. Kocaeli, located east of Istanbul, is considered Turkey's 'industrial capital'. Chemistry, steel, automotive and iron industries are its biggest industrial sectors. The city has a major role in the country's automotive industry.

The worst performing provinces are Sinop, Iğdır, Tunceli, Ardahan, and Bayburt. All these provinces are located in Eastern Anatoli Region. This result is not surprising as Turkey's eastern part is much less developed than the western part, and the disparities between them are high (Onder et al. 2007). In terms of many socio-economic indicators such as population, income, GDP per capita, industry, employment, and financial indicators, Turkey's eastern part has remained quite backward compared with the west. This is not much different when it comes to innovativeness, entrepreneurship, and human capital indicators as well.

Figures 3, 4, and 5 are maps that show the provinces and their net flow of priorities from various aspects. According to Figure 3, Turkey's western and southern provinces generally have positive net flow values, while the central and eastern provinces have negative ones. In Figure 4, the provinces are coloured in different tones according to their net flow values of priorities. It is clear from the figure that Φ values increase from east to west. Finally, Figure 5 shows a map of the provinces' grouping into five scales based on their net flow values. The first group has the highest net flow values, while the fifth group consists of provinces with the lowest Φ values.

Figure 3

Turkish provinces with positive/negative net flow of priorities, 2016

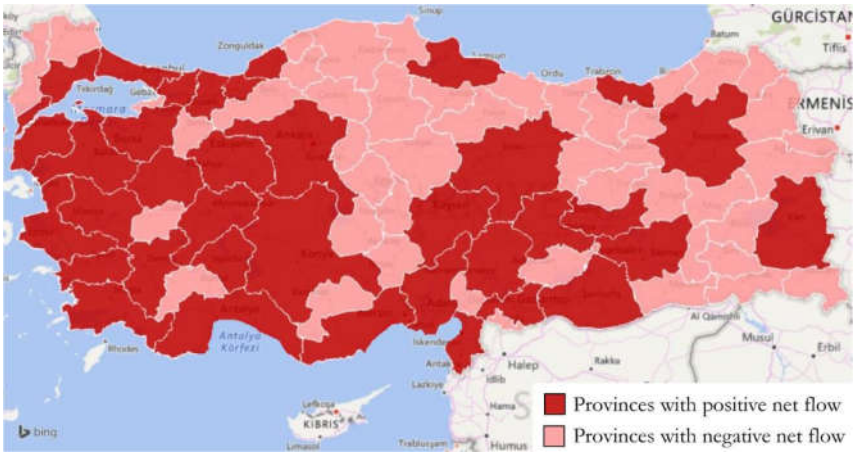


Figure 4

Turkish provinces by net flow value of priorities, 2016

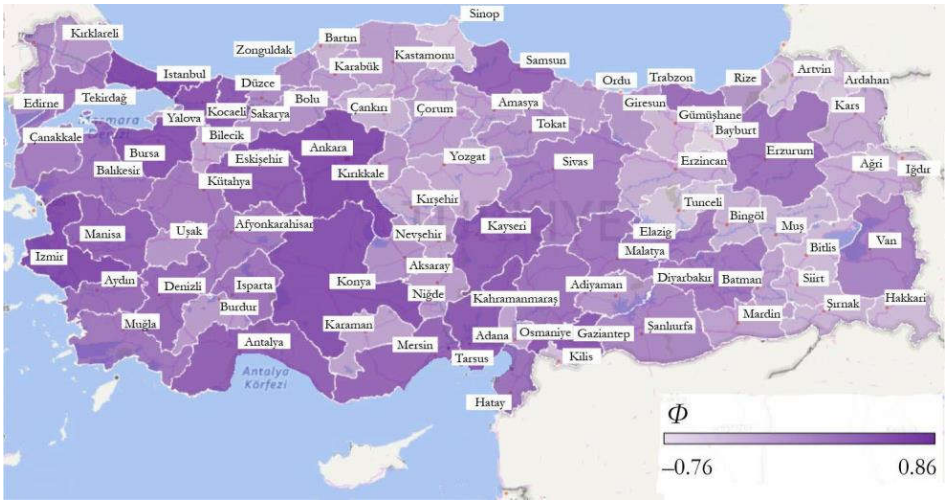
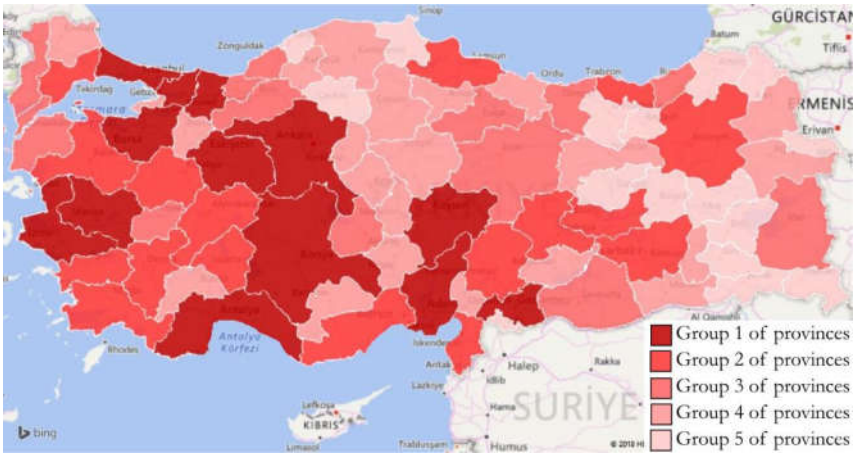


Figure 5

Five groups of Turkish provinces by net flow of priorities, 2016



Note: For the Φ intervals and the province list of the five groups, see Table 5.

Table 5 shows the provinces grouped into five categories based on their net flows of priorities. Istanbul, Ankara, Izmır, Konya, Kocaeli, Bursa, Gaziantep, Adana, Sakarya, Kayseri, Eskişehir, Antalya and Manisa have the highest values. They can be considered developed provinces based on their industrial and other socio-economic development indicators and are mainly located in Turkey's western part, as can be seen in Figure 5. Besides these 13 provinces of Group 1, there are 17 provinces in Group 2, 13 in Group 3, 22 in Group 4, and 16 provinces in Group 5 (that has the lowest net flows).

Figure 6 presents PROMETHEE II's final ranking based on the provinces' net flows. According to the results, while the provinces' ranking is evident to a certain point (Denizli province), after that it becomes unclear, especially after Van province. In other words, the provinces' superiority over one another is increasingly ambiguous following Denizli province.

Finally, the GAIA plane results are presented in Figure 7. The GAIA plane displays each alternative's relative position in terms of its contributions to the various criteria (Macharis et al. 2004, p. 309.). Even though the provinces' ranking remains unchanged, some useful conclusions can be drawn from the figure. The provinces on the left side of the optimal line (the left side of the vertical axis in the graph) are the ones that have no superiority in terms of any criteria. These include the worst performing provinces such as Kırıkkale, Bolu, Tunceli, Siirt, Yozgat, Ağrı, Ordu, Batman, Mardin, etc.

Table 5

Five groups of Turkish provinces by net flow interval of priorities, 2016

Number of provinces	Group 1	Group 2	Group 3	Group 4	Group 5
	Φ interval				
	0.86 to 0.54	0.54 to 0.22	0.22 to –0.12	–0.12 to –0.44	–0.44 to –0.76
1	İSTANBUL	SAMSUN	ÇANAKKALE	KIRIKKALE	ÇANKIRI
2	ANKARA	MERSİN	SİVAS	ADIYAMAN	BİNGÖL
3	İZMİR	DENİZLİ	VAN	KIRKLARELİ	MUŞ
4	KONYA	AYDIN	ŞANLIURFA	KARABÜK	BARTIN
5	KOCAELİ	TRABZON	DÜZCE	NİĞDE	SİİRT
6	BURSA	HATAY	ZONGULDAK	ORDU	ŞIRNAK
7	GAZİANTEP	KAHRAMANMARAŞ	EDİRNE	BURDUR	GÜMÜŞHANE
8	ADANA	BALIKESİR	TOKAT	KASTAMONU	HAKKARİ
9	SAKARYA	ERZURUM	BOLU	ÇORUM	BİTLİS
10	KAYSERİ	ISPARTA	AKSARAY	AMASYA	KİLİS
11	ESKİŞEHİR	TEKİRDAĞ	RİZE	NEVŞEHİR	ARTVİN
12	ANTALYA	MALATYA	GİRESUN	YALOVA	SİNOP
13	MANİSA	MUĞLA	UŞAK	MARDİN	IĞDIR
14		DİYARBAKIR		BATMAN	TUNCELİ
15		KÜTAHYA		KARAMAN	ARDAHAN
16		ELAZIĞ		OSMANİYE	BAYBURT
17		AFYON		BİLECİK	
18				YOZGAT	
19				KARS	
20				KIRŞEHİR	
21				ERZİNCAN	
22				AĞRI	

Figure 6

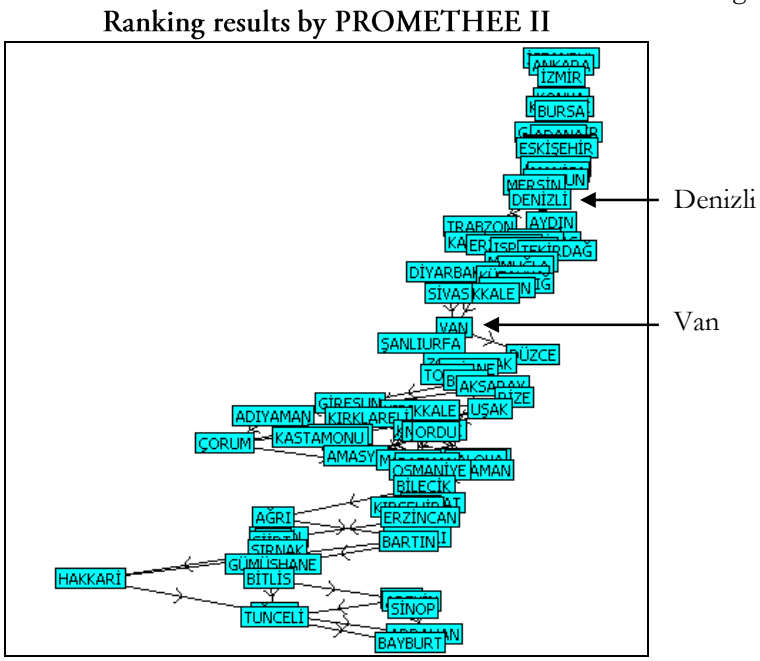
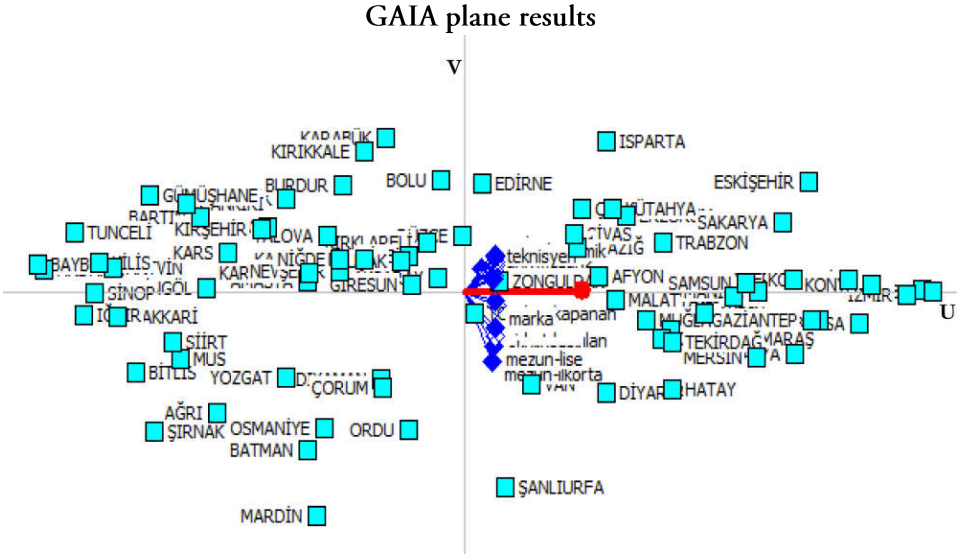


Figure 7



Note: Axis U denotes the first principal component and accounts for the maximum possible variance in information. Axis V is orthogonal to Axis U and shows the second principal component. It captures the maximum variance in additional information.

Conclusions

This study aimed to rank Turkey's provinces in terms of innovativeness, entrepreneurship, and human capital indicators. Although considerable research has been devoted in the literature to this subject, so far no study has used our analysis method. Besides emphasising the importance of using multiple variables in the provinces' ranking based on innovativeness, entrepreneurship, and human capital indicators, we demonstrated that PROMETHEE could be used as an alternative method.

Our findings are consistent with other research mentioned in the literature section. According to many studies, Istanbul, Ankara, İzmir, Kocaeli, Bursa, and Konya rank on the top places. This research also proves that these provinces are the best performers in terms of innovation, entrepreneurship, and human capital. However, several eastern provinces, especially Kilis, Artvin, Iğdır, Tunceli, Bayburt, and Ardahan, have been performing poorly as measured by the subject variables.

Acknowledgement

This study was financed by the Scientific and Technological Research Council of Turkey (TÜBİTAK). Project No. 1919B011600799.

REFERENCES

ALBAYRAK, A. S. (2005): Türkiye'de İllerin Sosyoekonomik Gelişmişlik Düzeylerinin Çok Değişkenli İstatistik Yöntemlerle İncelenmesi *ZKÜ Sosyal Bilimler Dergisi* 1 (1): 153–177.

AMINI, N.–YADOLAHI, H.–INANLOO, S. (2006): Ranking of country provinces health *Social Welfare Quarterly* 5 (20): 27–48.

AZAR, A.–GHOLAMREZAEI, D. (2006): Ranking of country provinces with trend of data envelopment analysis and by human development indicators *Journal of Economic Research* 27: 153–173.

BADAY YILDIZ, E.–SIVRI, U.–BERBER, M. (2010): *Türkiye'de İllerin Sosyo-Ekonomik Gelişmişlik Sıralaması Uluslararası* Bölgesel Kalkınma Sempozyumu, 7–9 Ekim, Yozgat.

BADAY YILDIZ, E.–SIVRI, U.–BERBER, M. (2012): Türkiye'de İllerin Sosyo-Ekonomik Gelişmişlik Sıralaması *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 39: 147–167.

BAGCI, H.–RENCBER, O. F. (2014): Kamu Bankaları ve Halka Açık Özel Bankaların PROMETHEE Yöntemi ile Karlılıklarının Analizi *Aksaray Üniversitesi İİBF Dergisi* 6 (1): 39–47.

BARTHA, Z.–TÓTHNÉ SZITA, K. (2015): Divergence in the socioeconomic development paths of Hungary and Slovakia *Regional Statistics* 5 (2): 125–143. https://doi.org/10.15196/RS05207

BRANDMUELLER, T.–SCHÄFER, G.–EKKEHARD, P.–MÜLLER, O.–ANGELOVA-TOSHEVA, V. (2017): Territorial indicators for policy purposes: NUTS regions and beyond *Regional Statistics* 7 (1): 78–89. https://doi.org/10.15196/RS07105

BRANS, J. P.–MARESCHAL, B.–VINCKE, P. (1984): PROMETHEE: A New Family of Outranking Methods in MCDM In: *Operational Research IFORS 84.* pp. 477–490., North-Holland, Amsterdam. https://doi.org/10.1007/0-387-23081-5_5

BRANS, J. P.–VINCKE, P. (1985): A preference ranking organization method *Management Science* 31 (6): 647–656. https://doi.org/10.1287/mnsc.31.6.647

BRANS, J. P.–VINCKE, P.–MARESCHAL, B. (1986): How to select and how to rank projects: The PROMETHEE method *European Journal of Operational Research* 24 (2): 228–238. https://doi.org/10.1016/0377-2217(86)90044-5

CSOMÓS, G. (2015): The Ranking of Cities as Centres of the Hungarian Economy 1992–2012 *Regional Statistics* 5 (1): 66–85. https://doi.org/10.15196/RS05104

DIKMEN, F. C.–DURSUN, G. (2016): Well-being and quality of life: Ranking of provinces in Turkey using MOORA method In: CEVIK, S.–SIMSEK, H.–MITTAL, H. (eds.) *Social and Economic Dynamics of Development: Case Studies* pp. 13–25., IJOPEC Publication, London.

DPT (2003): *İllerin ve Bölgelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması* Ankara.

EDAM (2009): *Türkiye İçin Bir Rekabet Endeksi* Istanbul.

ERILLI, N. A.–GUNDOGDU, O. (2013): *Bulanık Kümeleme Yöntemi ile İllerin Sosyoekonomik Gelişmişlik Endeks Sıralaması Hesaplanması* 14. Uluslararası Ekonometri, Yöneylem Araştırması ve İstatistik Sempozyumu, 24–28 Mayıs, Sarajevo.

ERILLI, N. A.–TUNC, T.–ONER, Y.–YOLCU, U. (2009): İllerin Sosyoekonomik Verilere Dayanarak Bulanık Kümeleme Analizi ile Sınıflandırılması *e-Journal of New World Sciences Academy* 4 (1): 1–11.

FERNANDEZ, N. G. (2014): *The Management of Missing Values in PROMETHEE Methods* ECOLE Polytechnique de Bruxelles, Brussels.

FILIZ, Z. (2005): İllerin Sosyo-Ekonomik Gelişmişlik Düzeylerine Göre Gruplandırılmasında Farklı Yaklaşımlar *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi* 6 (1): 77–100.

GUL, H. E.–CEVIK, B. (2014): *2010 ve 2012 Verileriyle Türkiye'de İllerin Gelişmişlik Düzeyi Araştırması* Türkiye İş Bankası İktisadi Araştırmalar Bölümü, Istanbul.

GUL, H. E.–CEVIK, B. (2015): *2013 Verileriyle Türkiye'de İllerin Gelişmişlik Düzeyi Araştırması* Türkiye İş Bankası İktisadi Araştırmalar Bölümü, Istanbul.

GULEL, F. E.–CAGLAR, A.–KANGALLI UYAR, S. G.–KARADENIZ, O.–YESILYURT, M. E. (2017): Türkiye'de İllere Göre İnsani Gelişme Endeksi *Pamukkale University Journal of Social Sciences* 27: 208–216. https://doi.org/10.5505/pausbed.017.99705

KALKINMA BAKANLIGI (2013): *İllerin Ve Bölgelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması (SEGE-2011)* Bölgesel Gelişme ve Yapısal Uyum Genel Müdürlüğü, Ankara.

KARABULUT, M.–GURBUZ, M.–SANDAL, E. K. (2004): Hiyerarşik Kluster (Küme) Tekniği Kullanılarak Türkiye'de İllerin Sosyo-Ekonomik Benzerliklerinin Analizi *Coğrafi Bilimler Dergisi* 2 (2): 65–78.

KARADENIZ YILMAZ, Y.–YILMAZ, M.–YIGITBASI, M. E.–COBAN, O. (2016): İnovasyon İndeksi Yardımıyla Türkiye'de İllerin Rekabetçilik Analizi: Düzey-III Örneği *SosyoEkonomi* 24 (30): 71–90.

KAYGISIZ, Z.–SARACLI, S.–DOKUZLAR, K. (2005): *İllerin Gelişmişlik Düzeyini Etkileyen Faktörlerin Path Analizi ve Kümeleme Analizi İle İncelenmesi* VII. Uluslararası Ekonometri ve İstatistik Sempozyumu, İstanbul Üniversitesi İktisat Fakültesi, 26–27 Mayıs, Istanbul.

KILIC, I.–SARACLI, S.–KOLUKISAOGLU, S. (2011): Sosyo-Ekonomik Göstergeler Bakımından İllerin Bölgesel Bazda Benzerliklerinin Çok Değişkenli Analizler ile İncelenmesi *İstatistikçiler Dergisi* 4: 57–68.

KOC, S. (2001): *Türkiye'de İllerin Sosyo-Ekonomik Özelliklere Göre Sınıflandırılması* V. Ulusal Ekonometri ve İstatistik Sempozyumu, Çukurova Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, 19–21 Eylül, Adana.

MACHARIS, C.–SPRINGAEL, J.–DE BRUCHER, K.–VERBEKE, A. (2004): PROMETHEE and AHP: The design of operational synergies in multicriteria analysis: Strengthening PROMETHEE with ideas of AHP *European Journal of Operational Research* 153 (2): 307–317. https://doi.org/10.1016/S0377-2217(03)00153-X

MEHRJARDI, T.–HOSSEIN, M.–HAMID, B. M.–ALI, M. S. (2012): Investigation and ranking of Iranian Provinces in terms of access to health sector indicators *Health Information Management* 9 (3): 356–369.

MURIAS, P.–MARTINEZ, F.–DE MIGUEL, C. (2006): An economic wellbeing index for the Spanish Provinces: A data envelopment analysis approach *Social Indicators Research* 77 (3): 395–417. https://doi.org/10.1007/s11205-005-2613-4

OZASLAN, M.–DINCER, B.–OZGUR, H. (2006): *Regional Disparities and Territorial Indicators in Turkey: Socio-Economic Development Index (SEDI)* paper presented at the 46th ERSA Congress, Enlargement, Southern Europe and the Mediterranean, 30 August – 3 September, Volos.

OZDEMIR, A. I.–ALTIPARMAK, A. (2005): Sosyo-Ekonomik Göstergeler Açısından İllerin Gelişmişlik Düzeyinin Karşılaştırmalı Analizi *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 24: 97–110.

ONDER, A.O.–KARADAG, M.–DELIKTAS, E. (2007): *The Effects of Public Capital on Regional Convergence in Turkey*, Ege University Working Papers in Economics 2007, No. 07/01.

ROSTAMPOUR, S. (2012): Ranking provinces based on development scale in agriculture sector using taxonomy technique *Management Science Letters* 2 (5): 1813–1818. https://doi.org/10.5267/j.msl.2012.04.003

SAKARYA, A.–IBISOGLU, C. (2015): Türkiye'de İllerin Sosyo-Ekonomik Gelişmişlik Endeksinin Coğrafi Ağırlıklı Regresyon Modeli ile Analizi *Marmara Coğrafya Dergisi* 32: 211–238.

TEPAV (2013): *81 İl İçin İnsani Gelişmişlik Endeksi* Ankara.

TUIK (2015): *Well-Being Index for Provinces* Ankara.

YILANCI, V. (2010): Bulanık Kümeleme Analizi ile Türkiye'deki İllerin Sosyoekonomik Açıdan Sınıflandırılması *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 15 (3): 453–470.