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ORIGINAL PAPER

AHP model for competitiveness analysis of selected countries

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Abstract Competitiveness analysis of countries and regions stands in the foreground in recent years. Different methods as well as indicators are used to assess competitiveness, but no single procedure is considered to be the main one and it can hardly be stated, which of the measurement approaches is the most proper. The IMD World Competitiveness Online database represents one of such tools, containing the Overall Competitiveness ranking that evaluates 59 world countries by more than 300 individual indicators in 2012. The paper proposes an original Analytic Hierarchy Process (AHP) model for competitiveness ranking of selected countries. The model is based, due to the high number of indicators and countries, on absolute measurement and expert evaluation. The results given by the AHP model are compared to IMD competitiveness ranking. Differences of both results are analysed and discussed.

Keywords Analytic Hierarchy Process · Competitiveness · Absolute measurement · Expert evaluation

JEL Classification C44

1 Introduction

Scientists as well as politicians often compare various indicators of selected countries and/or regions. They compare economic performance, level of environmental

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degradation, unemployment, quality of life, etc. In this sense it is often spoken about competitiveness. Competitiveness is mainly connected with firms and industries and famous Porter's competitiveness diamond (Porter 1998). Successful firms usually concentrate not far from universities and other firms to gain comparative advantages. This also contributes to faster diffusion of innovations. Important is also rivalry within the countries among their regions.

The process of considering company's competitiveness led step by step to assessments of regional competitiveness. Barkley (2008) points out the quantity issue of different national and regional indices. Various approaches usually differ in number of indicators as well as in number of compared regions/nations. Barkley (2008) also discusses the usefulness of such indices and rankings. Fisher (2005) poses four questions on the validity of index and its components. These are: (i) "Does the index include all of the relevant variables, and only relevant variables?", (ii) "Do the causal variables in fact measure what they claim to measure?", (iii) "How does the index deal with the problem of combining disparate measures into a single index number?" and finally (iv) "Does the index do a good job of predicting why some states or cities grew more rapidly than others over some time period?" Answering them may not be always easy.

The potential problem of multicollinearity is presented also by Huggins (2003) when constructing UK Competitiveness Index. Also Czesaný (2006) considers the disadvantages of using composite indicators, especially the possibility of simplification as a result of inadequate composite indicator construction or problematic selection of partial indicators and determination of their weights. On the other hand Czesaný (2006) sees also advantages, e.g. ability to summarize multiple perspectives, which can be among the main reasons, why competitiveness composite indicators are so popular. Hassan (2008) states that composite indicators are more and more often used especially in such fields as competitiveness, sustainability, globalisation and innovations. Composite indicators are being broadly discussed—among others e.g. Munda and Saisana (2011), Graymore et al. (2009) or Zhou et al. (2010)—and have many opponents as well as defenders. The most important task is to fulfil properly all methodological steps—see e.g. OECD/European Union/JRC (2008). We will further work with IMD competitiveness composite indicator.

Another problem connected with regional competitiveness, apart from composite indicators difficulties, can be seen straight in the regional competitiveness definition. Kitson et al. (2004) describe regional competitiveness as an elusive concept which is very complicated to measure. Gardiner et al. (2004) align regional competitiveness with success on export market. Their main focus is then on regional productivity. Boschma (2004) is unlike Viturka (2010) convinced that region can be assessed as a sum of companies located in its area. Therefore according to Boschma (2004) "successful region is just lucky to host more successful firms on average, and it does not have to be assumed that regions (like firms) act for this to happen". On the other hand Viturka (2010) states that costs and revenues (and subsequently competitiveness) of firms are (significantly) influenced by quality of local public administration and its decisions.

Despite aforementioned obstacles many composite indicators evaluating competitiveness of regions at almost any level (nations, regions, cities etc.) exist. Competitiveness is similarly as for example sustainability (Hudrlíková and Kramulová 2013;

Fusco and Toro 2007) or quality of life (OECD 2013) a complex phenomenon that has many ways of possible measurement. We think that contribution to the discussion is important because it helps to improve approaches and come to proper solutions. This paper also introduces comparison of results from the most common competitiveness indices.

In the paper we decided to compare rankings of the IMD World Competitiveness Online Database with results given by an AHP model while using the same groups of indicators (criteria). The Overall Competitiveness is measured using proposed AHP model with absolute measurement and application of weight expert estimation. Information necessary for deriving weights of the criteria using AHP model are based on a consensus of three experts. The differences in both methods (IMD and AHP) are being discussed as well as differences in results. Competitiveness is according to our opinion a good example for application of hierarchical multi criteria decision making method and we wanted to show that the AHP can give reliable results. Combining more methods in case of similar results leads to their confirmation.

The paper is organized as follows. After the theoretical background and overview of data set in Sect. 2, the computations and main results of the study results are presented in Sect. 3. Finally, Sect. 4 contains discussion of results and main conclusions are drawn.

2 Theoretical background

2.1 Data set

As it was already stated, there has been defined many competitiveness composite indicators up to now. The main ones are Global Competitiveness Index (Schwab and Sala-i-Martín 2012) published yearly by World Economic Forum (hereinafter WEF) in Global Competitiveness Report or data from World Competitiveness Yearbook (WCY) published yearly by Institute for Management and Development (hereinafter IMD). Among others EU Regional Competitiveness Index (see below) or UK Competitiveness Index (Huggins and Thompson 2010; Huggins 2003) can be mentioned. We compared results of both WEF and EU indices with IMD approach resulting in the fact, that all of them give very similar rankings (correlation coefficients were very high, see Figs. 1 and 2). Firstly it was the EU Regional Competitiveness Index, aggregated to national level (Annoni and Kozovska 2010). Taken into account just the countries analysed in both studies (European ones), the results can be seen in Fig. 1. Corresponding regression function (1) is as follows:

$$y = -7\mathrm{E}-08x^6 + 1\mathrm{E}-05x^5 - 0.0009x^4 + 0.0304x^3 - 0.4553x^2 + 2.7558x - 0.2161 \quad (1)$$

while having R-squared equal to 0.8362.

The second composite indicator we compared IMD results with was Global Competitiveness Index issued by WEF. The results obtained are in Fig. 2. In this case all 59 countries were compared. Corresponding regression function (2) is as follows:

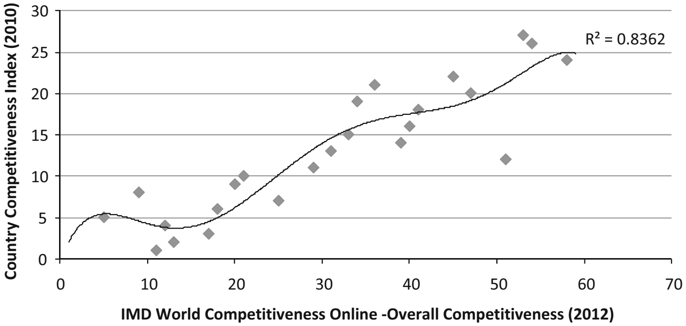

Fig. 1 Comparison of EU Country Competitiveness Index and IMD

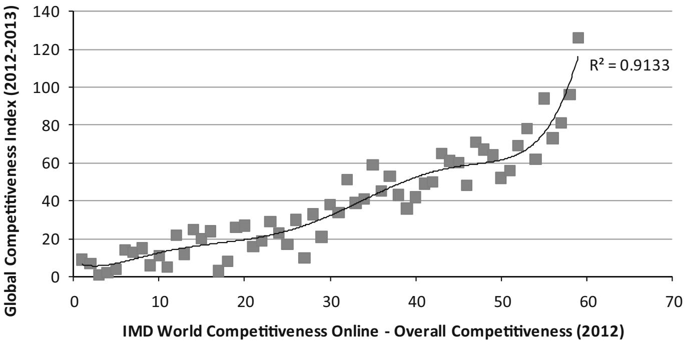

Fig. 2 Comparison of Global Competitiveness Index and IMD

$$y = 2\text{E}-07x^6 - 3\text{E}-05x^5 + 0.0017x^4 - 0.0455x^3 + 0.5648x^2 - 2.0662x + 7.9049 \quad (2)$$

while having R-squared equal to 0.9133.

Due to the limited space of the paper just one of them was chosen for further analysis—IMD approach. However, the methodology introduced below could be applied to the other indices as well. We decided to attract our attention to national level (Kramulova and Jablonsky 2013) and take into account indicators chosen by IMD World Competitiveness Online. Our aim is not to propose a new competitiveness indicator composed from various criteria but on the contrary we tried to compare results obtained from the database with results computed by using other methods while using the same data. The aim of this paper is to assess if the method selection has an impact on ranking of countries in relation to competitiveness issue.

IMD World Competitiveness Online database (IMD World Competitiveness Online 2013) contains information on 59 world countries (in 2012). According to IMD methodology the Overall Competitiveness is divided into four groups and these are further again divided as shown in Fig. 3. 329 indicators are covered in the analysis, as Economic Performance contains 78 indicators, Government Efficiency 70, Business Efficiency 67 and Infrastructure 114. More detailed information about the indicators can be found in IMD (2012). We took into account just the four groups of indicators,

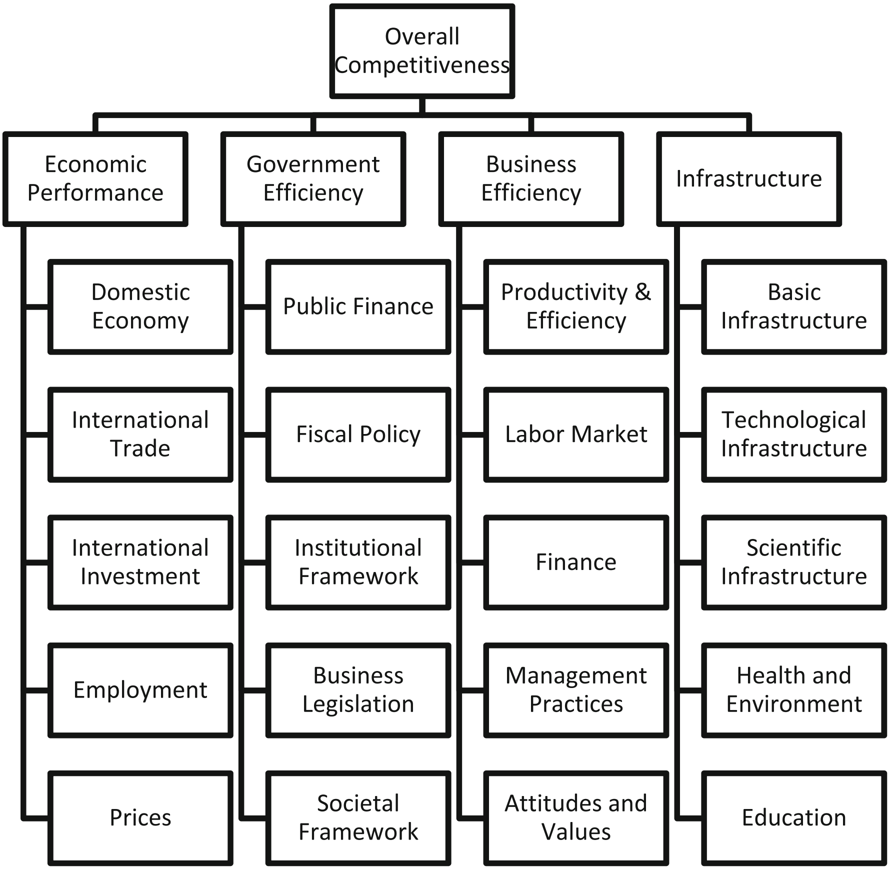

Fig. 3 Hierarchy of groups and sub-criteria for evaluation of Overall Competitiveness according to IMD

each of them containing 5 sub-criteria, i.e. together 20 most important particular criteria. In the official IMD methodology all 329 indicators are further divided into so called hard data (131 indicators) and survey data (115 indicators) and additional 83 indicators for background information.

2.2 Analytic Hierarchy Process

Competitiveness evaluation can be taken in general as a typical multiple criteria decision making (MCDM) problem. There are available many methodological approaches, models and methods for analysis of MCDM problems. One of the most popular and powerful tools for analysis of complex (multiple criteria) decision making problems is Analytic Hierarchy Process (AHP) developed by Saaty (1990). We decided to use AHP for analysis of competitiveness level. AHP divides the decision problem into several partly independent hierarchical levels that can be analysed separately. AHP hierarchy usually consists of the following levels:

- Overall objective of the decision problem—in our case the Overall Competitiveness of the countries;
- Criteria (i.e. two hierarchical levels as shown in Fig. 3)—in our study 4 groups of criteria, each of them further divided into five sub-criteria; as we already stated we abstracted from analysing of all individual indicators (329) and that is the main simplification compared to the IMD approach;
- Alternatives are usually at the lowest level of the hierarchy—in our case 59 world countries.

The principle of AHP consists in the division of overall priority from the topmost level of the hierarchy into the lower levels according to the decision maker's preferences. The decision maker expresses his preferences by comparing the importance of the elements at the given level with respect to the element of the preceding level. In standard AHP models the decision maker's judgments on elements at a given level with respect to an element at the preceding level are organized into pairwise comparison matrices. The judgments are estimates of the preference between two elements of the lower level with respect to the element at the level above. Let us denote the pairwise comparison matrix (3)

$$\mathbf{A} = \left\{ a_{ij} \middle| a_{ji} = \frac{1}{a_{ij}}, a_{ij} > 0, \quad i, j = 1, 2, \ldots, k \right\}, \tag{3}$$

where k is the number of elements in the particular comparison set of the lower level. Saaty (1990) proposes to use a_{ij} integers in the range 1–9 to express preferences, where 1 means that the ith and the jth element are equally important and 9 means that the ith element is absolutely more important than the jth element. The local priorities are derived by solving the following eigenvector problem (4):

$$\begin{aligned} \mathbf{A}.\mathbf{v} &= \lambda_{max}\mathbf{v}, \\ \sum_{i=1}^{k} v_i &= 1, \end{aligned} \tag{4}$$

where λ_{max} is the largest eigenvalue of $\mathbf{A}$ and $\mathbf{v}$ is the normalised right eigenvector belonging to λ_{max}. The eigenvector problem (4) is not always easily solvable. That is why several approximation methods can be used. Among them logarithmic least square method is the most popular. In this case the local priorities v_i, $i = 1, 2, \ldots, k$, are derived as the geometric average of all elements in the ith row of the matrix $\mathbf{A}$ and then they are normalised (5):

$$\begin{aligned} v_i' &= \left(\prod_{j=1}^{k} a_{ij} \right)^{\frac{1}{k}}, \quad i = 1, 2, \ldots, k, \\ v_i &= \frac{v_i'}{\sum_{j=1}^{k} v_j'}, \quad i = 1, 2, \ldots, k. \end{aligned} \tag{5}$$

In order to get correct results pairwise comparison matrices must be sufficiently consistent. Their consistency level is measured using so called consistency index (C.I.). More information about definition of C.I. and related topics can be found in Saaty (1990).

3 Computations and results

3.1 AHP model for competitiveness evaluation

Proposed AHP model for evaluation of competitiveness of selected countries is presented in Fig. 4. As shown below the model consists of 5 hierarchical levels. The first defines the main objective of the decision problem—evaluation of Overall Competitiveness. The next level contains four groups of criteria Overall Competitiveness consists of—we suppose that all of them have the same importance. That is why pairwise comparisons are not used for deriving priorities at this level and all the priorities of four main groups are $p_1 = p_2 = p_3 = p_4 = 0.25$. Finally we decided to use equal weights even though other options were also available. However, a right setting of weights is a very important and difficult topic. The original IMD methodology works with equal weights of all 20 sub-criteria due to comparability of results in time (IMD 2012). We determined the weights of sub-criteria on the basis of expert evaluation, but the four main groups are left on the identical level. One of the reasons is the same

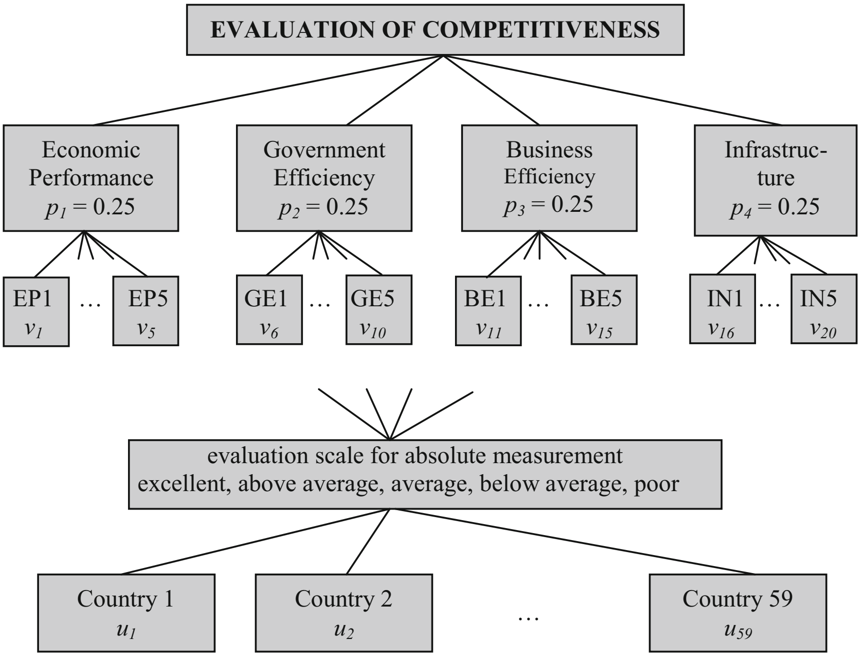

Fig. 4 AHP model for evaluation of Overall Competitiveness

Table 1 Judgment of elements of the scale with absolute measurement

Absolute measurement	E	AA	A	BA	P	q_i	C.I.
Excellent	1	3	5	7	9	0.5128	0.059
Above average	1/3	1	3	5	7	0.2615	
Average	1/5	1/3	1	3	5	0.1290	
Below average	1/7	1/5	1/3	1	3	0.0634	
Poor	1/9	1/7	1/5	1/3	1	0.0333	

number of sub-criteria in all groups. The priorities of these four main groups are further divided into lower level containing directly sub-criteria (each group is divided into five sub-criteria). The priorities of these sub-criteria are denoted as $v_1, v_2, \ldots, v_{20}$, where index corresponds to each sub-criteria listed in Fig. 3. The priorities of sub-criteria are derived by pairwise comparisons according to their importance with respect to the main groups (preceding level). Of course the condition that the sum of priorities of the elements of a lower level equals to the priority of the element of the preceding level must hold.

AHP offers two ways of measurements and deriving priorities—relative and absolute. The first one uses standard pairwise comparisons as explained in the previous section of the paper. In case of a higher number of alternatives or other elements at the level of the hierarchy the relative measurement cannot be used. This is the case of our model, in which the number of alternatives is very high (59 countries). That is why the number of pairwise comparisons would be too large in order to realize all pairwise judgments. Therefore absolute measurement was used. It consists in evaluation of elements of the bottom level of the hierarchy (usually alternatives) by their assignment to one of the elements of the evaluation scale. Each of the elements of this scale has its numerical judgment given either directly by decision maker or by pairwise comparisons of elements of the evaluation scale. For simplicity let us suppose that there is the same five-elements evaluation scale with the identical numerical judgment $q_i, i = 1, 2, \ldots, 5$ for all criteria of the model. Table 1 presents how the judgments q_i are derived by pairwise comparisons. Consistency index (hereinafter C.I.) should be lower than 0.1 for all pairwise comparison matrices, which is fulfilled (C.I. equals 0.059).

Let us finally denote the value of the ith alternative by criterion j as $x_{ij}, i = 1, 2, \ldots, 59, j = 1, 2, \ldots, 20$. According to the criterion values the alternatives are assigned to one element of the evaluation scale and the values x_{ij} are replaced by the appropriate numerical judgment of the given element of the evaluation scale—let as denote them y_{ij}. E.g. the ith alternative that is rated as excellent according to the jth criterion has $y_{ij} = 0.5128$, alternative rated as above average $y_{ij} = 0.2615$, etc. Assignment of the alternatives according to given criterion to the elements of the evaluation scale can be done automatically after the decision maker specifies lower and upper bounds of appropriate intervals of criterion values. Final utilities of evaluated alternatives (countries), $u_i, i = 1, 2, \ldots, 59$, are given as a simple weighted average of y_{ij} values:

Table 2 Weights of sub-criteria of Economic Performance

Economic Performance	DE	IT	II	E	P	v_i	C.I.
Domestic economy	1	1/3	5	3	1/2	0.1677	0.03
International trade	3	1	8	6	2	0.4378	
International investment	1/5	1/8	1	1/3	1/7	0.0372	
Employment	1/3	1/6	3	1	1/5	0.0722	
Prices	2	1/2	7	5	1	0.2852	

Table 3 Weights of sub-criteria of Government Efficiency

Government Efficiency	PF	FP	IF	BL	SF	v_i	C.I.
Public finance	1	1/3	1/7	1/5	2	0.0598	0.053
Fiscal policy	3	1	1/5	1/3	4	0.1276	
Institutional framework	7	5	1	3	7	0.5079	
Business legislation	5	3	1/3	1	6	0.2623	
Societal framework	1/2	1/4	1/7	1/6	1	0.0423	

$$u_i = \sum_{j}^{20} v_j y_{ij}, \quad i = 1, 2, \ldots, 59. \tag{6}$$

The alternatives can be ranked by their utilities u_i that can be considered as Overall Competitiveness indicator.

3.2 Computational procedure and results

In the first step of application of the AHP model the weights of all 20 sub-criteria are derived. Table 2 contains pairwise comparison matrix for sub-criteria within the group of Economic Performance. Consistency index of this matrix equals 0.03, again fulfilling the condition mentioned above. The pairwise comparison matrix contains information for deriving weights of the sub-criteria within this main group of criteria. The same procedure is applied for remaining three groups—Government Efficiency, Business Efficiency and Infrastructure. The resulting weights are presented in Tables 3, 4 and 5. Corresponding consistency indices are again lower than 0.1, namely 0.053 for Government Efficiency, 0.042 for Business Efficiency and 0.026 for Infrastructure. All comparisons were object of expert estimation made by three experts. All the weights were estimated on the basis of expert evaluation of alternatives (exogenous). Although the weights may be cause of discussion we preferred this approach to the endogenous approach based usually on statistical analysis and data itself.

Weighted sum of the y_{ij} values within the individual main group of criteria defines particular competitiveness indicators of the countries. Let us denote them u_i^{EP} (for Economic Performance), u_i^{GE} (Government Efficiency), u_i^{BE} (Business Efficiency),

Table 4 Weights of sub-criteria of Business Efficiency

Business Efficiency	PE	LM	FI	MP	AV	v_i	C.I.
Productivity and efficiency	1	5	5	4	2	0.4460	0.042
Labour market	1/5	1	2	1/3	1/3	0.0816	
Finance	1/5	1/2	1	1/4	1/4	0.0561	
Management practices	1/4	3	4	1	1/2	0.1690	
Attitudes and values	1/2	3	4	2	1	0.2472	

Table 5 Weights of sub-criteria of Infrastructure

Infrastructure	BI	TI	SI	HE	ED	v_i	C.I.
Basic infrastructure	1	6	3	5	5	0.5098	0.026
Technological infrastructure	1/6	1	1/4	1/3	1/3	0.0521	
Scientific infrastructure	1/3	4	1	2	2	0.2055	
Health and environment	1/5	3	1/2	1	1	0.1163	
Education	1/5	3	1/2	1	1	0.1163	

Table 6 Results for selected 4 countries (group Economic Performance)

Country	IMD value	Rank IMD	AHP u_i^{EP}	Rank AHP	Rank difference
Germany	77.51	5	0.4028	3	2
Greece	10.79	58	0.0551	59	1
Hong Kong	79.16	4	0.3761	8	4
Hungary	47.31	35	0.1850	33	2

Table 7 Results for selected 4 countries (group Government Efficiency)

Country	IMD value	Rank IMD	AHP u_i^{GE}	Rank AHP	Rank difference
Germany	59.55	19	0.3707	10	9
Greece	17.05	58	0.0425	58	0
Hong Kong	91.34	1	0.5022	3	2
Hungary	31.59	51	0.0794	49	2

and u_i^{IN} (Infrastructure). Comparison of the particular competitiveness indicators with the same IMD values is presented in Tables 6, 7, 8 and 9. Except the values of the indicators the ranking within the entire set of countries according to both methodologies is given.

Computing the particular competitiveness indicators of four main groups of criteria made it possible to finalise the procedure and compute the Overall Competitiveness

Table 8 Results for selected 4 countries (group Business Efficiency)

Country	IMD value	Rank IMD	AHP u_i^{BE}	Rank AHP	Rank difference
Germany	66.47	17	0.4194	4	13
Greece	23.20	56	0.0811	55	1
Hong Kong	86.31	1	0.5128	1	0
Hungary	30.93	49	0.0889	50	1

Table 9 Results for selected 4 countries (group Infrastructure)

Country	IMD value	Rank IMD	AHP u_i^{IN}	Rank AHP	Rank difference
Germany	78.95	7	0.3555	6	1
Greece	46.63	34	0.1275	37	3
Hong Kong	68.63	18	0.2592	20	2
Hungary	44.99	35	0.1059	40	5

Table 10 Results for selected 4 countries (Overall Competitiveness)

Country	IMD value	Rank IMD	AHP u_i	Rank AHP	Rank difference
Germany	89.26	9	0.3871	5	4
Greece	43.05	58	0.0765	58	0
Hong Kong	100.00	1	0.4126	1	0
Hungary	57.34	45	0.1148	50	5

values and ranking of countries by a simple average of the four indicators. The results for the same four set of countries are shown in Table 10.

4 Discussion and conclusion

The results of the analysis for all 59 countries—competitiveness indicators and ranking of the countries according to both IMD and AHP models—are too large. That is why we present them in Appendices 1 in Table 12 and 2 in Table 13. Here we will discuss just part of the results obtained. Table 11 shows first 5 and last 5 countries according to both methodologies. We computed the Overall Competitiveness indicators of all 59 countries, ranked them and then compared with results of the IMD methodology.

There were slight differences, but the average rank difference equals 3.02, what we see as a very good result. The greatest differences were observed in cases of Bulgaria (the greatest positive shift: +13 positions from 54th to 41st position), Croatia (positive shift: +9 positions from 57th to 48th position) and Portugal and USA (the greatest negative shift: −8 positions from 41st to 49th and from 2nd to 10th position). While in case of Bulgaria and Croatia the main discrepancies between both approaches were in group of Economic Performance (+35 and +26 respectively), in case of Portugal and

Table 11 Results of the IMD and AHP models

First 5	IMD	AHP	Last 5	IMD	AHP
1	Hong Kong	Hong Kong	55	Argentina	Colombia
2	USA	Singapore	56	Ukraine	Romania
3	Switzerland	Sweden	57	Croatia	Ukraine
4	Singapore	Switzerland	58	Greece	Greece
5	Sweden	Germany	59	Venezuela	Venezuela

USA it was in group of Infrastructure (−9 and −10). Generally the biggest differences were inside the group of Economic Performance, ranging from −20 to +35, in average 7.27 regardless sign, on the other hand the lowest were in case of Infrastructure group, ranging from −10 to +14, in average 3.53 regardless sign. Malaysia was the only case in which there were in two groups exactly the same ranks (Business Efficiency and Infrastructure), in other countries there were discrepancies in three or all four groups. The overview of all discrepancies is shown in Appendix in Table 13. They may be caused by differences in the weights assigned to the particular indicators. However, at the aggregated level of Overall Competitiveness the differences are quite small as stated above.

As a conclusion, we can summarise that our case study demonstrated that AHP method with absolute measurement represents a simple, fast and useful tool even for a big amount of alternatives. Presented case study also shows that results of this procedure correspond at the aggregated level with ranking determined by official IMD method. At the lower level the discrepancies may be caused especially by different weights assigned to the sub-criteria.

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5 Appendix

See Tables 12 and 13.

Table 12 Differences in rank of Overall Competitiveness of 59 countries using IMD approach and AHP method

2012 (Ranks)	Overall Competitiveness IMD	Overall Competitiveness AHP	Difference in rank
Argentina	55	53	2
Australia	15	20	−5
Austria	21	19	2

Table 12 continued

2012 (Ranks)	Overall Competitiveness IMD	Overall Competitiveness AHP	Difference in rank
Belgium	25	29	−4
Brazil	46	51	−5
Bulgaria	54	41	13
Canada	6	6	0
Chile	28	28	0
China Mainland	23	21	2
Colombia	52	55	−3
Croatia	57	48	9
Czech Republic	33	35	−2
Denmark	13	12	1
Estonia	31	30	1
Finland	17	17	0
France	29	27	2
Germany	9	5	4
Greece	58	58	0
Hong Kong	1	1	0
Hungary	45	50	−5
Iceland	26	26	0
India	35	34	1
Indonesia	42	44	−2
Ireland	20	15	5
Israel	19	24	−5
Italy	40	42	−2
Japan	27	33	−6
Jordan	49	54	−5
Kazakhstan	32	31	1
Korea	22	22	0
Lithuania	36	32	4
Luxembourg	12	16	−4
Malaysia	14	8	6
Mexico	37	36	1
Netherlands	11	11	0
New Zealand	24	23	1
Norway	8	9	−1
Peru	44	37	7
Philippines	43	39	4
Poland	34	40	−6
Portugal	41	49	−8
Qatar	10	13	−3

Table 12 continued

2012 (Ranks)	Overall Competitiveness IMD	Overall Competitiveness AHP	Difference in rank
Romania	53	56	−3
Russia	48	45	3
Singapore	4	2	2
Slovak Republic	47	52	−5
Slovenia	51	47	4
South Africa	50	46	4
Spain	39	38	1
Sweden	5	3	2
Switzerland	3	4	−1
Taiwan	7	7	0
Thailand	30	25	5
Turkey	38	43	−5
UAE	16	14	2
Ukraine	56	57	−1
United Kingdom	18	18	0
USA	2	10	−8
Venezuela	59	59	0

Positive difference stands for higher rank in AHP approach, negative difference for higher rank in IMD approach

Table 13 The overview of discrepancies in all groups and in Overall Competitiveness of 59 countries using IMD approach and AHP method

2012 (Disrepancies)	Economic Performance	Government Efficiency	Business Efficiency	Infrastructure	Overall Competitiveness
Argentina	5	2	10	−4	2
Australia	−8	−10	−5	10	−5
Austria	4	7	5	2	2
Belgium	−3	11	−4	−1	−4
Brazil	−1	−2	−2	3	−5
Bulgaria	**35**	−2	2	−1	**13**
Canada	−8	5	−2	0	0
Chile	−15	11	−6	−3	0
China Mainland	**−20**	**17**	2	8	2
Colombia	−10	−1	−2	2	−3
Croatia	26	−5	**15**	−4	9
Czech Republic	−7	−6	2	0	−2
Denmark	−1	2	3	2	1
Estonia	25	−8	−8	3	1

Table 13 continued

2012 (Disrepancies)	Economic Performance	Government Efficiency	Business Efficiency	Infrastructure	Overall Competitiveness
Finland	−16	2	−2	3	0
France	3	8	8	3	2
Germany	2	9	13	1	4
Greece	−1	0	1	−3	0
Hong Kong	−4	−2	0	−2	0
Hungary	2	2	−1	−5	−5
Iceland	−3	−9	5	9	0
India	−8	2	1	5	1
Indonesia	−12	−3	**−10**	−1	−2
Ireland	10	0	7	3	5
Israel	−13	−1	0	−5	−5
Italy	−13	8	6	−3	−2
Japan	−10	5	−1	−8	−6
Jordan	−3	−3	−7	2	−5
Kazakhstan	2	−7	13	**−10**	1
Korea	−1	2	0	5	0
Lithuania	21	−1	4	3	4
Luxembourg	−4	−3	−4	−1	−4
Malaysia	3	5	0	0	6
Mexico	−1	0	−6	6	1
Netherlands	3	5	−2	−6	0
New Zealand	0	−4	−3	1	1
Norway	−7	−1	4	−1	−1
Peru	8	−6	−7	4	7
Philippines	0	3	−2	−2	4
Poland	−9	0	3	−2	−6
Portugal	−1	5	−2	−9	**−8**
Qatar	1	−11	**−10**	7	−3
Romania	−1	−2	−2	0	−3
Russia	8	0	1	2	3
Singapore	1	1	−4	2	2
Slovak Republic	5	−9	3	−2	−5
Slovenia	21	0	1	−5	4
South Africa	3	2	−7	2	4
Spain	5	−4	4	0	1
Sweden	0	3	3	1	2
Switzerland	−5	3	−1	0	−1
Taiwan	9	−10	−4	−3	0

Table 13 continued

2012 (Disrepancies)	Economic Performance	Government Efficiency	Business Efficiency	Infrastructure	Overall Competitiveness
Thailand	4	−2	−1	**14**	5
Turkey	−4	−9	−5	2	−5
UAE	9	**−12**	5	5	2
Ukraine	−3	1	3	2	−1
United Kingdom	−16	10	0	4	0
USA	−5	1	1	**−10**	**−8**
Venezuela	1	9	−5	1	0

Positive difference stands for higher rank in AHP approach, negative difference for higher rank in IMD approach
The greatest positive and negative rank shifts in each group and in Overall Competitiveness are in bold

References

Annoni P, Kozovska K (2010) EU Regional Competitiveness Index RCI 2010. Publication Office of the European Union, Luxembourg

Barkley DL (2008) Evaluations of regional competitiveness: making a case for case studies. Rev Reg Stud 38:121–143

Boschma RA (2004) Competitiveness of regions from an evolutionary perspective. Reg Stud 38:1001–1014

Czesaný S (2006) Indikátory udržitelného rozvoje [Indicators of sustainable development]. Statistika 43:431–434

Fisher P (2005) Grading places: What do business climate rankings really tell us?. Economic Policy Institute, Washington

Fusco Girard L, De Toro P (2007) Integrated spatial assessment: a multicriteria approach to sustainable development of cultural and environmental heritage in San Marco dei Cavoti, Italy. Cent Eur J Oper Res 15:281–299

Gardiner B, Martin R, Tyler P (2004) Competitiveness, productivity and economic growth across the European regions. Reg Stud 38:1045–1067

Graymore MLM, Wallis AM, Richards AJ (2009) An Index of Regional Sustainability: a GIS-based multiple criteria analysis decision support system for progressing sustainability. Ecol Complex 6:453–462

Hassan OAB (2008) Assessing the sustainability of a region in the light of composite indicators. J Environ Assess Policy Manag 10:51–65

Hudrlíková L, Kramulová J (2013) Do transformation methods matter? The case of sustainability indicators in Czech regions. Adv Methodol Stat Metodoloski zvezki 10:31–48

Huggins R (2003) Creating a UK competitiveness index: regional and local benchmarking. Reg Stud 37:89–96

Huggins R, Thompson P (2010) UK competitiveness index 2010. Centre for International Competitiveness, Cardiff School of Management, University of Wales Institute, Cardiff

IMD (2012) IMD world competitiveness yearbook 2012. IMD World Competitiveness Center, Institute for Management Development

IMD World Competitiveness Online (2013). https://www.worldcompetitiveness.com/online. Accessed 24 Jan 2013

Kitson M, Martin R, Tyler P (2004) Regional aompetitiveness: An elusive yet key concept? Reg Stud 38:991–999

Kramulová J, Jablonský J (2013) Analysis of competitiveness of selected countries using AHP models. In: Vojáčková H (ed) Mathematical methods in economics 2013. College of Polytechnics, Jihlava, pp 440–445

Munda G, Saisana M (2011) Methodological considerations on regional sustainability assessment based on multicriteria and sensitivity analysis. Reg Stud 45:261–276

OECD (2013) How's Life? 2013: Measuring Well-being. OECD, Paris

OECD/European Union/JRC (2008) Handbook on Constructing Composite Indicators: Methodology and User Guide. OECD, Paris

Porter M (1998) The competitive advantage of nations. The Free Press, New York

Saaty TL (1990) The analytic hierarchy process: planning, priority setting, resource allocation. RWS Publications, Pittsburgh

Schwab K, Sala-i-Martín X (eds) (2012) The global competitiveness report 2012–20013: full, data edition. World Economic Forum, Geneva

Viturka M (2010) Kvalita podnikatelského prostředí, regionální konkurenceschopnost a strategie regionálního rozvoje České republiky [Business environment quality, regional competitiveness and regional development strategy of the Czech Republic]. Grada Publishing, Praha

Zhou P, Fan LW, Zhou DQ (2010) Data aggregation in constructing composite indicators: a perspective of information loss. Expert Syst Appl 37:360–365