# Competitiveness analysis and evaluation of Entrepreneurial Ecosystems: a multi-criteria approach

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**Abstract**

The purpose of this paper is, to propose a methodology for the comparison and ranking of Entrepreneurial Ecosystems (EEs) in order to offer the decision maker a straightforward way of assessing the competitiveness of national economies. EEs are a coordinated set of individual and institutional agents, on the national level, aimed to pursue economic development through the discovery and exploitation of entrepreneurial opportunities. Among the various approaches found in EE research, the Global Entrepreneurship Monitor consortium (GEM) evaluates the national economic development of more than 100 countries, concerning both individual and contextual factors. Entrepreneurship Framework Conditions of national EEs are rated on an annual basis by groups of domain experts on a number of predefined criteria. These ratings describe the various facets of the EEs, exposing strengths and weaknesses of the contextual environment, offering a snapshot of the competitiveness conditions of the national economy. However, comparative studies examining the relative performance of each EE, are needed in order to communicate useful information and help stakeholders make insightful decisions and design policy.

The ranking of EEs as different alternatives based on multiple criteria is a Multi-Criteria Decision Making (MCDM) problem. The relative importance of each criterion is defined either by experts or by statistical methods. The selection of criteria weights is usually a cumbersome procedure. The utilization of non-weighted or equal weight methods, eliminates the need for definition of weights, it has less computational overhead and can produce distinct and objective rankings of the alternatives. The Greek EE is taken as a working example, and it is compared with a number of developed and developing countries, as alternatives. The consistence of the ranking results produced by the method proposed is compared with the evaluations of other EE metrics and the results of other well accepted MCDM methods. The application of the method produced a distinct ranking for each alternative EE. The Greek EE ranked below average among the countries of the comparison group, implying that it is less conducive for entrepreneurship development, although it is categorized among the most developed Innovation Driven economies. The theoretical and practical implications of the results are thoroughly discussed offering useful conclusions.

**Keywords** entrepreneurial ecosystem, competitiveness, GEM, ranking, non-weight method, multiple criteria analysis, Greek national economy

## 1 Introduction

Entrepreneurship has become an emerging field of research in the recent decades, not only because it enables a variety of different people to pursuit economic success (Kuratko, 2011), but also because it is considered of great importance for a country's economy. The argument supporting this last conclusion is that successful entrepreneurship creates positive spillovers to the regional and national economies (D. Isenberg 2011). As a result, great efforts have been undertaken in the last decades for the improvement of the economic environment in order to support entrepreneurial activity (OECD 2005). The state of development of the entrepreneurial activity, can provide information about the actual state of a national economy (Singer et al. 2015), since entrepreneurship is considered a significant indicator of economic development (Z. Acs 2006; Z. J. Acs et al. 2018; D. Isenberg 2011), and vice versa, successful entrepreneurship is fundamental for economic growth (Ahmad and Hoffmann 2007; Baumol and Strom 2008; Carayannis 2014a; Della Peruta 2014).

Entrepreneurship scholars consider, not only the individual attitudes of the actual or prospective entrepreneurs, but also the contextual factors of the economic environment (Acs et al. 2014), essential for economic growth. The combination of these factors into a wider image, is referred to as the Entrepreneurship Ecosystem (EE) (D. Isenberg 2011; Kelley et al. 2016). Among the various definitions found in a recent literature review (Cavallo et al. 2018), one can conclude that Entrepreneurial Ecosystems (EEs) consist a unique set of individual and contextual actors, that foster the discovery and exploitation of entrepreneurial opportunities, on the national level, through innovation and competitiveness, in order to achieve economic growth (D. Isenberg 2011). Although, the focus of EEs approach emphasizes on the role of the contextual environment, the epicenter remains on the individual entrepreneur, as the primary actor (Z. J. Acs et al. 2012; Stam 2015). However, it is not bounded to some outdated definitions of entrepreneurship such as self-employment (D. Isenberg 2011; Stam and Spigel 2016). The combination of individual, and contextual level parameters in the EE ensemble, consists a systemic approach to the contribution of entrepreneurship in economic growth (Z. J. Acs et al. 2018), providing useful insights about national economy competitiveness (Corrente et al. 2018; D. Isenberg 2011; Spigel and Harrison 2018). Finally, EEs are distinguished from clusters and regional innovation systems, because the former are more concerned about the entrepreneurial knowledge required for venture creation and the difficulties faced by entrepreneurs, whereas the latter are focused on the flow of technical and market knowledge, in a regional or industrial sector and between sectors (Spigel and Harrison 2018).

Among the many different approaches to measure the determinants of entrepreneurship, developed by different initiatives, Global Entrepreneurship Monitor (GEM) is the first to offer standardized data on nascent entrepreneurial activity (Corrente et al. 2018). GEM provides an empirical basis for comparisons in an international level (Bergmann et al. 2013), having also the longest lifespan (Liguori et al. 2019; Reynolds et al. 2005). Global reports released by GEM on an annual basis, evaluate the EEs of the participating countries. Each EE is evaluated independently according to domain experts' ratings on twelve distinct criteria. Moreover GEM, opposite to other metrics, provides a set of distinct indicators instead of a single ranking, which leaves the responsibility of judgment to the stakeholder (Corrente et al. 2018).

International comparisons of EEs could expose dissimilarities between EEs and highlight the right practices to be adopted for the development of entrepreneurial activity (Ahmad and Hoffmann 2007). However, comparative studies, taking in account all the criteria at the same time are missing. Such comparisons could also shed some light on ambiguities observed and spot areas for intervention (Maroufkhani et al. 2018). Taking the example of the Greek national economy one observes that it is ambiguously rated among the most competitive group of Innovation Driven economies (Herrington et al. 2017; Porter et al. 2002), although it scores average in the EE metrics of GEM. It is worthy to examine how it performs, in terms of EEs, compared to other neighboring countries, or countries recently hit by the economic recession. Such a comparison can offer plausible explanations for the currently reduced development rate of the Greek economy and help policy makers in designing effective policy measures for economic development in order to eliminate the occurring brain drain. Moreover, the analysis of the comparison results can offer assistance to investors and strategic entrepreneurs in order to make efficient investments.

The nature of the problem described so far, is of a multi-criteria nature. The utilization of MCDM is convenient and can provide the methodological tools for evaluation, and objective ranking of EEs,

based on multiple criteria. Such an evaluation can help scholars and practitioners make implicit conclusions about the corresponding national economies competitiveness, in terms of EEs. However, academic research has not yet utilized EEs as indicators of national competitiveness (Corrente et al. 2018) and comparative studies among countries must become a high priority for future research (Maroufkhani et al. 2018). The development of methods enabling the study of the multiple different indices composing the various EE related frameworks is necessary to move research forward in this direction (Carayannis and Grigoroudis 2016).

The aim of this article is to supply decision makers with a handy and straightforward methodology of ranking EEs, according to a common set of multiple criteria, in order to assess the competitiveness of national economies. The adoption of a non-weighted method proposed by Huang and Moh (2016), for this purpose, in contrast to the majority of other MCDM methods, does not require the definition of weights for the criteria significance, neither by experts or statistical methods, which usually is a cumbersome procedure. On the other hand, different weights can result in totally different ranking results. The method proposed is very convenient for the decision maker, in case equal criteria importance is satisfactory, or in case the selection of weights is impossible or unwanted.

The rest of the article is structured as follows. Firstly the theoretical background is presented, regarding the concepts of entrepreneurship and EEs. Additionally, some information on the working example chosen is given, with reference to the sample of the selected EEs and a sort literature review of studies utilizing methods of OR for the evaluation of alternatives in managerial issues is given. In the methodology section the proposed non weight method applied for the ranking of the alternative EEs is presented. Next, the evaluation criteria are outlined and a preliminary comparison of EEs is conducted, on a one to one basis. Then follows the application of the non-weighted method, for the simultaneous comparison based on multiple criteria. The results are analyzed in the discussion, along with a comparison to the results of other ranking methods. Finally, some meaningful conclusions concerning the EEs of the selected countries are drawn from the results offering some directions for policy makers.

## 2 Theoretical Background

### *2.1 Entrepreneurship*

By the term Entrepreneurship we refer to a complex phenomenon associated with the activities involving one's willingness and the use of available resources, aiming to exploit market opportunities (Ahmad and Hoffmann 2007). The entrepreneur is the basic actor in that scene, who is considered as the “keeper” of the ecosystem and "miraculously" operates the mechanism of the market, by recognizing opportunities and turning them into products (Baumol and Strom 2008, p. 234). In that effort, entrepreneurs, occasionally, have to overcome the various constraints met in the economic environment (Sitaridis and Kitsios 2016), in order to obtain wealth, power and prestige. The adoption of a wider view, incorporating both the individual and the environment, referred as the EE, gives the deserved consideration to the role of the institutions in supporting the development of entrepreneurship (Carayannis 2014a, 2014b).

### *2.2 Entrepreneurship Ecosystems and economic development*

One initiative of scholars for the systematic observation and measurement of the role of entrepreneurship on economic growth is GEM. A variety of data are collected through harmonized surveys in more than 100 countries, providing important information on the differences between countries. The Adult Population Survey (APS) is used for the collection of individual data from the working-age adult population, whereas the National Expert Survey (NES) is used for the evaluation of the general national framework. The purpose of these surveys is twofold. Firstly, to measure the entrepreneurial activity and capture the opportunity perceptions and the intentions of the population towards entrepreneurship and second, to highlight on the contextual conditions under which entrepreneurship flourishes along with the problematic economic situations, where appropriate interventions are needed (Herrington et al. 2017). The contextual factors constitute the general national framework part of the GEM model (Bosma et al. 2007), which has a determinate impact on entrepreneurial activity. Data provided by an adequate number of domain experts and entrepreneurs, through NES and other available sources, describe in detail the mixture of attitudes, resources, and

infrastructure, recently referred to as the Entrepreneurship Ecosystem (Kelley et al. 2016). The conceptual model developed by the GEM initiative, called the Entrepreneurial Framework Conditions, measures several different elements of EEs, organized in six pillars i.e. conducive culture, enabling policy and leadership, availability of finance, quality of human capital, venture friendly markets for products and services, and adequate institutional support (Bosma 2013; D. Isenberg 2011).

The comparative analysis of the characteristics of EEs, based on data provided by the GEM Entrepreneurial Framework Conditions, can provide information for the competitiveness of a country's national economy (Singer et al. 2015). In contrast to other approaches using explicit competitiveness measures based on national innovation, which suffer from the lack of a universally accepted assessment framework (Carayannis and Grigoroudis 2016), the methodology proposed here offers an implicit evaluation of national competitiveness, since the entrepreneurial process is vitally linked to economic development (Z. Acs 2006; D. Isenberg 2011). Furthermore, productivity and competitiveness are enhanced by the increase of entrepreneurial activity by the presence of competitive or cooperative firms (Spigel and Harrison 2018).

The Entrepreneurial Framework Conditions data are used for the evaluation of the economic conditions under which entrepreneurial activity evolves on the national level (Z. J. Acs et al. 2012) and has offered a solid basis for further research. Ács and Szerb (2007) used the GEM framework as a basis for the development of GEDI, changing their focus from the quantity to the quality of nascent entrepreneurship, while Maroufkhani et al. (2018) extended the framework with additional indicators such as industrial dynamics and crowd-sourcing, in order to capture the ability of the industry to maintain the competitive advantage by rapidly adapting to changes in customer preferences, as well as the capacity of collaboration between parties in order to exchange resources. Other scholars added an evolutionary approach to EE research, distinguishing four phases of evolution, birth, growth, sustainment and death on an EE (Mack and Mayer 2015). Finally, in a comparison between GEM and GEDI frameworks, Szerb (2013) used GEM data to evaluate the entrepreneurial performance of Hungary, whereas Holienka (2015) used GEM among other sources of data in order to execute a multi-perspective comparison of the entrepreneurial environment in Slovakia with other innovation-driven economies.

Other approaches examining the preconditions of entrepreneurship and innovation include World Bank Doing Business, Global Opportunity Index (GOI) (Adams-Kane et al. 2016), Global Entrepreneurship Index (Ács and Szerb 2007), the World Economic Forum (WEF) Global Competitiveness Report (Schwab 2016), the OECD/ EUROSTAT entrepreneurship indicators program and GEM's motivational index (Kelley et al. 2016). Each approach comprises a different set of indicators, yielding to either a financial or entrepreneurial approach. The major differences with GEM is that they use data from different sources such as World Economic Forum, World Bank etc and use simple estimation techniques, resulting in a single ranking. Some of the advantages of using GEM in academic research are its longevity, the large number of countries and academic institutions involved, the harmonized data retrieved from a more than sufficient number of experts and the sophisticated, yet simple theoretical model (Bergmann et al. 2013).

GEM releases a global report on an annual basis, in addition to the national reports published by the national team members. Each country is rated independently, by experts, on the twelve criteria of the EEs. However, unique rankings taking in account all the criteria at the same time are not provided and moreover, comparative studies between countries are missing. The lack of international comparisons preserves some ambiguous phenomena about Entrepreneurship, and moreover generates an uncertainty about the right practices to be adopted for the promotion of entrepreneurship. International comparisons according to EEs evaluation criteria could shed some light on these ambiguities, and help the adoption of suitable practices for the enhancement of entrepreneurship (Ahmad and Hoffmann 2007). Moreover, these comparisons could assist investors, strategic entrepreneurs and policy makers make the right decisions and adopt the suitable policies for the support of entrepreneurship.

As a working example for the application of the proposed methodology, the EEs of nine countries, including Greece, were selected as alternatives for ranking. According to the World Economic Forum, the Greek economy is rated among the Innovation Driven (ID) economies (Kelley et al. 2016; Schwab 2016), which is the most developed group of economies. This, at least theoretically, means that, the Greek EE is fully developed and therefore, it incorporates a conducive entrepreneurial culture and it has adequate support infrastructures and availability of finance. Additionally, an entrepreneurship oriented policy, is supposed to be applied, giving a boost to the fully developed market, offering a

wide range of potential customers, and letting the good stock of talented entrepreneurs act as a fertile ground for further development (D. J. Isenberg 2008). Nevertheless, in the recent annual reports of GEM, opportunities perceived by the population in Greece, are below the average of ID economies (Herrington et al. 2017) and the Total Entrepreneurial Activity (TEA) shows serious decrement in the recent years ($TEA_{2016}$= 5.7%, $TEA_{2015}$= 6.7%, $TEA_{2014}$= 7.9%). These facts are corroborated by the Global Entrepreneurship and Development Institute (GEDI), claiming that Greece is among the 10 countries with the biggest decline in the Global Entrepreneurship Index (Ács and Szerb 2007) and the World Economic Forum (WEF) ranking Greece's overall competitiveness in the 57th place among 140 economies (GCI 4.0 2018). These findings may be due to the deep economic recession Greece went through (Herrington et al. 2017; Ioannides et al. 2016), or due to the failure of governmental measures since then, to address the real problems of the economy, resulting from a false perception of the influential factors. (Maroufkhani et al. 2018).

These conflicting data, raise some questions about how well is the Greek EE performing in comparison to the ecosystems of neighboring countries and other countries recently hit by economic crisis. Such a comparison could give insights about the performance of the Greek economy (Szerb and Trumbull 2015). In this line of reasoning and depending on the availability of data, the following countries were chosen for the comparison: Argentina, Bulgaria, Croatia, Cyprus, Greece, Ireland, FYROM, Portugal and Turkey. Four of the selected countries belong to the most advanced group of ID economies, namely, Cyprus, Greece, Portugal and Ireland. The rest five countries belong to the less developed group of Efficiency Driven (ED) economies, namely, Argentina, Bulgaria, Croatia, FYROM and Turkey. The comparison of the chosen EEs is based on the performance scores derived from NES. GEM offers a robust framework for the study of EEs, however, it is difficult for policy makers or other interested parties to elicit concrete inferences due to the multiple criteria involved. Additionally, comparative studies with other similar countries are required, to provide the Greek policy makers with feedback, in order to make appropriate adjustments (Liguori et al. 2019).

*2.3 Multi-criteria Decision Making*

MCDM is a field of Operational Research (OR), with constantly increasing research interest, and a wide range of applications in business and economics. A variety of methods are offered, including the Analytic Hierarchy Process (AHP) (Saaty 1990), the ELECTRE methods family (Roy 1968, 1991), the PROMETHEE methods (J. P. Brans et al. 1984), the TOPSIS method (Gwo-Hshiung and Jih-Jang Huang 2010) and the VIKOR method (Opricovic and Tzeng 2004, 2007). MCDM is gaining ground as an assessment tool in management research (Kitsios et al. 2009), attempting to predict economic development through measures of innovation, success and other applications (Dhochak and Sharma 2016a). Additionally, The fields of application of multi-criteria analysis include cost minimization and quality of service maximization, which usually rely on a plead of conflicting attributes (Xu and Yang 2001). Moreover, comparative studies between countries, aim to improve decision making in multiple levels (Carayannis et al. 2016).

Decision support can provide arguments based on models, which answer the questions posed by a decision maker (Roy 1996) However, an inherent difficulty for the decision maker is to consider all parameters simultaneously, in order to make rational choices. MCDM offers a number of Multi-Attribute Decision Making (MADM) methods addressing this problem that are suitable for the prioritization of factors in managerial research. To name a few examples, Analytic Hierarchy Process (AHP) has been used for ranking the influential factors for venture capitalists (Dhochak and Sharma 2016b), Fuzzy AHP has been utilized for the calculation of weights in the evaluation of firm Entrepreneurial Orientation (Rezaei et al. 2013), Analytic Network Process has been used for the calculation of weights for students' creativity evaluation criteria (Chen and Chen 2012). Another difficulty related to multi-criteria analysis is the selection of weights describing the significance of each criterion, which usually requires a cumbersome procedure by a panel of domain experts, who express their preferences as the relative importance of the criteria. The diversity of the field of expertise, the experience and personality are some of the factors that can seriously influence the process of the weight selection for each criterion, with significant complications for the final decision. Additionally, the weight selection procedure is difficult to design and standardize, in order to be sufficiently effective for the produced results to be of broad acceptance.

*2.4 Weighted vs. non-weighed methods*

The majority of the MADM methods evaluate a number of alternatives, using the weighted sum model, where each criterion is assigned a weight, according to its significance for the decision maker. Bigger weights correspond to greater significance of the attributes. The result is a ranking of the alternatives, with all attributes taken in account simultaneously. On the other hand, there are methods that do not require the assignment of weights, and therefore they are called the un-weighted, non-weighted or equal weight methods, which reduces the computational burden and ensures the objectivity of the ranking results.

The determination of the weights by the decision maker is a research topic by itself (Yue 2011) and usually complex validation procedures are required along with test cases from the real world (Opricovic and Tzeng 2007). The advantage of the selection of the weights by the decision maker is firstly, that his/her attitude can reflect on the final decision, through the differentiating significance of the criteria and secondly, that by adjusting the weights of preference, different scenarios concerning the final decision can be examined. However, this approach has some disadvantages. For example, in many cases the preference between criteria is not straightforward. In many cases the decision is not taken by a single person but rather by a group of experts with different backgrounds. Hence there is some subjectivity of judgment related to the group composition (Yue 2011). This complexity makes the weights selection procedure rather cumbersome, not to mention the extra computational overhead of the whole process (Schoemaker and Waid 1982). Additionally, in methods requiring pair-wise comparisons, the expression of the measure of preference is the main source of inconsistency (Rezaei 2015). To address this problem, statistical methods, like factor analysis, have been proposed, for the calculation of the weights, however, the process requires an adequate amount of data for sufficient accuracy, which are not always handy (Rezaei et al. 2013). Such an example is the use of UTADIS method for the "out of the sample" calculation of criteria weights for the evaluation of new service development strategies (Kitsios et al. 2009), however, the results are sensitive to changes in the number of cases and the number of criteria. The use of fuzzy MCDM (Rezaei et al. 2013) offers a solution to this problem, however, it is dependent to experts' judgments. Other approaches to the weight definition problem, is either the arbitrary testing of different sets of weights in order to select the optimal values (J.-P. Brans and Mareschal 2005), or the application of "naïve" equal-weight or non-weighted methods (Dhochak and Sharma 2016b; Huang and Moh 2017; Rezaei et al. 2012, 2013). The use of non-weighted methods is applicable even in circumstances that the assignment of weights is not desired or it is impossible (Jose Figueira et al. 2005). Table 1 summarizes the pros and cons of weighted and non-weighted methods.

**Table 1.** Comparison of weighted and non-weighted methods

| Weighted methods | Non-weighted methods |
|---|---|
| Long and complex procedures (-) | No extra burden for weight selection(+) |
| Express DMs attitude (+) | Independent from DM's attitude (+) |
| Subjectivity (-) | Objectivity(+) |
| Large amounts of data required (-) | Limited number of cases (+) |

## 3 Methodology

### *3.1 The non-weighted method*

The method proposed by Huang and Moh (2016) is an non-weighted ranking method. That means all criteria are considered equally important and no weights are needed. It was used for the evaluation of 17 hospitals in the US, according to 12 criteria concerning the performance of each hospital on specific medical specialties. In contrast to other methods adopting the weighted-sum method, it produced 17 distinct rankings. The method is based on the Perron-Frobenious Theorem. The implementation is similar to the football teams comparison methods proposed by Keener (1993), based on win-tie-loss results of the games, and Google page ranking algorithm (Langville and Meyer 2006), which ranks pages without human evaluation, based on their hyperlink connections.

The case examined in our example is a MADM problem, for the ranking a number of national economies, including Greece, as alternatives, depending on twelve evaluation criteria derived from GEM Entrepreneurial Framework Conditions. Multi-perspective comparisons based on GEM EE data, can provide informative rankings that highlight the strengths and weaknesses of the Greek entrepreneurial environment against the competition. Such comparisons can help investors and executives decide where and how they should invest (Dhochak and Sharma 2016a; Holienka 2015), and moreover assist strategic entrepreneurs make decisions (Adams-Kane et al. 2016). Furthermore, they can provide implications for policy makers in order to take measures for the improvement of their country's EE.

The non-weighted method proposed by Huang and Moh, (2016) is a MADM approach, specialized in handling discrete problems. The method has the following advantages:

- no need for experts evaluation on criteria relative importance
- produce distinct ranking for each alternative
- objectivity of the ranking
- relatively low mathematical complexity
- no linear relations assumed

In the general case of the evaluation table of $m$ alternatives, $P_1, P_2, \ldots, P_m$ , according to the performance scores on $t$ criteria, $c_1$ , $c_2$ ,..., $c_t$, is illustrated in Table 2.

**Table 2.** The performance scores of the alternatives

| Criteria | $C_1$ | $C_2$ | $C_3$ | $C_4$ | … | $C_t$ |
|---|---|---|---|---|---|---|
| Alternatives | | | | | | |
| $P_1$ | $P_{11}$ | $P_{12}$ | $P_{13}$ | $P_{14}$ | | $P_{1t}$ |
| $P_2$ | $P_{21}$ | $P_{22}$ | $P_{23}$ | $P_{24}$ | | $P_{2t}$ |
| $P_3$ | $P_{31}$ | $P_{32}$ | $P_{33}$ | $P_{34}$ | | $P_{3t}$ |
| … | | | | | | |
| $P_m$ | $P_{m1}$ | $P_{m2}$ | $P_{m3}$ | $P_{m4}$ | | $P_{mt}$ |

A comparison matrix $A_{mxm} = (a_{rs})_{mxm}$ of the alternatives $P_1, P_2, \ldots, P_m$, over the criteria $c_1$ , $c_2$ ,..., $c_t$, is calculated, with $a_{rs}$ defined as :

$$a_{rs} = \left(g_{rs} + \frac{1}{2}e_{rs}\right)/t, \text{ where } r, s = 1,2, \ldots, m, \quad \textbf{Eq. 1}$$

is calculated, where $g_{rs}$ is the count of wins $(p_{rk} > p_{sk})$ and $e_{rs}$ is the count of ties $(p_{rk} = p_{sk})$ of alternative $r$ over alternative $s$, respectively, with $k = 1,2,\ldots,t$. Considering all $p_{rk}$, $(r = 1,2,\ldots, m$ $k$=1,2,…,$t$) values are available for comparison, then all $a_{rs} \in R^+$. The resulting comparison matrix $A_{mxm}$ is a primitive matrix (Huang and Moh 2017; Langville and Meyer 2006).

The Perron-Frobenius theorem suggests that every primitive matrix $A_{mxm}$ has a positive real maximum eigenvalue $\boldsymbol{\lambda}$, also called its spectral radius, which is used to calculate the corresponding eigenvector of the matrix (Gantmacher 1959; Saaty 1987). The process is similar to the computation of weights in the original AHP method, as the elements of the eigenvector, by Saaty (1990). Furthermore, $\lambda$ has an algebraic and geometric multiplicity of 1 and a positive eigenvector $v > 0$, such that all positive eigenvectors of $A$ are multiples of $v$. Given the comparison matrix $A_{mxm}$, its spectral radius $\lambda$ and a vector $v_0 = [1, 1, 1, \ldots, 1]^T$, then the $lim_{n\to\infty}\left(\boldsymbol{A}/\boldsymbol{\lambda}\right)^n \cdot v_0 = cv$ , where $c = u \cdot v_0 > 0$ , given $u$ is some positive row vector, which is a multiple of the eigenvector $v$. Let $d = cv$, be the ultimate ranking vector (Huang and Moh 2016).

The ranking vector based on the comparison matrix $A_{mxm}$, given its spectral radius $\lambda$ and a vector $v_0 = [1, 1, 1, \ldots, 1]^T$, is calculated using the expression:

$$d = lim_{n\to\infty}\left(A/\lambda\right)^n \cdot v_0 , \qquad \textbf{Eq. 2}$$

where $d$ is the derived ranking vector :

$$d = [d_1, d_2, d_3, \ldots, d_m]^T ,$$

and each $d_n$ is the ranking of the *n*-th alternative.

Since the required ranking vector is a multiple of the eigenvector, it is adequate to use the eigenvector itself, as the ranking vector $d$ (Huang and Moh 2017).

In this working example, the method was used for the ranking of a set of nine EEs, of neighboring countries or countries suffering from economic recession were used as different alternatives compared on twelve equally weighted criteria.

### *3.2 Entrepreneurial Ecosystem's evaluation*

The twelve criteria used for the comparison, from GEM's NES, are summarized in Table 3. Each criterion is attributed under the corresponding pillar of EE, for reasons of convenience (D. Isenberg 2011).

**Table 3**. The 12 evaluation criteria of Entrepreneurial Ecosystems (GEM)

| Criterion | Description (GEM) | The 6 pillars of EEs |
|---|---|---|
| C1 | Financing for entrepreneurs | Availability of finance |
| C2 | Governmental support and policies | Support policy framework |
| C3 | Taxes and bureaucracy | |
| C4 | Governmental programs | |
| C5 | Basic school entrepreneurial education and training | Human capital |
| C6 | Post school entrepreneurial education and training | |
| C7 | R&D transfer | |
| C8 | Commercial and legal infrastructure | Markets |
| C9 | Internal market dynamics | |
| C10 | Internal market openness | |
| C11 | Physical and services infrastructure | Infrastructures |
| C12 | Cultural and social norms | Entrepreneurial culture |

As a first step, the scores of the Greek EE on each one of the twelve criteria are compared to average values of ED economies and ID economies of the alternative countries. The comparison results visually illustrated in Figure 1 are based on the performance scores of each alternative country, presented in Table 4.

Availability of finance is regarded as the most influential factor, for the development of entrepreneurial activity (Levie and Autio 2008). According to criterion **c1**, it is evident that financing for entrepreneurs in Greece (2.15) is well below the averages of both ED (2.34) and ID (2.49) economy groups averages. This means that Greek entrepreneurs have reduced opportunities for funding in comparison to their counterparts from other developed and developing countries and this definitely consists a serious barrier to starting-up a business (Choo and Wong 2006; Robertson et al. 2003). The most beneficial EEs in terms of financial availability are those of Portugal (2.95), Ireland (2.85) and Turkey (2.80).

On the second criterion **c2**, concerning "Governmental support and policies", Greece (1.78) is rated even lower, compared to its competitors from ED (2.30) and ID economies (2.43), meaning that governmental policies in favor of entrepreneurship are either rare or inefficient. The situation gets even worse in what concerns taxation and bureaucracy examined by criterion **c3**, where the Greek EE gets the lowest score (1.49), compared with ED (2.04) and ID (2.14) economies, with Argentina (1.34) only being worse. This finding suggests that, the Greek taxation system significantly encumbers the entrepreneurial firm, in addition to the bureaucratic procedures, which seriously impede startup efforts and add extra administrative burden and compliance costs to the entrepreneurial firm (Baumol 2007; Levie and Autio 2008). The situation regarding governmental programs aiming to facilitate the operation of entrepreneurial firm, examined by criterion **c4**, is more or less the same,

with Greece (1.77) seriously lagging behind ED (2.32) and ID (2.56) economies. As a result, subsidies and information in the direction of nurturing newly established firms are considered either scarce or inefficiently administered. Overall, in what concerns the Support policy framework pillar, the Greek EE shows considerable inconsistencies which are probably the causes of low the opportunity perceptions (13%) and low entrepreneurial intentions (8%) among the general adult population (Herrington et al. 2017) and especially among tertiary students (Sitaridis and Kitsios 2017). As a conclusion, Entrepreneurship, unfortunately, seems not to be included among the top priorities of Greek policy makers in the recent decades.

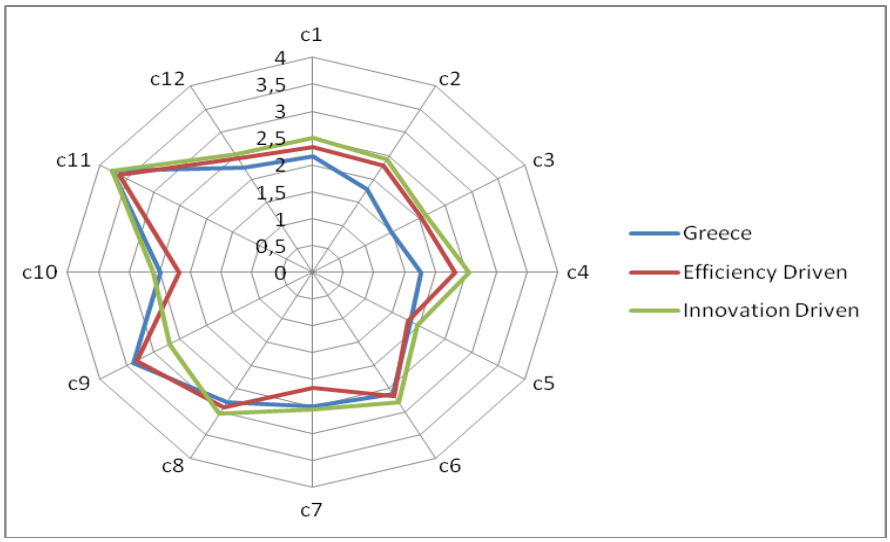


**Fig.1** The comparison of the Greek E.E. to the average values of ED and ID Economies

Education and training programs on entrepreneurial issues are expected to have a positive impact on the entrepreneurial intentions (Peterman & Kennedy, J. 2003; Pittaway and Cope 2007; Souitaris et al. 2007). On the criteria **c5** and **c6** examining the sufficiency of available entrepreneurship courses in the curriculum of basic and post school education programs the image is improved. Greece (1.84/2.62) is graded very close to the averages of the competitor ED (1.80/2.66) and ID (1.97/2.80) economies. It is worth mentioning that the performance of the Greek EE for both basic and post school educational programs is closer to the average of developing countries rather than to the average of the developed countries. This means that despite the serious efforts for the development of positive attitudes towards entrepreneurship through educational interventions and the interest of adult population on entrepreneurial course attendance (Kolvereid and Isaksen 2006), there are still many improvements needed. Regarding the last criterion under the human capital pillar, the criterion **c7**, concerning R&D transfer, the Greek EE (2.45) performs well above the ED economies average (2.15) and almost equals the average of the ID economies (2.55). Among the countries with exceptional performance in this field, we find Ireland (2.78) and Portugal (2.76) from the ID group and Turkey (2.63) from the ED group, which outperforms the other ED counties and Greece. From these results, it becomes evident that new knowledge created in research institutions is efficiently transferred to the industry in order to be commercialized through the creation of new products and services (Z. Acs 2006) and create local knowledge spillovers enhancing regional creativity (Audretsch and Lehmann 2006; Plummer and Acs 2012).

Commercial and professional infrastructures are evaluated by the criterion **c8**. Here are included the services required for the operation of an entrepreneurial firm, such as suppliers, lawyers and accountants, advertisers financial services and physical facilities. In this field, the Greek EE (2.79) is rated again below both ED (2.92) and ID (3.05) economies. All countries of the comparison, except for Croatia (2.56) are rated well above Greece, meaning that the availability of professional services is somewhat insufficient, which can prove a serious impediment for the development of entrepreneurial activity and especially for high-potential firms (Levie and Autio 2008) and discourage investors willing to invest in Greece.

The next criterion **c9**, under the title "Internal market dynamics" refers to the rate of change of the market, depending on product and technology life cycle. On this criterion the EE of Greece (3.38) is

rated higher than all other ID economies (2.69) and is closer to the levels of the ED economies (3.31). Generally, high values of market dynamics are expected in the underdeveloped Factor Driven and ED economies, showing either instability or insufficient market development, usually conceded by significant differences in TEA and Established Business Ownership (EBO) rates (Singer et al. 2015, p. 46). That is exactly the case for the Greek economy, with TEA at 5.7% and EBO at 14.1%, for the year 2016 (Herrington et al. 2017).

Internal market openness refers to the difficulty for new firms to enter to existing markets and is examined by the criterion **c10**. Here the Greek economy (2.49) is closer to the score of ID economies (2.61) than that of the ED economies (2.19), meaning that the entry to the market is relatively easy for new entrepreneurial firms, a fact considered positive for the development of entrepreneurial activity.

Physical infrastructures like telecommunications and transportation are among the basic requirements for the establishment of a new firm and can be proved vital for the successful operation thereafter (Levie and Autio 2008). The Greek EE (3.77) is well developed in this domain, as well as the rest of the countries of the comparison, according to criterion **c11**. ID economies (3.79) perform slightly better than ED economies (3.64), with Portugal (4.41) and Bulgaria (4.08) showing exceptional performance.

Last but not least, "Cultural and Social norms" refer to the general attitude towards entrepreneurship influenced mainly by cultural values and the public image of the entrepreneur (Levie and Autio 2008). According to criterion **c12**, the Greek EE (2.25) is rated below the averages of both ID (2.53) and ED (2.44) economies. This result is indicative of the low desirability for entrepreneurship among the population. Probable causes may be the negative social norms measured by the GEM's Adult Population Survey, shaping negative attitudes towards entrepreneurship, in combination with the reduced national respect for self-employment as an occupation, in contrast to the rest of the countries in the sample.

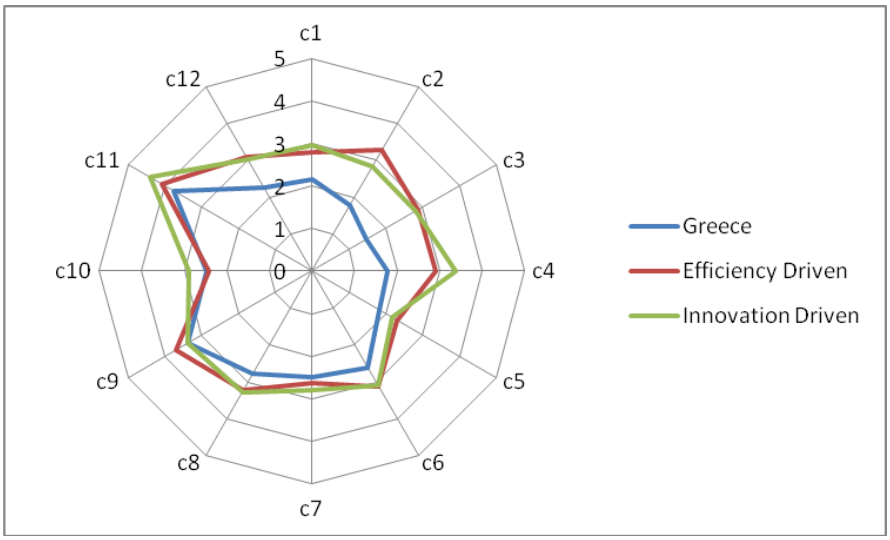


**Fig.2** The comparison of the Greek E.E. to the maximum values of ED and ID Economies

The examination of these 12 criteria, on a one by one basis, highlighted so far many of the weaknesses of the Greek EE. In Figure 2, a comparison of the Greek EE is provided with the maximum values obtained on each criterion, by ID and ED economies. This visualization shows the margins for potential improvement of the Greek EE, according to the competitor countries performance. However, it is difficult to make some final judgment on how the Greek EE performs in total, compared with those of the other countries. It would be very useful, especially in an executive level to have the opportunity to compare these countries on a multi-criteria manner, taking all criteria in account simultaneously.

## 4 Data Analysis

In Table 4, the evaluations of the EEs for a set of the nine countries are presented, based on their performance on twelve distinct criteria. The performance score for each country is derived from the GEM's NES, concerning the year 2016. Higher values correspond to a better performing EE. The objective is to rank the countries by their performance on the twelve criteria c1-c12. For each country a unique rank is required. The ranking of each alternative can be used as a straightforward indicator, of the suitability of the country's contextual environment for the development of entrepreneurial activity, in comparison to the other countries of the set. Higher ranks indicate a more suitable environment for entrepreneurship development and consequently correspond to a more advanced phase of actual economic development**.**

**Table 4.** The performance scores for 9 different countries on 12 criteria

| | THE ENTREPRENEURIAL ECOSYSTEM (GEM 2016) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEM 2016 | Financing for entrepreneurs | Governmental support and | Taxes and bureaucracy | Governmental programs | Basic school entrepreneurial | Post school entrepreneurial | R&D transfer | Commercial and professional | Internal market dynamics | Internal market openness | Physical and services | Cultural and social norms |
| Country (EDL*) | c1 | c2 | c3 | c4 | c5 | c6 | c7 | c8 | c9 | c10 | c11 | c12 |
| Argentina (E) | 1.74 | 3.30 | 1.34 | 2.91 | 1.77 | 3.12 | 2.38 | 2.67 | 3.26 | 2.14 | 3.17 | 3.08 |
| Bulgaria (E) | 2.64 | 1.67 | 2.87 | 1.92 | 1.64 | 2.30 | 1.94 | 3.04 | 2.91 | 2.27 | 4.08 | 2.18 |
| Croatia (E) | 2.30 | 1.73 | 1.48 | 2.14 | 1.61 | 2.33 | 1.70 | 2.56 | 3.29 | 1.95 | 3.77 | 1.82 |
| Cyprus (I) | 2.02 | 2.29 | 2.46 | 2.01 | 1.75 | 2.79 | 2.18 | 3.06 | 2.74 | 2.60 | 3.66 | 2.40 |
| Greece (I) | 2.15 | 1.78 | 1.49 | 1.77 | 1.84 | 2.62 | 2.49 | 2.79 | 3.38 | 2.49 | 3.77 | 2.25 |
| Ireland (I) | 2.85 | 2.78 | 2.83 | 3.37 | 2.18 | 2.70 | 2.78 | 3.06 | 2.47 | 2.90 | 3.31 | 3.02 |
| FYROM (E) | 2.21 | 2.10 | 2.68 | 2.37 | 2.32 | 2.66 | 2.11 | 3.10 | 3.37 | 2.14 | 3.68 | 2.26 |
| Portugal (I) | 2.95 | 2.85 | 1.77 | 3.07 | 2.10 | 3.10 | 2.76 | 3.27 | 2.17 | 2.45 | 4.41 | 2.47 |
| Turkey (E) | 2.80 | 2.68 | 1.82 | 2.26 | 1.68 | 2.90 | 2.63 | 3.22 | 3.70 | 2.43 | 3.49 | 2.89 |
| ED** Average | 2,34 | 2,30 | 2,04 | 2,32 | 1,80 | 2,66 | 2,15 | 2,92 | 3,31 | 2,19 | 3,64 | 2,45 |
| ID*** Average | 2,49 | 2,43 | 2,14 | 2,56 | 1,97 | 2,80 | 2,55 | 3,05 | 2,69 | 2,61 | 3,79 | 2,54 |

* Economic Development Level (Herrington et al. 2017)
** ED economies
***ID economies

The EEs of the nine countries (Argentina, Bulgaria, Croatia, Cyprus, Greece, Ireland, FYROM, Portugal and Turkey) represent the different alternatives to be ranked with respect to the twelve criteria, c1 to c12, used for the assessment. Each line of Table 4, constitutes the performance score vector of the corresponding country, with higher values indicating higher performance of the specific economy, with respect to the corresponding criterion.

In Table 5, the comparison matrix produced by the win-tie count procedure, after the application of equation Eq.1, is illustrated, based on the scores of the alternative EEs of Table 4.

**Table 5**. The comparison matrix $A_{9x9}$

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0,5000 | 0,5833 | 0,6667 | 0,5833 | 0,3333 | 0,3333 | 0,4583 | 0,3333 | 0,4167 |
| 0,4167 | 0,5000 | 0,6667 | 0,3333 | 0,4167 | 0,2500 | 0,3333 | 0,1667 | 0,1667 |
| 0,3333 | 0,3333 | 0,5000 | 0,3333 | 0,2083 | 0,1667 | 0,1667 | 0,0833 | 0,0833 |
| 0,4167 | 0,6667 | 0,6667 | 0,5000 | 0,5833 | 0,2917 | 0,4167 | 0,2500 | 0,3333 |
| 0,6667 | 0,5833 | 0,7917 | 0,4167 | 0,5000 | 0,1667 | 0,3333 | 0,1667 | 0,2500 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0,6667 | 0,7500 | 0,8333 | 0,7083 | 0,8333 | 0,5000 | 0,6667 | 0,5833 | 0,6667 |
| 0,5417 | 0,6667 | 0,8333 | 0,5833 | 0,6667 | 0,3333 | 0,5000 | 0,2500 | 0,3333 |
| 0,6667 | 0,8333 | 0,9167 | 0,7500 | 0,8333 | 0,4167 | 0,7500 | 0,5000 | 0,7500 |
| 0,5833 | 0,8333 | 0,9167 | 0,6667 | 0,7500 | 0,3333 | 0,6667 | 0,2500 | 0,5000 |

The ranking vector, calculated according to the equation Eq.2, based on the spectral radius λ=4.093976 of matrix $A_{9x9}$, is given in Table 6:

**Table 6**. The eigenvector

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***d*** | 1,0681 | 0,7721 | 0,5127 | 1,0083 | 0,9020 | 1,6093 | 1,1403 | 1,6301 | 1,3326 |

The ranking of the countries produced from the comparison matrix $A_{mxm}$, is illustrated in Table 7. In this specific case, a higher $d_n$ value indicates a higher rank. From Table 7, it becomes evident that, the Greek EE is ranked in the 7-nth place among the nine alternatives. This result has serious implications regarding its suitability for the development of entrepreneurial activity, according to the criteria presented in Table 3.

**Table 7**. The ranking of the EEs and comparison to other MADM methods

| Country (EDL*) | Non-Weighted Method (Huang and Moh 2016) | | Promethee II | TOPSIS |
|---|---|---|---|---|
| | Ranking vector *d* | Rank # | Index (rank) | Index (rank) |
| Portugal (I) | 1,6301 | 1 | 0.48 (1) | 0.593 (2) |
| Ireland (I) | 1,6093 | 2 | 0.43 (2) | 0.715 (1) |
| Turkey (E) | 1,3326 | 3 | 0.25 (3) | 0.557 (3) |
| FYROM (E) | 1,1403 | 4 | 0.05 (4) | 0.509 (4) |
| Argentina (E) | 1,0681 | 5 | -0.07 (5) | 0.505 (5) |
| Cyprus (I) | 1,0083 | 6 | -0.09 (6) | 0.439 (6) |
| Greece (I) | 0,9020 | 7 | -0.15 (7) | 0.339 (8) |
| Bulgaria (E) | 0,7721 | 8 | -0.31 (8) | 0.435 (7) |
| Croatia (E) | 0,5127 | 9 | -0.57 (9) | 0.251 (9) |

* Economic Development Level (Herrington et al. 2017)

Next to each country's name in Table 4 and Table 7, an indicator of EDL is included in the parentheses, with ID economies marked with an (I) and ED economies marked with an (E). Obviously, many ED economies are ranked above the Greek economy, meaning that their economic environment is more suitable for the development of entrepreneurial activity. A comparison with the rankings of two, widely accepted MADM methods is also provided, namely the PROMETHEE II and TOPSIS. In both methods, all weight factors are set equal to 1. The corresponding rankings for the two additional methods are given in the parentheses (see Table 7). The comparison results, indicating that when all criteria are considered equally important, all three methods produce, very similar ranking results, show the high reliability of the adopted non-weighted method. The small differentiations between the three methods, are frequently observed between MADM methods (Opricovic and Tzeng 2007).

The non-weighted method, for the purposes of this article, was implemented in Microsoft Excel Visual Basic. The maximum eigenvalue and the eigenvector of the comparison matrix were calculated by the Power Method, as introduced in Larson, Edwards, & Falvo, (2003) and Saad, (2011). The PROMETHEE II was executed in the Visual PROMETHEE software academic edition environment (Mareschal and De Smet 2009), whereas the TOPSIS calculations were also manually programmed in Microsoft Excel Visual Basic environment, based on examples provided by Krohling & Souza, (2011).

## 5 Discussion

The application of a Non-Weighted Method (Huang and Moh 2017), for the simultaneous comparison of the EEs of nine countries, according to twelve criteria, was utilized in this working example. With all criteria considered of equal importance, the comparison resulted in a unique ranking for every country. The rank of every alternative EE corresponds to its performance in comparison to the other alternatives and gives some insights about the actual condition of the country's national economy. A comparison with the rankings produced by other widely accepted MADM methods was conducted, for the assessment of the performance of the adopted method, as suggested by Kitsios et al. (2009). The corresponding rankings of the PROMETHEE II and TOPSIS methods presented in Table 7, indicated that when all criteria are considered equally important, all three methods produce, very similar ranking results. Furthermore, a comparison to the relative rankings of other initiatives is presented in Table 8. The variation between the rankings is not surprising, since each initiative bases its evaluation on different factors of the economic environment. The results of the adopted method are closer to these of the GEM motivational index (Herrington et al. 2017).

In what concerns the alternative EEs, on the top of the rank, one observes two ID economies namely Portugal and Ireland and one ED economy, Turkey. The ranking of the Greek EE in the 7th place is well below many ID and ED economies. Thus it becomes apparent that, for the time being, the Greek EE has more weaknesses than strengths, compared to the EEs of the other countries of the set, or at least it exhibits an ambiguous performance.

These findings are in line with the rankings of various initiatives on business and entrepreneurship research. Firstly, as indicated in Table 8, the Greek economy is ranked between the 7-th and 8-th position, in comparison to the other countries, according to the World Bank Doing Business initiative. Secondly, according to GEM's motivational index (Kelley et al. 2016) and the Global Opportunity Index (GOI), the Greek economy is ranked 8-th (Adams-Kane et al. 2016) and according to GEDI, it is ranked 5-th (Ács and Szerb 2007) among the alternatives. Finally, according to the WEF Global Competitiveness Index (GCI) the Greek economy is placed in the 8-th place (Schwab 2016). The small differences between the rankings observed can be justified by the different EE attributes examined by each initiative. However, all rankings are below the rankings of other countries of the less developed ED economies (Herrington et al. 2017).

**Table 8.** Comparison of the results with the rankings of other initiatives

| Country | Non-weighted method Ranking # | World Bank Doing business* | World Bank Competitiveness* | GEM motivational index 2016* | GOI 2015* | GEDI 2017* | WEF GCI* 2016 |
|---|---|---|---|---|---|---|---|
| Argentina | 5 | 116 (9) | 104 (9) | 1.6 (5) | 4.38 (9) | 22.2 (9) | 3.81(9) |
| Bulgaria | 8 | 39 (4) | 50 (3) | 1.1 (7) | 5.38 (7) | 22.7 (8) | 4.44(3) |
| Croatia | 9 | 43 (5) | 74 (6) | 1.3 (6) | 5.61 (5) | 30.8 (6) | 4.15(6) |
| Cyprus | 6 | 45 (6) | 83 (7) | 2.0 (3) | 6.76 (2) | 38.5 (4) | 4.04(7) |
| Greece | 7 | 61 (7) | 86 (8) | 1.1 (8) | 5.22 (8) | 34.6 (5) | 4.00(8) |
| Ireland | 2 | 18 (2) | 23 (1) | 3.2 (1) | 7.61 (1) | 71.0 (1) | 5.18(1) |
| FYROM | 4 | 10 (1) | 68 (5) | 0.7 (9) | 5.58 (6) | 28.7 (7) | 4.23(5) |
| Portugal | 1 | 25 (3) | 46 (2) | 2.7 (2) | 6.43 (3) | 47.2 (2) | 4.48(2) |
| Turkey | 3 | 69 (8) | 55 (4) | 1.9 (4) | 5.80 (4) | 43.7 (3) | 4.39(4) |

In conclusion, the congruence of the rankings of these international initiatives, regarding the Greek economy can justify why, at least currently, Greece is not between the best options of national and international capital investors. Additionally, the results raise questions about the classification of the Greek economy between the most advanced group of ID economies, since, despite of the positive entrepreneurial culture, the developed market and the good stock of potential entrepreneurs

(Herrington et al. 2017; Kelley et al. 2016), the entrepreneurial intentions of the adult population are among the lowest at an international level (Herrington et al. 2017; Kelley et al. 2016; Sitaridis and Kitsios 2017). Additionally, high expectation entrepreneurship is at the lowest levels globally (Bosma et al. 2007) and entrepreneurship seems to be impeded by ineffective infrastructures, shortages of credit and lack of entrepreneurship oriented policies (Herrington et al. 2017), resulting in moderate innovation, productivity and competitiveness performance compared to other European countries (Carayannis and Grigoroudis 2016).

These facts justify the low scores of the Greek EE on many criteria, presented in Table 3. The results should warn policy makers, to concentrate on the improved quality of governance, rather than the improvement of macroeconomic outcomes alone (Porter et al. 2002). In this direction, the good practices adopted concerning the availability of entrepreneurship courses in basic and post school education, indicated by the criteria c5 and c6, alongside the good score in R&D transfer, should be ensued by additional measures concerning the criteria scoring low. More precisely, in order to eliminate shortages in the availability of finance for entrepreneurs, as indicated by criterion c1, the appropriate legislation has to be stipulated, to trigger the financial aid provided by banks, angel investors and social capital foundations. Additionally, serious governmental initiatives are essential for the support of entrepreneurial activity, such as serious tax cuts and plain bureaucratic procedures for the startup and maintenance of a firm, as indicated by the criteria c2 and c3. These measures could be useful for the advance of the commercial and professional infrastructure needed, as indicated by the criterion c8. The establishment or enhancement of such supportive measures would enable the Greek economy take advantage of the relatively high market dynamics and the openness of the market witnessed by the criteria c9 and c10, and finally, the good physical infrastructure indicated by the criterion c11, in order to increase entrepreneurial activity in beneficiary sectors (Baumol and Strom 2008). Last but not least, beyond the identification of diverge criteria, policy makers need to understand that the most important achievement will be the facilitation of the collaboration and information exchange between all the stakeholders acting into the Greek EE (Maroufkhani et al. 2018; Mason and Brown 2013).

## 6 Conclusions

The evaluation of EEs according to GEM's NES criteria can provide insights about the suitability of a national economy’s context for the development of entrepreneurial activity. Since the measures of entrepreneurship can be used as indicators of vibrancy of a national economy (Z. Acs 2006), it is permissible to use the expert evaluations of a country's EE as an indicator of the level of competitiveness of the country's national economy and therefore rank alternative countries depending on how "entrepreneurial" they are. Multi-criteria analysis can support the decision maker's effort to make conclusions in cases of multiple and sometimes conflicting criteria. However, most of the multi-criteria methods suffer from complex interactive procedures for the selection of weights defining the criteria relative importance. Non-weighted or equal weight methods offer the advantage that they can be used even in cases, the selection of weights is unwanted or even impossible.

The non-weighted method proposed by Huang and Moh, (2016), used for the ranking of EEs of multiple countries, has proved its high reliability in comparison to two other MADM methods. In this working example, a set of nine EEs, countries of both ED and ID economies, including Greece, were used as different alternatives compared on twelve equally weighted criteria. In general, EE research until now, focused mainly on UK and USA, and analyses of other minor EEs were very rare, not to mention the total absence of multinational comparative studies (Maroufkhani et al. 2018).

According to the findings, the Greek EE was ranked in the 7th place of the comparison group, implying that it is practically less conducive for the development of entrepreneurship, compared to the rest of the countries in the set, although it is officially numbered among the most advanced group of ID economies. The suitability of the Greek EE for entrepreneurial activity is reduced, compared even to the EEs of countries of the less developed ED group. Unfortunately, the weaknesses revealed by the evaluations of experts on certain criteria, are seriously inhibiting the enterprising efforts of the population, bolstering necessity driven rather than opportunity driven entrepreneurship, corroborated by the fluctuations of Total Early stage Entrepreneurship in the recent years (Ioannides

et al. 2016). These findings have essential implications for policy and reinforce the aspect that serious interventions are needed in the problematic areas highlighted by the results.

In this direction, the identification of the phase of evolution of the Greek EE as defined in (Mack and Mayer 2015) is required in order to identify the missing links for economic development. Then serious and coordinated policy measures can be adopted for the enhancement of institutional support, based on the analysis presented in the discussion. Firstly, it is essential to increase the availability of entrepreneurial educational courses in secondary and tertiary education, as well as, establish a link between industry and education, in order to increase the entrepreneurial mindset of students and help education meet the needs of the industry. Access to knowledge resources is fundamental, as well as considerable entry barriers, in order to ensure the inclusiveness of the best candidates in the pursue of opportunities (Economidou et al. 2018). The stimulation of motives for entrepreneurs to chase entrepreneurial opportunities instead of bare necessity driven self-employment, especially in sectors crucial for the national economy, such as tourism, agriculture, information technology and biotechnology, to name a few, must be increased in order to increase sustainability of businesses and reduce the brain draining occurring in the last years. Secondly, the availability of a variety of financial sources, the simplification of bureaucratic procedures and the reduction of taxation, also noted by NES, can remove institutional barriers and act in favor of productiveness and innovation (Sitaridis and Kitsios 2016). Finally, successful entrepreneurs as mentors must enjoy the eminent appreciation of the media, for entrepreneurial ambition to gain momentum in the society (D. Isenberg 2011; Maroufkhani et al. 2018). Underpinning entrepreneurship in the social and cultural dimension can enable the necessary networking between the key actors and allow the flow of resources, which is important for the resilience of the EE (Spigel 2015; Spigel and Harrison 2018). Such measures will not only aid the efforts towards the development of opportunity driven entrepreneurship, which is considered of a highest quality and sustainability, but will also underpin the establishment of high growth - high potential entrepreneurial businesses and attract the interest of domestic and international investors in favor of the general welfare (Baumol and Strom 2008).

One limitation of the present study is the small number of alternatives and criteria used in the working example. Bigger numbers of alternatives and criteria might increase the complexity to the calculations required, however, they could reveal any hidden inconsistencies of the method. Another limitation is that the results of the method were compared only against two other MADM methods. More extensive comparisons of the method chosen, both with pair wise comparison methods (Rezaei 2015) and other weighted and non-weighted methods are needed (Huang and Moh 2017), in order to reinforce the robustness and reliability of the method. In regard to the EEs, the basic limitation is the use of one source of data. Future research should combine different sources of data, allowing an in depth investigation of the EE of interest.

## References


Acs, Z. (2006). How Is Entrepreneurship Good for Economic Growth? *Innovations: Technology, Governance, Globalization*, *1*(1), 97–107. doi:10.1162/itgg.2006.1.1.97

Acs, Z. J., Autio, E., & Laszlo, S. (2012). National Systems of Entrepreneurship : Measurement Issues and Policy Implications National Systems of Entrepreneurship : Measurement Issues and Policy Implications. *Research Policy*, *43*(February 2012), 476–494. doi:10.2139/ssrn.2008160

Acs, Z. J., Estrin, S., Mickiewicz, T., & Szerb, L. (2018). Entrepreneurship, institutional economics, and economic growth: an ecosystem perspective. *Small Business Economics*, *51*(2), 501–514. doi:10.1007/s11187-018-0013-9

Ács, Z. J., & Szerb, L. (2007). The Global Entrepreneurship Index (GEINDEX). *Foundations and Trends® in Entrepreneurship*, *5*(5), 341–435. doi:10.1561/0300000027

Adams-Kane, J., Lopez, C., & Wilhelmus, J. (2016). Global Opportunity Index : Methodology. Milken Institute.

Ahmad, N., & Hoffmann, A. (2007). *A Framework for Addressing and Measuring Entrepreneurship*. *OECD*. Paris. doi:10.2139/ssrn.1090374

Audretsch, D. B., & Lehmann, E. (2006). Entrepreneurial access and absorption of knowledge spillovers: Strategic board and managerial composition for competitive advantage. *Journal of Small Business Management*, *44*(2), 155–166. doi:10.1111/j.1540-627X.2006.00161.x

Baumol, W. J. (2007). On income distribution and growth. *Journal of Policy Modeling*, *29*(4), 545–548.

doi:10.1016/j.jpolmod.2007.05.004

Baumol, W. J., & Strom, R. J. (2008). Entrepreneurship and Economic Growth. *Strategic Entrepreneurship Journal*, *1*(2007), 233–237. doi:10.1002/sej

Bergmann, H., Mueller, S., & Schrettle, T. (2013). The Use of Global Entrepreneurship Monitor Data in Academic Research: A Critical Inventory and Future Potentials. *J. Entrepreneurial Venturing*, 1–43. https://www.alexandria.unisg.ch/217994/1/Bergmann Mueller Schrettle 2012_The use of GEM data in academic research_IJEV_Alexandria.pdf

Bosma, N. (2013). The Global Entrepreneurship Monitor (GEM) and its impact on entrepreneurship research. *Foundations and Trends in Entrepreneurship*, *9*(2), 143–248. doi:10.1561/0300000033

Bosma, N., Jones, K., Autio, E., & Levie, J. (2007). Global Entrepreneurship Monitor 2007 Executive Report.

Brans, J.-P., & Mareschal, B. (2005). PROMETHEE methods. In Josè Figueira, S. Greco, & M. Ehrgott (Eds.), *Multiple criteria decision analysis: state of the art surveys. International Series in Operations Research & Management Science*. Boston: Springer Science+Business Media. doi:https://doi.org/10.1007/0-387-23081-5_5

Brans, J. P., Mareschal, B., & Vincke, P. (1984). PROMETHEE: A New Family of Outranking Methods in Multicriteria Analysis. In *Operational Research* (pp. 477–490).

Carayannis, E. G. (2014a). Processes of Entrepreneurship and New Venture Creation. In M. Del Giudice, M. R. Della Peruta, & E. G. Carayannis (Eds.), *Student Entrepreneurship in the Social Knowledge Economy* (pp. 3–12). Springer International Publishing.

Carayannis, E. G. (2014b). Managing the Entrepreneurial Process: The Relationship Between Universities and Early Entrepreneurship. In M. Del Giudice, M. R. Della Peruta, & E. G. Carayannis (Eds.), *Student Entrepreneurship in the Social Knowledge Economy*. Springer International Publishing.

Carayannis, E. G., & Grigoroudis, E. (2016). Using multiobjective mathematical programming to link national competitiveness, productivity, and innovation. *Annals of Operations Research*, *247*(2), 635–655. doi:10.1007/s10479-015-1873-x

Carayannis, E. G., Grigoroudis, E., & Goletsis, Y. (2016). A multilevel and multistage efficiency evaluation of innovation systems: A multiobjective DEA approach. *Expert Systems with Applications*, *62*, 63–80. doi:10.1016/j.eswa.2016.06.017

Cavallo, A., Ghezzi, A., & Balocco, R. (2018). Entrepreneurial ecosystem research: present debates and future directions. *International Entrepreneurship and Management Journal*, 1–31. doi:10.1007/s11365-018-0526-3

Chen, J. K., & Chen, I. S. (2012). Critical creativity criteria for students in higher education: Taking the interrelationship effect among dimensions into account. *Quality and Quantity*, *46*(4), 1057–1075. doi:10.1007/s11135-011-9448-7

Choo, S., & Wong, M. (2006). Entrepreneurial intention: Triggers and barriers to new venture creations in Singapore. *Singapore Management Review*, *28*(2), 47–64. doi:10.1016/j.respol.2014.07.009

Corrente, S., Greco, S., Nicotra, M., Romano, M., & Schillaci, C. E. (2018). *Evaluating and comparing entrepreneurial ecosystems using SMAA and SMAA-S. Journal of Technology Transfer*. Springer US. doi:10.1007/s10961-018-9684-2

Della Peruta, M. R. (2014). Designing an Entrepreneurial Profile in Higher Educational Systems. In *Student Entrepreneurship in the Social Knowledge Economy* (pp. 73–86). Springer International Publishing. doi:10.1007/978-3-319-05567-1_6

Dhochak, M., & Sharma, A. K. (2016a). Integration of factors affecting venture capitalists' investment decision: an interpretive structural modelling approach. *Int. J. Management and Decision Making*, *15*(1), 38–52. doi:10.1504/IJMDM.2016.076838

Dhochak, M., & Sharma, A. K. (2016b). Identification and prioritization of factors affecting venture capitalists' investment decision-making process. *Journal of Small Business and Enterprise Development*, *23*(4), 964–983. doi:10.1108/JSBED-12-2015-0166

Economidou, C., Grilli, L., Henrekson, M., & Sanders, M. (2018). Financial and Institutional Reforms for an Entrepreneurial Society. *Small Business Economics*, *51*(2), 279–291. doi:10.1007/s11187-018-0001-0

Figueira, Jose, Mousseau, V., & Roy, B. (2005). ELECTRE Methods. In Josè Figueira, S. Greco, & M. Ehrgott (Eds.), *Multiple Criteria Decision Analysis State of the Art Surveys* (Springer.).

Gantmacher, F. R. (1959). *The Theory of Matrices*. *Chelsea Publishing* (Vol. 1). New York. doi:10.1007/978-3-642-99234-6

GEM. (2016). The Entreprenerial Ecosystem. *Global Entrepreneurship Research Association*. http://www.gemconsortium.org/data/key-nes. Accessed 20 June 2019

Gwo-Hshiung, T., & Jih-Jang Huang. (2010). *Multiple attribute decision making: methods and applications*. *CRC Press*. Springer Berlin Heidelberg.

Herrington, M., Kew, P., & Singer, S. (2017). *GEM Global Report 2016/17*. *Global Entrepreneurship Monitor*. doi:10.1017/CBO9781107415324.004

Holienka, M. (2015). Entrepreneurial Environment in Slovakia: Multi-Perspective Comparison with Innovation-Driven Economies. *Procedia Economics and Finance*, *34*(15), 437–444. doi:10.1016/S2212-5671(15)01652-4

Huang, P. H., & Moh, T. tsieng. (2017). A non-linear non-weight method for multi-criteria decision making. *Annals of Operations Research*, *248*(1–2), 239–251. doi:10.1007/s10479-016-2208-2

Ioannides, S., Korra, E., & Giotopoulos, I. (2016). *Entrepreneurship 2014-2015 : The dynamics of the Greek Entrepreneurship System during the Crisis*. *Entrepreneurship Observatory IOBE*.

Isenberg, D. (2011). *The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Development: Principles for Cultivating Entrepreneurship*. *The Babson Entrepreneurship Ecosystem Project* (Vol. 1). doi:10.1093/rfs/hhr098

Isenberg, D. J. (2008). The global entrepreneur. *Harvard Business Review*, *86*(12), 107-111+134. doi:10.4324/9780203728802

Keener, J. P. (2005). The Perron–Frobenius Theorem and the Ranking of Football Teams. *SIAM Review*, *35*(1), 80–93. doi:10.1137/1035004

Kelley, D., Singer, S. S., & Herrington, M. (2016). *GEM Global Report 2015/16*. *Global Entrepreneurship Monitor*. doi:ISBN: 978-1-939242-05-1

Kitsios, F., Doumpos, M., Grigoroudis, E., & Zopounidis, C. (2009). Evaluation of new service development strategies using multicriteria analysis: Predicting the success of innovative hospitality services. *Operational Research*, *9*(1), 17–33. doi:10.1007/s12351-008-0025-3

Kolvereid, L., & Isaksen, E. (2006). New business start-up and subsequent entry into self-employment. *Journal of Business Venturing*, *21*(6), 866–885. doi:10.1016/j.jbusvent.2005.06.008

Krohling, R. A., & Souza, T. T. M. De. (2011). Two Examples of Application of TOPSIS to Decision Making Problems. *Revista de Sistemas de Informação da FSMA*, *8*, 31–35.

Kuratko, D. F. (2011). Entrepreneurship theory, process, and practice in the 21st century. *International Journal of Entrepreneurship and Small Business*, *13*(1), 8. doi:10.1504/IJESB.2011.040412

Langville, A. N., & Meyer, C. D. (2006). *Google's PageRank and Beyond*. *Information Retrieval*. Princeton University Press.

Larson, R., & Falvo, D. (2009). Power Methods for Approximating Eigenvalues. In *Elementary Linear Algebra* (pp. 586–594). Houghton Mifflin Harcourt Publishing.

Levie, J., & Autio, E. (2008). A theoretical grounding and test of the GEM model. *Small Business Economics*, *31*(3), 235–263. doi:10.1007/s11187-008-9136-8

Liguori, E., Bendickson, J., Solomon, S., & McDowell, W. C. (2019). Development of a multi-dimensional measure for assessing entrepreneurial ecosystems. *Entrepreneurship and Regional Development*, *31*(1–2), 7–21. doi:10.1080/08985626.2018.1537144

Mack, E., & Mayer, H. (2015). The evolutionary dynamics of entrepreneurial ecosystems. *Urban Studies*, *53*(10), 1–16. doi:10.1177/0042098015586547

Mareschal, B., & De Smet, Y. (2009). Visual PROMETHEE: Developments of the PROMETHEE & GAIA multicriteria decision aid methods. In *IEEM 2009 - IEEE International Conference on Industrial Engineering and Engineering Management* (pp. 1646–1649). doi:10.1109/IEEM.2009.5373124

Maroufkhani, P., Wagner, R., & Wan Ismail, W. K. (2018). Entrepreneurial ecosystems: a systematic review. *Journal of Enterprising Communities*, *12*(4), 545–564. doi:10.1108/JEC-03-2017-0025

Mason, C., & Brown, R. (2013). Creating good public policy to support high-growth firms. *Small Business Economics*, *40*(2), 211–225. doi:10.1007/s11187-011-9369-9

OECD. (2005). Micro-Policies for Growth and Productivity : Final Report. OECD.

Opricovic, S., & Tzeng, G. H. (2004). Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European Journal of Operational Research*, *156*(2), 445–455. doi:10.1016/S0377-2217(03)00020-1

Opricovic, S., & Tzeng, G. H. (2007). Extended VIKOR method in comparison with outranking methods. *European Journal of Operational Research*, *178*(2), 514–529. doi:10.1016/j.ejor.2006.01.020

Peterman & Kennedy, J., N. E. (2003). Enterprise education: Influencing students' perceptions of entrepreneurship. *Entrepreneurship Theory and Practice*, *28*(2), 129–144. doi:10.1046/j.1540-6520.2003.00035.x

Pittaway, L., & Cope, J. (2007). Simulating entrepreneurial learning: Integrating experiential and collaborative approaches to learning. *Management Learning*, *38*(2), 211–233. doi:10.1177/1350507607075776

Plummer, L. a., & Acs, Z. J. (2012). Localized competition in the knowledge spillover theory of entrepreneurship. *Journal of Business Venturing*, *29*(1), 1–16. doi:10.1016/j.jbusvent.2012.10.003

Porter, M. E., Sachs, J. D., Mcarthur, J. W., Cornelius, P. K., Mcarthur, J. W., Mcarthur, J. W., & Vasquez, D. (2002). *Global Competitiveness Report*. *World Economic Forum*. doi:10.1002/yd.320

Reynolds, P., Bosma, N., Autio, E., Hunt, S., De Bono, N., Servais, I., et al. (2005). Global Entrepreneurship Monitor: Data Collection Design And Implementation 1998-2003. *Small Business Economics*, *24*(3), 205–231. doi:10.1007/s11187-005-1980-1

Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega (United Kingdom)*, *53*(June 2015), 49–57. doi:10.1016/j.omega.2014.11.009

Rezaei, J., Ortt, R., & Scholten, V. (2012). Measuring entrepreneurship: Expert-based vs. data-based methodologies. *Expert Systems with Applications*, *39*(4), 4063–4074. doi:10.1016/j.eswa.2011.09.091

Rezaei, J., Ortt, R., & Scholten, V. (2013). An improved fuzzy preference programming to evaluate entrepreneurship orientation. *Applied Soft Computing Journal*, *13*(5), 2749–2758. doi:10.1016/j.asoc.2012.11.012

Robertson, M., Collins, A., Medeira, N., & Slater, J. (2003). Barriers to start-up and their effect on aspirant entrepreneurs. *Education + Training*, *45*(6), 308–316. doi:10.1108/00400910310495950

Roy, B. (1968). Classement Et Choix En Presence De Points De Vue Multiples. *Revue française d'informatique et de recherche*

*opérationnelle*, *2*(8), 57–75. http://www.numdam.org/article/RO_1968__2_1_57_0.pdf

Roy, B. (1991). The outranking approach and the foundations of electre methods. *Theory and Decision*, *31*(1), 49–73. doi:10.1007/BF00134132

Roy, B. (1996). *Multicriteria Methodogy for Decision Aiding*. (B. Roy, Ed.) (Vol. 12). Dortrecht: Springer Science+Business Media. doi:DOI 10.1007/978-1-4757-2500-1

Saad, Y. (2011). *Numerical Methods for Large Eigenvalue Problems*. *Society for Industrial and Applied Mathematics* (II.). Minneapolis. doi:10.1137/1.9781611970739

Saaty, T. L. (1987). Rank According to Perron: A New Insight. *Mathematics Magazine*, *60*(4), 211. doi:10.2307/2689340

Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, *48*(1), 9–26. doi:10.1016/0377-2217(90)90057-I

Schoemaker, P. J. H., & Waid, C. C. (1982). An Experimental Comparison of Different Approaches to Determining Weights in Additive Utility Models. *Management Science*, *28*(2), 182–196. doi:10.1287/mnsc.28.2.182

Schwab, K. (2016). The Global Competitiveness Report. (K. Schwab, Ed.). Geneva: World Economic Forum. doi:92-95044-35-5

Singer, S., Amoros, J. E., & Arreola, D. M. (2015). *GEM Global Report 2014* (Vol. 53). Global Entrepreneurship Monitor.

Sitaridis, I., & Kitsios, F. (2016). A Taxonomy of barriers to entrepreneurship. In *5th International Symposium & 27th National Conference on Operational Research* (pp. 133–137). Aigaleo, Athens.

Sitaridis, I., & Kitsios, F. (2017). Entrepreneurial Intentions of Information Technology students: The Theory of Planned Behavior, the role of Gender and Education. *J. for International Business and Entrepreneurship Development*, *10*(3), 316–335.

Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, *22*(4), 566–591. doi:10.1016/j.jbusvent.2006.05.002

Spigel, B. (2015). The Relational Organization of Entrepreneurial Ecosystems. *Entrepreneurship Theory and Practice*, *44*(0), n/a-n/a. doi:10.1111/etap.12167

Spigel, B., & Harrison, R. (2018). Toward a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, *12*(1), 151–168. doi:10.1002/sej.1268

Stam, E. (2015). Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique. *European Planning Studies*, *23*(9), 1759–1769. doi:10.1080/09654313.2015.1061484

Stam, E., & Spigel, B. (2016). Entrepreneurial Ecosystems. In R. BlackBurn, D. Clereq, J. Heinonen, & Z. Wang (Eds.), *Handbook for Entrepreneurship and Small Business* (SAGE.). London. http://www.uu.nl/organisatie/utrecht-university-school-of-economics- use/onderzoek/publicaties/discussion-papers/2016

Szerb, L. (2013). The Comparison of the Global Entrepreneurship Monitor and the Global Entrepreneurship and Development Index Methodologies. *Foundations and Trends® in Entrepreneurship*, *9*(1), 1–142. doi:10.1561/0300000046

Szerb, L., & Trumbull, W. N. (2015). Entrepreneurship and entrepreneurial ecosystem in the V4 countries: The Global Entrepreneurship Index perspective. *Proceedings of the 5th International Conference on Management 2015. Management, leadership and strategy for SMEs' competitiveness*, 2–7. doi:10.17626/dBEM.ICoM.P00.2015.p001

Xu, L., & Yang, J. (2001). *Introduction to multi-criteria decision making and the evidential reasoning approach* (No. 106). doi:186115111X

Yue, Z. (2011). An extended TOPSIS for determining weights of decision makers with interval numbers. *Knowledge-Based Systems*, *24*(1), 146–153. doi:10.1016/j.knosys.2010.07.014