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RESEARCH ARTICLE

Measuring the Capacity of Global Human Capital as a tool of Socio-economic Development in E7 Economies

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Abstract

The aim of this study is to measure the capacity of human capital in E7 economies. Within this framework, 4 different dimensions and 21 criteria, emphasized in the Global Human Capital report, are taken into the consideration. In the first phase of the analysis, fuzzy DEMATEL methodology is used in order to weight these dimensions and criteria. In addition to this situation, the MOORA approach is considered to rank E7 economies with respect to the capacity of human capital. The findings show that deployment and know-how are the most important dimensions. Additionally, it is defined that underemployment rate and availability of skilled employee have the highest weights among criteria. Moreover, it is concluded that Russia and India are the best countries whereas Mexico and Brazil are on the last rank with respect to the human capital capacity. Hence, it is recommended that the countries, which have the lowest rank, should increase technological investment and conduct a new and effective training program to increase the skills and the qualifications of the employees. Therefore, it can be possible to reach sustainable socio-economic development.

Keywords: Global Human Capital; E7 Economies; Socio-economic Development; Fuzzy DEMATEL; MOORA

JEL Classification: J24, O15, C65

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Öz

Bu çalışmanın amacı, E7 ekonomilerinde beşerî sermaye kapasitesini ölçmektir. Bu çerçevede Küresel İnsan Sermayesi raporunda vurgulanan 4 farklı boyut ve 21 kriter ele alınmıştır. Analizin ilk aşamasında, bu boyut ve kriterleri değerlendirmek için bulanık DEMATEL yöntemi kullanılmıştır. Buna ek olarak, MOORA yaklaşımının beşerî sermaye kapasitesine göre E7 ekonomilerini derecekendirdiği düşünülmektedir. Araştırmanın sonucunda elde edilen bulgular en önemli boyutun sıralamada dağılım ve bilgi birikimi olduğunu ortaya koymaktadır. Bunun yanında, eksik istihdam oranı ve vasıflı çalışan mevcudiyetinin belirlenen kriterler arasında en yüksek ağırlığa sahip olduğu gözlemlenmektedir. Ayrıca beşerî sermaye kapasitesi açısından Rusya ve Hindistan'ın en iyi ülkeler olduğu, Meksika ve Brezilya'nın ise son sırada bulunduğu sonucuna varılmıştır. Bu nedenle, en alt sıradaki ülkelerin teknolojik yatırımlarını artırmaları, çalışanların beceri ve niteliklerini artırmak için yeni ve etkin bir eğitim programı yürütmeleri önerilmektedir. Araştırma sonucuna göre ancak bu yöntemle sürdürülebilir sosyo-ekonomik kalkınmaya ulaşmak mümkün olacaktır.

Anahtar Kelimeler: Küresel İnsan Sermayesi; E7 Ekonomileri, Sosyo-ekonomik Kalkınma; Bulanık DEMATEL; MOORA

JEL Sınıflandırması: J24, O15, C65

INTRODUCTION

All countries aim to reach development in all areas so that the living standards of the citizens can be increased. Within this context, increasing industrial production can be accepted as a significant purpose for the countries. With the help of this situation, the investment amount in the countries can be gone up and it has a positive effect on economic improvement. In addition to this issue, high investment amount also contributes to decrease unemployment problem in the countries. Therefore, it can be said that industrial production has a positive influence for both economic and social ways. Moreover, it is also obvious that countries should make investments on technological improvement in order to reach this objective. The main reason is that with the help of advanced technology, it can be much easier to develop the economy.

In addition to this aspect, qualified people in the countries, who can use this advanced technology, play also a crucial role in the development of the countries. Because of this aspect, it is a necessity that these countries should have necessary qualified people. Otherwise, it cannot be possible to get benefits from this advanced technology. Due to these issues, most countries make investments on human capital. It refers to the qualification, knowledge, and education level of the people who live in the country. As it can be understood from this definition, human capital is as important as technological improvement in the country. Thus, it is stated that educated people have a powerful contribution to the economic improvement of the countries.

There are many different factors that can affect human capital. For example, education level is a significant aspect which has an influence on human capital. It is accepted that there is a positive relationship between these variables. In this circumstance, the important point is that this education should be considered in research and development. Additionally, the health level of the people who live in the country has also a powerful impact on human capital. The main reason behind this issue is that when people in the country are healthier, they can work effectively, and this situation has a contribution on the production level. Furthermore, the young population is also another important aspect with respect to human capital. It is obvious that if most of the population in the country consists of old people, it cannot have an effect on the production level.

Emerging economies refer to the countries which have not developed yet. However, it is thought that these countries have a significant potential to be a developed country. For this purpose, these countries seek ways to increase investment amount so that production level can be increased. With the help of these conditions, they can have a chance to develop their economies. Owing to this aspect, emerging economies take different actions in order to attract the attention of investors. Hence, it is obvious that effective human capital is a key issue for these countries to reach this objective. Because of this situation, emerging economies try to increase the qualification of the people who live in these countries.

World Economic Forum issues the Global Human Capital Report annually. In this report, global human capital is measured at global and regional levels. After that, countries' profiles are explained according to the results of this evaluation. The main purpose of this report is to provide necessary recommendations in order to have better human capital. In this report, the importance of 4 different dimensions is underlined which are capacity, development, deployment, and know-how. Capacity refers to the education level of the people whereas development gives information about the education for the next-generation workforce. Additionally, deployment explains how many people in the country can actively participate in the workforce. Finally, know-how is the dimension which identifies the productive knowledge of the country. For these 4 dimensions, 21 different indicators are stated in this report.

While considering the aspects emphasized above, it is understood that the studies regarding the measurement of human capital play a crucial role. Therefore, the aim of this study is to measure the capacity of human capital in E7 economies. Within this scope, 4 different dimensions and 21 criteria, emphasized in the Global Human Capital report, are taken into the consideration. The analysis process consists of two different phases. In the first phase of the analysis, fuzzy DEMATEL methodology is used so as to weight these dimensions and criteria. In addition to this situation, MOORA approach is considered to rank E7 economies regarding the capacity of human capital.

This study has many different novelties. First of all, according to the results of the analyses, it can be possible to understand which components and indicators are more significant in global human capital capacity. Another important point is that necessary recommendations can be given for E7 countries to improve this situation so that socio-economic development can be obtained. In addition to these factors, using fuzzy DEMATEL and MOORA approaches also increases the originality of this study. While considering these conditions, it is thought that this study makes an important contribution to the literature.

There are five different sections in this study. In this introduction section, general information about the key topics is given. Moreover, in the second section, similar studies in the literature are detailed and the missing part is underlined. Furthermore, the third section explains fuzzy DEMATEL and MOORA methods. In addition, the fourth section gives information about the application on E7 economies. In this section, analysis results are shared. In the last section, recommendations are given based on these analysis results in order to provide socio-economic development for E7 countries.

LITERATURE REVIEW

In order to understand the popularity of this subject, firstly, the human capital topic is examined in Web of Science database. In a topic search, it is found that there are 17,637 studies in Web of Science Core Collection. In Web of Science Categories classification; economics has 7,611 studies, management has 2,887 studies, business has 1,910 studies. In addition to these issues, it is also understood that 77.36% of studies are article type and 21.33% of studies are proceedings paper. Moreover, country ranking for human capital topic studies order; United States, China, England, Germany, and Canada. Some selected studies regarding the subject of human capital are demonstrated on Table 1.

Table 1: Selected Studies of Human Capital in the Literature

Author	**Subject**	**Methodology**	**Conclusion**
Lafuente and Rabetino (2011)	Company Performance	Regression	The study concluded that human capital is important for growth of the companies.
Roca-Puig et al. (2011)	Company Performance	Comparative Analysis	Effective human capital has a positive influence on the sales performance of the companies.
Abdullah et al. (2013)	Human Capital Indicators	Analytic Hierarchy Process	It is found that the most important indicator is using knowledge.
Banerjee and Roy (2014)	Economic Growth	ARDL	The capacity of human capital has a positive effect on economic growth for India.
Massingham and Tam (2015)	Effects of Human Capital	Regression	Employee capability, employee satisfaction, and employee commitment can be improved with human capital capacity.
Vaitkevičius et al. (2015)	Effects of Human Capital	Factor Analysis	Human capital development has a different effect according to the types of European countries.
Čiutienė and Railaitė (2015)	Effects of Human Capital	Scientific Literature Analysis	Effective human capital has many advantages for companies and countries.
Pelinescu (2015)	Economic Growth	Regression	There is a positive relationship between GDP per capita and innovative capacity of human capital.
Onkelinx et al. (2016)	Effects of Human Capital	Regression	It is concluded that effective human capital leads to higher employee productivity.
Muda and Rahman (2016)	Company Performance	Conceptual Study	Human capital has a significant role of the performance of the companies.
Estrin et al. (2016)	Entrepreneurship	Multi-level Modelling	It is determined that specific entrepreneurial human capital is relatively more important for the commercial entrepreneurship.
Samagaio and Rodrigues (2016)	Company Performance	Fuzzy Logic	It is determined that effective human capital can lead to high performance.
Qin et al. (2016)	Human Capital Indicators	Regression	Education and health are important indicators of effective human capital.
Vidotto et al. (2017)	Effects of Human Capital	Scale Development	Employee satisfaction can be increased with the help of effective human capital.
Salim et al. (2017)	Energy Consumption	Unit root and co-integration tests	Effective human capital has a decreasing effect on energy consumption.
Fang and Chen (2017)	Economic Growth	Granger Causality Tests	Human capital has an important role on economic growth.
Brush et al. (2017)	Entrepreneurship	Regression	Effective human capital has an important effect on women's entrepreneurship.
Ruíz et al. (2017)	Company Performance	Regression	The financial performance of the companies is influenced by effective human capital.
Danquah and Amankwah-Amoah (2017)	Human Capital Indicators	GMM	Technologic development has an important influence on human capital capacity.
Bano et al. (2018)	Carbon Emission	Vector Error Correction Model	It is concluded that in long-term, there is a relationship between human capital and carbon emissions.
Ko and McKelvie (2018)	Company Performance	Regression	Training of employee has a direct effect on the performance of the companies.
Chen and Fang (2018)	Industrial electricity consumption	Regression	It is found that industrial electricity consumption is affected by human capital investment.
Velayutham and Rahman (2018)	Effects of Human Capital	Regression	Effective human capital has a positive influence on the job satisfaction.
Tho et al. (2018)	Company Performance	Structural Equation Model	It is concluded that human has a positive effect on company performance.
Passaro et al. (2018)	Entrepreneurship	Structural Equation Modelling	The educated human capital leads to higher entrepreneurship.
Amankwah-Amoah (2018)	Human Capital Indicators	Conceptual Framework	The study developed a conceptual framework for human capital flows.

Table 1 shows that some studies aim to analyze the relationship between effective human capital and energy consumption. For example, Bano et al. (2018) focused on this subject for Pakistan. As a result of vector error correction analysis, it is concluded that there is a negative relationship between human capital and carbon emission. Due to this condition, it is recommended that human capital should be improved by education to reduce carbon emission. Similarly, Salim et al. (2017) defined that 1% of increase in human capital could reduce energy consumption between 0.18% and 0.45% for China. Moreover, Chen and Fang (2018) also identified that there is a strong relationship between electricity consumption and human capital.

In addition, some studies also underlined the relationship between effective human capital and economic growth. For instance, Fang and Chen (2017) focused on this relationship with the help of Granger causality test. It is concluded that there is a positive relationship between human capital capacity and economic improvement. Pelinescu (2015) and Banerjee and Roy (2014) reached the same conclusion by using a different methodology. Furthermore, Ko and McKelvie (2018), Samagaio and Rodrigues (2016), Ruíz et al. (2017), Muda and Rahman (2016), Lafuente and Rabetino (2011), Roca-Puig et al. (2011), and Tho et al. (2018) stated that effective human capital has a strong influence on the company performance.

Moreover, it is seen that some studies aimed to analyze the indicators of human capital. As an example, Abdullah et al. (2013) tried to find the factors that have an effect on human capital. By using the analytical hierarchy process, they reached the conclusion that the most important indicator is using knowledge whereas the least significant indicator is employee's skill index. Additionally, Danquah and Amankwah-Amoah (2017) defined that technological improvement is an essential indicator of human capital. Amankwah-Amoah (2018) and Qin et al. (2016) concluded that education and health are important factors that affect human capital.

Furthermore, some studies evaluated the relationship between entrepreneurship and human capital. For example, Brush et al. (2017), Estrin et al. (2016), and Passaro et al. (2018) concluded that effective human capital is an important factor to increase entrepreneurship in the countries. In addition to these studies, it can also be understood that some other studies assessed the effects of human capital. For example, Massingham and Tam (2015) focused on this subject by using regression methodology. They defined that human capital capacity has a direct effect on employee capability, employee satisfaction, and employee commitment. Parallel to this study, Velayutham and Rahman (2018), Vidotto et al. (2017), Čiutienė and Railaitė (2015), and Vaitkevičius et al. (2015) underlined the positive effects of human capital on some other factors, such as employee productivity.

While considering the studies emphasized in Table 1, it can be seen that human capital is a very popular aspect in the literature. The main reason is that it was analyzed more than 17,000 studies according to Web of Science report. Another important point is that many different relationships are taken into the consideration, such as the effects of human capital on energy consumption, the relationship between effective human capital and economic growth, indicators, and the positive effects of human capital. By looking at the details of these studies, it is understood that there is a need for a new study that measures the human capital capacity with an original methodology, such as fuzzy DEMATEL and MOORA.

METHODOLOGY

Fuzzy DEMATEL

The word DEMATEL comes from the first letters of "The Decision-Making Trial and Evaluation Laboratory". This methodology was generated by Geneva Research Institute (Sangaiah et al., 2017). The main purpose of this methodology is decision-making in a complex environment. With the help of the DEMATEL approach, it can be possible to weight different alternatives and find which of them are more important. In addition to this factor, the DEMATEL approach is also helpful to understand the cause-and-effect relationship among these alternatives. DEMATEL approach was also preferred based on the fuzzy logic in many different studies. In such a circumstance, expert opinions are considered to make analysis with fuzzy DEMATEL. The details of this analysis are given below (Wu et al., 2017; Patil and Kant, 2014).

In the first step, the purpose is defined. Within this context, the purpose refers to the problem which aimed to be solved. In addition, the second step contains the definition of the criteria. In this step, fuzzy linguistic scales (no, low, medium, high, very high) is identified in order to solve this problem. Furthermore, the third step is related to the evaluation of the criteria by decision makers. Firstly, average fuzzy matrix is created, and the details are demonstrated below.

$$\check{Z} = \frac{\check{Z}^1 \oplus \check{Z}^2 \oplus \ldots \oplus \check{Z}^p}{p} \tag{1}$$

$$\check{Z} = \begin{bmatrix} 0 & \cdots & \check{Z}_{1n} \\ \vdots & \ddots & \vdots \\ \check{Z}_{n1} & \cdots & 0 \end{bmatrix} \tag{2}$$

In equations (1) and (2), p gives information about the number of decision makers. Moreover, $\check{Z}$ explains the fuzzy matrixes which are created based on the evaluations of the decision makers. Additionally, in the fourth step, there is a normalization of the direct relation fuzzy matrix. This matrix is detailed on equation (3). For this purpose, the equations (4) and (5) are taken into the consideration in the calculation process of this matrix.

$$\check{X} = \begin{bmatrix} \check{X}_{11} & \cdots & \check{X}_{1n} \\ \vdots & \ddots & \vdots \\ \check{X}_{n1} & \cdots & \check{X}_{nn} \end{bmatrix} \tag{3}$$

$$\check{X}_{ij} = \frac{\check{Z}_{ij}}{r}\left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right) \tag{4}$$

$$r = max_{1 \le i \le n}\left(\sum_{j=i}^{n} u_{ij}\right) \tag{5}$$

Total relation fuzzy matrix is created in the fifth step. The details of this matrix and calculation process are shown in the equations (6)-(11).

$$\breve{T} = \begin{bmatrix} \breve{t}_{11} & \cdots & \breve{t}_{1n} \\ \vdots & \ddots & \vdots \\ \breve{t}_{n1} & \cdots & \breve{t}_{nn} \end{bmatrix} \quad (6)$$

$$\breve{t}_{ij} = (l''_{ij}, m''_{ij}, u''_{ij}) \quad (7)$$

$$l''_{ij} = X_l \times (1 - X_l)^{-1} \quad (8)$$

$$m''_{ij} = X_m \times (1 - X_m)^{-1} \quad (9)$$

$$u''_{ij} = X_u \times (1 - X_u)^{-1} \quad (10)$$

$$X_l = \begin{bmatrix} 0 & \cdots & l'_{1n} \\ \vdots & \ddots & \vdots \\ l'_{n1} & \cdots & 0 \end{bmatrix} \quad X_m = \begin{bmatrix} 0 & \cdots & m'_{1n} \\ \vdots & \ddots & \vdots \\ m'_{n1} & \cdots & 0 \end{bmatrix} \quad X_u = \begin{bmatrix} 0 & \cdots & u'_{1n} \\ \vdots & \ddots & \vdots \\ u'_{n1} & \cdots & 0 \end{bmatrix} \quad (11)$$

In the last step, the values of $(\breve{D}_\iota - \breve{R}_\iota)^{def}$ and $(\breve{D}_\iota - \breve{R}_\iota)^{def}$ are calculated with the defuzzification of the fuzzy numbers. As a result, the following matrix can be generated.

$$\breve{T}^{def} = \begin{bmatrix} \breve{t}_{11}^{def} & \cdots & \breve{t}_{1n}^{def} \\ \vdots & \ddots & \vdots \\ \breve{t}_{n1}^{def} & \cdots & \breve{t}_{nn}^{def} \end{bmatrix} \quad (12)$$

Fuzzy DEMATEL methodology was preferred in many different types of studies in the literature. For example, Abdullah and Zulkifli (2015), Pandey and Kumar (2017) and Tooranloo et al. (2017) used this approach to analyze the effectiveness of human resource management of the countries. On the other side, Tadić et al. (2014), Mangla et al. (2018), Jiang et al. (2016), Keskin (2015), Mehregan et al. (2014), and Mirmousa and Dehnavi (2016) considered fuzzy DEMATEL for the logistic industry. Moreover, some studies evaluated the energy industry with this approach (Jeong and Ramírez-Gómez, 2018; Dinçer et al., 2018; Dong and Huo, 2017). Also, Dinçer et al. (2017), Dinçer et al. (2016), Govindan et al. (2015), and Tyagi et al. (2015) made performance analysis of the companies by using Fuzzy DEMATEL.

MOORA

MOORA consists of the first letters of "Multi-Objective Optimization on the basis of Ratio Analysis". Brauers and Zavadskas (2006) developed this approach to assess different alternatives in a complex environment. Some requirements should be satisfied so as to implement MOORA methodology. The details of the analysis process are demonstrated below.

In the first step, various alternatives are identified. Within this scope, a decision matrix is developed which is given on equation (13).

$$X_{ij} = \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \quad (13)$$

In equation (13), Xij explains the value for the criterion i and alternative j. The second step of the analysis process is related to the normalization of the fuzzy matrix. In this process, equation (14) is taken into the consideration.

$$X_{ij}^{*} = \frac{X_{ij}}{\sqrt{\sum_{j=1}^{m} X^{2}{}_{ij}}} \quad (14)$$

Moreover, positive and negative effects are evaluated in the third step with the following equation (15).

$$Y_i = \sum_{j=1}^{h} X_{ij}^{*} - \sum_{j=h+1}^{n} X_{ij}^{*} \quad (15)$$

In addition, the results are weighted in the fourth step. The calculation process is given on equation (16).

$$Y_i^{*} = \sum_{j=1}^{h} W_j X_{ij}^{*} - \sum_{j=h+1}^{n} W_j X_{ij}^{*} \quad (16)$$

In the final step, the best alternative is chosen by ranking the results. Similar to fuzzy DEMATEL, MOORA methodology is also very popular in the literature. For instance, Büyüközkan and Göçer (2017), Chand et al. (2018), Matawale et al. (2016) and Kumar Sahu et al. (2014) considered this methodology to evaluate the effectiveness of supply chain management of the companies. Additionally, Sahu et al. (2016), Sarkar et al. (2015), Maniya (2016), and Akgül et al. (2017) used the MOORA method to select the best machine in order to increase the performance of the companies. Furthermore, Yüksel et al. (2017), Şişman and Doğan (2016), and Özbek (2015) assessed the performance of the banking sector with the help of this approach.

MEASURING THE CAPACITY OF GLOBAL HUMAN CAPITAL IN E7 ECONOMIES

In the analysis process, firstly, dimensions and criteria are weighted by using the fuzzy DEMATEL approach. After identifying the weights of these dimensions and criteria, MOORA methodology is taken into the consideration in order to rank E7 countries with respect to the global human capital capacity.

Weighting the Dimension and Criteria with Fuzzy DEMATEL

The first process in the fuzzy DEMATEL is the creation of the direct relation matrix. The details are demonstrated on Table 2.

Table 2: The initial direct-relation fuzzy matrix for the Dimensions of the Global Human Capital

Dimensions	D1			D2			D3			D4		
Capacity (D1)	0	0	0	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
Deployment (D2)	0.5	0.75	1	0	0	0	0.5	0.75	1	0.5	0.75	1
Development (D3)	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75
Know-how (D4)	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0	0	0

After that, this matrix is normalized and this situation is detailed on Table 3.

Table 3: Normalized direct-relation fuzzy matrix for the dimensions

Dimensions	D1			D2			D3			D4		
Capacity (D1)	0.000	0.000	0.000	0.083	0.167	0.250	0.083	0.167	0.250	0.083	0.167	0.250
Deployment (D2)	0.167	0.250	0.333	0.000	0.000	0.000	0.167	0.250	0.333	0.167	0.250	0.333
Development (D3)	0.083	0.167	0.250	0.083	0.167	0.250	0.000	0.000	0.000	0.083	0.167	0.250
Know-how (D4)	0.167	0.250	0.333	0.167	0.250	0.333	0.167	0.250	0.333	0.000	0.000	0.000

In addition to the normalized direct-relation fuzzy matrix, total relation fuzzy matrix is generated. This matrix is given on Table 4.

Table 4: The total-relation fuzzy matrix for the dimensions

Dimensions	D1			D2			D3			D4		
Capacity (D1)	0.050	0.247	1.400	0.118	0.364	1.500	0.127	0.390	1.600	0.118	0.364	1.500
Deployment (D2)	0.235	0.545	2.000	0.076	0.309	1.625	0.235	0.545	2.000	0.218	0.509	1.875
Development (D3)	0.127	0.390	1.600	0.118	0.364	1.500	0.050	0.247	1.400	0.118	0.364	1.500
Know-how (D4)	0.235	0.545	2.000	0.218	0.509	1.875	0.235	0.545	2.000	0.076	0.309	1.625

In addition to these items, total impact-relationship degrees and the weights for the dimensions are calculated. The results are shown on Table 5.

Table 5: Total impact-relationship degrees and the weights for the dimensions

Dimensions	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def} + \tilde{R}_i^{def}$	$\tilde{D}_i^{def} - \tilde{R}_i^{def}$	Weights
D1	2.107	2.558	4.664	-0.451	0.238
D2	2.798	2.347	5.145	0.451	0.262
D3	2.107	2.558	4.664	-0.451	0.238
D4	2.798	2.347	5.145	0.451	0.262

Table 5 demonstrates that deployment (D2) and know-how (D4) are the most important dimensions with respect to the global human capital capacity because they have the highest weights (0.262). On the other hand, capacity (D1) and development (D3) have a smaller effect regarding the capacity of human capital due to the lowest weights (0.238). It shows that the number of people in the country who can actively participate in the workforce plays a significant role in this situation. In addition, it can also be seen that companies should invest in technological development in order to increase the capacity of human capital. Benhabib and Spiegel (2005), Bozeman et al. (2001), Danquah and Amankwah-Amoah (2017), and Keller (1996) underlined the importance of know-how for the aim of increasing human capital capacity. In addition to the dimensions, criteria are also weighted with the help of the fuzzy DEMATEL approach. The details of this calculation are given on the appendix section. On the other side, the summary results are presented on Table 6.

Table 6: Local and Global Weights of the Global Human Capital

Dimensions	Local Weights	Criteria	Local Weights	Global Weights
D1	0.238	C1	0.249	0.059
		C2	0.250	0.059
		C3	0.250	0.059
		C4	0.252	0.060
D2	0.262	C5	0.245	0.064
		C6	0.242	0.063
		C7	0.245	0.064
		C8	0.269	0.070
D3	0.238	C9	0.105	0.025
		C10	0.121	0.029
		C11	0.105	0.025
		C12	0.107	0.026
		C13	0.104	0.025
		C14	0.102	0.024
		C15	0.122	0.029
		C16	0.126	0.030
		C17	0.108	0.026
D4	0.262	C18	0.256	0.067
		C19	0.256	0.067
		C20	0.221	0.058
		C21	0.267	0.070

Table 6 gives information that underemployment rate (C8) and availability of skilled employee (C21) are the most important criteria in comparison with the others. The main reason is that they have the highest weights (0.070). This situation indicates that the number of employed people in a country who wish to work more plays a very significant role regarding human capital capacity. On the other side, it is also a very important point to make investment to improve the qualification of the employee. Campbell et al. (2017), Liu et al. (2017), and Delery and Roumpi (2017) are the studies that emphasized a similar conclusion in their studies.

Ranking E7 Countries with MOORA

After identifying the most significant dimensions and criteria by fuzzy DEMATEL approach, the MOORA method is also used in order to rank E7 companies according to the human capital capacity. For this purpose, first of all, global human capital results in 2017 are obtained for these countries. These values are demonstrated on Table 7.

Table 7: Global Human Capital Results of the E7 Economies for 2017

Criteria/ Alternatives	Brazil (A1)	China (A2)	India (A3)	Indonesia (A4)	Mexico (A5)	Russia (A6)	Turkey (A7)
C1	94.60	99.20	71.70	97.50	96.40	99.80	98.70
C2	95.20	97.90	70.10	97.80	96.10	100.00	90.60
C3	63.60	77.30	48.00	61.10	62.40	98.50	48.90
C4	10.20	8.40	10.70	11.10	17.80	29.80	12.20
C5	81.60	88.00	66.60	77.90	75.40	89.60	64.20
C6	0.76	0.84	0.30	0.58	0.59	0.91	0.46
C7	8.90	3.90	1.40	3.30	3.40	4.80	9.70
C8	5.20	5.00	4.00	8.10	5.00	0.70	1.70
C9	94.70	99.00	95.10	92.90	97.60	96.20	93.20
C10	2.60	4.50	4.70	4.30	3.00	4.40	3.10
C11	84.60	99.00	79.50	80.00	78.00	98.70	92.10
C12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C13	8.40	42.10	2.50	42.40	8.80	52.50	45.40
C14	49.30	43.40	25.50	31.10	29.90	78.70	86.30
C15	0.22	0.21	0.18	0.19	0.21	0.26	0.20
C16	2.60	4.30	4.50	4.40	3.00	3.70	3.20
C17	4.00	4.30	4.60	4.50	3.90	3.80	3.50
C18	22.00	11.90	14.90	9.90	18.90	44.30	20.00
C19	84.40	91.80	73.50	81.90	76.40	90.40	84.90
C20	0.01	1.10	0.24	-0.03	1.04	0.05	0.42
C21	3.70	4.60	4.50	4.60	4.40	3.80	3.90

Source: Adapted from World Economic Forum, The Global Human Capital Report 2017.

Additionally, dimension number for these countries are also obtained and they are given on Table 8.

Table 8: Dimension number for the E7 Economies

Criteria/ Alternatives	Brazil (A1)	China (A2)	India (A3)	Indonesia (A4)	Mexico (A5)	Russia (A6)	Turkey (A7)
C1	0.379	0.397	0.287	0.390	0.386	0.399	0.395
C2	0.387	0.398	0.285	0.397	0.390	0.406	0.368
C3	0.355	0.432	0.268	0.341	0.349	0.550	0.273
C4	0.243	0.200	0.255	0.264	0.424	0.709	0.290
C5	0.395	0.426	0.322	0.377	0.365	0.433	0.311
C6	0.432	0.477	0.170	0.330	0.335	0.517	0.261
C7	0.579	0.254	0.091	0.215	0.221	0.312	0.631
C8	0.409	0.393	0.314	0.636	0.393	0.055	0.134
C9	0.375	0.392	0.376	0.367	0.386	0.381	0.369
C10	0.253	0.438	0.457	0.419	0.292	0.428	0.302
C11	0.364	0.426	0.342	0.344	0.336	0.425	0.396
C12	0.378	0.378	0.378	0.378	0.378	0.378	0.378
C13	0.091	0.456	0.027	0.459	0.095	0.568	0.491
C14	0.345	0.303	0.178	0.217	0.209	0.550	0.603
C15	0.393	0.376	0.322	0.340	0.376	0.465	0.358
C16	0.263	0.435	0.455	0.445	0.303	0.374	0.324
C17	0.369	0.396	0.424	0.415	0.359	0.350	0.322
C18	0.363	0.197	0.246	0.164	0.312	0.732	0.330
C19	0.382	0.415	0.332	0.370	0.346	0.409	0.384
C20	0.006	0.692	0.151	-0.019	0.654	0.031	0.264
C21	0.331	0.411	0.402	0.411	0.393	0.340	0.348

After obtaining dimension number, E7 countries are ranked with the help of MOORA methodology. The details of this condition are given on Table 9.

Table 9: Benefit and Cost Criteria and Ranking Results

Alternatives	Benefit Criteria	Cost Criteria	Y_i^*	Ranking
A1	0.245	0.103	0.141	6
A2	0.268	0.124	0.144	5
A3	0.223	0.057	0.165	2
A4	0.252	0.088	0.164	3
A5	0.250	0.111	0.139	7
A6	0.344	0.068	0.276	1
A7	0.254	0.091	0.162	4

Table 9 indicates that Russia (A6) and India (A3) are the best countries as for the capacity of human capital. On the other hand, it is also identified that Mexico (A5) and Brazil (A1) are on the last rank with respect to this subject. It gives information that these countries should take necessary actions in order to increase this capacity. Otherwise, it will be very difficult for these countries to reach sustainable economic growth.

SOLUTIONS AND RECOMMENDATIONS

It is concluded that regarding the dimensions, the number of people in the country who can actively participate in the workforce and technological development play the most significant role. On the other hand, it is also identified that the number of employed people in a country who wish to work more and make investments to improve the qualification of the employee is the most important criteria. In addition to these results, it is stated that Russia (A6) and India (A3) are the best countries whereas Mexico (A5) and Brazil (A1) are on the last rank as for human capital capacity. Therefore, it is recommended that the countries, which have the lowest rank, should take action in order to increase the capacity of human capital. Within this framework, these countries should focus on the dimensions and criteria underlined in this study.

FUTURE RESEARCH DIRECTIONS

In this study, it is aimed to measure the capacity of human capital for E7 countries. Moreover, fuzzy DEMATEL and MOORA approaches are taken into the consideration. Therefore, it is believed that this study makes a contribution to the literature. Nevertheless, it is also thought that new studies for this subject can be considered in the future. For example, an analysis that covers the developed economies can give important results to increase human capital capacity. Additionally, a new and original methodology can also be used in future studies, such as hesitant fuzzy sets and interval type 2 fuzzy logic.

CONCLUSION

Higher living standard is the most important purpose of the countries. For this purpose, it is believed that sustainable economic development of these countries should be reached. Effective human capital capacity plays also a very key role in this scope. There are some factors which affect the capacity of human capital. For example, there is a positive relationship between education level of the people and human capital capacity. It is also thought that health level of the people who live in the country has also a significant influence on human capital. Effective human capital is especially very important for emerging economies. The main reason is that these companies make investments with the aim of becoming a developed economy

In this study, it is aimed to measure the capacity of human capital in emerging economies. Within this scope, E7 countries (Brazil, China, India, Indonesia, Mexico, Russia, Turkey) are taken into the consideration. For this purpose, 4 different dimensions and 21 criteria are identified by considering the Global Human Capital report. Moreover, there are two different phases of the analysis process. In the first phase, these dimensions and criteria are weighted by using the fuzzy DEMATEL approach. In addition to this issue, E7 economies are ranked in the second phase with respect to the global human capital capacity.

According to the results of the fuzzy DEMATEL approach, it is determined that deployment and know-how are the most significant dimensions while capacity and development have the lowest weight. This situation shows that the countries should make investments in technological development to have higher human development capacity. On the other side, the number of employed people in a country who wish to work, and the qualification of the employee play a very key role for this purpose. In addition to these results, with the help of the MOORA model, it is defined that Russia and India are the best countries whereas Mexico and Brazil are on the last rank with respect to the human capital capacity.

While considering these results, it is recommended that the countries, which have the lowest rank, should take action in order to increase the capacity of human capital. Otherwise, it can be very difficult for these countries to have sustainable economic development. Within this framework, these countries should increase technological investment. Another important point is that there should be a new and effective training program to increase the skills and the qualifications of the employees in these countries. By considering these aspects, it can be possible for these countries to have effective human capital capacity so that sustainable economic improvement can be provided.

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KEY TERMS AND DEFINITIONS

DEMATEL: It consists of the first letters of The Decision-Making Trial and Evaluation Laboratory" and it is a methodology which is used for decision making in complex situations.

Emerging Economy: It means the country which has not been developed yet. However, it is thought that it has a strong potential to be a developed economy.

E7 Countries: They include 7 emerging economies which have the highest GDP growth.

MOORA: It refers to the first letters of "Multi-Objective Optimization on the basis of Ratio Analysis" and it is used to rank different alternatives.

Table A1: The initial direct-relation fuzzy matrix for the Criteria of Capacity (D1)

Criteria	**C1**			**C2**			**C3**			**C4**		
Literacy and numeracy (C1)	0	0	0	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1
Primary education attainment rate (C2)	0.5	0.75	1	0	0	0	0.5	0.75	1	0.25	0.5	0.75
Secondary education attainment rate (C3)	0.5	0.75	1	0.5	0.75	1	0	0	0	0.25	0.5	0.75
Tertiary education attainment rate (C4)	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0	0	0

Table A2: Normalized direct-relation fuzzy matrix for the criteria of D1

Criteria	C1			C2			C3			C4		
Literacy and numeracy (C1)	0.000	0.000	0.000	0.083	0.167	0.250	0.083	0.167	0.250	0.167	0.250	0.333
Primary education attainment rate (C2)	0.167	0.250	0.333	0.000	0.000	0.000	0.167	0.250	0.333	0.083	0.167	0.250
Secondary education attainment rate (C3)	0.167	0.250	0.333	0.167	0.250	0.333	0.000	0.000	0.000	0.083	0.167	0.250
Tertiary education attainment rate (C4)	0.167	0.250	0.333	0.167	0.250	0.333	0.167	0.250	0.333	0.000	0.000	0.000

Table A3: The total-relation fuzzy matrix for the criteria of D1

Criteria	**C1**			**C2**			**C3**			**C4**		
Literacy and numeracy (C1)	0.084	0.357	2.484	0.150	0.466	2.516	0.150	0.466	2.516	0.206	0.495	2.419
Primary education attainment rate (C2)	0.243	0.594	2.903	0.083	0.354	2.472	0.226	0.554	2.722	0.150	0.466	2.516
Secondary education attainment rate (C3)	0.243	0.594	2.903	0.226	0.554	2.722	0.083	0.354	2.472	0.150	0.466	2.516
Tertiary education attainment rate (C4)	0.262	0.636	3.097	0.243	0.594	2.903	0.243	0.594	2.903	0.084	0.357	2.484

Table A4: Total impact-relationship degrees and the weights for the criteria of D1

Criteria	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def} + \tilde{R}_i^{def}$	$\tilde{D}_i^{def} - \tilde{R}_i^{def}$	Weights
C1	3.129	3.692	6.821	-0.563	0.249
C2	3.418	3.413	6.830	0.005	0.250
C3	3.418	3.413	6.830	0.005	0.250
C4	3.719	3.166	6.885	0.554	0.252

Table A5: The initial direct-relation fuzzy matrix for the Criteria of Deployment (D2)

Criteria	C5			C6			C7			C8		
Labour force participation rate (C5)	0	0	0	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1
Employment gender gap (C6)	0	0.25	0.5	0	0	0	0	0.25	0.5	0.25	0.5	0.75
Unemployment rate (C7)	0.25	0.5	0.75	0.5	0.75	1	0	0	0	0.5	0.75	1
Underemployment rate (C8)	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0	0	0

Table A6: Normalized direct-relation fuzzy matrix for the criteria of D2

Criteria	C5			C6			C7			C8		
Labour force participation rate (C5)	0.000	0.000	0.000	0.182	0.273	0.364	0.091	0.182	0.273	0.182	0.273	0.364
Employment gender gap (C6)	0.000	0.091	0.182	0.000	0.000	0.000	0.000	0.091	0.182	0.091	0.182	0.273
Unemployment rate (C7)	0.091	0.182	0.273	0.182	0.273	0.364	0.000	0.000	0.000	0.182	0.273	0.364
Underemployment rate (C8)	0.091	0.182	0.273	0.182	0.273	0.364	0.091	0.182	0.273	0.000	0.000	0.000

Table A7: The total-relation fuzzy matrix for the criteria of D2

Criteria	C5			C6			C7			C8		
Labour force participation rate (C5)	0.031	0.219	1.418	0.250	0.581	2.230	0.115	0.373	1.632	0.231	0.540	2.081
Employment gender gap (C6)	0.010	0.208	1.152	0.021	0.204	1.378	0.010	0.208	1.152	0.096	0.332	1.486
Unemployment rate (C7)	0.115	0.373	1.632	0.250	0.581	2.230	0.031	0.219	1.418	0.231	0.540	2.081
Underemployment rate (C8)	0.106	0.346	1.524	0.231	0.540	2.081	0.106	0.346	1.524	0.060	0.287	1.676

Table A8: Total impact-relationship degrees and the weights for the criteria of D2

Criteria	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def} + \tilde{R}_i^{def}$	$\tilde{D}_i^{def} - \tilde{R}_i^{def}$	Weights
C5	2.636	1.924	4.560	0.712	0.245
C6	1.645	2.856	4.501	-1.211	0.242
C7	2.636	1.924	4.560	0.712	0.245
C8	2.396	2.610	5.005	-0.214	0.269

Table A9: The initial direct-relation fuzzy matrix for the Criteria of Development (D3)

Criteria	C9			C10			C11			C12			C13			C14			C15			C16			C17		
Primary education enrolment rate (C9)	0	0	0	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5
Quality of primary schools (C10)	0.5	0.75	1	0	0	0	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1	0.25	0.5	0.75
Secondary education enrolment rate (C11)	0.5	0.75	1	0.25	0.5	0.75	0	0	0	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5
Secondary enrolment gender gap (C12)	0	0.25	0.5	0.25	0.5	0.75	0	0.25	0.5	0	0	0	0	0.25	0.5	0	0.25	0.5	0.5	0.75	1	0.5	0.75	1	0.5	0.75	1
Vocational education enrolment rate (C13)	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5
Tertiary education enrolment rate (C14)	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0	0.25	0.5	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5
Skill diversity of graduates (C15)	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0	0.5	0.75	1	0.5	0.75	1
Quality of education system (C16)	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0	0	0	0.5	0.75	1
Extent of staff training (C17)	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0.5	0.75	1	0	0	0

Table A10: Normalized direct-relation fuzzy matrix for the criteria of D3

Criteria	C9			C10			C11			C12			C13			C14			C15			C16			C17		
C9	0.000	0.000	0.000	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.000	0.033	0.067
C10	0.067	0.100	0.133	0.000	0.000	0.000	0.067	0.100	0.133	0.033	0.067	0.100	0.067	0.100	0.133	0.067	0.100	0.133	0.067	0.100	0.133	0.067	0.100	0.133	0.033	0.067	0.100
C11	0.067	0.100	0.133	0.033	0.067	0.100	0.000	0.000	0.000	0.067	0.100	0.133	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.000	0.033	0.067
C12	0.000	0.033	0.067	0.033	0.067	0.100	0.000	0.033	0.067	0.000	0.000	0.000	0.000	0.033	0.067	0.000	0.033	0.067	0.067	0.100	0.133	0.067	0.100	0.133	0.067	0.100	0.133
C13	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.000	0.000	0.000	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.000	0.033	0.067
C14	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.000	0.033	0.067	0.033	0.067	0.100	0.000	0.000	0.000	0.033	0.067	0.100	0.067	0.100	0.133	0.000	0.033	0.067
C15	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.033	0.067	0.100	0.000	0.000	0.000	0.067	0.100	0.133	0.067	0.100	0.133
C16	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.000	0.000	0.000	0.067	0.100	0.133
C17	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.067	0.100	0.133	0.033	0.067	0.100	0.033	0.067	0.100	0.067	0.100	0.133	0.067	0.100	0.133	0.000	0.000	0.000

Table A11: The total-relation fuzzy matrix for the criteria of D3

Criteria	C9			C10			C11			C12			C13			C14			C15			C16			C17		
C9	0.019	0.093	0.599	0.059	0.168	0.739	0.050	0.151	0.669	0.090	0.196	0.764	0.050	0.151	0.669	0.050	0.151	0.669	0.062	0.174	0.761	0.099	0.220	0.867	0.019	0.122	0.633
C10	0.094	0.212	0.827	0.039	0.134	0.765	0.091	0.205	0.803	0.071	0.196	0.853	0.091	0.205	0.803	0.091	0.205	0.803	0.104	0.231	0.908	0.113	0.256	1.003	0.056	0.171	0.761
C11	0.085	0.189	0.738	0.061	0.173	0.761	0.019	0.093	0.599	0.093	0.203	0.787	0.052	0.155	0.689	0.052	0.155	0.689	0.064	0.179	0.784	0.102	0.227	0.893	0.020	0.126	0.652
C12	0.012	0.118	0.628	0.050	0.162	0.705	0.012	0.115	0.610	0.016	0.097	0.610	0.012	0.115	0.610	0.012	0.115	0.610	0.082	0.195	0.752	0.086	0.209	0.824	0.079	0.176	0.659
C13	0.048	0.152	0.670	0.052	0.163	0.717	0.046	0.147	0.651	0.052	0.162	0.715	0.014	0.085	0.560	0.046	0.147	0.651	0.053	0.167	0.738	0.094	0.214	0.842	0.011	0.116	0.613
C14	0.051	0.148	0.651	0.056	0.158	0.696	0.049	0.143	0.632	0.025	0.128	0.666	0.049	0.143	0.632	0.017	0.081	0.541	0.057	0.161	0.715	0.093	0.207	0.817	0.014	0.111	0.593
C15	0.054	0.169	0.742	0.091	0.212	0.822	0.053	0.164	0.720	0.060	0.182	0.792	0.053	0.164	0.720	0.053	0.164	0.720	0.031	0.126	0.727	0.100	0.237	0.930	0.083	0.191	0.735
C16	0.054	0.173	0.760	0.093	0.216	0.842	0.053	0.167	0.738	0.091	0.215	0.839	0.053	0.167	0.738	0.053	0.167	0.738	0.095	0.223	0.867	0.035	0.153	0.837	0.089	0.196	0.755
C17	0.058	0.173	0.760	0.099	0.216	0.842	0.056	0.167	0.738	0.098	0.215	0.839	0.056	0.167	0.738	0.056	0.167	0.738	0.102	0.223	0.867	0.109	0.243	0.955	0.024	0.105	0.637

Table A12: Total impact-relationship degrees and the weights for the criteria of D3

Criteria	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def} + \tilde{R}_i^{def}$	$\tilde{D}_i^{def} - \tilde{R}_i^{def}$	Weights
C9	2.407	2.258	4.665	0.149	0.105
C10	2.915	2.476	5.391	0.438	0.121
C11	2.513	2.165	4.678	0.348	0.105
C12	2.196	2.579	4.775	-0.384	0.107
C13	2.291	2.323	4.614	-0.032	0.104
C14	2.196	2.322	4.519	-0.126	0.102
C15	2.652	2.762	5.413	-0.110	0.122
C16	2.482	3.140	5.622	-0.658	0.126
C17	2.547	2.259	4.807	0.288	0.108

Table A13: The initial direct-relation fuzzy matrix for the Criteria of Know-How (D4)

Criteria	C18			C19			C20			C21		
High-skilled employment share (C18)	0	0	0	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1
Medium-skilled employment share (C19)	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75	0.5	0.75	1
Economic complexity (C20)	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75
Availability of skilled employees (C21	0.5	0.75	1	0.5	0.75	1	0.25	0.5	0.75	0	0	0

Table A14: Normalized direct-relation fuzzy matrix for the criteria of D4

Criteria	C18			C19			C20			C21		
High-skilled employment share (C18)	0.000	0.000	0.000	0.182	0.273	0.364	0.091	0.182	0.273	0.182	0.273	0.364
Medium-skilled employment share (C19)	0.091	0.182	0.273	0.000	0.000	0.000	0.091	0.182	0.273	0.182	0.273	0.364
Economic complexity (C20)	0.091	0.182	0.273	0.091	0.182	0.273	0.000	0.000	0.000	0.091	0.182	0.273
Availability of skilled employees (C21	0.182	0.273	0.364	0.182	0.273	0.364	0.091	0.182	0.273	0.000	0.000	0.000

Table A15: The total-relation fuzzy matrix for the criteria of D4

Criteria	C18			C19			C20			C21		
ligh-skilled employment share (C18)	0.083	0.377	3.538	0.257	0.637	4.077	0.145	0.482	3.462	0.257	0.637	4.077
ledium-skilled employment share (C19)	0.154	0.493	3.503	0.083	0.377	3.538	0.134	0.448	3.231	0.237	0.591	3.805
conomic complexity (C20)	0.134	0.448	3.231	0.145	0.482	3.462	0.039	0.257	2.769	0.145	0.482	3.462
vailability of skilled employees (C21)	0.237	0.591	3.805	0.257	0.637	4.077	0.145	0.482	3.462	0.103	0.423	3.810

Table A16: Total impact-relationship degrees and the weights for the criteria of D4

Criteria	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def} + \tilde{R}_i^{def}$	$\tilde{D}_i^{def} - \tilde{R}_i^{def}$	Weights
C18	4.345	3.987	8.332	0.358	0.256
C19	3.980	4.324	8.304	-0.344	0.256
C20	3.575	3.614	7.189	-0.038	0.221
C21	4.348	4.324	8.671	0.024	0.267