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EVALUATION OF THE INVESTMENT CLIMATE BASED ON FUZZY LOGIC

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Abstract. The *subject* of the study is the investment climate of the country, region and investment attractiveness of the enterprise. The article is *aimed* at substantiating a fuzzy logical model for assessing the investment climate of a country, region and investment attractiveness of an enterprise under the influence of three groups of factors: economic, organizational and psychological. The *hypothesis* of the study is that it is possible to define the investment climate (IC) and make decisions on foreign direct investment (FDI) based on data on indicators of influence factors, even if these indicators are not clearly quantified. The division of all influence factors into three groups: economic, organizational and psychological, and the definition of linguistic assessments for those factors that do not have a natural quantitative scale, allows taking into account the expert assessment of those aspects of the investment climate that are not assessed by statistical data and cannot be expressed quantitatively, but only with the help of descriptive words based on a sense of the situation. The developed model allows determining the state of the investment climate or attractiveness under the influence of a set of factors that the user determines, depending on the country, territory, enterprise and the availability of statistical and expert information. A review of previous studies shows that the development of models based on the theory of fuzzy logic, as opposed to regression analysis, allows not only to use a larger number of indicators, but also to take into account the so-called qualitative indicators that were previously not taken into account due to the impossibility of their quantitative measurement. The *objective* of the study is to build a model based on fuzzy modelling, which is the method of this research. The *results* of the study show that the use of the obtained model can help determine the investment climate based on the analysis of factors. Practical implications – obtaining a built-in model for assessing the investment climate for making investment decisions. *Value/originality* of the study: the developed model, unlike similar ones, is flexible, i.e. it can include any number of factors and can be used by specialists of different levels, from civil servants to entrepreneurs. The model also allows for the inclusion of any factors that the researcher deems necessary, as they can be assessed on any scale.

Keywords: fuzzy logic model, investment climate, investment attractiveness, foreign direct investment, factors of influence, fuzzy sets, management decision.

JEL Classification: C12, H12

1. Introduction

The managerial decision of a foreign investor to make FDI depends on the state of the IC in the host country. IC and investment attractiveness, as components of the foreign investment process, are a complex phenomenon influenced by many factors. As noted in our previous studies, the factors should also take into account the subjective attitude of a person as one of the components of the investment process. Therefore, we have proposed a classification that, unlike others, divides possible factors by content and includes a group of psychological factors (Shevchenko, 2021). Most of these factors are qualitative and therefore, by their nature, are fuzzy values. For further research, we propose to divide the factors by two criteria at once: by content (economic (E), organisational (O), psychological (P)) and by the method of measurement (quantitative and qualitative). That is, a two-level classification is formed (Table 1).

As the practice of selecting factors shows, quantitative indicators prevail among economic ones, and qualitative ones among psychological

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Table 1
Grouping of factors for modelling

E		O		P	
Economic factors		Organisational factors		Psychological factors	
E1 quantitative	E2 qualitative	O1 quantitative	O2 qualitative	P1 quantitative	P2 qualitative

ones; the economic group has the largest number of factors, and the psychological group has the smallest number (Shevchenko, 2021). At the same time, in each case of studying the IR or attractiveness indicator, the number of factors will depend on the specific situation at the enterprise or in the country. The logic of the material is as follows. The study consists of four sections. The introductory section discusses the background of the study and the factors influencing the IC. The second section reviews the literature related to the methods of studying the impact of factors on the investment climate indicator. The third part explains the use of fuzzy logic method to determine the state of the investment climate. The fourth section contains conclusions.

2. Literature Review

The influence of the characteristics of the economic system on the investment attractiveness of an enterprise and the investment climate of a country or territory has been studied using various methods. Factor analysis with a two-digit verbal scale, such as "positive" or "negative signal" (Yaskov, Smiesova, 2023), avoids subjectivity in the formation of a set of factors, but not in their evaluation. This method also limits the decision maker (DM) in the number of factors to be assessed, as it does not involve the construction of economic and mathematical models (EMM). Therefore, to avoid these shortcomings, most studies use mathematical modelling (Sookram, Hosein, Boodram, Saridakis, 2022), namely correlation and regression analysis (Dang, Nguyen, Borz, 2021) with various modifications (Dua, Verma, 2024), to analyze the impact of factors. At the same time, the influence of factors on the state of investment attractiveness was studied using the method of fuzzy logic. Matviychuk conducted a cluster analysis of the world's countries and identified the main groups of indicators of a country's investment opportunities (Matviychuk, Lukianenko, Miroshnychenko, 2019). Boloș combined the valuation of assets with their economic and technical performance to make a management decision on the acquisition of assets (Boloș, Bradea, Delcea, 2019). Onar has developed a new spherical fuzzy cost-benefit analysis to evaluate uncertain wind energy investments (Onar, Oztaysi, Kahraman, 2021). Jankova has applied this methodology to the stock market (Jankova, Dipak, Dostal, (2021). The limitation of this study is the use of only economic indicators without the inclusion of psychological and technical factors. Buryachenko (Buryachenko, 2021) and Aliyev assessed the quality of innovation and construction projects (Aliyev, Habibov, Veliyev, Hasanova, 2021). Boltürk has used fuzzy images for alternative uses in investment analysis (Boltürk, 2021). The limitation of this study is the absence of qualitative factors among the parameters under study. The advantage of Kou's study by the quantum spherical fuzzy M-SWARA method is the assessment of qualitative factors among the critical determinants of the choice of a renewable energy investment project (Kou, Pamucar, Dinçer, Deveci, Yüksel, Umar, 2024). Sytyk has developed a model based on fuzzy logic that complements traditional methods of analysis, avoiding some of their shortcomings, in particular the probabilistic approach (Sytyk, Ieremenok, Nastopyrov, Havrylenko, Lysov, 2024). Rekik has developed a methodological framework with the fuzzy AHP method to analyse eleven factors (mostly quantitative) for making investment decisions on the location of solar PV installations (Rekik, El Alimi, 2024). Liu established a novel multi-criteria group decision-making framework based on an extended interactive and multi-criteria decision-making method under a fuzzy set of orthopairwise pairs q (q-ROF) for renewable energy investment (Liu, Qin, Liu, Abdullah, Rong, 2024). The study makes it possible to provide effective decision-making support for assessing the investment risk of a project by modelling the psychological behaviour of the assessment procedure. Thus, the

factors are divided into qualitative and quantitative according to the method of measurement. Quantitative factors range from macroeconomic to company sales. At the same time, the so-called 'psychological' factors are practically absent among the qualitative factors. These studies have a limited number of analysed factors. In most cases, their number ranges from 4 to 18 indicators. Their list usually includes economic quantitative parameters of the economy of the country under study, and thus almost does not take into account the organisational and psychological aspects of society development. The analysis of studies that used fuzzy logic shows that this method, unlike regression analysis, allows not only to use a larger number of indicators, but also to take into account the so-called qualitative indicators that were previously not taken into account due to the impossibility of their quantitative measurement. The review of studies shows that the developed models based on the theory of fuzzy logic can be effectively used both to support management decision-making to increase the investment attractiveness of the host country and for a potential investor looking for attractive and less risky markets.

3. Using the Fuzzy logic Method to Determine the State of the Investment Climate

The research method is based on the theory of fuzzy sets, which makes it possible to apply tools to take into account factors measured in imprecise and subjective expert assessments. Examples of such factors include the situation with the availability of loans in the territory under study or with currency convertibility, the presence of innovative projects, technological leadership, financial incentives, and special favourable conditions for foreign investors. Their assessment can only be made through the use of linguistic terms. The state of IR as an indicator does not have a quantitative measurement scale and is usually expressed by such linguistic characteristics as "favourable", "unfavourable", "bad", "good", etc. Therefore, by its nature, this indicator is also a qualitative value. It is estimated using imprecise and subjective expert knowledge without formalisation in the form of traditional mathematical models. This assessment is based on the fuzzy logic approach to the concept of a linguistic variable, the content of which is expressed in terms (terms of natural and artificial language) and is characterised by a membership function with values in the interval $[0; 1]$, and not only by the boundary values of 0 or 1, i.e., it is characterised by a fuzzy set. After identifying the state of the IC, the investor makes a managerial decision to make an FDI. Thus, the state of IC is a nonlinear object with many input variables, which are quantitative and qualitative in nature, and one output variable ("the state of IC itself"), which is qualitative in nature. To determine the state of the IC, it is necessary to build a model based on a fuzzy knowledge base. Such a model will work with both quantitative economic data and qualitative data (expert knowledge), which is a new development in this area, and will determine the state of the IC and predict investment processes. In such a model, the vector of fixed values of input variables

$$X^* = x_1^*, x_2^*, \ldots, x_n^*, x_i^* \in [\underline{x}_i, \overline{x}_i], \mathrm{i}=\overline{1,n} \quad (1)$$

will correspond to the solution

$$\mathrm{y} \in \left[\underline{y}, \overline{y}\right]. \quad (2)$$

The input variables for this model are estimates of the factors that influence the state of the host country's IC for FDI. Such estimates are made by experts on the basis of statistical information and personal experience in relation to certain territories, industries, enterprises, and firms. While there can be many assessments to evaluate the overall situation in the country, to study the IR in the regions, it is necessary to look for experts with a narrower profile. An expert assessment of a region's IR (meso-level) is based on an assessment of the state of socio-economic development of the region. In this case, the expert chooses the indicators that are crucial for this territory. At the micro level, the expert considers the problems of enterprises with foreign investments, which can also be assessed qualitatively rather than quantitatively. These include, for example, non-compliance with legal requirements, the presence and extent of corruption, excessive accounting regulation, specifics of obtaining licences, the level of labour organisation, marketing, etc. An expert assessment of such features can only be carried out by a specialist with experience of managing a similar enterprise. The advantage of an expert approach is the ability to compile different sets of IR factors to meet the needs of specific investors. An in-depth analysis of

the attractiveness of certain industries is also important. The disadvantages of this method are the subjectivity of the assessment of the situation and, in this regard, the need for additional costs to engage several experts of equal experience to compare the results of the assessments. To assess the IR using the fuzzy logic method, we will perform the following steps: 1) determination of the input variables of the model; 2) phasing of variables; 3) creation of a fuzzy knowledge base; 4) defuzzification of variables; 5) making a management decision based on the data obtained.

4. Building a Model for Determining the State of the Investment Climate

For example, let's build a model with three factors from each of the three groups. In Table 1, E1 is a group of indicators of the level of the economic situation under the influence of quantitative factors; E2 – the level of the economic situation under the influence of qualitative factors. Accordingly, O1 is the level of the organisational environment under the influence of quantitative factors and O2 is the level of qualitative factors. Similarly, P1 is the level of the psychological state of society under the influence of quantitative factors and P2 is the level of qualitative factors. Thus, in our example, E1 is influenced by "GDP per capita", O2 is influenced by the "Existence of an effective investment protection system", and P2 is influenced by the "Trust of foreign investors in the host country's authorities". The first factor, "GDP per capita", in other words, real GDP, shows the real level of economic activity and quality of life of the population of a country or region, most often for a year, and allows for comparisons with other countries. This indicator indicates the dynamics of economic growth and development of a country, which is a necessary indicator for an investor to establish relations with a representative of such a country. This indicator is also used to roughly estimate per capita income and does not use the nominal value of GDP, but GDP at purchasing power parity (PPP). Accordingly, the terms for the values of this indicator are as follows:

– 1000-5000 USD per 1 person – unsatisfactory situation in the country for investment, in particular, low purchasing power – term: "undeveloped country" (U);
– 5001 – 15000 USD per 1 person – satisfactory situation in the country for investment, in particular, the average purchasing power – term: "underdeveloped country" (Un);
– 15001 – 25000 USD and more per 1 person – a good situation in the country for investment, in particular, a sufficiently high purchasing power – term: "developed country" (D).

The second factor "Availability of an effective investment protection system" indicates a kind of insurance of the investor against the risks of loss of income in a certain territory and is determined by expert opinion with a range of "whether or not" and has the following two terms: "Yes" (E) and "No" (N). Finally, the third factor, "Foreign Investor Confidence in Host Country Authorities", is also qualitative and is defined by expert opinion with the following three terms:

– there is a high level of public confidence in foreign investors – term: "high" (H);
– the society has an average level of trust in foreign investors – term: "medium" (M);
– there is a low level of trust in foreign investors in society – term: "Low" (L).

The output indicator D of the model is the state of the investment climate (IC) of the host country, industry, territory or enterprise for FDI. Thus, the model calculates an integral indicator of the constituent elements of the socio-economic situation of the host country in terms of assessing the state of the IC. The integral indicator "IC" will take any value in the range from 0 to 1, with 0 indicating an absolute impossibility of investing in this country, and 1 – an absolute opportunity (favourable) for investment. The components of IC are presented as a multi-criteria selection of alternatives using fuzzy inference rules. The logic of the influence of these factors on the IC is shown in Figure 1.

These factors are the input variables of the model, based on the processing of which the output variable "investment climate (IC)" is obtained using the fuzzy knowledge base. In other words, we consider modelling investment processes with one output and n inputs of the following type:

$$y = f_y\left(x_1, x_2, \ldots, x_n\right), \quad (3)$$

where y – output variable; $x_1, x_2, \ldots, x_n$ – input variables.

Both input and output variables can be quantitative and qualitative.

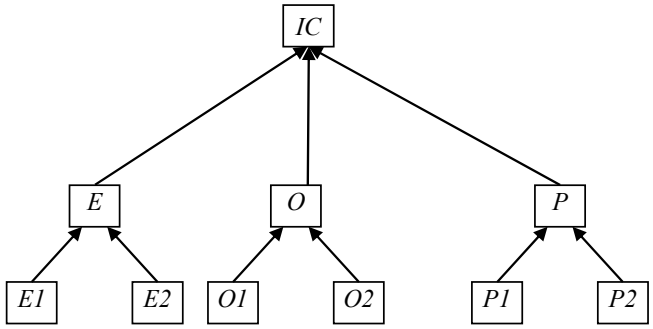

Figure 1. Tree of logical conclusion of the influence of factors on investment climate

For quantitative variables, the areas of change must be known:

$$U_i = \left[\underline{x_i}, \overline{x_i} \right], \quad i = \overline{1,n}, \tag{4}$$

$$\mathrm{Y} \in \left[\underline{y}, \overline{y} \right], \tag{5}$$

where $\underline{x_i}\left(\overline{x_i}\right)$ – is the minimum or maximum value of input variables x_i, when $i = \overline{1,n}$;

$\underline{y}, \overline{y}$ – is the minimum or maximum value of the output variable y. An example of a quantitative scale is the unemployment rate expressed as a percentage or GDP per capita expressed in monetary terms.

For qualitative variables for which there is no natural quantitative scale, qualitative terms such as "low", "medium", "high", "present" or "absent", "acceptable" or "unacceptable" are used. Another way is to measure on artificial scales with a different number of points (from five, for example, to one hundred). Such indicators include, for example, the availability of credit, the host country's place in international rankings, the state of society's institutions, etc.

The output variable IC will be considered a qualitative value with possible values of "favourable" (high), "mild" (above average), "medium", "difficult" (below average), "unfavourable" (low). It is possible to express the value of the output variable more detail.

For qualitative variables $x_1 - x_n$ and y it is assumed that the sets of all possible values are known:

$$\mathrm{U}_i = \left\{ v_i^1, v_i^2, \ldots, v_i^{q_i} \right\}, i = \overline{1,n} \tag{6}$$

$$Y = \left\{ y^1, y^2, \ldots, y^{q_m} \right\}, \tag{7}$$

where $v_i^1\left(v_i^{q_i}\right)$ – a score that corresponds to the smallest or largest value of the input variable x_i;

$y^1\left(y^{q_m}\right)$ – a score that corresponds to the smallest or largest value of the output variable y;

$q_i, i = \overline{1,n}$, та q_m are the powers of the sets in the formulas (6) and (7).

To use the fuzzy logic method to determine the impact of factors on the IC, we establish that there is a dependence (3). For this purpose, we will consider all input variables x_i and output variables y as linguistic variables defined on universal sets (4) - (7). To assess these linguistic variables, we will use qualitative linguistic terms from the following term sets:

$$\mathrm{A}_i = \left\{ a_i^1, a_i^2, \ldots, a_i^l \right\}, \tag{8}$$

$$\mathrm{D} = \left\{ d_1, d_2, \ldots, d_m \right\}, \tag{9}$$

where A_i – is a term set of a variable x_i,

D – is a term set of a variable y.

At the same time, qualitative linguistic terms a_i^p i d_j (when $p = \overline{1,l_i}$, $i = \overline{1,n}$, $j = \overline{1,m}$) we will consider as fuzzy sets, i.e. $a_i^p \in \mathrm{A}_i$, and $d_j \in D$. In turn, these fuzzy sets are defined on universal sets U_i and Y and are defined by the relations (4) – (7).

For quantitative variables, the components of a term set will be expressed as follows:

$$a_i^p = \int_{\underline{x_i}}^{\overline{x_i}} \mu^{a_i^p}\left(x_i\right) / x_i, \tag{10}$$

$$d_j = \int_{\underline{x_i}}^{\overline{x_i}} \mu^{d_j}\left(d\right) / d, \tag{11}$$

where $\mu^{a_i^p}\left(x_i\right)$ – is the membership function of the value $x_i \in \left[\underline{x_i}, \overline{x_i} \right]$ to the term $a_i^p \in A_i$ when $p = \overline{1,l_i}$, $i = \overline{1,n}$,

$\mu^{d_j}\left(d\right)$ – is the function of membership of the output variable value $y \in \left[\underline{y}, \overline{y} \right]$ to the decision term $d_j \in D$, ($j = \overline{1,m}$).

The components of the term set will be defined by the following equations for qualitative variables:

$$a_i^p = \sum_{k=1}^{q_i} \mu^{a_i^p}\left(v_i^k\right) / v_i^k, \tag{12}$$

$$d_j = \sum_{r=1}^{q_m} \mu^{d_j}\left(y^r\right) / y^r, \quad (13)$$

where $\mu^{a_i^p}\left(v_i^k\right)$ – is the degree of membership of the element $v_i^k \in U_i$ to the term $a_i^p \in A_i$ when $p = \overline{1, l_i}$, $i = \overline{1, n}$, $k = \overline{1, q_i}$,

$\mu^{d_j}\left(y^r\right)$ – is the degree of membership of the element $y^r \in Y$ to the decision term $d_j \in D$, $j = \overline{1, m}$,

U_i and Y are defined by equations (6) and (5) and the signs of the integral and sum denote the union of pairs.

Thus, for the model of determining the state of the IC, the linguistic assessment of the constituent term sets for each input variable of the model is determined for all the factors under study. As a result of using the model, each set of factor values will correspond to one of the linguistic variables that will indicate the state of IC and will be denoted by the term d_j (j = 1... m), $d_j \in$ D. The above possible values of the output variable «D», which are its characteristics, according to the theory of fuzzy sets, will correspond to the following levels (terms): d_1 – favourable; d_2 – easy; d_3 – medium; d_4 – difficult; d_5 – unfavourable (investment cannot be made for any reason). Decision-making on the state of the IC and the possibility of foreign investment is based on the output value of the model $Y \in \left[\underline{y}, \overline{y}\right]$. Thus, the output variable "IC" can take the following values according to the accepted terms of foreign investment processes: y = {"favourable" (F), "easy" (E), "medium" (M), "difficult" (Di), "unfavourable" (Un)}.

At the next stage, in order to make a management decision, it is necessary that a fixed vector of input variables $X^* = x_1^*, x_2^*, \ldots, x_n^*, x_i^* \in \left[\underline{x_i}, \overline{x_i}\right]$ corresponds to a decision $y \in \left[\underline{y}, \overline{y}\right]$. The output variable IC state takes values in the interval [0, 1], which can be expressed using the fuzzy terms "favourable", "easy", "medium", "difficult" and "unfavourable". To determine the state of the investment climate in the country through the given terms, it is necessary to represent the output variable y as a fuzzy set using the fuzzy logic inference algorithm. As a result, we get the output variable y in the following form:

$$\tilde{y} = \left\{\frac{\mu^{d_1}(y)}{\left[\underline{y}, y_1\right)}, \frac{\mu^{d_2}(y)}{\left[y_1, y_2\right)}, \frac{\mu^{d_3}(y)}{\left[y_2, y_3\right)}, \frac{\mu^{d_4}(y)}{\left[y_3, y_4\right)}, \frac{\mu^{d_5}(y)}{\left[y_4, \overline{y}\right]}\right\} \quad (14)$$

where $\frac{\mu^{d_i}(y)}{[y_{m-1}, y_m)}$ – is the function of membership of the interval of variable values $\left[y_{m-1}, y_m\right)$ in the fuzzy term d_i.

To obtain a crisp number y^* from the interval $\left[\underline{y}, \overline{y}\right]$, corresponding to the fuzzy value of (14) it is necessary to apply the operation of defuzzification, i.e., the transformation of fuzzy information into a crisp form. Let us define the crisp value of y^* corresponding to the fuzzy set (14) as follows:

$$y^* = \frac{\underline{y}\mu^{d_1}(y) + y_1\mu^{d_2}(y) + y_2\mu^{d_3}(y) + y_3\mu^{d_4}(y) + y_4\mu^{d_5}(y)}{\mu^{d_1}(y) + \mu^{d_2}(y) + \mu^{d_3}(y) + \mu^{d_4}(y) + \mu^{d_5}(y)} \quad (15)$$

Since the interval of IC values $\left[\underline{y}, \overline{y}\right]$ was divided into 5 equal parts, i.e:

$y_1 = \underline{y} + \Delta, y_2 = \underline{y} + 2\Delta, y_3 = \underline{y} + 3\Delta, y_4 = \overline{y} - \Delta,$

$\Delta = \frac{\overline{y} - \underline{y}}{m-1}$ then formula (15) is simplified and takes a convenient form for calculations:

$$y^* = \frac{\sum_{j=1}^{m}\left[\underline{y} + (j-1)\Delta\right]\mu^{d_j}(y)}{\sum_{j=1}^{m}\mu^{d_j}(y)}. \quad (16)$$

In the model for determining the impact of factors on the state of the IC, this formula will be used to make the final decision on the host country's IC. The use of information technology allows for the inclusion of a large number of influence factors in the model.

For our example model, given the selected three factors of influence on the state of the IC, taking into account the intermediate indicators E1, O2 and P2, the investment climate of the host country will be favourable if:

1. The estimate of the host country's real GDP will correspond to the level of a developed country, which affects the favourable economic situation.
2. At the same time, the country will have an effective investment protection system in place, which will create a favourable organisational environment.
3. At the same time, there will be a high level of trust in the host country's authorities among foreign investors, which will contribute to a favourable psychological state of society in the host country.

5. Conclusions

An investor makes an investment decision based on information, including information

about the investment attractiveness of a country. In addition to using well-known indices and indicators, an investor can independently determine the level of investment climate or attractiveness of an object by assessing the impact of factors on such indicators. Dividing all the factors of influence into three groups: economic, organisational and psychological, and defining linguistic assessments for those factors that do not have a natural quantitative scale, allows for the expert assessment of those aspects of the investment climate that are not assessed by statistical data and cannot be expressed quantitatively, but only by descriptive words based on a sense of the situation. The built model allows to determine the state of the investment climate or attractiveness under the influence of the set of factors that the user determines, depending on the country, territory, enterprise and the availability of statistical and expert information. Such an assessment can be made, in particular, using the tools of fuzzy logic theory. The modelling results can be used both by a decision-maker making a foreign direct investment in assets of another country and by government officials to improve the investment attractiveness of their country.

References:

Aliyev, E. A., Habibov, I. A., Veliyev, V. K., & Hasanova, T. B. (2021). The Use of Fuzzy Logic for Risk Assessment in the Construction Projects. *Economics and Region.* Vol. 3 (82), p. 133–137. DOI: http://dx.doi.org/10.26906/EiR.2021.3(82).2377

Boltürk, E. (2021). Containership Investment Analysis With Using Picture Fuzzy Present Worth Analysis. *Journal of ETA Maritime Science*, Vol. 9(4), p. 233–242. DOI: https://doi.10.4274/jems.2021.89156

Boloș, M-I., Bradea, I-A., & Delcea, C. (2019). A Fuzzy Logic Algorithm for Optimizing the Investment Decisions within Companies. *Symmetry*, Vol. 11(2), p. 186. DOI: https://doi.org/10.3390/sym11020186

Buryachenko, O. (2021). Modeling Of The Risk Management System Of The Innovative Project. *Modern Technologies, Materials and Structures in Construction,* Vol. 1, p. 105–110. DOI: http://dx.doi.org/10.31649/2311-1429-2021-1-105-110

Dang, V. C., Nguyen, Q. K., & Borz, G. (2021). Determinants of FDI attractiveness: Evidence from ASEAN-7 countries. *Cogent Social Sciences,* Vol. 7(1). DOI: https://doi.org/10.1080/23311886.2021.2004676

Dua, P., & Verma, N. (2024). Drivers of Foreign Direct Investment Inflows to Emerging Asian Economies. *Journal of Emerging Market Finance,* Vol. 23(1), p. 83–107. DOI: https://doi.org/10.1177/09726527231196722

Jankova, Z., Dipak, K. J., & Dostal, P. (2021). Investment Decision Support Based on Interval Type-2 Fuzzy Expert System. *Inzinerine Ekonomika-Engineering Economics,* Vol. 32(2), p. 118–129. DOI: http://dx.doi.org/10.5755/j01.ee.32.2.24884

Kou, G., Pamucar, D., Dinçer, H., Deveci, M., Yüksel, S., & Umar, M. (2024). Perception And Expression-Based Dual Expert Decision-Making Approach To Information Sciences With Integrated Quantum Fuzzy Modelling For Renewable Energy Project Selection. *Information Sciences*, Vol. 658. DOI: https://doi.org/10.1016/j.ins.2023.120073.

Liu, Y., Qin, Y., Liu, H., Abdullah, S., & Rong, Y. (2024). Prospect Theory-Based q-Rung Orthopair Fuzzy TODIM Method for Risk Assessment of Renewable Energy Projects. *International Journal of Fuzzy System,* Vol. 26, p. 1046–1068. DOI: https://doi.org/10.1007/s40815-023-01652-5

Matviychuk, A., Lukianenko, O., & Miroshnychenko, I. (2019). Neuro-fuzzy model of country's investment potential assessment. *Fuzzy economic review,* Vol. 24, (2), p. 65–88. DOI: https://doi.org/10.25102/fer.2019.02.04

Onar, S. C., Oztaysi, B., & Kahraman, C. (2021). Spherical Fuzzy Cost/Benefit Analysis of Wind Energy Investments. *Intelligent and Fuzzy Techniques: Smart and Innovative Solutions. INFUS 2020. Advances in Intelligent Systems and Computing,* Vol. 1197, p. 134–141. DOI: https://doi.org/10.1007/978-3-030-51156-2_17

Rekik, S., & El Alimi, S. (2024). A GIS based MCDM Modelling Approach For Evaluating Large-Scale Solar PV Installation in Tunisia. *Energy Reports*, Vol. 11, p. 580–596. DOI: https://doi.org/10.1016/j.egyr.2023.12.018

Shevchenko, L. (2021). Factors Of Influence On Foreign Investment In The Economy Of Ukraine: Approaches To Classification. *Bulletin of V. N. Karazin Kharkiv National University Economic Series*, Vol. 100, p. 57–67. DOI: https://doi.org/10.26565/2311-2379-2021-100-06

Sookram, S., Hosein, R., Boodram, L., & Saridakis, G. (2022). Determining Factors of FDI Flows to Selected Caribbean Countries. *Journal of Risk and Financial Management*, Vol. 15, p. 48. DOI: https://doi.org/10.3390/jrfm15020048

Sytyk, R., Ieremenok, V., Nastopyrov, V., Havrylenko, M., & Lysov, O. (2024). Managing The Investment Attractiveness Of Agro-Industrial Entities: Approaches To The Study And Analysis Of Structural Elements. *International Interdisciplinary Scientific Journal "Expert"*, Vol. 1 (2), p. 117–129. DOI: https://doi.org/10.62034/2815-5300/2024-v1-i2-008

Yaskov, Y., & Smiesova, V. (2023). The Market of International Rating Agencies and Approaches To Assessing The Investment Attractiveness of The Country. *Academic Review*, Vol. 1(58), p. 270–283. DOI: https://doi.10.32342/2074-5354-2023-1-58-20

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