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UNIVERSALLY SUSTAINABLE DEVELOPMENT AS A FRAMEWORK OF SMALL COUNTRIES' ECONOMIC EFFICIENCY AND NATIONAL SELF-SUFFICIENCY

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Abstract. The concept of sustainability and, particularly, of sustainable development dominates in the literature among the most ambitious and controversial concepts. The knowledge and researches of state, evolution or development become not only the original means of generation of socio-economic science knowledge, but also an alternative in analyzing strongly sophisticated development problems pertaining to such complexes as city, region, field of activity or state. Finding the ways of such knowledge conversion into the field of science is complex, but necessary. Abundant researches of sustainable development become oriented towards the analysis of multifactor nature of development, or its universality. The paper uses the category of universally sustainable development, which is treated as a qualitatively-innovative instrument of thinking. Universally sustainable development is being analysed through the reality cognition prism of experts pertaining to the four blocks of knowledge, improving the idea of round table already developed in previous researches made by the authors. The impact of universally sustainable development on country economic efficiency and national self-sufficiency is analysed.

Keywords: universally sustainable development, sustainability subsystems, adaptive complex systems.

JEL classification: Q01, O11, C18, H50.

1. Introduction

Researches related to sustainability are increasingly popular nowadays and attract great attention of scientists and practitioners. Merely the concepts of sustainability and sustainable development can be yet viewed as very ambitious and controversial concepts. And such situation turns to be unfavourable with regard to the development of sustainability science. First, unsystemical investigation of sustainable development objects has not only initiated the inflation of value of these researches, but also discredited the power of sustainability as a unique system of knowledge. Here the credo of scientific researches needs to be taken into account: it is necessary to recognize consistent patterns and to notice possible exceptions. Such situation is noticed by many researchers of development sustainability (Bell, Morse 2008; Streimikiene, Barakauskaite-Jakubauskiene 2012; Schneidewind, Augenstein 2012; Tabara, Chabay 2013; Hay *et al.* 2014).

Along with that, a discussion goes on about the reasoning of practical management of such development on a generalized level with the help sustainable development concept and full-fledged knowledge system. A perception is being developed stating that while analysing complex phenomena, processes or subjects a system analysis ideology should be involved. This would allow clustering the whole of research objects according the types of systems possessing the developed and approved principles of identification, analysis and management. This, in turn, would disclose for researchers the major fields that require focused attempts (Innes, Booher 1999; Fiksel 2006).

However, continuing the researches described above, it is impossible to avoid the ambiguity (Moles *et al.* 2008). The reason is at least due to the abundance and variety of systems as instruments for reality cognition.

Taking into account all the presented assumptions, the objective of the paper could be formulated as follows: applying the provisions of systems' theory, expert valuations and adequate portfolio model, to develop a possible case of small country universally sustainable development in the form of optimal resource allocation among the components of universal sustainability.

In order to reach the stated objective the following tasks will be performed subsequently:

– to provide a conceptual description of small country or region development seeking the possibilities of sustainable development;

– to analyse the key features of system and its behaviour in order to describe the formation of gravitational powers of country as a complex system, and to find the ways of their management;
– to find out what is the contents of country universally sustainable development and what are its core subsystems;
– to obtain the composition of efficiency and reliability as the essence of subject's state or development sustainability;
– to estimate the optimal allocation of marginal investment unit among the components of country sustainable development in order to ensure the case of universally sustainable development.

While conducting the research the methods of comparative analysis of literature, synthesis, generalization were used. Also, to obtain the practical results of resource allocation the methods of expert valuation and adequate investment portfolio were applied.

2. The cognition of complex systems and their behaviour

It is worth noticing that systems' instruments possible to foster sustainable development of complex processes are limited and need to be evolved. Probably the main disturbance in order to solve the problems of operational management of sustainability in the case of complex subjects or processes is the inflexibility of a system of categories being used and its inadequacy to the cognition of sustainability phenomenon.

This can be illustrated with the help of complex systems, such as adaptive complex systems (Spangler, Peters 2001; Amaral, Ottino 2004; Akgun *et al.* 2014) that possess the great pool of instruments intended for analysis and search of management solutions for complex and multidimensional processes or subsystems. Such instruments as a rule are oriented towards the investigation of comprehensive economic-biological-technological complexes (Katz, 2006; Rammel, *et al.*, 2007; Richey *et al.* 2014).

While analysing general characteristics of a system it can be concluded that almost all types of systems possess the following features:

– a system has a structure, and its elements or subsystems possess a special variety of dependencies;
– a system can be characterized by a certain behaviour disclosing the transformation of inputs into output results;
– a system possesses the interconnectivity of subsystems that are evidenced by the dependency of structural elements, as well as by the dependency of consistent patterns of behaviour;
– consistent patterns of systems' structure and behaviour can be disaggregated into subsystems or subprocesses.

All the features presented above constitute an impressive pool of requirements in order for the existing whole of elements to be analysed and managed according to the general principles of systems' management.

However, almost none of the formal system possesses a characteristic common to real existing systems. For example, the majority of social systems, as well as mechanical or universe systems, possess the following features:

– there are gravitational powers and gravitation centers of the system;
– the behavior of the system can be also identified using the allocation of gravitation centers and the media of the gravitation.

Also, it is worth noticing that formalized mechanisms of the systems' analysis and management should be credited with uncertainty, which is an important context of behavior or interdependence of virtually all processes. In turn, uncertainty is the core aspect which should be deeply recognized in order to perceive the concept of sustainability as well as its management possibilities.

The major impediment for the application of possibilities of systemic analysis is that in analysis of separate countries' or regions' development sustainability an assumption is being made that the core, if not unique, problem is a trade-off between the economic growth and environment protection (Meadows 1998; Streimikiene *et al.* 2009; Ang *et al.* 2011; Liobikiene, Mandravickaite 2011; Raslavičius, Strakšas 2011; Makiela, Misztur 2012; Urban, Govender 2012). Appealed to many failures of such ideology, some authors (Innes, Booher 1999; Baumgärtner, Quaas 2009; Nadal 2011; Rutkauskas 2012) strictly take the position that the dichotomy of environment protection and economic development should not be the main obstacle in preparing the scheme of complex systemic thinking in order to seek the development sustainability.

3. Peculiarities of small country universal sustainability analysis

3.1. Sustainability as a feature integrating economic efficiency and reliability of development

The science of sustainability pertaining to a process or system existence or development has been patiently cultivated by the science of economics (Xu *et al.* 2006; Bartelmus 2010). Economic activity eventually intuitively searching for the correct decisions under the conditions of uncertainty finally strongly started developing the knowledge and skills that in general became the science of state, growth or development sustainability.

Sustainability as a valid composition of efficiency and reliability reveals its conceptual and practical constructiveness by the situation where on the basis of adequate utility function the possibility of maximum utility while projecting the perspective is disclosed. Reliability or guarantee here is perceived and assessed as probability (P) of the possible effect (ξ) being higher than the desired effect (ξ_k) and equals to the selected probability P_k:

$$P\{\xi > \xi_k\} = P_k . \quad (1)$$

This is the analogue of the survival function found in the analysis of population survival, which, in turn, is an add-on of the distribution function:

$$P\{\xi > \xi_k\} = 1 - P\{\xi \le \xi_k\} . \quad (2)$$

The adequacy of the utility function form $N(\xi_k, P_k)$ often is dictated by the particular situation, but for the initial evaluation the following form is quite suitable:

$$N(\xi_k; P_k) = \frac{\xi_k \times P_k}{r}, \quad (3)$$

where *r* is the riskiness of the efficiency possibilities' set.

The concept of reliability or guarantee, which is formed among the categories of probability theory and by its content is completely adequate to the density or accumulated density functions, obviously reveals its constructiveness in the research of population survival possibilities. While analysing the problem mentioned above it is worth noticing that the critical number of population units should be retained with the certain guarantee.

There is no doubt that this is the key problem also in projecting the development sustainability, when it is especially important to determine whether the necessary efficiency of development can be retained with the certain guarantee.

3.2. A scheme of country sustainable development as an adaptive complex system

Repeating the thoughts of Innes and Booher (1999) about the application of complexity theory for the research of complex systems' state and development sustainability, the complexes of social, political and economic problems will be selected as the components of country sustainability ensuring, and linking them with physical and biological components which influence the development sustainability we will obtain the possibility to use directly the ideology and methods of complex systems' research (Innes, Booher 1999).

The principles of complexity theory are especially important also because the exceptional attention is given to the evaluation of uncertainty as inherent component of development. This allows us to understand, forecast and quantitatively assess the impact of stochastic changes on the possibilities of country development.

Along with that the necessity to consider the mechanistic models of system centricity ideas must be highlighted, and without its social, economic, political and other subsystems the researches would be incomplete. However, the necessity to take into account the ideas of gravitation centres, as well as the concept of the gravitation force itself for the social and other subsystems requires an innovative point of view.

3.3. Dependence of sustainability concept and management methods on the character of the analysed object

The technique of sustainability analysis and management undoubtedly must be universal and allowing to solve the main problems with as less as possible dependence on the nature of the analysed object. However, the category of validity, which becomes an increasingly important component while analysing the sustainability management problem, often demands a specification or even investigation of the principal features of the subject (Rutkauskas, Stasytytė 2012).

Like it was already mentioned at the beginning of the paper, the object of the research of the paper is a problem of development sustainability of the independent country, which possesses a small geographical territory, little natural resources and at the same time low results of economic activity. And even if the functioning of the state is perceived as a system of complex interactions and dependences, it must be able to react sensitively to global as well as to local-regional changes. Though since the times of Plato, Aristotle or Euclid the definition of the system has changed, but speaking about the system's

sustainability still the central gravitation force is kept in mind, which is the centre of system's existence. There is still truth therein. In social systems this force can be substituted by the interest, the foundation of which should be in utility and possibility to adapt the historically determined system to the changing internal and external conditions.

When the gravitation force (the gravitation of the sun) or simply engineering constructions (a water supply system) are considered, it is not so important or may be impossible to perceive the interests and resources that are required in order to ensure the sustainability of these systems in their constantly regenerating state. But in universally sustainable systems regeneration must be identical to the perfection, because otherwise any system is doomed to failure. Then the ability to optimally distribute resources among subsystems' state sustainability and their interaction possibilities' retention often is equivalent to the survival of the state or development sustainability of the whole system.

The strategies of retention or development of sustainable system of Lithuania as an independent country constitute the particular object of the conducted research, where these strategies are grounded by the historically formed need for the retention of country self-sufficiency and ability to generate and implement the intelligent development strategies. The guarantee and motto of survival of Lithuania as a self-sufficient country is the historically formed intelligence of self-sufficiency retention and development. Immediate assumption of country self-sufficiency survival and successful implementation of development strategies is the intelligent use of natural, as well as human-possessed and created resources. The main guarantee context of country development effectiveness and success is a universally sustainable development. In order to touch more thoroughly all the accents of development, as well as to use all the created powers, the subsystems of country sustainable development has to be distinguished. A brief description of these subsystems will be presented in the next chapter.

4. The structure of country universal sustainability

4.1. Description of subsystems of country universal sustainability and their functions

If an assumption is made that country development sustainability should be analysed with the help of the model of a complex system, then it should be taken into account that for the whole of elements existing in the reality the following characteristics are typical:

– it has a very complex structure;
– it has high sensitivity for even small changes of dependencies among the separate components;
– it is difficult to identify and verify the whole of elements even if its design or functional dependence, or both of these moments are known;
– it is characterized by the abundance of interactions among the different components;
– new characteristics or even states of the whole can be revealed over time.

There is no doubt that all these characteristics are typical for the phenomenon of country sustainability development. However, if it is also required that it would be a self-regulating open system, the functional purpose of which demands resources that in the process of becoming the input elements can cause not only the changes of internal dependences, but also the effect of separate subsystems, along with the effect created by the whole system, then it is worth accepting that the system, the content of which is composed of all the characteristics mentioned above, also requires the adequate possibilities of system's cognition and management.

The four subsystems of universal country sustainability and their components are as follows:

1. Social-economic-ecological subsystem (SEE) – social-demographic, economic and ecological components.

2. Educational-creative-religious subsystem (ECR) – educational, creative and religious components.

3. Financial-investment-technological subsystem (FIT) – innovative-technological-energy, investment and financial components.

4. Political-integrative-managerial subsystem (PIM) – political, integrative and marketing-managerial components.

There is no need to present the definition of every subsystem of universal sustainability, because it has been already made in the previous publications of the authors (Rutkauskas 2012; Rutkauskas, Navickas 2013). The hierarchy of the subsystems and their components is graphically presented on Fig. 1.

The substantial background for development sustainability research can be provided by the functions, intelligence determinants and the contents of the instruments of knowledge, innovation and technology cluster. The latter needs separate attempts of research, and it has already started by describing the essence of the KNIT cluster (Rutkauskas *et al.* 2013; Rutkauskas *et al.* 2014). Intelligence determinants inevitably will be a further trend of research. While certain functions of subsystems and their components will be briefly presented.

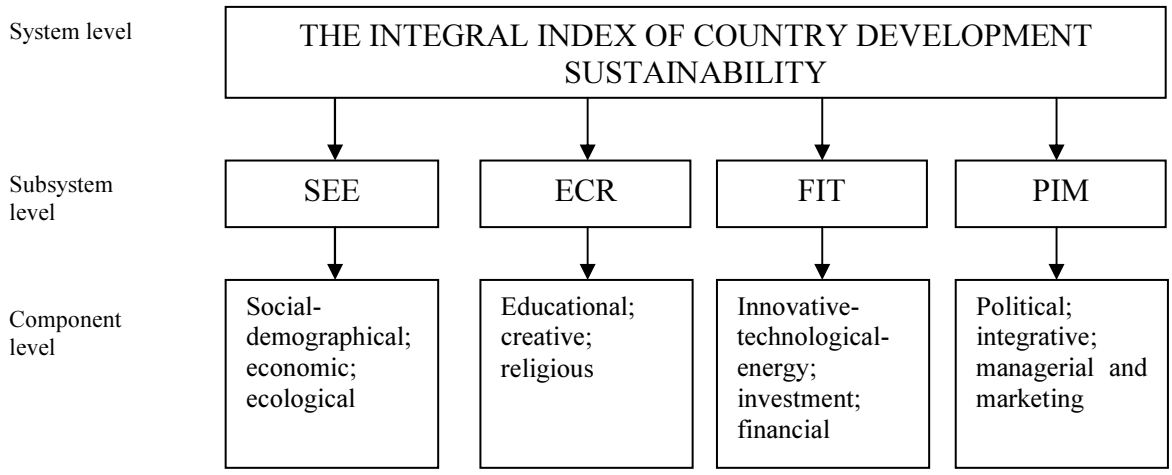

Fig. 1. The structure of integral index of country development sustainability (source: compiled by the authors)

The functions of country financial system, representing the functions of the financial component of FIT subsystem, are as follows:

- to guarantee the effective functioning of the country market with regard to economic interests of all the subjects;
- to reveal for business the possibilities of using human and material resources of a country for creating the maximum profit;
- to implement the instruments of country fiscal policy;
- to restore and develop human capital; to strengthen the responsibility and intelligence of every individual or household in managing personal finance more effectively.

The functions of investment component can be understood through the description of investment meaning:

- it is the key growth factor (resource) of economics and social welfare;
- it is an aggregate means for government, business and individual citizens' objectives of developing sustainability;
- it is a success assumption for solving social, economic, ecological and other problems in the future;
- it is a means of capital structure formation of tangible and intangible assets intended for future needs.

The functions of economic sustainability:

- production of competitive material and intellectual goods;
- ways of production that save resources and preserve environment;
- ensuring the quality of society needs for professional activity and consuming.

The function of political component is to seek the realization of democratic principles including the citizens and allowing them to behave rationally, transparently and responsibly. This function is implemented through the democratic processes, where the key factors are society inclusion (political, managerial and legal inclusion) and political culture that can be evaluated with the help of corruption index, the degree of unique governance and the degree of management based on arguments.

The managerial component can be disclosed through the functions of executive governance: planning, organizing, motivation, participation and control.

4.2. Assumptions of formation of integral country development sustainability index

The case of adaptive complex systems is named by the theorists and practitioners as the most complex case of interaction of social-economic processes. Along with that, it requires a perfectly adequate system of models, allowing to recognize conceptually and quantitatively the processes taking place in reality, as well ad their interactions.

Solving a problem of investment resource allocation among the most important subsystems of development in order to reach the universal sustainability development is a rather difficult task because of several reasons. First, there is no unambiguous concept of universally sustainable development. Second, a scientifically grounded quantitative measure of development sustainability has not been formulated yet. It should help to evaluate the past trend of sustainability, its impact on the effect of development, as well as future trends of development sustainability.

The transformation of country development is represented by the so-called logics of sustainability indices, when with the help of indices expressing the change of important development components (economic and social changes, country management efficiency, etc.) the integral country development index is being formed, indicating the trends of country development.

As a result, a country investment strategy should be formed that is oriented towards the change of the integral development index, indicating the features of development efficiency and reliability.

At the moment there are only separate scientific researches, oriented towards the estimation of resources or means of development sustainability nurturing. Thus there is a need for large-scale data mining and analysis. Along with that, an exceptional attention is being paid to the formation of expert system gathering the starting knowledge of the high-class analytics, as well as the knowledge of experienced specialists in separate fields of the processes.

The analytical idea of expert valuation states that a marginal investment unit should be allocated among 12 components seeking the change of the integral development index providing the highest utility.

The practical base for such analytical action and expert valuation is formed by the dynamics of dependency between the parameters of investment amount intended for component development and the parameters of components' sustainability contents. The hierarchized principle of country development power formation is shown in Fig. 1.

5. The results of expert optimization and investment resources allocation in order to form country sustainability development powers

In the analysed case the expert valuations were obtained as follows:

– The groups of experts form the stochastic values (probability distributions) of marginal investment unit effect in every development component according the performed researches of interaction among the investment volume and sustainability indicators;
– The form of indices composition of components' sustainability is grounded while assessing the integral sustainability index;
– The criterion for the optimization of investment allocation among the components is selected;
– The constraints of optimization space and dependencies are determined in order to maintain the established relations, dependencies and consistent patterns of the analysed parameters;
– The scenarios of solution search conforming to the features described above are performed using the developed technique of stochastic optimization intended for the search of a composition of efficiency, reliability and risk allowing to reach the highest utility.

The selected experts presented the consistent patterns of investment transformation into the changes of development sustainability index in the separate development components. The experts presented their valuations in the form of probability distributions.

Taking into account the experimental nature of the performed research and seeking the simplicity and unambiguity of the presentation, the probability distributions generated by the experts are represented by the respective theoretical distributions and their parameters (Table 1):

- Triangulat probability distribution (minimum value, maximum value, mode);
- Normal probability distribution (mean value and standard deviation);
- Gumbel probability distribution (scale parameter, location parameter);
- Uniform probability distribution (minimum value, maximum value).

Table 1. Types and parameters of probability distributions for every development component (source: compiled by the authors)

No	Components	Type and parameters of distribution
1	Social-demographical	Triangular (1.0, 1.2, 1.1)
2	Economic	Triangular (1.06, 1.12, 1.09)
3	Ecological	Normal (1.05, 0.07)
4	Educational	Gumbel (1.12, 0.05)
5	Creative	Gumbel (1.11, 0.05)
6	Religious	Uniform (1.04, 1.09)
7	Innovative-technological-energy	Gumbel (1.12, 0.06)
8	Investment	Gumbel (1.13, 0.07)
9	Financial	Triangular (1.015, 1.11, 1.05)
10	Political	Triangular (1.05, 1.15, 1.08)
11	Integrative	Triangular (1.03, 1.15, 1.07)
12	Managerial and marketing	Triangular (1.05, 0.15, 1.07)

The compatibility of probability distributions was performed using the Kolmogorov-Smirnov test. Thus every development component is assigned a particular theoretical probability distribution that is compatible with the empirical distribution formed on the basis of expert valuations (Table 1).

A group of 11 experts was selected for expert valuation. Their field of research is mathematics (probability theory) and economics, so they possess a substantial experience and can present a valuable opinion with a high level of reliability on a question of development of each component of sustainability system.

In the current step of research the integral country development index has been analysed as a weighted geometrical average of indices of development components. The reasons for using the weighted geometrical average, first, is the fact that multiplication of events indicate that they both or a group of events happen together, and, second, - a substantial positive experience of using the mentioned method.

Stochastic optimization takes an exceptional position in the process of optimal situation or optimal solution search. Such a case is not limited to the optimization of the specific types of possibilities (mean value, minimum, maximum, mode, etc.) that usually are even not mentioned in the case of determined optimization. The stochastic optimization being performed considers the internal review of possibilities while selecting the efficiency, reliability and risk level. In the analysed situation a certain function of the characteristics - efficiency, reliability and risk, that always strongly influence the result, was selected as the optimization criterion.

Finally, after accepting the consistent patterns of investment transformation into the indicators describing the sustainability of development components, presented by the experts, and considering the possessed statistical data, as well as gathered scientific and analytical material, the algorithm of the adequate investment portfolio for decisions search was applied (Rutkauskas 2006; Rutkauskas, Stasytytė 2011a, 2011b; Rutkauskas *et al.* 2011). The mentioned algorithm allows determining:

– The proportions of investment unit allocation among the development components;
– The level of risk containing the coordinates of the optimal solution;
– Indicators of efficieny and reliability representing the optimal solution.

The application of adequate investment portfolio ideology and technique allows finding the point of optimal solution as the intersection point of survival function and utility function (Fig. 2). In the analysed case the survival function represents all the efficient possibilities of universal sustainability index possessing the values of all the 12 components. And the utility function represents the utility level of the subject (in this case – the country seeking the universal sustainability development).

Next according the applied algorithm the optimal structure of marginal investment unit allocation has been formed (Table 2). The numbers represent the part that is invested in the respective subsystem, the general investment unit being equal to 1.

The parameters of optimal solution are as follows:

Efficiency: 1.0069;
Reliability: 0.42178;
Risk: 0.017541.

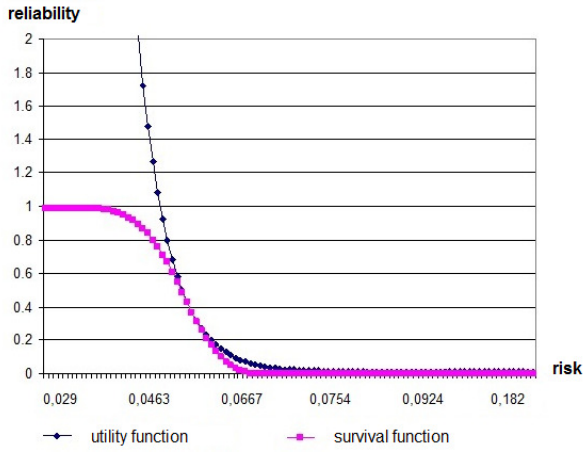

Fig. 2. The point of optimal solution (source: compiled by the authors)

Table 2. The structure of optimal solution (source: compiled by the authors)

No	Components	Proportions of investment unit allocation
1	Social-demographical	0.0822
2	Economic	0.0955
3	Ecological	0.0879
4	Educational	0.0858
5	Creative	0.0854
6	Religious	0.0746
7	Innovative-technological-energy	0.0787
8	Investment	0.0863
9	Financial	0.0811
10	Political	0.0788
11	Integrative	0.0806
12	Managerial and marketing	0.0841

The proposed technique of decision formation should become an object of further discussions among the separate development components and subsystems, as well as an evaluation if the obtained solution could serve as a base for projecting and implementing the investment strategy.

6. Conclusions

Immediate assumption of country self-sufficiency survival and successful implementation of development strategies is the intelligent use of natural, as well as human-possessed and created resources. The main guarantee context of country development effectiveness and success is a universally sustainable development.

The country development sustainability could be analysed with the help of the model of a complex system. Here the system of country development sustainability would be perceived as a complex of elements (subsystems), and such a system would have a complex structure, would be sensitive to the changes in dependencies among its separate components and would have a lot of different interactions among the components.

The particular subsystems of country universally sustainable development are: social-economic-ecological, educational-creative-religious, financial-investment-technological, political-integrative-managerial. The substantial background for development sustainability research can be provided by the functions and intelligence determinants of all the components in the mentioned subsystems, as well as and the contents of the instruments of knowledge, innovation and technology cluster.

The transformation of country development is represented by the so-called logics of sustainability indices, when with the help of indices expressing the change of important development components, the integral country development index is being formed, indicating trends of country development.

The consistent patterns of investment transformation into the changes of development sustainability index were obtained by the experts, and the problem of marginal investment unit allocation among the 12 components was solved using stochastic optimization and the algorithm of adequate investment portfolio.

The results of allocation of investment unit among the sustainability development components state that the proportions for every component range from 0.0746 (religious component) to 0.0955 (economic component). However, it is worth noticing that the presented results are of experimental nature and should become an object of further discussions and a base for projecting and implementing the investment strategy for a country.

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