JEL Classification:
F36, O35, P46

UDC 378-057.177:
33.012.8-045.45+001.
895-048.87

DOI: 10.30857/2415-
3206.2022.1.1

METHODICAL ASPECTS OF DETERMINING THE EFFECTIVENESS OF FREE ECONOMIC COOPERATION IN THE SYSTEM OF COOPERATION MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS

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Introduction. The Cooperation of Cooperation in Higher Education Institutions is becoming the most important component of the innovation process. For regional politicians, it is a vital component of regional innovation policy, as the successful use of R&D results of local free economic zones is important for the competitiveness not only of the region but also of the country as a whole.

There is a clear shift towards regionalization in higher education innovation policy and technologies. One of its consequences is the expectation from universities to create networks and establish regional connections. It is also important to create broad shared cluster networks, although most clusters focus on weak local networks. Nevertheless, network members are responsible for more patent applications than others. Moreover, it seems that the quality of patents is not reduced in cooperation with the universities of one regional cluster.

The hypothesis of the research is to substantiate the methodological recommendations and proposals to increase the effectiveness of the interaction of free economic zones in the management system of cooperation of higher education institutions.

The purpose of the study is to substantiate the features and effectiveness of the interaction of free economic zones in the management system of cooperation of higher education institutions.

The methodology of scientific research is general and special research methods: logical and comparative analysis in revealing the principles of forming the scientific essence of cooperation of higher education institutions; the method of induction was used to make formal-logical generalizations, which allows the formulation of a general conclusion based on the analysis of individual facts and phenomena, the method of deduction was used to obtain intermediate (partial) conclusions based on the analysis of the general process, the method of abstraction was used to identify processes due to the neglect of random phenomena, For modeling and calculations used special software and hardware: MS Excel, RSPSS, programming language "R".

Conclusions and prospects for further research. Theoretical and methodological provisions for managing the development of cooperation of international higher education institutions, based on maximizing resource complementarity and minimizing institutional incompatibility, and whose main goal is to ensure the development of cooperation of international higher education institutions as a way to improve areas (education, research, technology transfer).

The scientific and methodological provisions of ensuring the management of the development of cooperation of international higher education institutions, which are based on selected key areas and strategic opportunities from the cooperation of international free economic zones, which allows to ensure the effectiveness of their international activities and provides a basis for leveling economic opportunism;

Keywords: institutions of higher education (HEI); interaction of HEIs; cooperation; integration; innovation policy of HEIs; management system of HEIs.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
32	1	1

JEL Classification:
F36, O35, P46

УДК 378-057.177:
33.012.8-045.45+
001.895-048.87

DOI: 10.30857/2415-3206.2022.1.1

МЕТОДИЧНІ АСПЕКТИ ВИЗНАЧЕННЯ ЕФЕКТИВНОСТІ ВІЛЬНОГО ЕКОНОМІЧНОГО СПІВПРАЦІ В СИСТЕМІ УПРАВЛІННЯ СПІВРОБІТНИЦТВОМ ЗАКЛАДІВ ВИЩОЇ ОСВІТИ

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Вступ. Управління кооперацією закладів вищої освіти стає найважливішим компонентом інноваційного процесу. Для регіональних політиків він є життєво важливим компонентом регіональної інноваційної політики, оскільки успішне використання результатів НДДКР локальних ЗВО має важливе значення для конкурентоспроможності не тільки регіону, а й країни в цілому.

Очевидним є помітний зсув у бік регіоналізації в інноваційній політиці та технологіях вищої школи. Одним із його наслідків є очікування від університетів створення мереж та встановлення регіональних зв'язків. Також важливе значення має створення широких спільних кластерних мереж, хоча більшість кластерів зосереджено на слабко виражених мережах місцевого рівня. Незважаючи на це, члени мережі відповідають за більшу кількість патентних заявок, ніж інші. Більше того, схоже, що якість патентів не знижується у співпраці з університетами одного регіонального кластеру.

Гіпотеза наукового дослідження полягає у обґрунтуванні методичних рекомендацій та пропозицій щодо підвищення ефективності взаємодії ЗВО в системі управління кооперацією закладів вищої освіти.

Метою дослідження є обґрунтування особливостей та ефективності взаємодії ЗВО в системі управління кооперацією закладів вищої освіти.

Методологією наукового дослідження є загальнонаукові методи дослідження: логічного та порівняльного аналізу у розкритті засад формування наукової сутності кооперації закладів вищої освіти; метод індукції для здійснення формально-логічних узагальнень, метод дедукції використовувався для одержання проміжних (часткових) висновків на основі аналізу характеру загального процесу, метод абстрагування для виявлення та ідентифікації значимих тенденцій економічних процесів. Для моделювання використовувались спеціальні програмно-технічні засоби: MS Excel, RSPSS, мова програмування «R».

Висновки та перспективи подальших досліджень. Сформовано теоретико-методологічні положення управління розвитком кооперації міжнародних закладів вищої освіти, які базуються на максимізації ресурсної взаємодоповнюваності і мінімізації інституційної несумісності. Обґрунтовано науково-методичні положення забезпечення управління розвитком кооперації міжнародних закладів вищої освіти, які базуються на виокремлених ключових сферах та стратегічних можливостях від кооперації міжнародних ЗВО, що дозволяє забезпечувати ефективність їх міжнародної діяльності і дає підґрунтя для нівелювання економічного опортунізму її учасників;

Ключові слова: заклади вищої освіти (ЗВО); взаємодія ЗВО; кооперація; інтеграція; інноваційна політика ЗВО; система управління ЗВО.

Problem statement. Joint patenting, joint publications and scientific and technological specialization have a special impact on the effectiveness of the interaction of free economic zones in the management system of their cooperation. Analysis of data on joint patenting improves understanding of transnational knowledge flows, especially when used in conjunction with the interpretation of joint publication statistics. The share of jointly published studies has increased since the 1990s, especially with the free economic zones of European countries (Muscio and Vallanti, 2014; Koschatzky and Stahlecker, 2010). In other words, the free economic zones of small countries tend to cooperate more often, and the free economic zones of the new member states of the European Union (EU) account for a larger share of joint publications. The distance between knowledge plays a much bigger role than the scientific and technological distance for the joint publishing activity of ZVO. Connections between remote regions in Europe are less likely than in the United States (USA). However, the neighborhood is more important in the United States than in Europe. This balances the geographical effect for far-flung regions. A study of the free trade patents of countries such as the United States, Japan, Canada and Western Europe (G4) shows that the vast majority of them are created by international teams (almost 80%), the rest – a combination of free economic teams from the rest of the world. However, these two groups have different tendencies, and the collaboration of free economic zones of other countries of the world almost catches up with the collaborations of free economic zones within G4 (Lata et al., 2018).

Analysis of recent research on the problem The interaction of free economic zones in the system of cooperation management of higher education institutions is mainly based on the transfer of knowledge and technology. For example, S. Philbin (2010) notes that there is much evidence of a strong correlation between technology transfer and practical knowledge, on the one hand, and successful collaboration, on the other. Intensive transfer can increase the novelty of technology (Guan et al., 2005), stimulate innovation (MingJi and Ping, 2014) and / or accelerate the development of a new product (Fernandes Ferreira, 2013). However, many barriers affect the transfer of knowledge and technology, and this is the subject of many studies (Hair et al., 2019; de Medeiros Rocha et al., 2012). In their 2009 study, M. Flores et al. argue that the transfer of technology and knowledge is influenced by strategy and motivation (Flores et al., 2009), and the use of adequate policies and incentives can intensify the transfer of knowledge to business. Knowledge transfer can affect universities and companies in different ways. If the former initiate the transfer of knowledge through research, the latter later occupy senior management positions (Goel et al., 2017).

There are many motives for cooperation between higher education institutions, which often encounter many barriers. The following obstacles in the cooperation of free economic zones should be identified: inconsistency of incentives between researchers and firms; lack of academic procedures or intermediaries to facilitate interaction with business (problems of academic networks); discrepancy between academic goals and technology transfer activities, as well as the distance between academic research and needs (nature of research). Financial barriers are related to the propensity of knowledge-intensive business services to cooperate with universities and research institutes. Barriers related to knowledge are moderately related to the propensity of high-tech manufacturing small and medium-sized enterprises (SMEs) to cooperate with free economic zones. And while free trade and business cooperation play other important roles in the technical and economic system, their likely contribution to alleviating internal innovation barriers for technology SMEs may be less than expected by policy makers in economies, developing.

The purpose of the study there is a substantiation of features and efficiency of interaction of ZVO in system of management of cooperation of establishments of higher education.

Presentation of the main material The data provided by the Global Innovation Index (GII) were used to study the factors influencing the cooperation of international free economic zones.

The Innovation Index (GII) consists of sub-indices. The innovation input sub-index and the innovation output sub-index – each of which is built on the basis of columns – are two sub-indices on which the GII is based. In the sub-index of innovation input, the elements of the national economy that provide innovation are reflected in five main components. These five components are business development, market development, infrastructure, human capital and research, and institutions. The sub-index of innovation results covers the results of innovation activities that are a consequence of the innovation activity of the economy. The main components of the results are creative results, as well as results in the field of knowledge and technology. The average value of the sub-indices "Input" and "Output" determines the total GII (Cornell University, INSEAD, and WIPO, 2010–2020). Based on these elements, groups of factors were created that influence the effectiveness of the interaction of free economic zones in the system of cooperation management of higher education institutions (factors of influence). On the other hand, the level of effectiveness of the interaction of free economic zones in a particular country is measured by a set of initial factors. Differences in approaches to supporting the interaction of free economic zones also lead to the fact that free economic zones achieve different results. This prompted the study of the main factors influencing the effectiveness of the interaction of free economic zones of different countries. Thus, this study

is designed to answer the following question: "What are the main factors influencing the effectiveness of the interaction of free economic zones in the management system of cooperation of higher education institutions"?

The ordering of factors that determine the effectiveness of the interaction of free economic zones, which were defined as "input factors" was divided into 4 categories. First, there are institutional factors that include the business environment, legal constraints, and government support. Second, there are human factors that relate to human capital and research. Third, there are the factors of communication and communication that relate to the links between universities. Fourth, there are framework factors related to higher education infrastructure. The "starting factors" that represent the level of development of the higher education system in a particular country are also identified.

The first category of institutional factors defines government as an influential force capable of either facilitating or hindering cooperation. On the one hand, a government network, public funding, or tax breaks can promote free trade cooperation. On the other hand, the lack of regional support structures (Şerbănică, 2011) and / or regulatory and legal constraints (Arvanitis et al., 2008) may adversely affect cooperation. As a rule, partnerships between universities largely depend on government support (Collier et al., 2011). Additional factors for the success of cooperation between individual free economic zones correspond to the market potential of research results (Ankrah and AL-Tabbaa, 2015) or market uncertainty. Fourth, there are framework factors related to the infrastructure of freelance activities.

Human resources play a vital role in the successful implementation of projects between universities (Albats et al., 2020). As a rule, there is a strong dependence of the usefulness and quality of cooperation on the resources available to the partner. The need for specific resources further limits the range of potential partners. Highly qualified human resources are of paramount importance for successful cooperation. Unrestricted access to libraries, laboratory facilities and similar infrastructure is also important (Boardman and Bozeman, 2015); and / or technical equipment (Arvanitis et al., 2008). EIAs with more educated and / or knowledgeable managers / executives tend to introduce more innovations (Boardman and Bozeman, 2015). Due to the higher level of human capital, large universities can use the knowledge gained as a result of cooperation with other HEIs more efficiently than small ones. The latter are less able to acquire this knowledge, because they usually lack qualified personnel who are invaluable for innovative endeavors.

In this study, the communication factors are the gross internal costs of R&D (R&D), formed by the Free Economic Zone, R&D, funded by the enterprise, which carry out research cooperation between the university and industry, the state of cluster development, R&D, funded due to borders, as well

as agreements on the establishment of joint free economic zones. Working together and applying experience and feedback to each other in the pursuit of improvement have proven to be beneficial for both universities and companies (Boardman and Bozeman, 2015). The most important aspect of the free economic development strategy in the formation of innovation is the creation of strategic partnerships, in particular, partnerships with universities. To establish a common understanding, the frequency of communication is of paramount importance (Marotta et al., 2007). Close personal relationships also make it possible to establish the most important links between universities. Contacts and actions should be at the operational level and cover the level of management (Hong et al., 2010). Lack of communication channels is the main barrier in the relationship between partners. Also for the formation of positive expectations about the future behavior of the partner (especially when the partnership has just begun) useful mutual communication (accurate, adequate, timely and regular), culture as a mutual understanding of how employees should look, feel and think about issues and problems. In this study, the framework factors relate to access to intellectual capital, environmental performance, and the rule of law. Legal aspects and intellectual property rights are important for the cooperation of international free economic zones. The policy of governments and universities in the field of intellectual law has a positive and significant impact on the performance of free economic cooperation projects, controlling the characteristics of the firm and the project and taking into account the potential shift in selection for cooperation. By default, a favorable business environment does not have a positive effect on the university's technology transfer activities. It is the implemented strategy of each university that is much more important than environmental factors. However, with the overall improvement of R&D capacity, R&D and technology cooperation, commercialization will also be improved.

The results show that the increased attention of governments and free economic zones to R&D in technology and patent protection has led to huge improvements in the intellectual capital sector. Moreover, free economic zones have become the main conductor of technological innovations. Some international free economic zones have developed dynamic programs to enrich intellectual capital and have adopted an innovative partnership model, which in the form of a complex on campus is aimed at bridging the gap between academia and business. Such projects offer a productive internal environment of cooperation for technical and business faculties, which jointly implement projects for the development of cooperation with partners. Moreover, it helps to bring the skills and knowledge of the university staff and students in line with modern real needs of the business environment and to update the knowledge base of the university taking into account the latest industry achievements.

In the literature there are many indicators of the effectiveness of cooperation ZVO. It is proposed to use the number of patents (Ryan, 2009), scientific and technical articles (Xia et al., 2014), high-tech production and exports (Salimi and Rezaei, 2016), income from intellectual property (Aiello et al., 2019), export of intellectual capital services, export of cultural and creative services, export of creative goods (Valentin and Jensen, 2007). In general, the initial indicators can be divided into two groups: tangible and intangible. To find a suitable partner, it is recommended to conduct the correct process of choosing a partner before starting cooperation. In this sense, confidence in goals, objectives and needs is also a necessary condition. Only then can you start looking for a suitable partner with the same interests and goals. Adequate search strategies can facilitate the search for a suitable cooperation partner. To do this, you must use the method of evaluating the partner using certain criteria. For this purpose, 36 partial indicators were initially selected. They were grouped into six constructs, four of which focused on input factors and the rest on output factors (Table 1).

Table 1

Factor indicators and data source for establishing cooperation of higher education institutions

Latent variables	Description of the indicator	Code
Institutional factors		IIF
	Political and operational stability	IIF1
	Government efficiency	IIF2
	Quality of legal regulation	IIF3
	Ease of starting a business	IIF4
	Gross R&D expenditures (R&D)	IIF5
	Education costs	IIF6
Human factors		IHF
	PISA scales for reading, mathematics and science	IHF1
	Graduates in science and engineering	IHF2
	Entry mobility at the level of higher education	IHF3
	Researchers, full-time equivalent / million people	IHF4
	Employment in knowledge-intensive services	IHF5
	Research talents in commercial enterprises	IHF6
Relationship factors		ILF
	VRNDKR, performed by commercial enterprises on the basis of ZVO	ILF1
	VRNDKR, financed by commercial enterprises on the basis of ZVO	ILF2
	Research cooperation between universities and industry	ILF3
	The state of development of clusters	ILF4
	Joint Venture Agreements / Strategic Alliances	ILF5

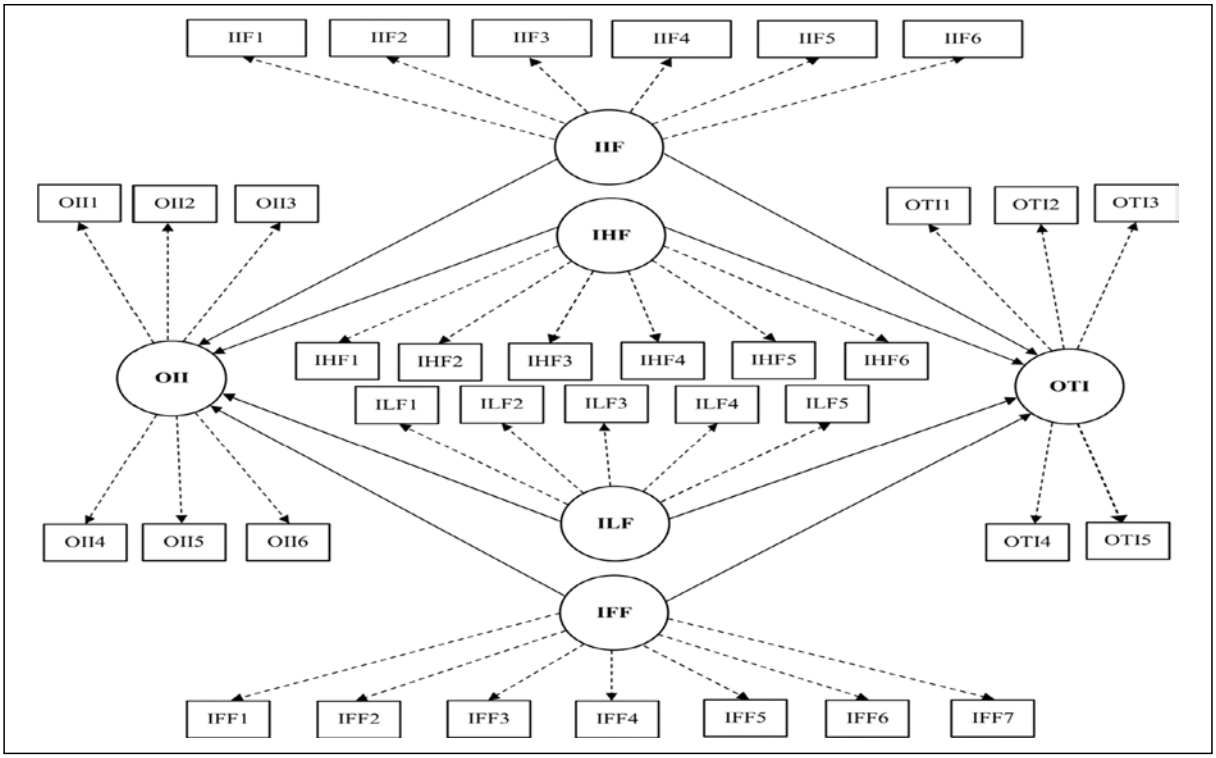
End table 1

Latent variables	Description of the indicator	Code
Framework factors		IFF
	Access to information and communication technologies (ICT)	IFF1
	Use of ICT	IFF2
	Electricity production, kW / mln. os.	IFF3
	Logistics indicators	IFF4
	Gross capital accumulation	IFF5
	Environmental indicators	IFF6
	The rule of law	IFF7
Intangible outputs		OII
	Patent applications for origin	OII1
	International applications for the conclusion of agreements on patent cooperation (PDC) on origin	OII2
	Scientific and technical publications	OII3
	Number of classes of applications for trademarks by origin	OII4
	Industrial designs by origin	OII5
	ICT and business modeling	OII6
Tangible indicators of results		OTI
	Export of cultural and creative services	OTI1
	Export of creative goods	OTI2
	GDP growth rate per employee	OTI3
	Production of high-tech and medium- and high-tech products on the basis of joint clusters with ZVO	OTI4
	Density of new enterprises created jointly with the Free Economic Zone	OTI5

Source: World Intellectual Property Organization (WIPO), 2019–2021.

The compatibility of goals between the partners is one of the greatest guarantees of the effectiveness of the cooperation of the Free Economic Zone. The inability to achieve the desired result is often the result of incompatibility. For example, companies seek to hide from competitors the revolutionary discoveries made at universities, while universities want to publish them. Therefore, finding a win-win situation with balanced benefits for both partners is of paramount importance. This can only be achieved if both partners understand each other's interests. It is also important that partners agree on achievable goals through a common understanding of the objectives and develop a clear strategy throughout the collaboration. It should also be added that partners often have unrealistic expectations about the results of cooperation, and / or have different feelings of urgency.

Based on these constructs, a model of the interaction of free economic zones in the system of cooperation management of higher education institutions was proposed (Fig. 1).



Source: developed by the author.

Fig. 1. **Schematic diagram of internal and external relations of the model for the creation of cooperation of higher education institutions**

In fig. 1 shows a diagram of the model, where during its construction were considered both internal and external relationships. The evaluation was performed using SmartPLS software.

This study uses the method of modeling structural equations (SEM). SEM covers many statistical techniques that can be used to approximate a network of causation. The theoretical model defines a network that connects at least two latent complex concepts. Several observable indicators measure each of these concepts. In essence, we can study the complexity within the system by considering the network of causal relationships between latent concepts – "latent variables". Many measured indicators are used to measure each of these latent variables and are defined as "explicit variables". Accordingly, models of structural equations are the point of contact between path analysis and confirmatory factor analysis (Banal-Estañol et al., 2011). Among the methods of estimating SEM models, the method based on covariance (CB) 2, invented by K. Yeresky, has long been the most popular. Its recognition was so general that the phrases appeared in the social sciences: SEM and covariance-based structural equation modeling (CB-SEM) have been synonymous for many years (Esposito Vinzi et al., eds., 2010). Meanwhile, H. Wald developed an alternative approach – the method of least partial squares (PLS). Its description and application for estimating models with latent variables was presented by

H. Wald, in particular, in the following works: (Esposito Vinzi et al., eds., 2010; Chin et al., 1996; Wold, 1980). Since the PLS method was an alternative to K. Jeresky's "hard" modeling, ie based on strong assumptions about the normality of distributions and requires large samples, H. Wald called his PLS approach "soft" modeling (Chin et al., 1996; Wold, 1980). After some time, the term "PLS-modeling of paths" came into use, and then, to emphasize that PLS is an alternative to CB, it became known as "PLS-modeling of structural equations" (PLS-SEM). PLS-SEM and CB-SEM were developed as different, albeit complementary, methods with specific goals and requirements in the early 1980s (Hair et al., 2017). Currently, there are also different properties of PLS-SEM and CB-SEM, with an emphasis on the complementarity of these two methods, rather than competition between them.

The SEM model consists of two submodels: structural and measuring. The phrases "internal model" and "external model" are also used in PLS-SEM terminology, respectively. The structural model describes the relationships between latent variables, while the measurement model describes the relationships between latent variables and the indicators by which they are identified, also known as expressed variables (Esposito Vinzi et al., eds., 2010).

Research Findings and Prospects. When constructing a structural model, it is necessary to pay special attention to two aspects: the nature of the analyzed latent variables and the associations that arise between them. It is important to distinguish between exogenous and endogenous variables. In addition, all the formulated elements of the conceptual scheme must be derived from theory and logic. If the theoretical basis is missing or the theory is contradictory, you should rely on your own judgments, experience and intuition (Rogowski, 1990).

The specification of the measurement model is at least an important step in the modeling process. Testing the hypotheses reflected in the equations of the structural model can be reliable even when the latent variables are correctly determined using indicators. And the choice of indicators is just as important as the choice of how to determine them (Rogowski, 1990). Determination of latent variables using indicators can be deductive or inductive (Henseler et al., 2012). In the first approach, the indicators reflect the latent variable being determined and are called the reflecting indicators, and the measurement model is called the reflecting measurement model. In the case of inductive determination, it is assumed that the indicators are latent variables, hence the expressions formative indicators and formative measurement model (Henseler et al., 2012). In addition, the choice of observable indicators should be preceded by an in-depth and thorough review of the literature, including theory and empirical research to measure the latent variables present in the model. Along with the study of correlations of latent variables, PLS-SEM modeling allows to approximate the values of these variables (weighted sums of indicators). To do this, for each of

the latent variables of the model is calculated synthetic dimension, which can be used to obtain a linear ordering of the studied objects.

The PLS-SEM model is evaluated by the PLS method. The algorithm simultaneously evaluates the internal parameters of the model – path coefficients – and the external parameters of the model – external weights and external loads. The procedure also provides estimates of the values of all latent variables included in the model. The purpose of the estimation is to maximize the explained variance of the dependent latent variables. At the first stage there is an iterative estimation of scales of model of measurements and values of latent variables. In the second stage, the loads and path coefficients of the structural model are estimated. A detailed description of the PLS algorithm can be found, for example, J. Henseler et al. (2012) and N. Wold (1980), and its generalization – in J. Rogowski (1990). Verification of the PLS-SEM model is a two-step process. First, the structural model is evaluated. Second, if the validity of the structural model is confirmed, the structural model is tested.

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HOW TO CITE THIS ARTICLE
Bebko, S. (2022). Methodical aspects of determining the effectiveness of free economic cooperation in the system of cooperation management of higher education institutions. *Management*, 1(35): 9–21. https://doi.org/10.30857/2415-3206.2022.1.1.