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ASSESSMENT OF THE FINANCIAL RESULT OF PUBLIC-PRIVATE PARTNERSHIP PROJECT IMPLEMENTATION USING THE EXAMPLE OF A CONCESSION AGREEMENT

ABSTRACT

The article is aimed at developing a methodological approach to improving the efficiency of assessing the financial results of implementing Ukrainian and European business projects. In this context, the object of study is a specific individual partnership and cooperation project. The research has established that one of the key informational aspects of such a partnership is the assessment and forecasting of the financial result. The goal of the research is to present the methodological approach to assessing financial performance for an individual project in the most detailed form possible. The article presents an approach based on modern simulation modelling methods, systems analysis methodology, and the method of composite seasonal indices. All modelling processes were conducted using MATLAB software. MATLAB is a high-level programming language and interactive environment for numerical computation, visualization, and programming. This program is widely used for modelling and data processing in fields such as engineering, scientific research, and mathematics. The research result is presented as an approach to the mathematical modelling of assessing the financial performance of partnership projects of Ukraine with representatives of EU business. It is necessary to emphasize that the presented research has limitations related to changes in Ukraine's hyperdynamic external environment provoked by war. Forecasts may vary depending on the development of military actions. Therefore, the prospects for further research should be directed towards improving the informational provision in the system of partnership and cooperation with EU countries to increase their own investment security.

Keywords: financial performance, modeling, infrastructure projects, investment security, business, state, partnership, evaluation system

JEL Classification: E60, F30, C50

INTRODUCTION

It is well known that public-private partnership, as a process of interaction between the state and the private sector aimed at implementing certain projects or programs focused on the development of the economy, infrastructure, science, education, healthcare, and other fields, is a subject of constant research and discussion at both national and international levels. The involvement of a private partner from another more developed country is becoming increasingly relevant. In Ukraine, this issue is also under constant consideration. The activation of public-private partnership relations in Ukraine and their effective use as financing tools for public projects is one of the priority areas for the development of national economic sectors in the context of the ongoing war and even for post-war reconstruction. The goal of forming such a partnership is to create favourable conditions and opportunities for the implementation of joint projects between businesses from another country and the state. The transformation of socio-economic relations, and changes in economic, social, and political priorities, in fact, create new demands for government authorities to develop effective financial mechanisms capable of stimulating the development of economic entities. Financial forecasting plays a significant role in this process. It should be noted that the initiation of such a partnership arises from existing deficiencies that the state is unable to resolve on its own. However,

involving a private partner from another country requires that they have certain guarantees or information about the financial benefits of this partnership. This aspect is emphasized when determining the financial mechanism of public-private partnerships in the legal frameworks of countries around the world, including Ukraine. In our opinion, public-private partnership is an effective tool that will accelerate the post-war recovery of Ukraine's economy. At the same time, fully utilizing its potential for post-war reconstruction requires specific efforts and reforms to achieve the maximum result. First and foremost, the government must ensure appropriate conditions for attracting private partners from other countries. This can be achieved by creating a favourable legal environment and demonstrating political will to develop such partnerships. This will attract more investors and businesses from EU countries to joint projects. Secondly, implementing anti-corruption reforms, reforming the legal environment, and enhancing administrative efficiency will help create favourable conditions for partnerships and ensure transparency and public trust. Even in wartime, corruption can be overcome and transparency increased. Equally important is supporting active public-private dialogue to consider the interests of both parties and develop effective strategies. This can be achieved through forecasting and providing complete information about the project and its potential benefits.

The last thirty years have been marked by a gradual realization among business representatives and the state of the need to pay maximum attention to security issues. Specialized units solely focused on physical protection have been replaced by services that now emphasize addressing threats and creating conditions for achieving investment-related interests. Gradually, the issue of the financial performance of new projects at all levels, from micro to macro, has become most significant, especially with significant changes in the external environment dynamics. At the same time, the more traditional concept of investing has undergone significant changes over the past decades due to the influence of global socio-economic trends related to poverty alleviation, population well-being, social justice, and environmental improvement. Even impact investing has emerged, aimed at inclusive and innovative economic development. All this requires financial evaluation.

It should be noted that the proliferation of economic, financial, and social problems in Ukraine due to the implementation of martial law and the actions of the aggressor country has necessitated the creation of the safest possible conditions under such circumstances, to preserve its own infrastructure and withstand new threats. At the beginning of the hostilities, the management of most enterprises began to change their own security strategies. Along with this, the partnership between the state and the private sector decreased for a short period, although it remains relevant and necessary in today's conditions.

LITERATURE REVIEW

It should be noted that public-private partnership is an extremely popular theme among a significant number of leading researchers around the world. The majority of research focuses on the financial aspects of such partnerships and forms of cooperation where the state and private businesses work together to achieve a certain socio-economic effect. For example, Jiao (2017) and Guo, et al. (2017) view public-private partnership as a model for obtaining financial benefits by both participants. While this can be partially agreed upon, it raises the question of how to accurately predict or forecast this benefit.

In most scholarly works, it is constantly noted that public-private partnerships have several structural elements that must be adhered to. Interestingly, one such element is the problem of forecasting the potential financial benefit for both sides. Typically, the state does not pursue financial results from such cooperation, so forecasting is more critical for the private partner (Brinkerhoff, 2011; Liu, 2019, Videira, 2023).

In the scientific-practical literature, there is an opinion (Rezouki, 2022) that the concept of forecasting financial outcomes from public-private partnerships is highly flawed due to various reasons, one of which is the extremely unstable external environment. For instance, more recent publications (Yemanov, et al., 2023, Richardson, 2024) have noted that the COVID-19 pandemic and the war in Ukraine have once again proven how unstable and hyperdynamic the external environment can be, making forecasting extremely difficult. As Cui, et al. (2018) rightly notes, forecasting the financial results of public-private partnerships today is information that only partially demonstrates what the private business can expect from such cooperation. Correctly stated (Amadi, 2018), however, part of managing public-private partnership projects is satisfying the informational needs of all project participants, including the results of forecasting financial outcomes.

The scientific and practical literature (Shuliuk, 2023) states that public-private partnership encompasses a set of ownership rights, financial-economic, organizational-managerial, and legal relations that develop between the state, local governments, and a private partner within the frameworks of financing models, ownership, and management relations. These involve participating in a system of agreed-upon activities for value creation, forming various public-private partnership models and serving as the basis for choosing a specific scheme of relations between partners for implementing a particular

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project. Notably, the private partner can be from another country. Ukraine also practices this approach. Public-private partnership is considered a form of agreement among the public, private, and public sectors of the economy, requiring qualitatively new investment resources from the private partner (funds, technologies, experience, reputation, etc.) and transferring key risks to the private partner (design, construction, etc.). However, this is extremely difficult to achieve during wartime. It should be noted that the war continues, destroying our cities and villages, military and civilian objects, industry, transportation, energy, and social infrastructure. Nonetheless, the understanding of an inevitable return to peace-time forces Ukraine to change laws now to encourage investments in the restoration of lost property and the reconstruction of the economy as a whole. Given the scale of destruction and the loss of housing for a significant part of the population, there is a need to involve private partnerships. One such private partner could be businesses from EU countries.

At the same time, it should be noted that the issue of cooperation with the EU countries in the context of increasing the security of Ukraine has not remained without attention among the scientific community. For example, Parisi, (2019) suggests considering partnership as one form of security. We should agree with this, since attracting foreign investment in any form is only beneficial in the context of security development a more recent study, by Kryshtanovych et al. (2023) and Dobrovolska et al. (2024) addresses the optimization of state regulation concerning the safety and security of business operations. Their focus on local approaches provides valuable perspectives on how EU countries can tailor regulations to improve investment climates and safeguard economic interests within cooperative frameworks. At the same time, it is possible to single out a number of gaps in the literature that still remain (Figure 1).

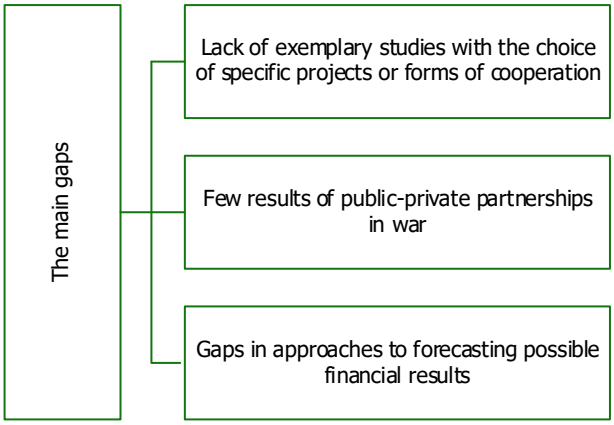

Figure 1. Gaps in the literature in the context of the selected research topic.

In this context, our research focuses on infrastructure projects in Ukraine. The literature review and theoretical material analysis revealed that the financial viability of such projects significantly depends on the approach to evaluating their performance.

AIMS AND OBJECTIVES

This article aims to present a methodical approach to improving efficiency in evaluating the financial performance of partnership projects between Ukraine and EU business representatives. The task of the article is to select a clear example of one type of active partnership between Ukraine and foreign business, in order to demonstrate the effectiveness and efficiency of the approach to evaluating the financial result of implementing Ukrainian and European business projects.

METHODS

Systems analysis is a methodology for studying any objects as systems and analyzing these systems. The method of complex seasonal indices is a model used for analyzing time series where the effects of factors are considered as a combination of additive and multiplicative effects. In such a model, data variations are explained through addition (additive components, for example, trends and seasonality) and multiplication (multiplicative components, which scale the effect, typically associated with cyclical or other variable factors). This allows for more precise modelling of data that exhibit variable amplitude over time. Simulation modelling is a research method in which the studied system is replaced by a model that accurately describes the real system, and experiments are conducted to obtain information about this system. Simulation modelling will facilitate the possibility of forecasting various financial benefits from the partnership between

Ukraine and EU businesses. For all this, a computer program for mathematical modelling, MATLAB, has been used. MATLAB is a suite of application programs for solving technical computing tasks and a programming language of the same name. This package is aimed at preparing interactive documents with calculations and visual support. MATLAB is used for designing control systems and in many other scientific and engineering fields and is used in complex projects to visualize the results of mathematical modelling. Innovation is revealed through the combination and mixed use of already traditional methods for scientists, in such a way that, through the appropriate software, it is possible for the project management or one of the cooperation parties to carry out this kind of modelling and forecasting.

RESULTS

Of course, the active phase of the COVID-19 pandemic has already ended, and EU countries, including businesses, have transitioned into the post-pandemic phase, but the consequences are still felt. It is still possible to observe active collaborations between businesses and states in the form of individual joint projects. That is, when there are significant crisis events in the external environment, there is a substantial activation of joint projects with business and the state. Meanwhile, Ukraine has faced new challenges. Military actions have significantly altered financial security issues, exacerbating resource provision issues, including investments in the country as a whole. Losses, the slowdown of economic processes in the national economy, and limitations in foreign economic activity significantly affect the financial state of both individual enterprises and the state as a whole. The problem exists at all levels, from micro to macro. Alongside this, one of the ways out of such crisis situations is partnership and collaboration on joint projects. The current practice of financial security does not address investment security issues well enough and is oriented towards authoritarian management with strict adherence to the regime for responding to typical risks and threats, which, in conditions of high dynamism of changing operating conditions and shifts in the priority of certain factors, does not provide the necessary level of security activity effectiveness. The current situation fundamentally actualizes the issue of partnerships with businesses beyond the country's borders. It is necessary to involve resilient and stable business units from outside, which together can help restore Ukraine. It is evident that the number of infrastructure projects in Ukraine has decreased due to the onset of military actions, including those with the international business of EU countries, but those that remain must yield positive financial results and therefore are subject to thorough assessment. There has been a significant decrease in the number of such partnerships during the period of active hostilities in Ukraine in 2022 (Figure 1).

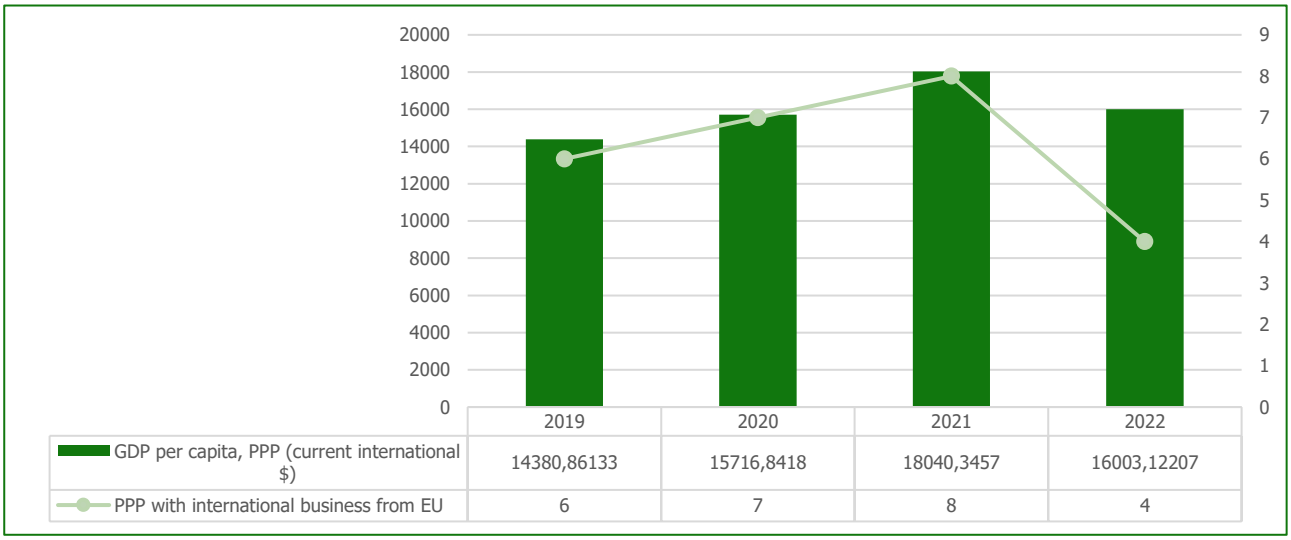

Figure 2. The number of Ukraine-EU Business Partnerships and GDP Per Capita in Private-Public Partnerships. *(Source: State Statistics Service of Ukraine, 2023)*

In the context of a practical example, a partnership in the form of a concession at the Izmail Sea Port will be chosen. The seaport is served by one railway station with three railway entrances. The port is connected to roadways. The idea in the concession is the development of a technical and economic justification funded by a private investor from an EU country. (the project term is approximately 35 years, and the projected profit volume is expected to be more than UAH 2 billion). At the same time, it should be noted that concession agreements are contracts under which the state (in our specific case, Ukraine) transfers to a private partner (in our case, a representative of a business from the EU country) the right to

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manage and modernize the facility (in our case, port mentioned above). Let us present the initial data for constructing a model to assess the financial performance of this project over the next 35 years (Table 1).

Table 1. Projected amount of profit from the process of implementing a partnership project between Ukraine and businesses from EU countries over 35 years.

Year	Value of profit, UAH billion
1	0.17
2	1.17
3	1.96
4	3.97
5	5.46
6	2.63
7	4.58
8	6.61
9	5.23
10	8.47
11	9.42
12	15.29
13	16.86
14	19.42
15	23.81
.....	
35	62.82

If we graphically represent the curve of changes in the resulting monetary result over 35 years, we get Figure 2.

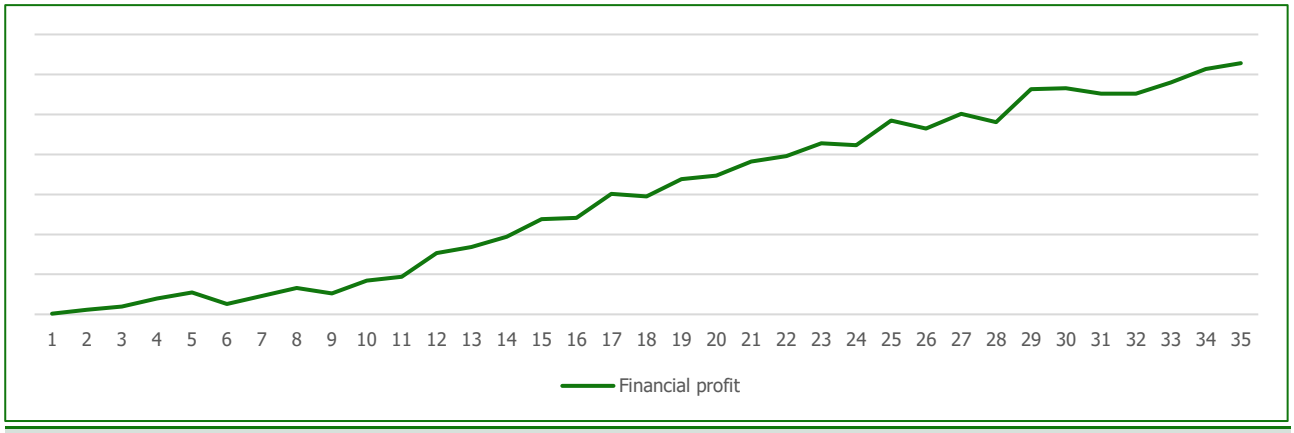

Figure 2. The curve of changes in financial profit for the implementation of the partnership project, UAH billion.

Further, in order to construct an appropriate mathematical model of financial performance for this project, it is necessary to take into account the effect of the so-called financial instability. In our case, this assumes intermediary equality (1):

$$g(t)-FD(t)=\min \quad (1)$$

where FD(t) represents potential profit data; In the equation g(t) is being subtracted from another function FD(t) (potential profit data), and this difference is being minimized. The function g(t) is described as an approximate function modelled by a polynomial of a certain degree.

Fitting financial profit curves has revealed that profit growth is not linear, but is in fact exponential. Thus, the exponential growth of profits was confirmed (Figure 3).

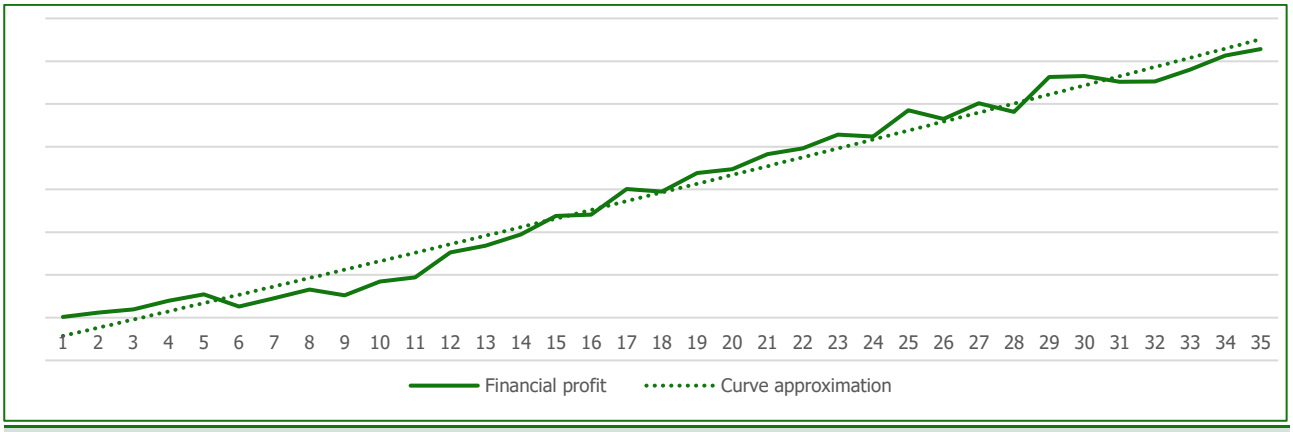

Figure 3. Curve approximation of changes in financial profit during the implementation of the partnership project, UAH billion.

In our opinion, modelling in the form of forecasting possible financial outcomes will provide an opportunity to better understand how effective the partnership can be both for the business engaging from another country and for Ukraine itself.

In our opinion, it is the construction of the model - the process of obtaining financial results for both businesses from the EU countries and Ukraine in a partnership that will allow us to assess the effectiveness of such a partnership. In this case, the financial result model FR(t) itself will be as follows (2):

$$FR(t)=A * e\left(\frac{K}{t}\right)+n(t), t \in [0,T] \quad (2)$$

where A is the maximum level of expected financial result; k – coefficient of the growth rate of financial performance; t - the time-space of project implementation; T is the time duration of the project implementation; n(t) is an unpredictable random factor.

At the same time, Figure 4 shows the curves of the financial performance indicator for 35 years for the selected partnership project depending on the change in this coefficient k (Figure 4).

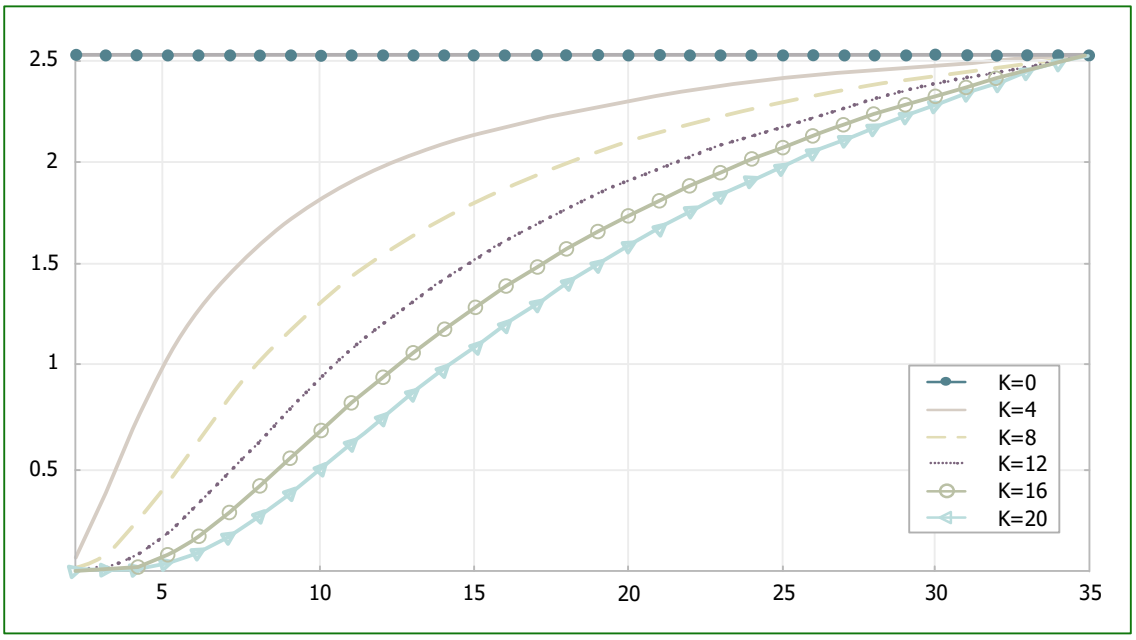

Figure 4. Dependence of the financial performance indicator on the value of k. Notes: X-axis represents years, Y-axis represents profit, UAH billion.

At the same time, the coefficient k itself is given mathematically by the following function (3):

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$$k=\frac{k2}{k1} \quad (3)$$

where k1 is just an indicator of financial results (FR) and profitability; k2 is an indicator of financial losses and costs in general.

At the same time, k2 itself is determined by the following formula (4):

$$k2=k21+k22+k23+k24 \quad (4)$$

where k21 – represent operational financial losses; k22 – capital financial losses; k23 – tax payments; k24 – concession payment.

At the same time, it should be noted that when attracting business from EU countries, we must also adhere to international practice regarding the socio-economic significance of this type of cooperation. And therefore, it is necessary to establish and take into account the concession payment. For this purpose, there is a separate resolution of the Cabinet of Ministers of Ukraine "On approval of the methodology for calculating concession payments" dated August 12, 2020 No. 706 based on the results of the concession competition or direct negotiations with potential investors. We propose to this Resolution the following calculation according to formula (5):

$$KP=NF*SR \quad (5)$$

where, KP is the volume of the concession payment expressed in the currency of the state that forms the basis of the partnership (in our case, in UAH); NF will be the net income from concession activities for the year; SR – payment rate.

First, the net income model (6) is determined:

$$NF(t)=A_{NF}*e\left(\frac{k23/_{k1}}{t}\right)+n(t,m,D), t\in[0,T] \quad (6)$$

The very model of the concession payment to the budget should be submitted as an additive-multiplicative mixture of deterministic and random components.

At the same time, the model of financial performance will have the following form (7):

$$FR(t)=A*e\left(\frac{\sum k2i/_{k1}}{t}\right)+n(t), t\in[0,T] \quad (7)$$

But at the same time, it should be remembered that the already mentioned financial instability has the character of zero expectation, i.e., the following equality (8) is achieved:

$$n(t)=n(t, m, D) \quad (8)$$

D – variance (maximum deviation of financial instability); the value of financial instability n(t); t – time-space of project implementation.

Thus, to develop a suitable model of the expected financial result from the project, we have the following modelling result (Figure 5).

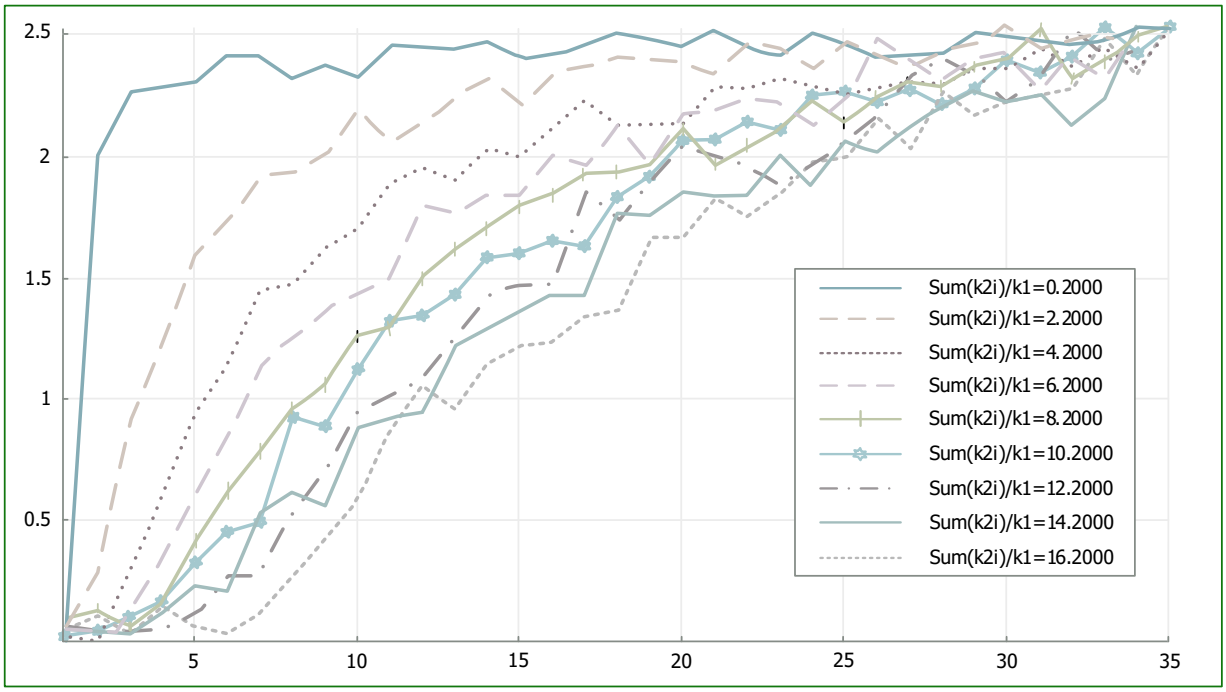

Figure 5. The result of modelling the expected financial effect of partnership and cooperation.

Thus, the constructed model of the expected financial result from partnership and cooperation in the form of an additive symbiosis allows to make a forecast of the received profit in this way. At the same time, there is always an opportunity for the entire period of 35 years to identify the optimal period in the life cycle of the partnership project. This kind of modelling will be useful both for Ukraine and for the leadership of the interested business regarding cooperation and partnership.

DISCUSSION

Discussing the results of our research, it should be noted that when compared to existing studies, there are several distinctive differences and changes. For instance, Martenes et al. (2023) well describe the social risks and outcomes that can stem from financial partnership projects. However, their approach to evaluation does not include forecasting as such.

Popelo et al. (2022) suggest evaluating partnerships considering new conditions brought by digitalization. This is extremely interesting since our forecast extends many years into the future, and within this time, technologies will undoubtedly change. We already see how technologies based on artificial intelligence are altering the investment climate in EU countries.

It should be noted that when we discuss the results we have obtained, it is important to compare them with those that also use the method of modelling to obtain a certain forecast based on specific indicators. For example, Zheng, et al. (2021) and Zarcojasso (2005) propose such forecasting models, but in our view, their all-encompassing approach is flawed because each partnership project or form of cooperation between the state and private business is an extremely individual matter. In our opinion, forecasting should be done on an individual basis, as exemplified by our work. Moreover, forecasting in the formation of public-private partnerships is not only about providing information that satisfies all parties in financial terms; it is also a way of effective budget planning and seeking opportunities to reduce costs, which is extremely important in the context of, for example, ensuring financial security (Versal, et al., 2023). However, the forecasting model proposed by Tunčikienė, et al. (2014) is more aimed at making short-term managerial decisions and does not use modern programming methods. This is another problem with most research prior to 2020, where the software proposed within the approach does not leverage artificial intelligence technologies, leading to inherent errors in forecasting.

It's also appropriate to mention that various approaches to forecasting financial activity during the active phase of the COVID-19 pandemic proved incorrect due to the onset of the war in Ukraine (Savitri et al. 2022). However, the approach to evaluation itself will not disappear and can be either modified or adapted. In this context, we agree with the results presented by Khrushch et al. (2023), in which forecasting and any forms of evaluation—both security and performance—are all informational support or a basis for making appropriate decisions. As a result, this may be one of the achievements

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in the conducted research. Alongside this, Zachepa et al. (2019) suggest evaluating security and financial results through a management perspective, i.e., in a way that facilitates making correct and effective managerial decisions in the future.

In this regard, it should be noted in the discussion that, as an example, we have selected only one type of partnership concerning the aforementioned port. Therefore, at this moment, the demonstration of the capabilities of the proposed approach is confined to a specific practical application. For this reason, it is too early to speak of the durability and high informational provision of the obtained results, since each type of partnership and cooperation is characterized by its own individual features.

When discussing such partnerships, it should be noted that their essence lies in the fact that, as a result, government authorities and local governments can achieve the desired socio-economic effect and cost optimization during implementation while meeting the financial expectations of the private partner from another country (in our case, a port project with a partner from an EU country). Thus, the state (Ukraine) and businesses from the EU, starting to work on a joint project, have a mutual interest in port-related projects. Both in theory and practice, both parties should benefit from the collaboration – for the foreign business, this means financial profit (which can be forecasted using the proposed approach), and for the state, suitable moored ships in the ports, among other things. Effective implementation of financial mechanisms of public-private partnership in the development and support of the country's economic sectors requires an institutionally prepared environment. This involves promoting the ideology of partnership, providing regulatory and methodological support for the implementation process of such business-government interaction, ensuring political and economic stability, and preparing all potential participants for implementing promising forms of partnership. Moreover, if, as in our case, the business is from EU countries, all of the above must comply with EU norms and standards.

CONCLUSIONS

In summary, the article proposes a methodological approach for assessing the financial performance of partnership projects between Ukraine and EU business entities. It is recommended that such evaluations be conducted throughout the entire life cycle of the project using the types and criteria based on achieving the individual goals of the participants. At the same time, it is noted that it is necessary to take into account the conditions of project implementation and the associated risks, which significantly affect the final cost of goods or services. It is argued that the application of this methodology will enable the assessment of the level of achievement of partnership goals at each stage of project implementation, identify negative trends, and determine factors that hinder achieving the desired socio-economic effect. The model presented can illustrate what the profit model might look like in the context of activity from the private partner's side in international business with EU countries. The forecasted financial instability over the next 35 years from such a partnership is revealed. A model for forecasting profits for a specific partnership project with a private business from an EU country is presented.

In our opinion, in practice, the proposed approach to assessing financial results can be used in the activities of enterprises that aim to deal with various countries in the context of implementing joint infrastructure projects. While the proposed approach is effective, forecasting may vary depending on the development of military actions in Ukraine. Therefore, the prospects for further research lay the foundation for improving the information support in the partnership and cooperation system with EU countries to enhance our own investment security.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ОЦІНЮВАННЯ ФІНАНСОВОГО РЕЗУЛЬТАТУ ДЕРЖАВНО-ПРИВАТНОГО ПАРТНЕРСТВА ПІДПРИЄМСТВ КРАЇН ЄС З УКРАЇНОЮ НА ПРИКЛАДІ ДОГОВОРУ КОНЦЕСІЇ

Дослідження спрямоване на розроблення методичного підходу до підвищення ефективності оцінювання фінансового результату реалізації українських і європейських бізнес-проєктів. У цьому контексті о'бєктом дослідження є конкретний окремо взятий проєкт партнерства й співпраці. У результаті дослідження встановлено, що одним із ключових інформаційних аспектів реалізації такого партнерства є оцінювання й прогнозування фінансового результату. Мета дослідження полягає в представлені в максимально деталізованому вигляді методичного підходу до оцінювання фінансової результативності за окремо взятим проєктом. У статті представлено такий підхід, який ґрунтується на сучасних методах імітаційного моделювання, методиці системного аналізу й методі складених сезонних індексів. Усі процеси моделювання здійснені за допомогою програми MATLAB. MATLAB — це високорівнева мова програмування та інтерактивне середовище для числових обчислень, візуалізації й програмування. Цю програму широко використовують для моделювання та обробки даних у таких галузях, як інженерія, наукові дослідження та математика. Результат дослідження подано у вигляді підходу до математичного моделювання оцінки фінансової результативності реалізації партнерських проєктів України з представниками бізнесу країн ЄС. Необхідно підкреслити, що в представленому дослідженні є обмеження й стосуються вони змін у гіпердинамічному зовнішньому середовищі України, спровокованих війною. Прогнози можуть відрізнятися залежно від розвитку воєнних дій. Саме тому перспективи подальших досліджень мають бути спрямовані на вдосконалення інформаційного забезпечення в системі партнерства й співпраці з країнами ЄС для підвищення власної інвестиційної безпеки.

Ключові слова: фінансова результативність, моделювання, інфраструктурні проєкти, інвестиційна безпека, бізнес, держава, партнерство, система оцінювання

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