DOI: 10.55643/fcaptp.3.56.2024.4380

STATISTICAL METHODS FOR MANAGING RISKS IN PLANNING FOREIGN ECONOMIC AND LOGISTICS ACTIVITIES FOR SUSTAINABLE DEVELOPMENT OF THE ENTERPRISE

Maryna Ivanova
D.Sc. in Economics, Professor of the Department of Management, Dnipro University of Technology, Dnipro, Ukraine;
e-mail: ma_riva@ukr.net
ORCID: 0000-0002-1130-0186
(Corresponding author)

Svitlana Sannikova
Candidate of Technical Sciences, Associate Professor of the Department of Management, Dnipro University of Technology, Dnipro, Ukraine;
ORCID: 0000-0002-5676-2528

Olena Varyanichenko
Candidate of Economy Sciences, Associate Professor of the Department of Management, Dnipro University of Technology, Dnipro, Ukraine;
ORCID: 0000-0002-1331-9673

Serhii Kharin
D.Sc. in Engineering, Professor of the Department of Management, Dnipro University of Technology, Dnipro, Ukraine;
ORCID: 0000-0002-8500-163X

Mykola Boichenko
D.Sc. in Economics, Professor of the Department of Management, Dnipro University of Technology, Dnipro, Ukraine;
ORCID: 0000-0002-9874-3085

Hanna Riabyk
Candidate of Economy Sciences, Associate Professor of the Department of Entrepreneurship, Production Organization and Theoretical and Applied Economics, Ukrainian State University of Chemical Technology, Dnipro, Ukraine;
ORCID: 0000-0002-2194-3054

Received: 17/03/2024
Accepted: 06/06/2024
Published: 30/06/2024

ABSTRACT

The article examines the topical issue of risk management in foreign economic and logistics activities, which is closely related to the enterprise's chosen strategy and ensures its sustainable development. The study considers the issue of developing a hedging strategy using statistical methods since adequate forecasting allows predicting the impact of external environment factors on the exchange rate, which will allow the enterprise to timely predict and mitigate the risks in foreign economic and logistics activities. The authors have used general scientific and special methods of systemic and structural analysis to clarify the directions of sustainable performance and risk management tools; formulate the goals and steps in choosing a strategy of hedging; compare the methods of foreign exchange rate risk hedging and perform correlation and regression analysis of factors that impact exchange rate under crisis conditions. The purpose of the paper is to study the specifics of ensuring the sustainable performance of an enterprise using statistical methods in risk management for planning foreign economic and logistics activities. The authors have proposed a definition of a hedging strategy based on the concepts, approaches, and ideas of asset and/or investment management with the aim of reducing loss through hedging instruments, whose feasibility can be substantiated by statistical methods. It has been found that the formation and successful implementation of a hedging strategy requires the use of statistical analysis in order to timely predict fluctuations in exchange rates. The findings of the research were tested based on the performance of PrJSC "Linde Gas Ukraine". In the strategy of hedging the exchange rate risks, it has been proposed to simultaneously open a foreign currency deposit and take a loan in the national currency to replenish the company's working capital. The perspective of further research is the implementation of the proposed hedging strategy and assessment of its effectiveness.

Keywords: statistical methods, risk management, foreign economic activity, logistics, hedging, strategy, planning, sustainability of the enterprise

JEL Classification: C40, E 47, G13, L19, O24

INTRODUCTION

Since 2014, the economy of Ukraine has been operating under the conditions of a hybrid war, which the Russian Federation has been waging against Ukraine. The large-scale military actions of the aggressor country on the territory of Ukraine, which began on February 24, 2022, have created new extraordinary challenges. There has been an increase in price and exchange rate volatility. As of 12/30/2023 compared to 02/23/2022, the official UAH/USD exchange rate devalued by 29.8%, and UAH/EUR devalued by 23.034%. The NBU imposed significant restrictions on the purchase of foreign currency by both individuals and legal entities. For a long time, it was only possible to purchase currency under contracts for the import of goods that were exclusively included in the lists of critical imports. Given the significant advantage and existing prospects for sustainable performance of many domestic enterprises, business entities need to consider statistical methods in risk management in general and hedging in particular when planning their foreign economic and logistics activities, given the conditions of company operation and development of the Ukrainian financial instruments market.

LITERATURE REVIEW

Modern scholars pay special attention to achieving the sustainable performance of enterprises by simultaneously addressing urgent issues related to environmental protection, increasing the efficiency of economic activity and compliance with social standards.

J. Cheng in [9] argues that the instability of both energy and financial markets significantly deteriorates the state of an economy, since supply chain logistics is highly dependent on economic and geopolitical factors, and macroeconomic uncertainty disrupts the smooth flow of goods and services throughout the supply chain. In his study, the author used QQR and GCQ analyses to discover the relationships between supply chain disruptions and factors of structural uncertainty, including the Russian-Ukrainian conflict (2022), the COVID-19 pandemic (2020-2021), and the GFC 2008. The findings can be used by policymakers, economists, and managers to formulate a strategy for mitigating the challenges and achieving a sustainable and resilient supply chain system, which would take into account the negative and destructive effects of geopolitical developments.

In his study [31], Sh. Shan focused on the increase in bank financing of blue-chip and other sustainable companies along with the growth of investments in digitalization, which leads to an increase in net interest margins. In other words, the risk of losing solvency decreases as firms' sustainability increases. Similarly, investment in digitalization reduces banking risks. These empirical findings indicate the need to adhere to the principles of sustainability to reduce risks in all types of economic activities of both blue-chip companies and the banking sector as a whole.

Notable research conducted by Manninen Kaisa [24] highlights the increasing interest among managers and scholars in effectively managing corporate sustainability (CS) to foster sustainable development. By merging principles of CS management with strategic management, an integrated approach should evaluate how managerial endeavours and resource utilization contribute to firm performance, emphasizing sustainability. Favourable conditions within the organization and among employees facilitate the implementation of an integrated strategy across the company. Internal activities become more targeted, encouraging interaction between managers and employees. Market conditions may both facilitate and impede implementation efforts, potentially constraining progress in specific market segments. Through outward-facing initiatives, companies can actively steer the market toward more sustainable practices.

In addition to this research is the article authored by Agoraki M.-E. K. [3], which explores the correlation between a firm's ESG reputational risk and its financial performance. ESG performance positively influences companies' stock market performance by enhancing transparency among stakeholders and aligning management actions with investor behaviour. Moreover, compared to conventional investment reporting, ESG metrics provide novel non-financial insights that impact financial markets, thereby mitigating information asymmetry and associated costs such as adverse selection and agency costs. Consequently, firms with robust ESG scores attract greater investor attention and cultivate consumer loyalty, thereby gaining a competitive edge. Additionally, cultivating an ESG reputation enables companies to showcase their dedication to societal values and align their interests with those of stakeholders and society, thereby bolstering their legitimacy. As a strategic objective, companies aim to enhance investor engagement and mitigate ideological risks by adhering to ESG regulations and integrating environmentally sustainable practices.

A notable article authored by Yu Tiffany Hui-Kuang [40] discusses the Universal Sustainable Development Goals (SDGs) established by the UN, which serve as global benchmarks for countries' economic and social advancement. The author proposes the utilization of indices as predictors (independent variables) to investigate the intricate cause-and-effect relationships influencing SDG accomplishments (outcome or dependent variable). The indices include the Inclusive Internet Index for evaluating digital technologies, the Corruption Perception Index for assessing transparency and integrity, the Global Innovation Index for quantifying innovation, the Global Entrepreneurship Monitor for gauging entrepreneurship, GDP for monitoring economic growth, and the Global Findex for examining financial technology (fintech). Employing Fuzzy Set/Qualitative Comparative Analysis (fsQCA) as the methodology, the study unveils numerous relationships across subsequent periods, each involving multiple predictors. Moreover, the causal relationships demonstrate similarities between different periods. Based on the research findings, countries can strategically select relevant causal relationships to enhance their progress toward achieving the SDGs, considering their unique competitive advantages.

To ensure the sustainability of enterprises, M.V. Shashina in [32] proposed the diversification of sales markets by searching for new markets and customers that are independent of the internal situation in Ukraine. These include first, exports, expansion of the distribution network, development of new products and services for the global market, and use of new technologies; second, search for alternative sources of funding since traditional sources of funding become unavailable in the context of military aggression. For this reason, companies should actively consider opportunities to receive investment from the state, and international organizations, or to attract credit resources under favourable conditions.

DOI: 10.55643/fcaptp.3.56.2024.4380

According to O. Karpenko, sustainability is ensured through constant interaction, impact and coherence of elements of the external and internal environment of the enterprise by maintaining a balance between resources, competencies and available market opportunities, and implementation of strategic and corporate management in accordance with the company's changing operating conditions. The easiest way for companies to achieve sustainability goals is to increase their own efficiency while reducing the loss of environmental and social value. This refers to the ratio between the value created and the resources used. Combined with a simultaneous overall absolute reduction in consumption, this should ensure a sufficient balance between the economic, social, and environmental components of sustainable production growth [20].

N.V. Kratkova, in turn, argues that sustainability is not an ultimate goal in itself, but a condition for achieving the organization's strategic goals. The effectiveness of the sustainable development mechanism is assessed by comparing the actual metrics of the enterprise's sustainability with the planned ones. If the desired results have not been achieved, then measures for sustainable performance are being developed. The study used a bionomic approach to the implementation of a sustainability mechanism as a tool to reach the strategic goals of the enterprise; the mechanism includes the following steps: diagnosis of shortcomings and available resources, identification of short-term goals; formation of scenarios for the ratio of components of the enterprise's sustainability; substantiation of tools for ensuring sustainable performance; control over the implementation of the sustainability mechanism; assessment of the sustainability mechanism effectiveness [21].

Thus, the implementation of the sustainability mechanism allows the enterprise to plan its foreign economic and logistics activities and mitigate external environmental risks.

Obadia C. [28] argues that the promotion program for exporting enterprises in foreign markets has not received adequate attention in research. While most studies focus on evaluating the adaptation of marketing strategies, they overlook the actual impact of the promotion program. Moreover, they often treat small and medium-sized businesses as miniature versions of multinational corporations, neglecting their unique characteristics. This study investigates the elements of SME export promotion programs and assesses their effectiveness in achieving export success. The author demonstrates that the behaviour of importers significantly influences the positive effects of promotion. Furthermore, the study illustrates how the interaction between the exporter's promotion program and the exporter-importer relationship impacts the importer's efforts on behalf of the exporter. Through structural modelling and analysis of survey data from SME exporters, the study develops and tests hypotheses. The analytical examination provides cost-saving recommendations particularly beneficial for resource-constrained exporting SMEs.

Mishrif A. [27] asserts that economic integration plays a crucial role in fostering economic growth, serving as a cornerstone in the modern global trade landscape for forging strong economic bonds between nations. Providing efficient trade logistics services is imperative for a nation's success in international trade. Competitive advantages are essential for enterprises engaged in active international trade. Logistics and supply chain infrastructure and operational capacity are pivotal for both international trade and local commercial activities. However, empirical studies delving into the impact of logistics on trade efficiency are scarce and limited. Therefore, this study aims to explore the role of logistics and supply chains in both international and domestic trade within a developing country context. Secondary data is utilized for analysis, employing the gravity model and GTAP10a software. The study encompasses the years 2014–2030. The findings underscore the necessity for developing countries to invest in logistics and supply chain infrastructure, workforce training, and the formulation of flexible logistics policies to bolster trade and commerce.

Ascari G. adds to the existing literature by investigating the influence of global supply chain pressures on inflation in the Eurozone and its implications for monetary policy. The findings from the Bayesian structural vector autoregression model reveal that shocks related to global supply chain pressures were the primary determinant of inflation in the euro area in 2022. Moreover, these shocks exhibit a highly persistent pattern and have a hump-shaped effect on inflation over time. Additionally, employing a New Keynesian model featuring two countries engaged in international trade of intermediate goods, the study demonstrates that the optimal monetary policy response to inflation driven by global supply chain factors is contingent upon the level of participation in the global value chain, suggesting a non-linear relationship [5].

In [11], Ji-Feng Ding investigated the risks of logistics operations using the best-worst-method (BWM) method to assess key risk factors. The author singled out 15 risk factors based on three aspects of risk assessment.

Ding Suiting [12], in turn, focused on the implementation of the Internet of Things (IoT). Real-time management strategies have been adopted by the global logistics industry, turning the branch into an intelligent service supplier. This paper establishes an evaluation framework for the logistics performance under social, economic and environmental dimensions by using time entropy weighting. Using a grey correlation approach, it was found a strong positive correlation between the logistics performance and the IoT market scale. The environmental regulation though positively correlated with logistics

sustainability, shows less potential to directly improve economic and social performance. It also indirectly promotes the sustainability performance of the logistics industry through support for technological innovation.

A noteworthy article by Kanno Masayasu examines the effectiveness of ESG in improving a company's creditworthiness. To this end, the author develops two methodologies for logistic regression with or without two-stage least squares for selecting default risk factors pertaining to Japanese firms given their ESG scores. The results show that ESG performance contributes more to the prediction of a firm's default risk for longer risk horizons [19].

Xiao Ping [38] performed research on risk assessment of blockchain-driven supply chain finance. For a long time, small and medium-sized enterprises (SMEs) have been facing the problem of financing difficulties. Therefore, how to solve the financing problem has become one of the most concerning problems in the development of SMEs. SMEs' credit risk spreading to core companies will have a major negative impact on their operations and growth, which will subsequently disrupt the smooth functioning of the whole supply chain. The steps of supply chain risk management (SCRM) can be divided into risk assessment, processing, and monitoring. The author illuminate present conditions and future development trends in risk assessment based on blockchain-driven SCF, mapping the study landscape from literature into a cohesive taxonomy and uncovering a few traits that distinguish this research along the way.

O.I. Pushkar studies a step-by-step process of risk management [30], which involves five stages. Step 1: identify external and internal risks for the logistics system; Step 2: carry out a qualitative and quantitative assessment of the risks; Step 3: analyze how the risk factors, risk amount and risk frequency impact the logistics metrics, using correlation and regression analysis, simulation modelling and analytical methods; step 4: carry out forecasting and modelling of the consequences of decisions taken to prevent logistics risk; step 5: assess the acceptability of the logistics risk and choose a management method for its mitigation (risk avoidance, localization, diversification, compensation, transfer, limitation, insurance).

Reducing the negative impact of logistics risks on the enterprise's activities can only be achieved by building an effective logistics risk management at the enterprise, which should be based on a scientifically sound methodology adapted to the realities of the enterprise, on advanced intellectual, innovative and information technologies, as well as on the global experience of managing enterprise risks [34]. Risk management in foreign economic activities and logistics is closely linked to the chosen strategy of the enterprise, which ensures its sustainable and efficient performance.

One of the most widely used risk mitigation tools is the hedging strategy, which was studied by G.I. Andreeva in [4]. The author believes that hedging involves the use of points that compensate for risk and transfer it (partially or fully) from the hedger to another market participant who has a contractual relationship with the hedger. These risks can be quantified and assets can be protected using various tools and technologies. A hedging strategy, in turn, is a set of specific hedging tools and methods to mitigate price risks. An effective hedging strategy is developed in order to transform risk from unfavourable to acceptable forms, i.e., the goal of hedging is to achieve an optimal risk structure - the ratio of benefits to cost.

In [39], V.O. Yavorska emphasizes that the long hedge strategy is aimed at managing price risks against price increases in assets or financial instruments that are hedged, while the short hedge is effective for managing price risks against price decreases in the future. In many cases, market participants can combine both types of hedges at the same time.

In [23], Zh.V. Kudrytska explains that there are two types of hedging according to the transaction technique: a short hedge, which begins with the sale of a futures contract and ends with its purchase (i.e., a reverse transaction); and a long hedge, which begins with the purchase and ends with the sale of a futures contract. It should be noted that a short hedge is used by the owners or manufacturers of a commodity to secure the price of future sales of the commodity in the existing market, while a long hedge is used by traders, processing companies or consumers of products to protect against an increase in the price of the products they are intending to purchase.

Noteworthy is the use of ETFs as a listed financial tool of investment, which is a portfolio of securities and is readily traded on exchanges similar to ordinary shares. In this case, the hedging strategy involves investing in securities for the period of market correction. This investment portfolio does not lose its value when the market declines, and in the event of an unjustified upward jump, the investor will be able to record profits on securities and wait for a natural price recovery. The most attractive option for implementing the strategy under such conditions is inverse (reverse) ETFs [2].

V.Y. Khokhlov, in turn, sees the essence of hedging in such a portfolio structure where its value remains unchanged despite changes in the input parameters used for hedging. The author researched the hedging strategy and proved that option contracts can solve the problems in risk management. For example, delta-neutral hedging only works well when there are slight fluctuations in the price of the underlying asset; dual-parameter hedging strategies allow overcoming some of the disadvantages of delta-neutral hedging and achieving better results. The Delta-Gamma strategy allows effectively hedging

DOI: 10.55643/fcaptp.3.56.2024.4380

a portfolio in the case of larger fluctuations in the price of the underlying asset, while the Delta-Vega strategy takes into account volatility fluctuations. Experimental results show that both strategies are significantly better than the delta-neutral strategy, although their results do not differ much from each other. From a theoretical point of view, the Delta-Vega strategy is to be more versatile, but in practice, no advantages over the Delta-Gamma strategy have been identified [22].

N. Hachicha [13] considers that advancements in econometric tools have facilitated a deeper comprehension of the interconnectedness among financial markets. A thorough understanding of how volatility transmits across various financial markets would furnish decision-makers, particularly investors and regulators, with insights into the extent and causes of market co-movements. For regulators, it's imperative to grasp the genuine causes and repercussions of market interdependencies to preempt volatility spillage from international markets into the national arena, thereby safeguarding financial stability and fostering economic growth. From an investor's standpoint, a nuanced understanding of market interdependence enables more efficient portfolio management and the formulation of effective hedging strategies. The heightened correlation among different segments of financial markets presents fresh opportunities, particularly for hedgers. When prices are perfectly correlated, risk can be mitigated as losses in one market can be perfectly offset by gains in another, thus any deviation from perfect correlation results in imperfect hedging.

Papathanasiou S. received the research findings demonstrating that value stocks can effectively mitigate the risk associated with volatility in other investment instruments, particularly when dealing with high beta and volatile stocks. Therefore, this analysis offers valuable insights for portfolio managers and investors, equipping them with strategies to hedge their stock portfolios more effectively [29].

The publications of foreign scholars deserve special attention. For example, Xing Yu in [41] examines selective hedging strategies for futures contracts based on market state expectations and compares hedging efficiency with traditional conventional hedging strategies with minimum variance. The main advantage of the proposed method is that it is a compromise between profit and risk rather than risk hedging at any cost. To achieve this result, a multi-input Hidden Markov Model (HMM) was used to identify the market state, assess the impact on the market, and further integrate the identification and measurement results to predict the price trend. The author proposed an adjustment criterion for model-driven hedge ratios based on the expected state of the market. For this purpose, an empirical analysis was conducted; the results revealed an advantage of the proposed dependencies of hedging strategies over traditional model-driven ones.

Yu-Min Wang develops a strategy for effective and dynamic risk hedging by taking into account the transitions between the types of spillovers between assets (stocks, bonds, real estate, currency, crude oil, gold), which are usually the basis for creating investment portfolios. The information on different asset prices in multi-directional states of the market was taken into account to determine the impact of state transformations on the effectiveness of dynamic hedging. The empirical results show that the model proposed by the authors reveals changes in information dissemination during the financial crisis and/or economic recession, and the use of dynamically weighted hedging portfolios is possible when constructed using different metrics. It was found that hedging efficiency and volatility vary depending on the state of information dissemination between different asset markets. The results also showed that panic (the fear index) explains the probability of market declines, and the hedging portfolio should be dynamically adjusted with changes in fear mood [37].

N. Hachicha considers a portfolio strategy as a risk mitigation tool, and impact of volatility between commodity markets and certain financial markets. The author empirically investigates the relationship between three financial indicators and five groups of products, based on the vector autoregressive process and variance distribution of forecast errors. The findings emphasize the significance of volatility impact on financial markets, which is not the case for commodity markets with low volatility externalities. It should be noted that commodity and financial markets are segmented rather than integrated [13].

M. Just focused on assessing the effectiveness of hedging the global stock markets by cryptocurrency, applying the theory of extreme value. The use of hedging tools significantly reduces the risk associated with benchmark investment, and the effectiveness of hedging should be assessed by comparing the percentage reduction in volatility of the paired portfolio relative to a single risky asset [18].

In the last time of the recent global financial crisis, there has been a heightened research focus on quantifying financial stability through various methods and models. These efforts have predominantly centred on individual countries, taking into account their unique characteristics and economic traits. However, unlike price stability, defining and measuring financial stability poses greater challenges due to the intricate interplay and complex dynamics among different elements of the financial system and their interactions with the real economy. This complexity is further compounded by the temporal and cross-border dimensions inherent in such interactions. Nevertheless, there is considerable appeal in developing composite quantitative measures of financial system stability that can serve as early warning indicators. Such measures would

empower policymakers and participants in the financial system to more effectively monitor the stability of the financial system, anticipate sources and triggers of financial stress, and communicate the implications of such conditions efficiently [8].

Bernoth K. [7] quantified the causal relationship between exchange rate movements and sovereign risk across 16 major emerging market economies (EMEs) using structural vector autoregressive models (SVARs). They employed a novel data-driven identification method for structural shocks, which considers the complex interplay among exchange rates, sovereign risks, and interest rates. The impact and direction of the response of sovereign risk to FX rate fluctuations vary depending on the type of exchange rate measure considered and the magnitude of an economy's net foreign currency exposure. A depreciation of the domestic currency against the USD tends to elevate sovereign risk. However, when examining the nominal effective exchange rate, which is not influenced by changes in the USD exchange rate, there appears to be no significant effect observed overall. These findings suggest that the 'financial channel' plays a more substantial role in transmitting exchange rate shocks to sovereign risk compared to the traditional 'net trade channel'. Additionally, the study confirms the significant role of currency mismatch in the non-public sector in influencing the strength of the «financial channel».

Cho D. examines the tail behaviour of safe haven currencies using high-frequency data spanning, encompassing both favourable and challenging financial conditions. The study utilizes the cross-quantilogram technique, to assess the quantile dependence between currencies and foreign exchange (FX) volatility, as well as equity and bond markets. The analysis reveals that during periods of rapid increases in FX volatility and US Treasury bond yields, the Swiss franc, euro, and Japanese yen tend to appreciate significantly. However, a pronounced decline in US stock returns is associated primarily with a significant appreciation of the Japanese yen. Moreover, the effects of various shocks on safe haven currencies exhibit asymmetry, suggesting heightened investor responsiveness during financial distress. Furthermore, the study demonstrates that safe haven currencies display stronger responses over certain lag periods in extreme market conditions compared to more moderate market phases. Overall, the findings indicate that the Japanese yen emerges as the strongest safe haven currency, followed by the Swiss franc and the euro [10].

To assess the risks in foreign economic activity, qualitative and quantitative methods are chosen. Among the best-known methods of qualitative analysis are methods of modelling the organization's activities, heuristic methods, methods of information collection, etc. The most commonly used method of qualitative analysis is expert assessment, which makes it possible to assess the degree of risk under the conditions of lack of complete and reliable information that would allow the use of statistical methods. Based on the information obtained from the qualitative analysis, a quantitative assessment of the impact of risks is often carried out. Among a large number of quantitative assessment methods, the best known are statistical methods, sensitivity method, scenario method, Monte Carlo simulation method, and cost-benefit analysis method. The most commonly used ones are the statistical method and the scenario method [35].

In [14], S.V. Hadetska stated that currency exchange operations are subject to uncertainties of different nature, taking into account the time factor, and, accordingly, this requires the use of exchange risk hedging. The author proposes the following methods: determining the main statistical characteristics of changes in exchange rates and the statistical relationship between individual currencies included in the portfolio; determining the statistical properties of the time series of data on changes in the exchange rate. The article shows that solving the problem of multi-criteria (vector) optimization of the currency portfolio in a non-stochastically uncertain external economic environment allows simultaneously maximizing profit and minimizing the risk of operations related to currency exchange.

Thus, the recent publications highlight the relevance of the issue under study and prove the urgency of ensuring the sustainable performance of enterprises through risk management using statistical methods for planning foreign economic activities and logistics, given the conditions of enterprises' operation and the development of the financial tools market.

AIMS AND OBJECTIVES

The purpose of the paper is to study the use of statistical methods in risk management when planning foreign economic and logistics activities to ensure the sustainability of an enterprise. To achieve the goal the following tasks must be solved: 1. Systematize the causes of risks in foreign economic and logistics activities, directions for predicting the reduction and elimination of the impact of risks to ensure the sustainable development of the enterprise; 2. Investigate risk hedging tools and propose an author's definition of the «hedging strategy» category; 3. Argue the expediency of using statistical methods in risk management with the aim of the timely forecast of exchange rate fluctuations; 4. Conduct a correlation and regres-

DOI: 10.55643/fcaptp.3.56.2024.4380

sion analysis of the factors affecting the exchange rate under the crisis conditions; 5. Conduct a comparative characterization of currency risk hedging methods and develop a strategy for hedging for an industrial enterprise engaged in foreign economic and logistical activities to ensure sustainable development.

METHODS

General scientific and special methods of systemic and structural analysis were used to clarify the directions of sustainable development and risk management tools; to formulate goals and steps in choosing a strategy for an exchange rate risk hedging and to compare the methods of exchange rate risk hedging.

Statistical methods of correlation and regression analysis were used to determine the relationships between various factors, assess the strength and direction of the relationships, and determine how the factors under study impact the resulting indicator i.e., the euro exchange rate. The paper has studied statistical correlation between economic indicators, such as GDP growth rate, consumer price index growth rate, interest rate, change in the current account balance and change in the consolidated balance of Ukraine, growth rate of exports of goods and services in Ukraine, growth rate of the imports of goods and services to GDP ratio in Ukraine, change in economic sentiment and exchange rate; based on the above, a correlation matrix has been built. A multiple linear regression equation has been formed, which can be used for modelling, determining the impact of independent variables on the exchange rate, and forecasting the exchange rate as a function of changes in factor attributes; the equation is of practical value for planning, decision-making and influencing the processes in foreign economic and logistics activities.

In the general form, the equation of the multiple linear regressions is as follows:

$$Y = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \varepsilon$$

where Y is the dependent variable; n is number of independent variables; X_i is independent variables (factor attributes); β_0 is a free term, whose value is equal to Y when all X_i are equal to 0; β_i are theoretical regression coefficients that characterize the response of the dependent variable to a change in the corresponding independent variable X_i, provided that all the other factor attributes remain unchanged; ε is a random variable that is a deviation from the expected functional dependence.

RESULTS

In carrying out foreign economic and logistics activities, there are risks associated with instability and unpredictability of geopolitical and economic factors, which may result in unpredictable loss. Therefore, risk management is an important component of the effective functioning of an enterprise when planning measures aimed at sustainable performance in all types of economic and financial activities. In risk management, risk hedging is an effective and most commonly used tool. The Law on Foreign Exchange and Exchange Transactions and the NBU regulations allow individuals and legal entities to use eight risk hedging instruments [1], which were analyzed in detail in [4]. The following instruments can be distinguished: 1) TOM – buying and selling foreign currency on the next day basis; 2) SPOT – buying and selling foreign currency on the next day plus two business days basis; 3) purchase and sale of foreign currency by legal entities on delivery forward terms to secure export-import operations and credit obligations in foreign currency; 4) NDF is a cash-settled forward contract only available for export-import and foreign currency loans; however, the contract does not deliver the underlying asset (foreign currency), but settles in UAH the equivalent of the difference between the transaction rate and the market rate with an unlimited term of applicability; 5) currency swap for exchange between the client who places foreign currency in the bank and the bank that pays UAH to the client, which allows calculating possible exchange rate changes; at the request of a non-resident, the bank carries out a swap in the opposite direction and takes UAH from the non-resident and places foreign currency; 6) purchase and sale of foreign exchange domestic government bonds by individuals and legal entities for UAH at the current market rate; redemptions are made directly by the Ministry of Finance, without the need to go through a bank; 7) hedging i.e. buying Ukrainian Eurobonds for UAH within the country, which allows for a higher yield on Eurobonds; 8) currency futures contract traded on margin by exchanges, insurance deposit, etc.

Our vision is that a hedging strategy is a plan of action aimed at mitigating the risk caused by fluctuations in exchange rates, which may result in a shortfall in profit. The hedging strategy is based on the concepts, approaches, ideas of asset and/or investment management in order to reduce losses by applying hedging instruments, whose feasibility should be justified taking into account the forecast of exchange rate changes; the forecast can be made by using the methods of statistical analysis in planning foreign economic and logistics activities with the aim of achieving sustainable performance.

The development and successful implementation of a hedging strategy requires the use of statistical methods to predict currency fluctuations in a timely manner and plan measures to minimize them. We have deepened the study conducted by V.Y. Hordopolov and G.L. Nord who constructed a correlation and regression model which shows that, with a probability of 54.88%, the changes in the exchange rate are determined by the impact of input variables; in particular, the exchange rate is most closely related to the indicators of GDP, Ukraine's external debt, state budget deficit, exports and imports, and inflation [9]. The shortcoming is that the authors in [9] used statistical data for the period 1999–2016, which questions the feasibility of using their findings in relation to the present. This was the reason for our developing their research with a focus on the use of statistical data obtained during the crisis period of 2020–2022 in Ukraine.

Planning and making the necessary managerial decisions for the effective implementation of foreign economic and logistics activities should be based on a hedging strategy that directly depends on changes in the exchange rate, which emphasizes the expediency of long-term forecasting of the exchange rate in accordance with the changes in economic environment factors.

We believe that GDP growth is the main indicator of changes and development of the country's economy and a positive signal for the intensification of innovation, investment, foreign economic and logistics activities by both domestic and foreign investors, which would result in strengthening the national currency and growth of demand for it from the population. The upward change in consumer prices, manifested in the form of an increase in inflation, contributes to the depreciation of the national currency [10], while an increase in the interest rate leads to increased foreign capital inflows and, accordingly, an increase in the exchange rate under conditions of monetary freedom [8]. The current account balance in Ukraine shows the net income of the country; it can be negative and put pressure on the national currency exchange rate due to additional demand for foreign currency by residents of the country to fulfil their obligations; or it can be positive, which helps to strengthen the national currency due to an increase in the supply of foreign currency in the domestic market [25]. Since the consolidated balance of payments is the ratio of the sum of receipts from abroad to the sum of payments abroad, then its reduction is a signal of a weakening of the national currency. The growth of export operations as a component of foreign economic and logistics activities usually results in a weakening of the national currency, which contributes to the state budget, while import operations, on the contrary, are accompanied by a strengthening of the national currency. We consider it necessary to take into account the changes in the Economic Confidence Indicator (ECI) in Ukraine, which includes the Manufacturing Confidence Indicator, the Construction Confidence Indicator, the Retail Confidence Indicator, the Services Confidence Indicator, and the Consumer Confidence Indicator. The indicator is calculated in accordance with the Methodology for Calculating Business Confidence Indicators in compliance with the requirements of the International Monetary Fund's expanded Special Data Dissemination Standard, updated by the State Statistics Service in December 2017. Sector-specific indicators of business confidence are assessed based on surveys on the current level of orders and inventories of finished goods, changes in sales over the past three months, forecasts of changes in production/sales, and the number of employees in the next three months. The largest contribution to the PMI is made by the industrial confidence indicator (40%), followed by the services sector (30%), and construction and retail trade (5% each). The weight of consumer sentiment is 20% [16].

We perform a correlation and regression analysis of the factors (quarterly dynamics of 2020–2022) that impact the change in the exchange rate (Y is the average value of the UAH/ EUR exchange rate per quarter) under the crisis conditions in our country, i.e., COVID-19 pandemic and military aggression. The values of these factors (or their changes in %) are presented in Table 1.

Table 1. Factors influencing the change in the UAH/ EUR exchange rate. Notes: Y is the average quarterly exchange rate under the crisis conditions in our country, Covid-19 pandemic and military aggression, UAH/ EUR; X_1 is the GDP growth rate, %; X_2 is the growth rate of the consumer price index in Ukraine, %; X_3 is the interest rate in Ukraine, %; X_4 is the change in the current account balance in Ukraine, %; X_5 is the change in the consolidated balance sheet in Ukraine, %; X_6 is the growth rate of exports of goods and services in Ukraine, %; X_7 is the growth rate of the ratio of imports of goods and services to GDP in Ukraine, %; X_8 is the change in economic sentiment in Ukraine, %. *(Source: compiled by the authors based on [17, 22])*

No.	Quarter	Y	X1	X2	X3	X4	X5	X6	X7	X8
1	Q1 2020	27,6154	-22.883	0,0989	11.6222	45.5209	-192.076	-19.003	9.3585	11,1
2	Q2 2020	29.6028	2.5053	0.6018	8.0879	4.6003	1136.444	-5.86764	-16.4514	-9
3	Q3 2020	32.2429	33.3203	-1.5867	6	-71.5235	-229.387	15.80469	-2.1499	-3.9
4	Q4 2020	33.6965	11.7179	1.5474	6	23.6817	250.1207	17.75662	6.9898	-2,1
5	Q1 2021	33.7569	-22.1934	0.7929	6.15	-172.618	-61.6591	-5.55504	17.8557	-4.8
6	Q2 2021	33.2332	15.9451	-1.7676	7.3352	165.095	30.1608	14.9812	-6.8949	9.4
7	Q3 2021	31.7388	27.96	-1.0904	7.9946	-511.214	-225.611	9.831567	-8.7094	10
8	Q4 2021	30.5167	14.7438	1.2056	8.6196	-70.4897	210.0721	8.148822	-1.3115	7.5
9	Q1 2022	32.2788	-37.2276	2.1162	9.7778	191.8971	-297.164	-26.3042	2.9724	7.3
10	Q2 2022	31.1984	-5.7608	1.5005	14.6154	-59.2627	-45.9493	-30.6302	-13.7482	-21
11	Q3 2022	35.1844	41.1212	-4.9686	25	651.6809	154.9327	37.9134	4.5227	-15.6
12	Q4 2022	37.2522	12.1467	0.19084	25	-97.6984	44.04875	10.41227	5.5493	-7.5

DOI: 10.55643/fcaptp.3.56.2024.4380

The data in Table 1 were used to build a correlation matrix of the dependence of the UAH/ EUR exchange rate on the factors that affect it. The matrix determines the strength of the relationship between the selected factor attributes and the resulting indicator; Table 2 shows the results of calculating the values of the correlation coefficients, carried out in MS Excel using the Correlation function.

Table 2. Identification of a relationship between the factors and the UAH/ EUR exchange rate using a correlation matrix.

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1								
X1	0.3513	1							
X2	-0.3040	-0.7181	1						
X3	0.5160	0.2368	-0.41668	1					
X4	0.2077	0.08683	-0.46365	0.4645	1				
X5	-0.1338	0.1463	0.0531	-0.0157	0.15014	1			
X6	0.5431	0.8589	-0.7276	0.2293	0.2737	0.1396	1		
X7	0.3304	-0.2945	0.0162	0.1138	0.1610	-0.4043	0.1288	1	
X8	-0.3522	-0.1972	0.1474	-0.4941	-0.2893	-0.3301	-0.0446	0.1641	1

Analyzing the dependencies shown in Table 3, we note that factors X_6 (growth rate in exports of goods and services), X_3 (interest rate), as well as X_7 (growth rate in the ratio of imports of goods and services to GDP), X_8 (change in economic sentiment), and X_1 (GDP growth rate) have a significant impact on the euro exchange rate; factors X_4 (change in the current account balance) and X_5 (change in the consolidated balance sheet of Ukraine) have a less strong impact on the exchange rate.

In order to identify the type and features of the relationship between the dependent variable Y (UAH/ EUR exchange rate) and the independent variables (factors X_1 - X_8) listed in Table 2, the method of regression analysis was used and multiple linear regression was built in MS Excel using the "Regression" function (Table 3).

Table 3. Regression analysis results.

Regression statistics	
Multiple R	0.9884
R-square	0.9769
Normalized R-square	0.9154
Standard error	0.7425
Observation	12

Dispersion analysis					
Indicators	**df**	**SS**	**MS**	**F**	**Signifi-cance of F**
Regression	8	70.0234	8.7529	15.8749	0.02207
Residual	3	1.6541	0,5514		
Total	**11**	**71.6775**			

Variables	**Coeffi-cients**	**Standard er-ror**	**t-statistics**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95,0%**	**Upper 95,0%**
Y	31.2737	0.5375	58.1804	1.12E-05	29.5631	32.9844	29.5631	32.9845
X1	-0.3133	0.0523	-5.9868	0.0093	-0.4798	-0.1467	-0.4798	-0.1467
X2	0.5012	0.2206	2.2717	0.1078	-0.2009	1.2034	-0.2009	1.2034
X3	0.1788	0.0446	4.0123	0.0278	0.037	0.3206	0.037	0.3206
X4	-0.0045	0.0013	-3.3907	0.0428	-0.0088	-0.0003	-0.0088	-0.0003
X5	-0.0061	0.001	-6.1427	0.0087	-0.0093	-0.003	-0.0093	-0.003
X6	0.4585	0.0604	7.586	0.0048	0.2661	0.6508	0.2661	0.6508
X7	-0.3121	0.0620	-5.0326	0.015	-0.5094	-0.1147	-0.5094	-0.1147
X8	-0.1991	0.0328	-6.0735	0.009	-0.3034	-0.0948	-0.3034	-0.0948

The multiple correlation coefficient R characterizes the strength of the relationship between the resultant attribute and the set of factor attributes. Its high value of 0.9884 indicates a strong relationship between the resultant attribute of this model (UAH/ EUR exchange rate) and the factors under study. The coefficient of determination R^2 is 0.9769, which is rather high. This indicates that 97.69% of the variation of the resultant attribute (the UAH/ EUR exchange rate) is determined by the variation of the values of the studied factors, and 2.31% by other factors. The standard error is 0.7425, which means that the model can make an average mistake of 0.7425 UAH in estimating the change in the UAH/ EUR exchange rate.

The multiple linear regression of the UAH/ EUR exchange rate is as follows (1):

$$Y = 31{,}2737 - 0{,}3133\,X_1 + 0{,}5012\,X_2 + 0{,}1788\,X_3 - 0{,}0045\,X_4 - 0{,}0061\,X_5 + 0{,}4585\,X_6 - 0{,}3121\,X_7 - 0{,}1991\,X_8 \quad (1)$$

Based on the analysis of the proposed multiple linear regression model, it can be concluded that, with all other parameters of the correlation coefficient remaining unchanged, a 1% increase in the consumer price index, interest rate, and exports will result in an increase in the UAH/ EUR exchange rate by UAH 0.5012, UAH 0.1788, and UAH 0.4585, respectively. With a 1% increase in GDP, current account balance, consolidated balance sheet, imports to GDP ratio, and economic sentiment indicator, the exchange rate decreases by UAH 0.3133, UAH 0.0045, UAH 0.0061, UAH 0.3121, and UAH 0.1991, respectively.

Thus, the exchange rate appreciation is driven by GDP growth, an increase in the current account balance, a rise in the consolidated balance sheet, an increase in the imports-to-GDP ratio, and a rise in the economic sentiment indicator. Growth in consumer prices, interest rates, and exports leads to an appreciation of the euro.

The analysis of the reasons for the fluctuations in the UAH/ EUR exchange rate in Ukraine over the quarters of 2020–2022 allows the following conclusions: with a high probability, the proposed regression model shows that the change in the resultant attribute (exchange rate) is determined by the impact of the input variables (the studied factors that influence the exchange rate).

Therefore, the use of the proposed model will enable scientists, managers and other researchers to predict with a high probability the UAH/ EUR exchange rate and form the current goals in planning foreign economic and logistics activities, using a hedging strategy.

The study was tested based on the data from PJSC "Linde Gas Ukraine", which is part of the international industrial group Linde Group, a leading global manufacturer and supplier of industrial gases and engineering. The main focus of the company's foreign economic activity is the development and deepening of trade and economic cooperation with EU enterprises to import carbon dioxide, argon, cryogenic tanks and their components, as well as gas and electric welding equipment.

Table 4 summarizes the main methods of exchange rate risk hedging for PJSC Linde Gas Ukraine, which should be analyzed to select the best approach.

Table 4. Comparative characteristics of methods of exchange rate risk hedging based on the activities of PJSC "Linde Gas Ukraine".

Method of hedging exchange rate risks	Description
Open a foreign currency account	PJSC "Linde Gas Ukraine" is not engaged in export activities, therefore, the foreign currency account can only be replenished by purchasing foreign currency to pay for import contracts
Change the payment term	Early payment for imported goods is possible (at a favourable rate for the enterprise), but the benefit of the payment terms impact (deferral) is reduced, which will negatively affect the efficiency of imports
Forward contracts	Forward transactions are usually costly and in practice, they are mainly used between commercial banks and the NBU
Cross-forward hedging	It is possible to enter into a hryvnia-dollar forward contract with a foreign bank, but given the currency of import contracts, it is also necessary to enter into a dollar-euro forward contract, i.e. to implement cross-hedging. To carry out this transaction, it is necessary to have a license from the NBU to open a current foreign currency account in a foreign bank, which is quite problematic in practice
Swap transactions	Interbank swaps are well-developed in Ukraine
Balanced approach to asset and liability management	Restructuring of foreign currency debt through hedging in the short-term capital market. A prerequisite is sufficient profitability of the company's assets to cover the difference in interest rates

As can be seen from Table 4, PJSC Linde Gas Ukraine should use a balanced approach to asset and liability management in the development of its hedging strategy.

Goals and steps in choosing a strategy of an exchange rate risk hedging at PJSC Linde Gas Ukraine are shown in Figure 1.

DOI: 10.55643/fcaptp.3.56.2024.4380

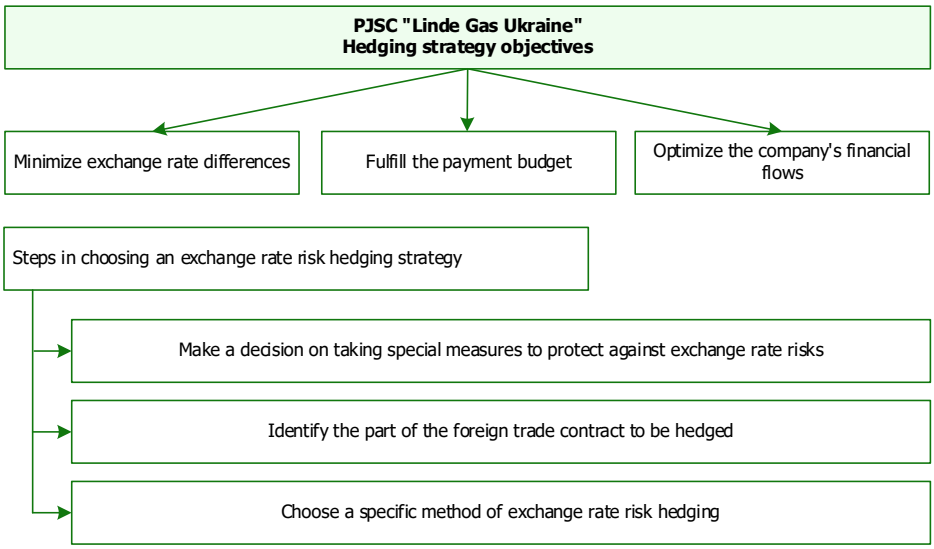

Figure 1. Goals and steps in choosing a strategy of exchange rate risk hedging at PJSC Linde Gas Ukraine.

The choice of a specific method of exchange rate risk hedging depends on the specifics of the foreign economic and logistics activities at PJSC Linde Gas Ukraine. The contractual period between the date of receipt of imported goods and the date of payment for them is 30 days, and this is the source of exchange rate risks. Early payment reduces the impact of the credit impact factor on the efficiency of import operations. If the company buys foreign currency on the day of the goods' receipt, it secures itself against changes in exchange rates (the exchange rate difference is zero).

Disadvantages of the approach:

- if the euro falls against the national currency, the company loses the opportunity to generate additional profit through positive exchange rate differences, but given the trend of negative exchange rate differences over the past two years, the possibility of obtaining a positive exchange rate difference is not realistic for PJSC Linde Gas Ukraine;
- the option of payment on the day of receipt of goods offsets the impact of the credit impact factor and the company loses profit from import operations;
- the purchase of foreign currency on the day of receipt of goods and opening a foreign currency deposit for this amount has its advantages and disadvantages, namely: the positive impact of payment terms on import efficiency remains, and interest on the deposit is added, but this diverts funds from the company's turnover and "freezes" them on the deposit, which is impractical under the conditions of crisis and martial law.

For this reason, the strategy of exchange rate risk hedging for PrJSC Linde Gas Ukraine, shown in Figure 2, proposes to take credit in national currency simultaneously with opening a foreign currency deposit so that to replenish the company's working capital.

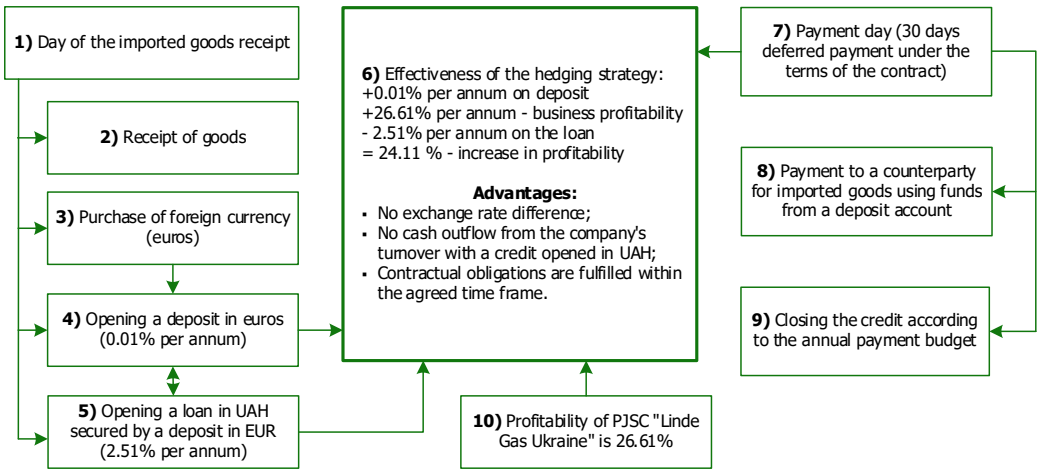

Figure 2. Strategy for hedging exchange rate risks at PJSC Linde Gas Ukraine.

Opening a credit will not be a problem because it will be secured by a foreign currency deposit; the credit interest rate will be 2.51%, and the deposit interest rate will be 0.01%. Since the credit funds are used to replenish the company's working capital, the company's return on their turnover will be 26.61% (the company's profitability for the 9 months of 2023). In other words, the expenses of PJSC "Linde Gas Ukraine" will amount to 2.51%, and the income will be 0.01% + 26.61% = 26.62%, on the condition that:

- the exchange rate difference is absent and, accordingly, the efficiency of import activities is improved;
- the contractual obligations are fulfilled within the stipulated timeframe;
- there is no cash outflow from the company's turnover.

DISCUSSION

The relevant issues covered in this paper are addressed from different angles in the scientific literature. We agree with Bitetto A. [8] regarding the expediency of using in the study of factors of the external environment, the consideration of which will allow policymakers and participants of the financial system to more effectively control the stability of the financial system, to predict the sources and factors of financial stress and effectively report the consequences of such conditions. The obtained results of the study confirm the thesis of Manninen Kaisa [24] that market conditions can both facilitate and hinder efforts to implement sustainable development. Considering the factors of external influence, companies can actively influence the market and use more sustainable practices in their activities. To ensure the sustainable development of enterprises M.V. Shashina in [32] proposed the diversification of sales markets by finding new markets and customers that are independent of the internal situation in Ukraine. According to Agoraki M.-E. K [3] the strategic goals of firms are attracting investors, mitigating risks and aligning their own interests with the interests of stakeholders and society.

From this point of view, the study of Yu Tiffany Hui-Kuang [40] is timely; it examines universal goals and indicators of sustainable development, which, in our opinion, should be supplemented with indicators that take into account currency risk and foresee the use of such indices as Inclusive Internet Index to assess digital technologies, Global Innovation Index to measure innovation, Global Entrepreneurship Monitor to measure entrepreneurship, GDP to track economic growth and Global Findex to analyze financial technologies.

We agree with Tkach O.V. [34] that risk management in foreign economic and logistics activities is closely related to the chosen strategy of the enterprise, which ensures its sustainable development and effective functioning. We consider it necessary to deepen the study of currency risks and hedging by Obadia C. [28] and Mishrif A. [27], since export activity is directly related to the high probability of currency risks, and their management with the help of hedging will allow to form stable supply chains in the international trade with a reduction the negative impact of unforeseen factors of the external environment on the activities of enterprises. A significant approach is the analysis [29], in which Papathanasiou S. uses valuable information for portfolio managers and investors to form strategies for more effective hedging of their share portfolios. We agree with N. Hachicha [13] that from the investor's point of view, understanding market factors allows allows managing the portfolio and formulating hedging strategies more effectively. Increased correlation between different segments of financial markets opens up new opportunities, especially for hedgers. We consider the adjustment criteria proposed by Xing Yu in [41] to be appropriate for hedging coefficients of managed models based on the expected state of the market, for which an empirical analysis was conducted, the results of which revealed an advantage in applying the proposed dependencies of hedging strategies over traditional managed models. Khokhlov V.Yu., in turn, sees the essence of hedging in such a construction of a portfolio, when its value remains unchanged when the input parameters, according to which hedging is carried out, change. The author deepened the research in the hedging strategy and proved that the problem of risk management is solved with the help of options [22].

Further development in the article by Ascari G. [5] requires a study of the impact of inflation pressure on the global supply chain. Taking the inflation factor into account is mandatory when forecasting foreign economic and logistics activities, as inflation has a direct impact on the risks of the external environment.

In turn, we agree with Bernoth K. [7] that a decrease in the national currency against the USD increases sovereign risk; conversely, the nominal effective exchange rate, which is not linked to changes in the USD exchange rate, does not fluctuate significantly. Thus, the "financial channel" is more important in transmitting exchange rate shocks to sovereign risk compared to the traditional "pure trade channel". We support Cho D. [10] that during periods of rapid growth in currency volatility and US Treasury bond yields, the Swiss franc, the euro, and the Japanese yen tend to appreciate significantly. In addition, the effects of different shocks on safe-haven currencies show asymmetry, suggesting heightened investor reaction during financial distress.

DOI: 10.55643/fcaptp.3.56.2024.4380

In this aspect, a positive experience for our research is the grey correlation approach used by Ding Suiting in [12], which revealed a strong positive correlation between logistics performance and IoT market scale. We consider the technique and methodology of two-stage least squares logistic regression to select credit risk factors, which was developed by Kanno Masayasu [19] to study the effectiveness of ESG in improving the creditworthiness of the company, to be practically valuable. We agree with Xiao Ping [38], because the increase in the number of credit risk factors of small and medium-sized enterprises (SMEs) affecting key companies will have a serious negative impact on their activities, will limit their growth, which will subsequently disrupt the smooth functioning of the entire supply chain. At the same time, the stages of supply chain risk management (SCRM) can be divided into risk assessment, processing and monitoring.

Foreign economic and logistics activities are important components of the company's sustainable performance. The practical findings of the study can be recommended for business entities of various types of entrepreneurial activity. Unpredictable environmental factors can become a source of risk and thus adversely affect the performance of companies.

The Currency and Currency Transactions Act and NBU regulations allow individuals and legal entities to use the following risk hedging instruments: TOM, SPOT, purchase and sale of foreign currency on a deliverable forward basis, NDF, swap, hedge, and currency futures.

In this study, the definition of a hedging strategy has been deepened. The importance of this type of study for planning foreign economic and logistics activities in order to ensure the sustainable development of enterprises has been emphasized for the first time. The development and successful implementation of a hedging strategy requires the use of statistical methods to predict currency fluctuations in a timely manner and plan measures to mitigate them. The study presents statistically significant results on the impact of factors on the exchange rate. Forecasting the euro exchange rate will allow for better selection of a specific hedging method and development of the necessary hedging strategy to improve the efficiency of foreign economic and logistics activities and to plan and make optimal management decisions for specific external environment conditions. The correlation and regression analysis of the factors (quarterly dynamics over 2020–2022) that impact the changes in the exchange rate (Y is the average value for the exchange rate UAH/EUR per quarter) under the crisis conditions (Covid-19 pandemic and military aggression) in our country, showed high adequacy of application in the context of crisis phenomena.

The use of statistical methods is a notable advantage of this study, however, it has some controversial aspects: firstly, the influence of other factors on the resulting attribute, in the case of economic and geopolitical factors are manifestations, is not taken into account; factors not taken into account may bias the results; secondly, the study provides quantitative data, but does not consider the qualitative aspects of the behaviour of business entities under crisis conditions, although this is partially reflected by including the economic sentiment factor; thirdly, when using the results of the study, it is necessary to bear in mind the fact that in crisis conditions the factor of manual control of economic processes may be a significant lever. Although this study highlights the potential problems associated with the assumptions of unforeseen risks, it emphasizes the importance of formation a strategy of risk management and hedging strategy while planning foreign economic and logistics activities with the aim of ensuring the sustainability of enterprises. The proposed approach is relevant for enterprises in various industries, as long as they seek to adapt their foreign economic and logistics activities to a dynamically changing external environment.

CONCLUSIONS

An urgent issue is to ensure the sustainable development of enterprises through risk management using statistical methods, based on the conditions of companies' functioning, the development of the financial instruments market in planning foreign economic and logistics activities. Risk hedging instruments include TOM, SPOT, purchase and sale of foreign currency on delivery forward, NDF, swap, purchase and sale of foreign currency domestic government bonds, hedging, and exchange rate futures. Thus, a hedging strategy is a plan of action aimed at limiting and mitigating the risk caused by fluctuations in foreign exchange rates, which may result in a loss of profit. The hedging strategy is based on the concepts, approaches, ideas of asset and/or investment management and used in order to reduce the enterprise’s losses by applying hedging instruments, the feasibility of which should be based on a prediction of changes in the exchange rate; the prediction is made using statistical analysis methods and is important for planning foreign economic and logistics activities aimed at ensuring sustainable performance of enterprises. The use of statistical analysis methods allows a timely prediction of currency fluctuations, which is required for the development and successful implementation of a hedging strategy.

The correlation and regression analysis of the factors that impact the exchange rate under the crisis conditions in our country (Covid-19 pandemic and military aggression) showed that the strengthening of the exchange rate is influenced by GDP growth, an increase in the current account balance, an increase in the consolidated balance sheet, an increase in the

import-to-GDP ratio, and an increase in the economic sentiment indicator. Growth in consumer prices, interest rates, and exports leads to an appreciation of the euro. The proposed hedging strategy was tested on the basis of data from PJSC Linde Gas Ukraine, which is part of the international industrial group Linde Group, a leading global producer and supplier of industrial gases and engineering. It has been found that PJSC "Linde Gas Ukraine" should use a balanced approach to asset and liability management in the development of a hedging strategy. As part of their strategy of foreign exchange risk hedging, PJSC Linde Gas Ukraine were proposed to take out a loan in national currency along with opening a foreign currency deposit so that they could replenish the company's working capital.

The prospect of further research is to assess the effectiveness of the implementation of the proposed hedging strategy.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

FUNDING

The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

REFERENCES

1. About currency and currency transactions (2018). The Law of Ukraine dated 21.06.2018. 2473-VIII. https://zakon.rada.gov.ua/laws/show/2473-19#Text
2. Afanasiev, I.V. (2014). Stratehiia khedzhuvannia investytsij za dopomohoiu obernenykh ETF na prykladi SPY ETF. *Efektyvna ekonomika*, *5*. http://www.economy.nayka.com.ua/?op=1&z=3017
3. Agoraki, M.-E. K., Giaka, M., Konstantios, D., & Patsika V. (2023). Firms' sustainability, financial performance, and regulatory dynamics: Evidence from European firms. *Journal of International Money and Finance, 131*. https://doi.org/10.1016/j.jimonfin.2022.102785
4. Andrieieva, H.I. (2010). Stratehii khedzhuvannia: instrumenty ta sposoby zastosuvannia. *Innovatsijna ekonomika*, *4*(18), 206–210. https://essuir.sumdu.edu.ua/bitstream-download/123456789/57196/6/Andrieieva_Stratehii_khedzhuvannia_instrumenty.pdf
5. Ascari, G., Bonam, D., & Smadu, A. (2024). Global supply chain pressures, inflation, and implications for monetary policy. *Journal of International Money and Finance, 142*. https://doi.org/10.1016/j.jimonfin.2024.103029
6. Banks offer eight methods of hedging currency risks (2020). http://finclub.net/ua/news/bankiry-znaishly-visim-sposobiv-khedzhuvannia-valiutnykh-ryzykiv.html
7. Bernoth, K. (2021). Exchange rates, foreign currency exposure and sovereign risk. *Journal of International Money and Finance, 117*. https://doi.org/10.1016/j.jimonfin.2021.102454
8. Bitetto, A., Cerchiello, P., & Mertzanis, Ch. (2023). On the efficient synthesis of short financial time series: A Dynamic Factor Model approach. *Finance Research Letters, 53*. https://doi.org/10.1016/j.frl.2023.103678
9. Cheng, J., Mohammed, K. Si, Misra, P., Tedeschi, M., & Ma, X. (2022). Role of green technologies, climate uncertainties and energy prices on the supply chain: Policy-based analysis through the lens of sustainable development. *Technological Forecasting and Social Change*, *194*. https://doi.org/10.1016/j.techfore.2023.122705
10. Cho, D. (2021). The tail behavior of safe haven currencies: A cross-quantilogram analysis. *Journal of International Financial Markets, Institutions and Money, 70*. https://doi.org/10.1016/j.intfin.2020.101257
11. Ding, Ji-Feng, Weng, Ju-Hui, & Chou, Chien-Chang. (2023). Assessment of key risk factors in the cold chain logistics operations of container carriers using best worst method. *International Journal of Refrigeration, 153*, 116–126. https://doi.org/10.1016/j.ijrefrig.2023.06.013
12. Ding, Suiting, Ward, Hauke, & Tukker, Arnold. (2023). How Internet of Things can influence the sustainability performance of logistics industries – A Chinese case study. *Cleaner Logistics and Supply Chain, 6*. https://doi.org/10.1016/j.clscn.2023.100094
13. Hachicha, N., Amar, A.B., Slimane, I.B., Bellalah, M., & Prigent, J.L. (2022). Dynamic connectedness and optimal hedging strategy among commodities and financial indices. *International Review of Financial Analysis, 83*. https://doi.org/10.1016/j.irfa.2022.102290
14. Hadetska, S.V., Dubnytskyj, V.Yu., Kushneruk, Yu.I., Khodyriev, O.I., & Shkodina, I.V. (2021). Bahatokryterialna (vektorna) optymizatsiia portfelia valiut pry nestokhastychno nevyznachenomu zovnishnomu

DOI: 10.55643/fcaptp.3.56.2024.4380

ekonomichnomu seredovyschi. *Systemy obrobky informatsii*, *3*(166), 6–21. https://doi.org/10.30748/soi.2021.166.01

15. Hashchyshyn, A., Marushchak, K., Sukhomlyn, O., & Tarasenko, A. (2020). How Does the Interest Rate Influence the Exchange Rate? *Visnyk of the National Bank of Ukraine*, *250*, 4–14. https://doi.org/10.26531/vnbu2020.250.01
16. Hordopolov, V.Yu., & Nord, H.L. (2019). Metodychne zabezpechennia analizu valiutnykh ryzykiv v chastyni zastosuvannia metodiv upravlinnia valiutnymy ryzykamy. *Ekonomichnyj prostir*, *144*, 5–32. http://www.prostir.pdaba.dp.ua/index.php/journal/article/view/81
17. Hudz, T.P. (2012). Prychyny ta naslidky zminy valiutnoho kursu natsional'noi hroshovoi odynytsi. *Naukovi zapysky. Seriia Ekonomika, 19,* 321–326. https://ecj.oa.edu.ua/articles/2012/n19/73.pdf
18. Just, M., & Echaust, K. (2024). Cryptocurrencies against stock market risk: new insights into hedging effectiveness. *Research in International Business and Finance*, *67*(A). https://doi.org/10.1016/j.ribaf.2023.102134
19. Kanno, Masayasu. (2023). Does ESG performance improve firm creditworthiness? *Finance Research Letters, 55*(A). https://doi.org/10.1016/j.frl.2023.103894
20. Karpenko, O.O., & Majzel, S.P. (2023). Teoretychni aspekty staloho rozvytku pidpryiemstva. *Economic synergy*, *1*(7), 98–111. https://doi.org/10.53920/ES-2023-1-8
21. Katkova, N.V., & Murashko, I.S. (2019). Alhorytm realizatsii mekhanizmu staloho rozvytku pidpryiemstva. *Naukovi zapysky. Seriia Ekonomika, 19*, 271–276. https://doi.org/10.32983/2222-4459-2019-2-271-276
22. Khokhlov, V.Yu. (2012). Optsionni stratehii khedzhuvannia. *Naukovi zapysky. Seriia Ekonomika*, *20*, 300–304. https://ecj.oa.edu.ua/articles/2013/n20/64.pdf
23. Kudrytska, Zh.V., & Hnylytska, A.Yu. (2017). Khedzhuvannia valiutnoho ryzyku. *Biznes Inform*, *2*, 439–442. https://doi.org/10.32983/2222-4459-2019-2-271-276
24. Manninen, K., & Huiskonen, J. (2022). Factors influencing the implementation of an integrated corporate sustainability and business strategy. *Journal of Cleaner Production, 343*. https://doi.org/10.1016/j.jclepro.2022.131036
25. Methods of calculating indicators of business expectations (2021). *State Statistics Service of Ukraine*. https://ukrstat.gov.ua/metod_polog/menu/menu_/2_mekon_st.htm
26. Ministry of Finance of Ukraine. (n.d.). https://minfin.com.ua/
27. Mishrif, A., Antimiani, A., & Khan, A. (2024). Examining the Contribution of Logistics and Supply Chain in Boosting Oman's Trade Network. *Economies, 12*(3), 70. https://doi.org/10.3390/economies12030070
28. Obadia, C., & Vida, I. (2024). Export marketing strategy and performance: A focus on SMEs promotion. *International Business Review, 33*. https://doi.org/10.1016/j.ibusrev.2023.102229
29. Ponomarenko, T., & Rasshyvalov, D. (2023). Logistic risks factoring in corporate marketing strategy in the fmcg market in the context of the war in Ukraine. *Financial and credit activity: problems of theory and practice*, *6*(53), 501–515. https://doi.org/10.55643/fcaptp.6.53.2023.4252
30. Pushkar, O.I., Kovalskyj, V.S., & Kravchenko, N.V. (2020). Ryzyky u lohistychnij diial'nosti ta problemy ikh zmenshennia v suchasnykh umovakh hospodariuvannia. *Yevropejskyj vektor ekonomichnoho rozvytku*, *2*, 85–93. https://doi.org/10.32342/2074-5362-2020-2-29-8
31. Shan, Sh., Mirza, N., Umar, M., & Hasnaoui, A. (2023). The nexus of sustainable development, blue financing, digitalization, and financial intermediation. *Technological Forecasting and Social Change, 195*. https://doi.org/10.1016/j.techfore.2023.122772
32. Shashyna, M.V., & Mosijchuk, D.O. (2023). Stalyj rozvytok pidpryiemstv Ukrainy v umovakh rosijs'koho vijs'kovoho vtorhnennia. *Naukovi zapysky. Seriia Ekonomika*, *20*, 300–304. https://doi.org/10.52058/2786-5274-2023-6(20)-147-156
33. State Statistics Service of Ukraine. (n.d.). https://www.ukrstat.gov.ua/
34. Tkach, O.V., Hryniv, L.V., & Mykhajliv, H.V. (2020). Napriamy minimizatsii ryzykiv lohistychnoi systemy pidpryiemstva pid chas zdijsnennia zovnishnoekonomichnoi diial'nosti. *Prychornomorski ekonomichni studii, 51*, 125–130. https://doi.org/10.32843/bses.51-20
35. Tomashkov, S.B., & Oherchuk, Yu.V. (2023). Otsiniuvannia vplyvu ryzykiv zovnishn'oekonomichnoi diialnosti. *Menedzhment ta pidpryiemnytstvo v Ukraini: etapy stanovlennia i problemy rozvytku*, *2*(9), 142–151. https://doi.org/10.23939/smeu2023.02.142
36. Vakhnenko, T.P. (2004). Teoretychni zasady valiutnoho kursoutvorennia: kontseptsii ta modeli. *Ekonomika i prohnozuvannia*, *2*, 21–30. http://eip.org.ua/docs/EP_04_2_21_uk.pdf
37. Wang, Yu-Min, Lin, Che-Chun, & Tsai, I-Chun. (2023). State transformation of information spillover in asset markets and effective dynamic hedging strategies. *International Review of Financial Analysis*, *89*. https://doi.org/10.1016/j.irfa.2023.102772
38. Xiao, Ping, Ithnin, Salleh Mad, Zaidan, B.B., & Xuelan, Yang. (2023). Research on risk assessment of blockchain-driven supply chain finance: A systematic review. *Computers & Industrial Engineering, 176*. https://doi.org/10.1016/j.cie.2023.108990
39. Yavorska, V.O., & Kublij, Ye.V. (2018). Khedzhuvannia v upravlinni tsinovymy ryzykamy. *Naukovi innovatsii ta peredovi tekhnolohii*, *6*(20). http://perspectives.pp.ua/index.php/nauka/article/view/5019/5047
40. Yu Tiffany Hui-Kuang, & Huarng Kun-Huang. (2024). Technological Forecasting and Social Change Causal analysis of SDG achievements. *Technological Forecasting*

and Social Change, 198. https://doi.org/10.1016/j.techfore.2023.122977

41. Yu, X., Shen, X., Li, Ya., & Gong, X. (2023). Selective hedging strategies for crude oil futures based on market state expectations. *Global Finance Journal*, *57*. https://doi.org/10.1016/j.gfj.2023.100845

Іванова М., Саннікова С., Варяниченко О., Харін С., Бойченко М., Рябик Г.

СТАТИСТИЧНІ МЕТОДИ В УПРАВЛІННІ РИЗИКАМИ ПРИ ПЛАНУВАННІ ЗОВНІШНЬОЕКОНОМІЧНОЇ ТА ЛОГІСТИЧНОЇ ДІЯЛЬНОСТІ ДЛЯ ЗАБЕЗПЕЧЕННЯ СТАЛОГО РОЗВИТКУ ПІДПРИЄМСТВА

У цій роботі досліджено актуальне питання управління ризиками в зовнішньоекономічній і логістичній діяльності, яке тісно пов'язане з обраною стратегією підприємства та забезпечує його сталий розвиток. Розглянуті питання розробки стратегії хеджування, використовуючи статистичні методи, оскільки адекватні результати прогнозування дозволяють передбачити вплив факторів зовнішнього середовища на валютний курс, що дасть можливість підприємству своєчасно спрогнозувати та зменшити ризики зовнішньоекономічної та логістичної діяльності. При цьому були використані загальнонаукові та спеціальні методи системно-структурного аналізу для уточнення напрямів забезпечення сталого розвитку, інструментів управління ризиками; формування цілей та етапів вибору стратегії хеджування; порівняння методів хеджування валютного ризику, кореляційно-регресійного аналізу факторів, які впливають на зміну валютного курсу під час кризових явищ. Мета роботи полягає в дослідженні особливостей забезпечення сталого розвитку підприємства при плануванні зовнішньоекономічної та логістичної діяльності, застосовуючи статистичні методи в управлінні ризиками. Запропоноване визначення стратегії хеджування, що ґрунтується на концепціях, підходах, ідеях управління активами та / чи інвестиціями з метою зменшення втрат, застосовуючи інструменти хеджування, доцільність яких може бути обґрунтована шляхом використання статистичних методів. З'ясовано, що для формування та вдалої реалізації стратегії хеджування необхідне застосування статистичного аналізу з метою своєчасного передбачення коливання валютних курсів. Апробація проведених досліджень зроблена за результатами діяльності ПрАТ «Лінде Газ Україна». У його стратегії хеджування валютних ризиків запропоновано одночасно з відкриттям валютного депозиту взяти кредит у національній валюті для поповнення обігових коштів підприємства. Перспективою подальших досліджень є оцінка ефективності впровадження стратегії хеджування.

Ключові слова: статистичні методи, управління ризиками, зовнішньоекономічна діяльність, логістика, хеджування, стратегія, планування, стійкість підприємства

JEL Класифікація: C40, E 47, G13, L19, O24

DOI: 10.55643/fcaptp.3.56.2024.4380