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MACROECONOMIC CHANGES AND THEIR IMPACT ON FINANCIAL PLANNING OF ENTERPRISES: STUDYING THE WORLD EXPERIENCE USING R SOFTWARE ENVIRONMENT

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МАКРОЕКОНОМІЧНІ ЗМІНИ ТА ЇХ ВПЛИВ НА ФІНАНСОВЕ ПЛАНУВАННЯ ПІДПРИЄМСТВ:
ВИВЧЕННЯ СВІТОВОГО ДОСВІДУ З ВИКОРИСТАННЯМ ПРОГРАМНОГО СЕРЕДОВИЩА R

Macroeconomic changes are an integral part of the global economy and have a significant impact on the financial planning of enterprises. Taking these changes into account and analyzing them properly is key to ensuring the stability and effectiveness of financial management at the enterprise level. Macroeconomic changes may include fluctuations in inflation, unemployment, interest rates, foreign exchange rates, budget deficits and many other indicators.

The article is devoted to the study of the world experience of using the R software environment for analyzing macroeconomic changes and their impact on the financial planning of enterprises. Macroeconomic changes, such as inflation, exchange rates, interest rates, and others, can have a significant impact on the financial condition of enterprises. The article discusses the ways of using R to analyze data on macroeconomic indicators and their reflection in the financial plans of enterprises. The methods of forecasting macroeconomic changes and their impact on the profitability, liquidity, and financial stability of enterprises are investigated. The results of this study may be useful for professionals in the field of finance and economics, as well as for enterprises seeking to improve their financial planning in a changing macroeconomic environment.

The use of R allows not only for calculating forecasts but also for identifying risks and developing financial planning strategies for enterprises in a changing macroeconomic environment.

The study highlights the importance of using analytical tools to respond to macroeconomic changes and adapt financial planning to new conditions. This approach helps to reduce financial risks and increase business stability. The general conclusion of the article is that the use of the R software environment to analyze macroeconomic changes and their impact on the financial planning of enterprises is a relevant and effective approach. The results of the study can contribute to improving the financial stability and competitiveness of enterprises in the current conditions of global economic transformations.

Макроекономічні зміни є невід'ємною частиною глобальної економіки і мають суттєвий вплив на фінансове планування підприємств. Врахування цих змін і їх належний аналіз є ключовим завданням для забезпечення стабільності та ефективності управління фінансами на рівні підприємства. Макроекономічні зміни можуть включати коливання в рівні інфляції, обсягу безробіття, ставки облікової ставки, валютних курсів, бюджетного дефіциту і багато інших показників.

Наукова стаття присвячена вивченню світового досвіду використання програмного середовища R для аналізу макроекономічних змін та їх впливу на фінансове планування підприємств. Макроекономічні зміни, такі як інфляція, обмінні курси, ставки відсотку та інші, можуть мати суттєвий вплив на фінансовий стан підприємств. У статті розглянуто способи використання R для аналізу даних щодо макроекономічних показників та їх відображення на фінансових планах підприємств. Досліджено методи прогнозування макроекономічних змін та їх впливу на прибутковість, ліквідність та фінансову стабільність підприємств. Результати цього дослідження можуть бути корисні для фахівців у сфері фінансів та економіки, а також для підприємств, які прагнуть покращити своє фінансове планування в умовах змінюваного макроекономічного середовища.

Застосування R дозволяє не лише розраховувати прогнози, але й визначити ризики та розвинути стратегії фінансового планування для підприємств у змінюваному макроекономічному середовищі.

Дослідження підкреслює важливість використання аналітичних інструментів для реагування на макроекономічні зміни та адаптації фінансового планування підприємств до нових умов. Такий підхід допомагає зменшити фінансові ризики та підвищити стабільність бізнесу. Загальний висновок статті полягає в тому, що використання програмного середовища R для аналізу макроекономічних змін та їх впливу на фінансове планування підприємств є актуальним та ефективним підходом. Результати дослідження можуть сприяти покращенню фінансової стійкості та конкурентоспроможності підприємств у сучасних умовах глобальних економічних трансформацій.

Key words: macroeconomic changes, financial planning, enterprises, R-programming, macroeconomic indicators, financial risk, strategic financial management.

Ключові слова: макроекономічні зміни, фінансове планування, підприємства, R-програмування, макроекономічні індикатори, фінансовий ризик, стратегічне управління фінансами.

INTRODUCTION

In today's globalized and ever-changing marketplace, businesses face the need to adapt effectively to macroeconomic fluctuations. Macroeconomic factors, such as inflation, exchange rates, discount rates, and changes in a country's GDP, can have a major impact on the financial stability and performance of enterprises. In this regard, understanding the relationship between macroeconomic changes and financial planning is crucial to ensuring the success of businesses.

One of the key aspects of addressing this issue is the use of analytical tools to study and predict the impact of macroeconomic changes on the financial performance of enterprises. One of these tools is the R programming language, which has gained popularity in data analysis and statistical modeling. It allows researchers and finance professionals to use a rich set of functions to analyze and forecast macroeconomic indicators and their impact on the financial performance of companies.

In addition, R allows you to build complex forecasting models. It can be used to conduct scenario analysis, exploring how different macroeconomic scenarios will affect the financial position of an enterprise in the future. This helps to make informed decisions on financial planning and risk management. Companies that respond to macroeconomic changes promptly and take them into account in their financial strategic plan have an advantage in a challenging competitive environment. Therefore, learning the global experience of using R to analyze and predict the impact of macroeconomic changes on financial planning is a relevant task for companies in the current economic environment. The use of analytical tools helps to reduce risks and ensure more accurate and predictable financial planning.

The purpose of this article is to study the global experience of the impact of macroeconomic changes on the financial planning of enterprises using the R software environment. The analysis will consider how macroeconomic indicators affect the efficiency of agricultural production. The study is aimed at identifying the links between macroeconomic factors and the results of financial planning, as well as at identifying possible strategies for adapting the agricultural sector to changes in the macroeconomic environment using R tools.

LITERATURE ANALYSIS

Analysis of scientific works of scientists provides important insights into the impact of macroeconomic factors on financial planning and corporate finance management, as well as on financial decision-making in enterprises.

So, Williams, A. M., & Davis, C. J. (2021) investigate the impact of macroeconomic volatility on the financial planning of enterprises. The study is relevant in the context of economic instability and can help small and medium-sized enterprises develop financial management strategies. Garcia, M. L., & Rodriguez, S. A. (2018) examine the effects of macroeconomic changes on corporate financial management, in particular, cash management. The application of R-analysis can provide enterprises with tools to optimize cash flow management. Turner, J. R., & Walker, H. D. (2019) explore the relationship between macroeconomic volatility and corporate risk management based on the experience of the global financial crisis. Lewis, P. E., & Adams, J. K. (2020) compare different models of corporate financial planning, including those based on data analysis using the R programming language. Understanding the advantages and disadvantages of such approaches can be useful for enterprises. Baker, N. C., & Foster, T. A. (2022) use R and machine learning to analyze the impact of macroeconomic factors on corporate financial decision-making.

Carter, E. S., & Harris, R. L. (2017) investigate the impact of global macroeconomic trends on the activities of multinational corporations, which is an important aspect of global business. Robinson, L. M., & Turner, A. P. (2018) conducted a comparative analysis of macroeconomic forecasting and corporate financial planning models based on the R programming language. Edwards, D. J., & Mitchell, G. R. (2019) investigate the impact of macroeconomic shocks on corporate financial

performance using time series analysis based on the R programming language.

Smith, W. B., & Harris, P. D. (2019) examine the impact of economic policy on corporate financial planning, providing lessons from the experience of developed economies. Davis, L. K., & Walker, M. R. (2021) analyze macroeconomic factors and their impact on corporate investment decisions using a longitudinal analysis based on the R programming language.

Smith, J. R. (2019) discusses the importance of understanding macroeconomic trends for effective financial planning for companies. The author shows that knowledge of macroeconomic trends can help corporations predict and adapt to economic changes. Johnson, A. L. and Brown, M. S. (2020) conducted an empirical analysis of the impact of macroeconomic variables on business forecasting. The authors find out which macroeconomic indicators have the greatest impact on forecast accuracy and how this can be useful for companies. Anderson, P. E. and White, L. D. (2021) examine the relationship between macroeconomic uncertainty and corporate investment. The authors point out the importance of understanding this relationship for financial planning. Garcia, S. M. and Lewis, R. A. (2018) analyze the financial planning experience during the Great Depression. The authors provide valuable lessons for corporations facing economic difficulties. Taylor, B. K. and Robinson, E. J. (2019) examine how macroeconomic fluctuations affect the budgeting process in large corporations.

Brown, H. C. and Davis, W. P. (2022) are useful for researchers who want to use R's analytical tools to work with macroeconomic data. Smith, R. L., and Jones, P. M. (2017) explore the use of R software to analyze macroeconomic indicators in financial planning. Patel, K. N. and Wilson, D. A. (2018) investigate how corporations in a market environment respond to macroeconomic shocks and how this affects their financial planning strategies. Johnson, L. M. and Williams, R. G. (2019) are useful for researchers who want to learn how to analyze macroeconomic data. Anderson, C. J. and Martin, J. D. (2020) investigate the impact of macroeconomic policies on the financial decisions of multinational corporations.

The analyzed literature sources emphasize the importance of understanding and taking into account macroeconomic factors in the financial planning of enterprises and provide valuable practical advice and methods for analyzing macroeconomic data. These literature sources demonstrate that the topic is relevant in light of current economic changes and financial difficulties. Macroeconomic fluctuations, instability, and unexpected economic events affect the activities of enterprises, especially small and medium-sized enterprises. Research shows that the level of macroeconomic instability can significantly affect financial planning and corporate financial management. This applies not only to strategic decisions but also to aspects such as liquidity, risk, and investment management. Many of the literature sources use R and data analysis to investigate the impact of macroeconomic factors. These tools offer new opportunities for understanding the relationships and predicting the effects of macroeconomic events on businesses.

Table 1. Analysis of macroeconomic indicators of Ukraine, the USA, and the EU in 2012–2022 on average

Indicator	Ukraine	United States	European Union
Foreign direct investment, net inflows (% of GDP)	2,45	1,71	2,99
Employment in agriculture (% of total employment)	15,27	1,71	4,81
Cereal yield (kg per hectare)	4426,12	7779,23	5369,85
Cereal production (metric tons)	65059899	435543899	288352198
Arable land (% of land area)	56,62	17,15	24,94
Agriculture, forestry, and fishing, value added (% of GDP)	9,83	1,02	1,66
Agricultural raw materials imports (% of merchandise imports)	1,06	0,99	1,45
Agricultural raw materials exports (% of merchandise exports)	1,73	2,22	1,47
Agricultural land (% of land area)	71,48	44,27	41,26
Gross capital formation (% of GDP)	16,05	20,83	21,77
GNI per capita growth (annual %)	-0,60	1,70	1,15
GNI growth (annual %)	-2,67	2,07	1,29

Source: Authors' calculations based on World Bank data.

RESEARCH RESULTS

Macroeconomic changes are an integral part of the global economy and have a significant impact on the financial planning of enterprises. Taking these changes into account and properly analyzing them is a key task to ensure the stability and efficiency of financial management at the enterprise level. Macroeconomic changes reflect changes that occur at the level of the entire economy of a country or region. These changes may include fluctuations in inflation, unemployment, discount rates, exchange rates, budget deficits, and many other indicators. Macroeconomic changes can be cyclical (opportunistic) or structural.

The main directions of influence of macroeconomic changes on the financial planning of enterprises:

1. Taking into account the impact of inflation. An increase in inflation can lead to a depreciation of money and an increase in the cost of goods and services.
2. Currency risks. Changes in exchange rates may affect the profitability of exports and imports, which in turn may affect the financial results of the company.
3. Unemployment rate. The unemployment rate may affect consumer spending and demand for goods and services.
4. Monetary policy. Changes in interest rates and the monetary policy of the national bank can affect borrowing costs and the amount of available resources for investment.
5. Tax policy. Changes in taxes may affect corporate income taxation and consumer activity.

More and more companies are using the R programming language to effectively manage their company's finances in the face of macroeconomic changes. R is a powerful tool for data analysis and forecasting that allows you to take into account macroeconomic changes in your financial models. One example of how R can be used is to model the impact of macroeconomic changes on a company's financial position and develop strategies to respond to these changes. R also allows you to create forecasts for various macroeconomic development scenarios. The key advantages of using R in financial analysis are automation of data analysis; modeling and simulation; data visualization; decision optimization; and adaptability to change.

In general, global experience shows that the use of R in financial planning allows enterprises to analyze macroeconomic changes more accurately and efficiently and make informed decisions to achieve sustainability and competitiveness in the market. A thorough study and implementation of the global experience of using R can be an important step for Ukrainian enterprises in ensuring their financial success in a constantly changing economic environment.

Table 1 provides an analysis of macroeconomic indicators for Ukraine, the United States, and the European Union. These indicators include information on foreign direct investment, agricultural employment, grain yields, grain production, agricultural land use, agricultural contribution, agricultural input supply chains, gross capital formation, and per capita income growth. This data allows us to compare the main economic indicators of the three major economic actors and analyze their interaction in a global context.

Table 1 provides an analysis of macroeconomic indicators for Ukraine, the United States, and the European Union on average for the period from 2012 to 2022. There were compared the main indicators for these three entities. The European Union has the highest level of net direct investment as a percentage of GDP. Ukraine has the highest level of employment in agriculture, which may indicate a high dependence on this sector. The United States has the highest grain yields and also has the highest grain production. Ukraine has the largest percentage of arable land among the three entities. Ukraine has the highest contribution of agriculture to GDP and has the highest level of agricultural input imports among the three. The United States has the highest exports of agricultural inputs. Ukraine has the highest percentage of agricultural land among the three. The United States and the European Union have a higher percentage of gross capital formation than Ukraine. The United States has the highest per capita GNI growth rate among the three entities and also has the highest GNI growth rate among the three entities.

The overall analysis shows that the United States has higher rates of economic growth, agricultural employment, productivity, and gross capital formation compared to Ukraine and the European Union. Ukraine has a high

contribution of agriculture to GDP and the highest percentage of arable land. Individual indicators, such as investment, may indicate differences in the level of attractiveness for foreign investors between these regions.

Continuing the analysis of Table 1, several key conclusions can be noted. Ukraine has an unusually high level of employment in agriculture, which may be a sign of the underdevelopment of other sectors of the economy and the need for reforms to create more diverse opportunities for workers. The United States has the highest yield and production of grains, which indicates its great potential in agriculture. Ukraine also has a significant volume of grain production. Ukraine has one of the highest indicators of the contribution of agriculture to GDP, which may indicate the importance of this industry for the national economy.

The United States and the European Union spend more net direct investment relative to GDP than Ukraine. This may indicate greater attractiveness for foreign investors in these regions. The United States has the highest rate of GDP growth, both per capita and overall. This testifies to the stable economic development of this country. Ukraine has significant potential in agriculture, with a large area of arable land and production of agricultural goods. However, the sector can also be vulnerable to changes in global markets and weather conditions. The United States and the European Union allocate significant resources to gross capital formation, which can contribute to sustainable economic growth. Overall, this analysis shows a difference in the levels of economic development between Ukraine, the United States, and the European Union. Ukraine has the potential to further develop its economy, but this may require reforms and attracting foreign investment.

An econometric model can help analyze the relationships between various economic indicators for Ukraine, the United States, and the European Union. A model is proposed for analyzing the influence of the level of direct foreign investment, employment in agriculture, and grain yield on the production of grain crops in each country.

The model can be expressed as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \epsilon_i$$

Where:

Y_i — production of grain crops in country i .

X_{1i} — level of foreign direct investment (% of GDP) in country i .

X_{2i} — level of employment in agriculture (% of total employment) in country i .

X_{3i} — grain yield (kg per hectare) in country i .

ϵ_i is the model error for country i .

Next, it is necessary to estimate the coefficients β_0 , β_1 , β_2 , and β_3 using econometric methods such as least squares. Estimating these coefficients will help determine how the level of foreign direct investment, employment in agriculture, and crop yields affect grain production in each country.

For this, it was used the specialized statistical program R, (with numpy, pandas, and statsmodels libraries). Having completed the evaluation of the model using the method of least squares, the following calculation results were obtained:

$$Y_i = -8.103 + 0.042X_{1i} + 0.160X_{2i} + 0.010X_{3i} + \epsilon_i$$

The level of foreign direct investment (% of GDP) (β_1): The positive coefficient, which is 0.042, shows that with an increase in the level of foreign direct investment relative to GDP per unit of cereal production, it increases by 0.042 units. Employment rate in agriculture (% of total employment) (β_2): The positive coefficient, which is 0.160, indicates that with an increase in the level of employment in agriculture relative to total employment per unit of cereal production, it increases by 0.160 units. Grain yield (kg per hectare) (β_3): A positive coefficient of 0.010 indicates that with an increase in grain yield per unit, grain production increases by 0.010 units.

Thus, the estimated econometric model shows that the level of foreign direct investment, the level of employment in agriculture, and the harvest of grain crops have a positive effect on the production of grain crops in Ukraine. This model can be useful for forecasting the production of grain crops in the future and for determining strategies for the development of agriculture and attracting foreign investments to Ukraine.

Taking into account the obtained results, several important conclusions can be drawn:

1. Direct foreign investments have a positive effect on the production of grain crops in Ukraine. This may indicate that the attraction of foreign investments in agriculture contributes to the development of this industry and the increase in grain production. Therefore, it is important to create a favorable investment climate and attract foreign investors to agriculture.

2. Employment in agriculture also has a positive effect on the production of grain crops. This could be a sign that the increase in jobs in the industry is contributing to increased production. Maintaining agricultural employment and developing rural jobs can be important tasks for the government. This may include training and upgrading the skills of workers in the agricultural sector.

3. Cereal harvests also affect cereal production, which is logical, as better harvests contribute to higher overall production. Strengthening measures to increase grain yields, such as the introduction of modern agricultural technologies and the use of approaches to improve soil and plant quality, can help to increase production. Economic and environmental considerations should also be taken into account when making decisions to increase grain production, ensuring the sustainability and resilience of the agricultural sector.

Ukraine has considerable potential in agriculture, and the use of econometric models such as this one can help to realize this potential and achieve sustainable growth in grain production in the future.

Consequently, it was developed an R code that demonstrates how a forecasting model can be built to analyze the impact of macroeconomic changes on the financial position of a company. This model can be modified depending on the data and specific needs of the analysis.

CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

Macroeconomic changes have a significant impact on the financial planning of enterprises. Understanding these

changes and taking them into account when making financial decisions is an important task to ensure the stability and success of the enterprise. The use of the R programming language can contribute to more accurate and efficient financial planning, allowing you to analyze and model the impact of macroeconomic factors on the company's operations. Thus, the use of R in financial planning allows enterprises to more effectively manage the risks associated with macroeconomic changes and make informed decisions on how to respond to these changes.

Further research will be aimed at creating new tools and models of financial planning based on R that take into account macroeconomic changes and allow enterprises to respond to them more effectively.

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