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AUTHORS	Fedir Zhuravka Yuriy Petrushenko Svitlana Chorna Bohdana Huriy Inessa Yarova Olga Pankiv Wojciech Duranowski

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Fedir Zhuravka (Ukraine), **Yuriy Petrushenko** (Ukraine), **Svitlana Chorna** (Ukraine), **Bohdana Huriy** (Poland), **Inessa Yarova** (Ukraine), **Olga Pankiv** (Poland), **Wojciech Duranowski** (Poland)

FINANCIAL SECURITY OF UKRAINE IN DEBT BURDEN: ASSESSMENT AND FORECASTING

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Fedir Zhuravka, Doctor of Economics, Professor, Department of International Economic Relations, Academic and Research Institute of Business, Economics and Management, Sumy State University, Ukraine.

Yuriy Petrushenko, Doctor of Economics, Professor, Department of International Economic Relations, Academic and Research Institute of Business, Economics and Management, Sumy State University, Ukraine.

Svitlana Chorna, Ph.D., Senior Researcher, Scientific Research Part, Academic and Research Institute of Business, Economics and Management, Sumy State University, Ukraine. (Corresponding author)

Bohdana Huriy, Ph.D. in Sociology, Project Expert, Ignatianum University in Krakow, Poland.

Inessa Yarova, Ph.D., Associate Professor, Department of International Economic Relations, Academic and Research Institute of Business, Economics and Management, Sumy State University, Ukraine.

Olga Pankiv, Ph.D., Assistant Professor, Department of Sociology, Economic Sociology Unit, Collegium of Socio-Economics, SGH Warsaw School of Economics, Poland.

Wojciech Duranowski, Ph.D., Assistant Professor, Institute of Economics and Finance, University of Opole, Poland.

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Abstract

This study aims to comprehensively assess the state's financial security of Ukraine in the context of mounting debt and economic instability. Particular attention is paid to the security of the financial sector, which determines the overall level of financial system security. This involves constructing a regression model of the relationship between the level of financial security and debt, the size of the economy, and reserves, as well as forecasting likely medium-term dynamics.

Modeling revealed imbalances. During the war, the level of financial security dropped to a critical level, providing only about 30% of the required level of economic protection. One of the most vulnerable components was debt security, which shows a high degree of dependence on external financing. Regression modeling demonstrated a clear negative correlation between the amount of external debt and the level of financial security, with each increase in the debt burden being accompanied by a decrease in the integral index. Conversely, despite being observed, the positive impact of GDP growth proves insufficient to counterbalance the identified threats. Consequently, if current trends persist, Ukraine's financial security level may decline to 16.6% by 2030, indicating an imminent approach to a critical point of macro-financial vulnerability.

The study highlights the pressing need to reconsider public financial policy, particularly concerning debt management, budget planning, and the modernization of the financial system. This is essential not only to sustain the economy but also to safeguard the state in the face of an existential threat.

Keywords financial security, debt, macroeconomics, risks, crisis, economic security, public debt management, financial threats

JEL Classification C53, F34, G01, H63

INTRODUCTION

Financial security is a cornerstone of national security, and its state directly affects the stability of the financial system, debt stability, and socio-economic balance in the country.

With the outbreak of a full-scale war, the structure and dynamics of Ukraine's external public debt underwent significant transformations. In the context of a deep economic and security crisis, the government was compelled to thoroughly revise its approach to financing the state budget, with a significant portion of the budget being covered by external assistance in the form of loans, grants, and macro-financial support. Consequently, there was both an absolute increase in the volume of external debt and a change in its currency and institutional structure. The share of official debt issued through loans from partner governments and international financial organizations (particularly the IMF, the World Bank, and the EBRD) increased significantly compared to previous periods. This contributed to improved debt servicing conditions, thanks to lower interest rates and longer grace periods.

According to the Ministry of Finance of Ukraine (Ministry of Finance of Ukraine, 2025a-j), international partners provided Ukraine with USD 89.3 billion in financial assistance from February 2022 to March 2024. Of this amount, non-repayable funds, i.e., grants, account for 30% of financial assistance. Meanwhile, 70% of the assistance, equivalent to USD 62.4 billion, is comprised of long-term loans that will need to be repaid over the next 15 years. A significant portion of the credit-based financial injections has resulted in an increase in the country's debt burden. Ukraine's public and publicly guaranteed external debt reached USD 120.09 billion in 2024, representing a 90% increase compared to pre-war levels. According to the Ministry of Finance's calculations, Ukraine's public debt to expected GDP in 2024 is 87.9% (Ministry of Finance of Ukraine, 2025a-j).

Consequently, the transformation of the state's financial security in the context of global challenges caused by the war is a subject of particular interest. These changes can be analyzed by examining the impact of the growing debt burden on key parameters of financial stability. Additionally, the potential limits of the state's economic security in the event of further intensification of debt pressure can be determined. This will allow the formation of predictive scenarios and justify directions for strengthening financial security in the medium term.

1. LITERATURE REVIEW

Traditionally, the concept of financial security of the state was formed under the influence of profound socio-political, economic, and technological transformations taking place in the world. With the development of globalization processes and the complication of financial relations between states, research has begun to emphasize the importance of ensuring stable access to financial resources as a prerequisite for fiscal sustainability and economic well-being. The scientific literature offers numerous interpretations of this phenomenon, which have evolved from individual financial protection to the concepts of national and institutional security in an interdependent global economy.

The idea of financial security as a category has been shaped over the centuries in close connection with the evolution of statehood, economic activity, and global financial relations. Its earliest manifestations can be traced back to the practices of financial support for armies and public administration during wars. In early civilizations, such as Mesopotamia, elements of financial security were inextricably linked to land ownership, as fertile land provided stable income, food security, and solvency. In particular, the Code of Hammurabi (c. 1754 BC) enshrined rules that regulated financial obligations and protected the property rights of citizens (Atack & Neal, 2009).

In the modern scientific discourse, financial security is regarded as a crucial component of a state's economic security, ensuring its ability to withstand internal and external financial threats while maintaining the stability of the financial system. The modern concept of financial security was influenced by the Great Depression of the 1930s, which exposed the vulnerability of market economies to systemic failures and showed the inability of the private sector to overcome a large-scale crisis on its own. In response to the challenges of that period, many countries expanded the role of the state in the economy, which included social welfare programs to stabilize fiscal and monetary policies, as well as strengthened the supervision of the banking sector. This has gradually laid the groundwork for a future financial security system as an essential component of public policy.

In the field of international relations, the concept of financial security gained importance after the creation of the Bretton Woods system in 1944. This new financial order enshrined the principles of monetary stability, capital controls, and institutional cooperation within the International Monetary Fund (Obstfeld & Taylor, 2004). Since then, financial security has come to be seen not only as a domestic policy of the state, but also as an element of global stability, important both for maintaining economic growth and preventing transnational financial crises.

The evolution of financial systems demonstrates that periods of economic instability, such as economic downturns, wars, and financial crises, have

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often led to a reevaluation of the role of financial security. As Blikhar et al. (2021) emphasize, effective financial risk management systems are crucial during these times. The growth of public debt, exchange rate fluctuations, and balance of payments deficits are all factors that can compromise financial system stability. To mitigate these risks, it is crucial to conduct a thorough risk assessment and implement preventive measures.

In the scientific literature, financial security is interpreted as a multidimensional phenomenon that combines both the institutional characteristics of the financial system and the economic capacity of the state to ensure the stability of the macroeconomic environment. In particular, Hacker et al. (2010) posit that financial security constitutes a fundamental component of both national security and personal well-being. Concurrently, Allen et al. (2014) assess it through the lens of financial stability, public debt management, financial institution stability, and the potential risk of a systemic crisis.

Tirole (2002) emphasizes the importance of building anti-crisis strategies based on a detailed analysis of the risks arising from global shocks, devaluations, and loss of confidence in the banking system. His approach emphasizes the need for international coordination of efforts in financial regulation to reduce the systemic vulnerability of countries.

The evolution of approaches to defining financial security reflects the transformation of finance from a simple infrastructure for the exchange of goods to a key instrument for implementing the state's economic policy. In this context, financial security serves a dual purpose: it both acts as a defense against threats and serves as an active tool for economic development and social protection. Shkolnyk et al. (2022) defined financial security as a multifaceted structure comprising key components such as financial sector security, stock market stability, debt sustainability, and budget security. These components are closely interconnected and form the systemic basis of the state's economic security. At the same time, in the context of rapid technological development, the findings underscore the digitalization of the financial sector as a new yet integral component of financial security.

Despite diverse interpretations, there is a growing consensus among scientists that financial security is a systemic concept covering financial sector stability, effective public finance management, domestic resource mobilization, and resilience to external financial shocks.

Modern research pays considerable attention to identifying and preventing threats that may affect the stability of the financial system. Orlov et al. (2021), Petruk et al. (2022), Shkolnyk et al. (2021), Shkolnyk et al. (2020), Oliynyk et al. (2017) determined that achieving a strategic level of security in critical areas requires focusing on stimulating scientific and technological progress, improving the quality of education, and increasing the efficiency of domestic financial and investment institutions. Without developing these basic systems, it is impossible to establish a self-sufficient economy capable of effectively countering modern challenges and threats. Strengthening the domestic institutional environment, particularly the financial architecture, should form the basis of full-fledged financial security. In the context of global instability, financial security is a prerequisite for overall national security.

Khalatur et al. (2018) developed a methodology for assessing financial security based on the principles of early threat detection in the context of the transnationalization of economic processes while also taking into account Ukraine's national interests. Regression models are an important methodological basis, as they allow for dynamic analysis based on continuously updated input information. This approach ensures the model's adaptability to changing external conditions, enabling more precise conclusions about the impact of specific factors on financial security levels. Yehorova et al. (2024) instead employed a methodological approach developed by Ukraine's Ministry of Economy for a thorough evaluation of foreign economic security.

Financial security is an integral part of the state's overall economic security system. Its level largely depends on the efficiency with which the state manages its budget, currency, and monetary sectors. Balatskyi et al. (2018), Dankiewicz et al. (2022) emphasize that the financial security of the banking system and of individual banks is integral to a country's financial security. The sustainability of the banking sector is crucial to the financial security of the state, as banking institutions implement the primary monetary and payment mechanisms, transmit financial policy, and finance the economy. The results present three main methodological approaches to assessing the financial security of the banking sector: instrumental, systemic, and target (criterion).

Research on consumer finance, such as Dewi et al. (2023) and Alam et al. (2022), explores technological and systemic influences on financial institution effectiveness, exploring fraud prevention in banks and mobile banking use in Islamic finance, underlining the multifaceted nature of financial security across cultures and systems.

One of the critical challenges to Ukraine's financial security in times of war is the disruption of foreign economic logistics and distribution chains. Due to the loss of access to seaports and restrictions on transport infrastructure, a significant number of Ukrainian companies were forced to urgently reorient their export flows through Western borders and European logistics hubs. Such changes not only complicate export activities but also significantly reduce foreign exchange earnings, putting pressure on the balance of payments and the exchange rate.

Zhuravka et al. (2024) focus on analyzing structural changes in foreign trade and identifying effective adaptation strategies. The development of such strategies is considered a key condition for maintaining economic sustainability, ensuring export continuity, and minimizing losses in the foreign economic sector amid the transformation crisis. Given that exports are one of the sources of replenishing international reserves and maintaining exchange rate stability, effective logistics reorganization and strategic support for exporters are among the essential elements that affect the level of the state's financial security under martial law.

The impact of the debt burden on the financial system is also important. High levels of external debt may negatively impact a nation's financial security, exacerbating macroeconomic instability and creating risks for economic growth and recovery. These risks include the loss of control over public finances and the difficulty of servicing debt. This is particularly relevant for Ukraine, where international partners have been providing financial assistance since the start of the full-scale invasion. However, only a small portion of this assistance is in the form of grants, with the bulk consisting of loans. The circumstances in which Ukraine found itself resulted in not only quantitative changes in the volume of external debt but also a qualitative restructuring of the state's debt policy. This policy underwent a shift toward a greater emphasis on official external support and the restructuring of commercial obligations.

Along with the provision of assistance and financing to Ukraine's budget, this creates an additional burden on the economy, which justifies the need to study the impact of external debt on the country's economic indicators. Thus, this paper aims to comprehensively study and summarize the impact of macroeconomic factors on Ukraine's financial security in the context of debt burden.

2. METHODS

The current level of financial security was quantified by calculating relevant indicators according to the Ministry of Economy's methodology (Ministry of Economy of Ukraine, 2013). Then, a multiple linear regression model was built to determine the dependence of the overall financial security indicator on the selected key parameters (X_1, X_2, ..., X_n). These parameters were chosen based on theoretical analysis and empirical data.

The second stage involves creating forecasts of each parameter's value included in the regression model. The final stage integrates the obtained forecast values into the regression equation to calculate the expected level of financial security in the short and medium term. This makes it possible to determine the stability limits below which the state's financial system may be exposed to systemic risks.

To determine the levels of state security through quantitative assessment, a system of indicators, along with their permissible thresholds, is used. The integral indicator of the level of security of individual sectors, as well as the overall level of economic security of the state, is calculated using the weighting coefficients described by the Ministry of Economy of Ukraine (2013). These coefficients reflect the importance of each indicator and de-

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termine its effect on the final value of the security index. Financial security has the highest weight (0.1294, 13%) among all components of economic security (Haber et al., 2018). These coefficients are determined using the expert method, taking into account the specifics of how each indicator affects the financial stability of the state.

The integrated assessment of economic security is determined according to the following scheme:

a) formation of a set of indicators;

b) determination of the characteristic values of the indicators;

c) normalization of the indicators;

d) determination of the weighting coefficients;

e) calculation of the integrated indices for individual sectors of the economy and the integrated index of economic security as a whole.

Since financial and economic security indicators are interrelated and can signal potential threats, they have a differentiated impact on the integral index. To unify the interpretation of these indicators, it is advisable to classify them into three groups: stimulating, discouraging, and mixed-type.

Stimulating indicators (S) have a direct positive relationship with the integral index – as these indicators grow, so does the level of security. Discouraging indicators (D) have an inverse relationship – growth in values is accompanied by a decrease in the integral index. This group includes indicators that reflect economic deterioration or increased risks, such as inflation, debt burden, or budget deficit.

To facilitate comparison and analysis, the values of the indicators are normalized into a single range. This process converts initial values with different units and ranges into a single dimensionless scale, greatly simplifying their aggregation and analytical processing. According to the Ministry of Economy of Ukraine (2013), normalization uses a linear function determined by the indicator's type, i.e., whether it stimulates or discourages. The relevant normalization formulas are presented in Appendix A (Table A1) and reflect the logic of interpreting values within a unified scale. Each indicator is transformed into a value within the range of 0 to 1 or 0% to 100%. The resulting value reflects the degree to which the conditionally optimal level of security is approximated. Values close to 1 (or 100%) indicate a high level of the relevant security aspect.

The integral security index is formed according to a hierarchical principle. At the lower level, indices of individual sectors (security spheres) are calculated. At the higher level, an integral, generalized indicator reflects the state's overall security level. The integral index for each sphere is calculated by taking into account weighting coefficients that reflect the relative importance of each normalized indicator within its respective sphere. This process is described by the following equation:

$$I_m = \sum w_i y_i, \quad (1)$$

where I_m is the index/sub-index of the m security sphere, m = (1, 2, 3...); w_i is the weighting coefficient that determines the degree of contribution of the i indicator to the integral index of the economic security component; y_i is the normalized score of the i indicator.

The indices obtained for each area are aggregated into a generalized economic security index by calculating a weighted average, considering the weight of each area in the overall financial security structure.

The method of multiple linear regression was used to assess the impact of factor attributes on the level of the state's financial security. This statistical model describes dependence and establishes the nature and strength of the relationship between one dependent (target) variable and several independent (explanatory) variables.

The formal representation of the model is as follows.

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \ldots + \alpha_m X_m, \quad (2)$$

where Y is the dependent variable (financial security index); X_1, X_2, …, X_m X are independent variables; a_0 is a constant term; a_1, a_2, …, a_m are regression coefficients showing the influence of each variable on the target indicator.

After estimating the model parameters, the statistical significance of each regression coefficient is checked. The t-statistic, defined as the ratio of the parameter estimate to its standard error, is used. Additionally, confidence intervals (upper and lower bounds) and p-values are calculated for each coefficient. This allows one to assess the significance level of the variable at a given α level (usually 0.05).

The interpretation of the results is based on the following criteria:

- If the p-value is less than 0.05, the coefficient is considered statistically significant.
- If the t-statistic is significantly higher than the critical value in the table, the variable has a significant impact on the dependent variable.
- The confidence interval should not include zero, which also indicates the existence of a relationship.

The use of a multiple regression model enables not only the quantification of the impact of individual economic factors on financial security, but also the identification of the most critical ones for making informed management decisions.

The method of extrapolation by average absolute growth was used to make the forecast. This method belongs to a class of simple adaptive time series methods. It involves calculating the average annual growth of each variable under study over previous years and applying this dynamic to predict future values. This approach enables the creation of a realistic forecast based on existing trends, even without a comprehensive econometric forecasting model.

The essence of the method is as follows:

$$\Delta X_{avg} = \frac{X_t - X_0}{t}, \quad X_{t+1} = X_t + \Delta X_{avg}, \qquad (3)$$

where: ΔX_{avg} is the average absolute growth of the indicator over t years; X_t is the value of the indicator in the last accessible year; X_{t+1} is the forecast value of the indicator for the next year.

The indicators were integrated into the previously developed multiple regression model using the obtained forecast values of the independent variables. This enabled the calculation of the expected level of the integrated financial security index for the state during the forecast period. Using a combination of extrapolation and regression analysis provides a quantitative basis for assessing future risks and identifying critical financial security thresholds in the context of macroeconomic instability.

3. RESULTS

Economic security is defined as the weighted average of nine sub-indices covering the main areas of macroeconomic development (Ministry of Economy of Ukraine, 2013). One of the key components is financial security, which is structurally represented by six sectors (Figure 1) covering the relevant functional areas of the state's financial system: banking security, non-banking financial sector security, debt security, budget security, currency security, and monetary security.

The analysis revealed significant imbalances in a number of components of financial security, indicating its fragmented nature and uneven level of protection of individual financial sectors. In particular, the debt segment of financial securities demonstrated heightened vulnerability. Its critically low value is due to both the significant burden of external and internal debt obligations and the imbalanced structure of public and state-guaranteed debt. According to the results of the analyzed period, the average level of security for this sector was approximately 16%, indicating significant vulnerability and a potential threat to economic stability.

The state of the non-banking financial sector is characterized by a low level of stock market development and limited penetration of insurance services. This significantly reduces the potential for financial stability and adaptability of the system in times of crisis.

The area of budget security has shown negative dynamics, as indicated by budget imbalances at all levels. This is defined as a discrepancy between revenues and expenditures, also known as the budget deficit. This is attributable to the prevailing military situation in the country. In the

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Source: National Bank of Ukraine (n.d.a.), State Statistics Service of Ukraine (n.d.), World Bank Group (WBG) (n.d.).

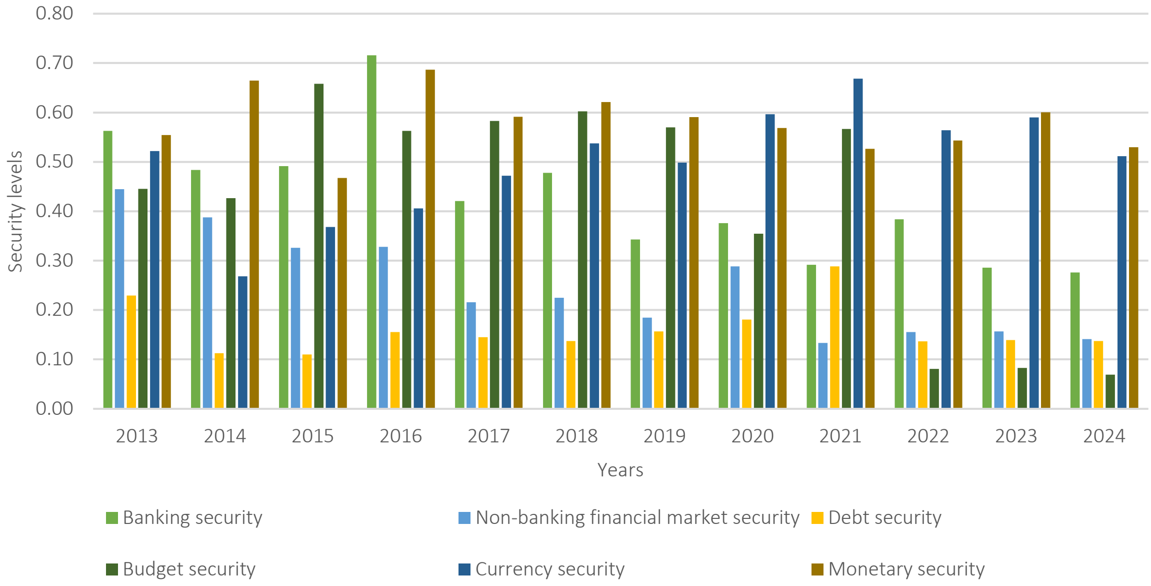

Figure 1. Security levels of Ukraine's financial sectors, 2013–2024

pre-war period, the level of budget security fluctuated between 56% and 66% from 2015 to 2019. Since the start of Russia's full-scale invasion in 2022, the indicator has fallen to a critical 8%, remaining at this level in 2023 and further declining to 7% in 2024.

This sharp decline can be attributed to a substantial increase in government spending, primarily on defense under martial law. According to the Ministry of Finance of Ukraine (Ministry of Finance of Ukraine, 2025a-j), the defense sector received a significant budgetary boost, increasing from UAH 191.4 billion in 2021 to over UAH 1,500 billion in 2023, marking an unprecedented level in the nation's modern budgetary history. According to preliminary data in 2024, the trend of extremely high defense spending, accounting for more than 50% of the total budget, is expected to continue.

Additional budgetary constraints stem from the necessity to service both external and internal debt, the volume of which has increased considerably as a result of financing the budget deficit by drawing on credit resources from international financial institutions. The international financial assistance received by Ukraine from its partners is earmarked and can only be used to finance budgetary needs. The budgetary system is losing its financial autonomy due to its dependence on external financing and limited resource maneuvering on the part of the government.

Therefore, Ukraine's budget security is extremely vulnerable due to both exogenous shocks of a military nature and endogenous factors, in particular structural imbalances between revenues and expenditures.

The monetary and credit security sector continues to demonstrate stability. Despite the growth of macroeconomic risks caused by the full-scale war, inflationary pressure, and devaluation expectations, this sector continues to demonstrate a relatively high level of adaptability. The average monetary security indicator for the period under review remains at around 58%, which allows this area to be classified as relatively secure.

The National Bank of Ukraine (NBU, n.d.a-i) plays a key role in maintaining the stability of this segment by pursuing a consistent restrictive monetary policy aimed at reducing inflationary pressure, stabilizing the currency market, and ensuring control over the money supply in circulation. During periods of crisis, the NBU has taken a number of measures, including raising the discount rate, introducing currency restrictions, and implementing mechanisms to regulate the liquid-

Source: National Bank of Ukraine (n.d.a.), State Statistics Service of Ukraine (n.d.), World Bank Group (WBG) (n.d.).

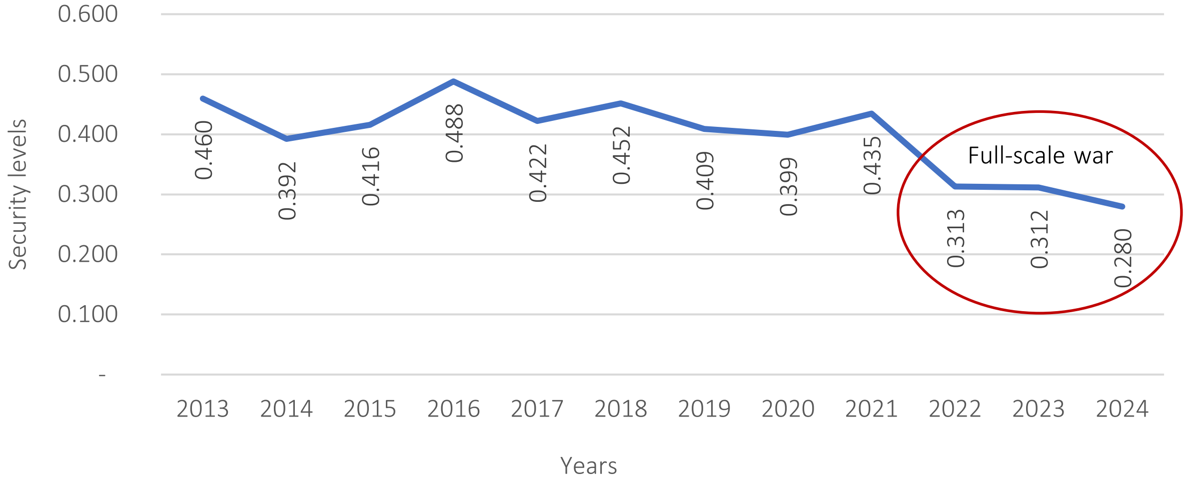

Figure 2. Integral index of Ukraine's financial security, 2013–2024

ity of the banking sector. This policy contributed to maintaining macro-financial stability. It is also important to consider the impact of external factors, particularly international assistance and stabilization programs with the IMF, which became an additional source of currency support. This strategy enabled the NBU to accumulate international reserves and maintain exchange rate stability during critical periods. Concurrently, domestic demand for cash, which traditionally rises during crises, remained manageable, indicating a sufficient level of monetary discipline.

A comprehensive sectoral assessment covering areas such as banking security, non-banking financial sector security, debt, budget, currency, and monetary security has made it possible to develop an integrated index of Ukraine's financial security. This summary indicator reflects the current state of Ukraine's financial security (Figure 2).

According to the assessment of Ukraine's integrated financial security index for the period 2013–2024, a clear downward trend was identified. At the beginning of the study period, in 2013, the index stood at 0.460, indicating an average level of financial system security. In subsequent years, moderate volatility was observed, with slight increases (2016 – 0.488; 2018 – 0.452) alternating with decreases (2014 – 0.392; 2020 – 0.399). This indicates cyclicality in the financial system's response to internal and external challenges.

The most critical factor is the dynamics of the index from 2022 to 2024. In 2022, there was a significant decrease to 0.313, which remained at a similar level in 2023 (0.312). In 2024, the indicator continued to decline to 0.280. Specifically, the level of financial security has dipped below 30% over the past three years, indicating a notable decline in adaptability and resilience within the financial system. This level indicates that Ukraine's economy is functioning at the minimum level of financial security.

The reasons for this deterioration are multifaceted and interconnected. First and foremost, the full-scale war that has been ongoing since 2022 has placed an unprecedented strain on public finances, causing a sharp increase in the budget deficit and debt burden. The state has experienced a decline in financial self-sufficiency due to increased spending on defense, critical infrastructure, and social programs, which are largely dependent on external assistance. Concurrently, the majority of international resources (grants and loans) are earmarked for specific purposes, primarily to finance budgetary needs, which limits the potential for strategic investments in economic development.

Preliminary sectoral analysis indicates that Ukraine's financial system is vulnerable to debt security issues. Specifically, a steady decline in the financial security index is accompanied by a significant increase in public and guaranteed debt, high budget dependence on external financing, and a

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Table 1. Input parameters for multiple regression analysis

Years	Financial Security Index	Ukraine's external public and publicly guaranteed debt (USD billion)	GDP growth (annual %)	Total reserves (incl. gold, current billions of US dollars)
	Y	X1	X2	X3
2013	0.460	37.54	0.0	20.41
2014	0.392	38.79	–10.1	7.54
2015	0.416	43.45	–9.8	13.3
2016	0.488	45.60	2.4	15.54
2017	0.422	48.99	2.4	18.81
2018	0.452	50.46	3.5	20.82
2019	0.409	48.94	3.2	25.32
2020	0.399	53.72	–3.8	29.14
2021	0.435	57.20	3.4	30.97
2022	0.313	71.40	–28.8	28.51
2023	0.312	101.70	5.5	40.51
2024	0.280	120.09	2.9	43.80

decline in international reserves. In this context, there is a need for quantitative research on the impact of key macroeconomic factors on the level of financial security of the state.

For this purpose, a multiple regression model was used to analyze the relationship between the level of financial security (dependent variable) and three main economic indicators (independent variables) that influence its formation (Table 1).

The selection of these variables is based on the logic of system analysis:

- External debt (X_1) in the context of growing debt servicing creates an additional burden on the budget system and increases vulnerability to external shocks.
- GDP growth (X_2) reflects the overall dynamics of economic growth, which directly affects the stability and adaptability of the financial system.
- The volume of reserves (X_3) is an indicator of currency and monetary stability, as well as the state's ability to withstand crises.

A close examination of Ukraine's external debt reveals a substantial increase in public debt following the full-scale invasion (see Table 1). This rise in debt was evident both in nominal terms and relative to GDP. In 2023, the total amount of public and publicly guaranteed debt increased by 30% in dollar terms (to USD 101.70 billion) compared to 2022. The debt burden reached 85% of GDP, compared to 49% in 2021. This indicates a sharp deterioration in debt dynamics as a result of the military crisis. In 2023, the government secured USD 30.9 billion in external financing, equivalent to UAH 1.13 trillion.

The primary driver of the surge in public debt was external borrowing, which was primarily facilitated on preferential terms, characterized by reduced interest rates and extended repayment periods. While these conditions may positively impact current budget financing, they also introduce potential currency risks and future fiscal obligations. The unpredictability of the security environment presents significant challenges for forecasting and implementing budget parameters, particularly in terms of revenue and expenditure. Of particular relevance is Ukraine's growing fiscal dependence on external official transfers. These financial inflows include resources from the European Union, foreign governments, international financial organizations, donor structures, and other state entities.

According to operational data from the Ministry of Finance of Ukraine (2025a-j), as of December 31, 2024, Ukraine's state and state-guaranteed external debt amounted to UAH 5.05 trillion (72.3% of the total state and state-guaranteed debt), or USD 120.1 billion. In 2024, the amount of debt increased primarily due to an increase in long-term concessional financing from international partners. In 2024, the European Union was the largest source of financing for the state budget. During the full-scale year, Ukraine's debt on concessional loans from the EU increased by UAH 600.5 billion (USD 11.1 billion), with servicing payments to be compensated by European Union countries.

Regarding the composition of the nation's debt obligations, a significant portion of Ukraine's public and publicly guaranteed debt structure is currently comprised of concessional loans from international financial organizations (IFOs) and foreign governments, accounting for 58% of the total debt portfolio. The second-ranking category comprises bonds issued within the domestic market, accounting for 28% of the debt structure. Securities issued on external capital markets account for 12%, while loans from commercial banks and other non-bank financial institutions have the smallest share at only 2%. The aforementioned structure signifies a considerable reliance on external official sources of financing for the state budget, thereby ensuring favorable debt service conditions. Conversely, this reliance heightens sensitivity to geopolitical dynamics and the availability of international financial support.

Today, Ukraine's largest creditors (Ministry of Finance of Ukraine, 2025a-j) include:

- EU – USD 44 billion (UAH 1,850 billion); according to the memorandum of understanding, EU aid packages account for 26.5% of Ukraine's total external debt structure;
- IMF – USD 13.5 billion (UAH 569 billion) under the four-year Extended Fund financing program;
- IBRD – under various programs, USD 16.18 billion (about UAH 680 billion) and USD 5.79 billion (UAH 243 billion) from the International Development Agency (a World Bank institution);
- Government of Canada – USD 5.08 billion, or over UAH 213 billion.

Additionally, the government has reached agreements with a group of official creditors and G7 countries to extend the moratorium on servicing official debt until the end of 2027.

Slav'yuk and Slaviuk (2018) conducted a comprehensive analysis of the dynamics of Ukraine's public debt, outlining both the potential benefits of debt financing and the threats posed by its uncontrolled growth. Government borrowing can serve as a vital tool for mobilizing resources for economic development, particularly in the form of investments in strategic industries and infrastructure. Concurrently, in the Ukrainian context, borrowing is directed toward servicing existing debt obligations, creating a debt spiral effect. The trend of extending the maturity of public debt and reducing its cost has been observed in 2024 and in previous periods. Specifically, from 2022 to December 31, 2024, the weighted average cost of Ukraine's public and state-guaranteed debt decreased by 1.5 times, from 7.79% to 5.09%, while the weighted average maturity increased by 2 times, from 6.27 years to 12.26 years. On the positive side, these are preferential loans with reduced interest rates and extended repayment terms, which allow for the financing of current tasks. On the downside, there is an accumulation of risks and an increase in the debt burden, which needs to be repaid in future periods.

Given the identified debt burden issues, the model focuses on analyzing the impact of three factors that are critical in conditions of economic turbulence, military action, and financial instability. The findings of the multiple regression analysis are outlined in Table 2.

The multiple regression model that describes the relationship between financial security and its associated factors is as follows:

$$Y = 0.539 - 0.002 \cdot x_1 + 0.003 \cdot x_2 + 0.0002 \cdot x_3, \tag{4}$$

where x_1 is external public and publicly guaranteed debt (USD billion); x_2 is GDP growth (annual %); x_3 is total reserves (incl. gold, billions of US dollars).

The next step is to verify whether the model is statistically significant and accurately reflects reality (see Table 3). The coefficient of determination, R^2 = 0.89, is a reliable indicator, indicating that 89% of the variation in variable Y is attributable to the macroeconomic variables under study, with only 11% of the variance not explained by the model and attributed to other factors.

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Table 2. Multiple regression analysis

Regression statistics								
Multiple R	0.9434							
R-squared	0.8900							
Normalized R-squared	0.8488							
Standard error	0.0251							
Observations	12							
Dispersion analysis								
	df	**SS**	**MS**	**F**	**Significance of F**			
Regression	3	0.04079	0.01360	21.57707	0.00034			
Residue	8	0.00504	0.00063	–	–			
Total	11	0.04583	–	–	–			
Variable	**Coefficients**	**Standard error**	**t-statistics**	**p-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Y-intersection	0.539	0.020	26.790	0.000	0.492	0.585	0.492	0.585
Variable X 1	–0.002	0.001	–3.662	0.006	–0.004	–0.001	–0.004	–0.001
Variable X 2	0.003	0.001	3.342	0.010	0.001	0.005	0.001	0.005
Variable X 3	0.0002	0.002	0.139	0.893	–0.003	0.004	–0.003	0.004

The *F*-value for the model is then compared with the critical *F*-value. The critical value is 4.066, and the observed value (21.577) is greater than this critical value. Therefore, there is a linear relationship between *X* and *Y*, and the model proves to be reliable.

Three different methods of testing the coefficients for statistical significance revealed that coefficient X_3 (corresponding to the parameter of Ukraine's total reserves) is not statistically significant for the model under study. After conducting a thorough review of the statistical testing results, it has been determined that there is currently insufficient evidence to conclude that the influence of this parameter on the dependent variable differs from zero. In other words, the model may be overloaded with this variable, which is of little benefit. Therefore, it was decided to exclude it from further analysis.

3.1. Economic interpretation of the model

After excluding variable X3, the model becomes the following:

$$Y = 0.539 - 0.002 \cdot x_1 + 0.003 \cdot x_2, \tag{5}$$

where x_1 is external public and publicly guaranteed debt (USD billion); x_2 is GDP growth (annual %).

Table 3. Verification of model coefficients (parameters) for statistical significance

No.	**For Y**	**For X_1**	**For X_2**	**For X_3**
	Hypothesis	**T crit. = 2.306**	**–**	**–**
1	**H0_a: a = 0 – the parameter is statistically insignificant H1_a: a ≠ 0 – the parameter is statistically significant**			
	26.790 > 2.306	3.662 > 2.306	3.342 > 2.306	0.139 < 2.306
	H0_Y is rejected with a probability of 95%. Parameter Y is statistically significant	H0_X_1 is rejected with a probability of 95%. Parameter X_1 is statistically significant	H0_X_2 is rejected with a probability of 95%. Parameter X_2 is statistically significant	H0_X_3 is accepted. Parameter X_3 is statistically insignificant
2	Y lower = 0.4924 Y upper = 0.5851	X_1 lower = –0.004 X_1 upper = –0.001	X_2 lower = 0.001 X_2 upper = 0.005	X_3 lower = –0.003 X_3 upper = 0.004
	0 does not fall within the range (0.492; 0.585) Parameter Y is statistically significant	0 does not fall within the range (–0.004; –0.001) Parameter X_1 is statistically significant	0 does not fall within the range (0.001; 0.005) Parameter X_2 is statistically significant	0 falls within the range (–0.003; 0.004) Parameter X_3 is statistically insignificant
3	**If the p-value is lower than the mistake probability of 0.05, the coefficient is statistically significant**			
	P_Y (0.000) < 0.05 Parameter Y is statistically significant	P_X_1 (0.006) < 0.05 Parameter X_1 is statistically significant	P_X_2 (0.010) < 0.05 Parameter X_2 is statistically significant	P_X_3 (0.893) > 0.05 Parameter X_3 is statistically insignificant

The model analysis enables the following interpretation regarding the impact of indicators on the financial security level of the state:

- Constant (0.539): the expected value of the financial security index, assuming that external debt and GDP growth are zero. This is a purely technical parameter and is conditional; in reality, these values cannot be zero, but the constant is needed to shift the line in space.

- Coefficient at X_1 (–0.002): means that an increase in external debt by USD 1 billion leads (on average) to a decrease in the financial security index by 0.002 units, with GDP growth remaining unchanged. An increase in debt reduces a country's financial security, which is logical, as the risk of debt burden increases.

- Coefficient at X_2 (0.003): a 1% increase in annual GDP growth leads to an increase in the financial security index by 0.003 units, with the debt level remaining unchanged. Economic growth improves financial stability, as the state's GDP is the basis for budget revenues and debt servicing.

The model reveals a clear correlation between external debt and financial security, with higher levels of external debt associated with reduced financial security. Conversely, economic growth is shown to have a positive impact on financial security. Given the statistical significance of the model variables, as determined by *t*-statistics, upper and lower levels, and *p*-values, the findings point to their real impact.

To predict possible scenarios for the development of changes in the country's financial security, its level has been forecast for future periods. This is especially necessary for public policy, investment planning, macroeconomic management, and early detection of crisis threats. The forecast identifies potential threats to the country's financial stability. This process involves a thorough review of the current debt level, an assessment of the state's capacity to manage its debt obligations, and the development of proactive public policy measures to ensure long-term financial stability.

In accordance with the selected forecasting model, the objective was to ascertain the potential for shifts in Ukraine's financial security in the forthcoming years. In the context of the model under study, it was decided to assess in advance the risks of exceeding the debt burden and the possible degree of growth or contraction of the economy. According to the model, a forecast was made for the two main factors that most influence financial security: external government and government-guaranteed debt as the main debt burden and GDP growth as an indicator of the country's overall economic development. The forecast was generated by extrapolating the average absolute growth and integrating the results into the model (Table 4).

The regression model was constructed, and the key variables – external public debt (X_1) and gross domestic product growth rates (X_2) – were forecasted. Forecast values of financial security (Y) for the 2025–2030 period were then obtained. The calculations have yielded several key conclusions.

The forecast indicates a gradual but steady decline in Ukraine's financial security throughout the period under review. While the financial security index will remain at 0.2502 in 2025 (i.e., 25% security), it is projected to decline to a critical level of 0.1663 (16.6%) by 2030. This trend signals heightened risks to the country's macro-financial stability.

Table 4. Model parameter forecasting

Forecast period	External public and publicly guaranteed debt (X_1)	GDP growth (X_2)	Financial Security Index (Y)
	Average absolute growth = 7.5049	Average absolute growth = 0.2636	$Y = 0.539 - 0.002X_1 + 0.003X_2$
2025	127.5952	3.1636	0.2502
2026	135.1002	3.4273	0.2334
2027	142.6051	3.6909	0.2166
2028	150.1100	3.9545	0.1999
2029	157.6150	4.2182	0.1831
2030	165.1199	4.4818	0.1663

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According to the model, the most significant negative impact on financial security is the growth of external public and guaranteed debt (X_1). The average annual increase in debt is $7.5 billion. This is because debt creates obligations to service it – to pay interest and the principal amount. In the event of insufficient economic growth, this can worsen the state's financial capacity and reduce its security.

While economic growth rates have a positive impact on financial security (the coefficient at X_2 is positive), they remain relatively low. The projected annual GDP growth ranges from 3.2% to 4.5%, which does not compensate for the negative impact of the growing debt burden. In summary, the positive impact of GDP growth is insufficient to offset the overall downward trend in security.

The value of 0.1663 obtained in 2030 indicates that should the trend persist, Ukraine may approach a perilous threshold of financial insecurity. The conditional scale for interpreting the level of security (from 0 to 1 or 0% to 100%) concludes that a fall below 20% is a sign of a serious threat to the stability of the budget system, an increased likelihood of a debt crisis, and a loss of confidence among investors and creditors.

Given these forecasts, maintaining the status quo is not a viable option. It is imperative to assess the public debt management strategy and explore avenues to stimulate:

- Actual economic growth (investment, innovation, and support for domestic production);
- Exports and foreign exchange earnings;
- Effective spending of borrowed funds with a focus on creating long-term economic value.

Consequently, given the rise in external public and state-guaranteed debt, coupled with negligible GDP growth, financial security is anticipated to deteriorate. If current trends persist, Ukraine's financial security is projected to deteriorate significantly by 2030, with the economy's resilience to financial threats estimated at only 16%. To address this challenge, prompt strategic decisions are essential to reduce debt pressure and proactively stimulate sustainable economic growth. Razinkova et al. (2023) underscore the necessity to establish an effective system for managing Ukraine's external public debt. In the context of a full-scale war, issues such as debt restructuring, optimization of external financing sources, and ensuring transparency and control over debt operations are of particular importance. The management system should be based on a combination of short-term stabilization measures and long-term strategic approaches aimed at reducing the debt burden, maintaining the country's credit rating, and minimizing the risks of default. Effective debt management is currently a key factor in ensuring the financial security and economic stability of the state.

4. DISCUSSION

The study's findings align with the conclusions of several prior research efforts, underscoring the adverse impact of escalating external debt on a nation's financial stability. The debt security sector demonstrated the most significant vulnerabilities. The critically low value is due to the significant burden of external and internal debt obligations, as well as the imbalanced structure of public and state-guaranteed debt. Stashchuk (2025) identified similar patterns, leading to the key factors causing a decline in Ukraine's debt security. These include the rapid growth of the state budget deficit, political instability, and the introduction of martial law, which led to record levels of national defense spending. Furthermore, the government's proactive approach to deficit reduction through strategic borrowing was a crucial element in this process. The cumulative effect was exacerbated by structural imbalances caused by falling budget revenues and rising expenditures amid the consequences of the pandemic and large-scale war in Ukraine. Aizenman and Ito (2020) also analyzed strategies for exiting the debt crisis after the pandemic and their implications for developing countries, highlighting the risks to financial stability in the context of high debt burdens.

At the same time, empirical estimates of regression model coefficients indicate that economic growth in a state of martial law is not a sufficiently powerful compensator for reducing financial risks. This finding stands in contrast to the approaches

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outlined by Levine and Zervos (1998), who identified economic growth as a key factor in enhancing financial security. The reasons for this discrepancy likely stem from the distinct circumstances in Ukraine, including the ongoing war, fluctuations in budgetary inflows and outflows, significant reliance on external assistance, and the fragility of financial institutions.

The study builds upon existing approaches to assessing a country's financial security in the scientific literature, particularly by developing a regression model that enables a quantitative assessment of the impact of key indicators on the overall level of financial stability. Voronova et al. (2023) conducted a retrospective analysis of global financial crises and identified a number of indicators that most often precede crisis phenomena. These include the state of the balance of payments, the ratio of external debt to GDP, exchange rate volatility, and the level of import coverage by international reserves. The primary focus of the study is on the relationship between external debt and the balance of payments, which is undoubtedly an important but fragmentary component of the broader issue of financial security. The current study proposes a comprehensive approach that involves integrating several macroeconomic indicators – external debt, international reserves, and economic growth rates – into a single regression model. This approach helps to determine the direction and strength of the influence of each factor, as well as to make predictive calculations of the overall level of financial security of the state. In particular, it has been established that the growth of external debt has a statistically significant negative impact on the integral index of financial security, while GDP growth rates demonstrate a positive compensatory effect, albeit less pronounced.

Qian and Steiner (2017) examined the impact of international reserves on the maturity structure of external debt. Using a theoretical model, the authors demonstrate that, with sufficient reserves, a country can influence the yield curve, in particular by extending the average maturity of external borrowing. In this context, reserves function as a confidence buffer, mitigating refinancing risks and enhancing conditions for accessing external capital markets.

The results of this empirical study, conducted using a multiple regression model, revealed a slightly different picture. Despite the widely acknowledged importance of international reserves as a stabilization tool, this variable was not statistically significant in the model used to assess Ukraine's financial security. This outcome may suggest model oversaturation or the relatively limited impact of reserves on financial security, when compared to other factors, particularly debt burden and economic growth dynamics. This may be related to the specifics of Ukraine's macroeconomic conditions during martial law (when a significant part of reserves is formed from external assistance) and to the country's limited access to capital markets, which negates the classic effect of reserves on investor confidence. International reserves are still a key component of macro-financial stability, but their role in ensuring financial security during crises is not as significant as often assumed in theoretical models.

This updated assessment confirms an even more alarming trend: over the past three years (2022–2024), the integrated financial security indicator has consistently remained below the critical threshold of 30%, indicating an extremely low level of adaptability and the financial system's extreme vulnerability to shocks. This suggests that Ukraine's economy is operating at the threshold of stability, where systemic support for macroeconomic stability is only partially guaranteed and cannot be relied upon to fully withstand external and internal pressures. Given the multidimensional nature of the crisis – a combination of debt, currency, budgetary, and geopolitical factors – the key conclusion is the need for a comprehensive, multifactorial approach to assessing financial security.

The results obtained not only corroborate some of the conclusions of previous scientific works but also provide valuable insights into contemporary threats to Ukraine. The proposed approach allows for the assessment of current financial security, the establishment of a monitoring framework, and the development of predictive scenarios for strategic management in uncertain conditions. This work builds upon existing approaches to the study of financial security by emphasizing the need to consider the complex effects of macroeconomic factors and establishing the foundation for future empirical research in this area.

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CONCLUSION

The study provides a thorough evaluation of Ukraine's financial security in the face of mounting external debt, military instability, and shifts in the global financial landscape. The construction of an integrated financial security index and the application of a multiple regression model enabled the identification of key determinants and the quantitative assessment of their impact on the country's financial stability.

The findings indicate that between 2022 and 2024, Ukraine exhibited only a marginally adequate degree of financial security, providing roughly one-third of the requisite safeguards against domestic and foreign economic challenges. Systemic imbalances in debt and budget security pose a threat to the country's macro-financial stability.

Econometric modeling confirmed the significant negative impact of external debt. Specifically, an increase in its volume by USD 1 billion has been shown to reduce the financial security index by an average of 0.002. Concurrently, a 1% rise in GDP results in a 0.003% rise in the index, underscoring the favorable impact of economic growth on financial stability. While economic growth has a stabilizing effect, its compensatory effect is insufficient to neutralize the risks associated with the debt burden.

Forecast calculations indicate that further growth in external public and guaranteed debt, under conditions of only moderate economic growth (GDP), will contribute to a further decline in the country's financial stability. A probable decline in the financial security index to a critical level (about 16%) by 2030 has been recorded, assuming that current macroeconomic trends and debt policy remain unchanged. This necessitates the immediate implementation of structural reforms and the strengthening of debt management.

The practical results can be used to make informed management decisions in the areas of public finance, borrowing, and economic development. Further research should include the following: expanding the model to incorporate institutional factors, introducing time lags in impact through dynamic models, and conducting a comparative analysis with other countries that have experienced deep crises, military conflicts, or actively utilized external financing. At the government level, the creation of a dynamic panel system for monitoring financial security is a viable strategy. This system can serve as a tool for strategic analysis and planning.

AUTHOR CONTRIBUTIONS

Conceptualization: Fedir Zhuravka, Yuriy Petrushenko, Bohdana Huriy.
Data curation: Yuriy Petrushenko, Svitlana Chorna.
Formal analysis: Fedir Zhuravka, Yuriy Petrushenko, Svitlana Chorna, Bohdana Huriy, Inessa Yarova, Olga Pankiv.
Funding acquisition: Inessa Yarova, Olga Pankiv, Wojciech Duranowski.
Investigation: Fedir Zhuravka, Bohdana Huriy, Olga Pankiv, Wojciech Duranowski.
Methodology: Svitlana Chorna, Inessa Yarova.
Project administration: Fedir Zhuravka.
Resources: Bohdana Huriy, Inessa Yarova, Olga Pankiv, Wojciech Duranowski.
Software: Svitlana Chorna, Inessa Yarova, Olga Pankiv, Wojciech Duranowski.
Supervision: Fedir Zhuravka.
Validation: Yuriy Petrushenko, Bohdana Huriy.
Writing – original draft: Svitlana Chorna, Inessa Yarova, Olga Pankiv, Wojciech Duranowski.
Writing – review & editing: Fedir Zhuravka, Yuriy Petrushenko, Bohdana Huriy.

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APPENDIX A

Table A1. Standardization of financial security indicators by type of impact for assessing the security levels of the state's financial sectors

Source: Summarized by the authors based on the Methodological Recommendations from the Ministry of Economy of Ukraine (2013).

Range of values	Standardization of the indicator by type S-stimulator	Standardization of the indicator by type D-destimulator
Minimal $[y_0, y_{crit})$	$y_{ij} = 0.2\exp\left(\frac{x_{ij} - x_{crit}}{n_i}\right),\ x_{ij} < 0,\ \ x_{ij} < x_{crit}$ $y_{ij} = 0.2\frac{x_{ij}}{x_{crit}},\quad 0 < x_{ij} < x_{crit}$	$y_{ij} = 0.2\frac{x_{crit}}{x_{ij}},\quad x_{ij} \geq x_{crit}$
Dangerous $[y_{crit}, y_{dang})$	$y_{ij} = 0.2 + 0.2\frac{(x_{ij} - x_{crit})}{(x_{dang} - x_{crit})},\ x_{crit} < x_{ij} < x_{dang}$	$y_{ij} = 0.2 + 0.2\frac{(x_{crit} - x_{ij})}{(x_{crit} - x_{dang})},\ x_{dang} < x_{ij} < x_{crit}$
Dangerous $[y_{dang}, y_{unsat})$	$y_{ij} = 0.4 + 0.2\frac{(x_{ij} - x_{dang})}{(x_{unsat} - x_{dang})},\ x_{dang} < x_{ij} < x_{unsat}$	$y_{ij} = 0.4 + 0.2\frac{(x_{dang} - x_{ij})}{(x_{dang} - x_{unsat})},\ x_{unsat} < x_{ij} < x_{dang}$
Unsatisfactory $[y_{unsat}, y_{sat})$	$y_{ij} = 0.6 + 0.2\frac{(x_{ij} - x_{unsat})}{(x_{sat} - x_{unsat})},\ x_{unsat} < x_{ij} < x_{sat}$	$y_{ij} = 0.6 + 0.2\frac{(x_{unsat} - x_{ij})}{(x_{unsat} - x_{sat})},\ x_{sat} < x_{ij} < x_{unsat}$
Satisfactory $[y_{unsat}, y_{opt}]$	$y_{ij} = 0.8 + 0.2\frac{(x_{ij} - x_{sat})}{(x_{opt} - x_{sat})},\ x_{sat} < x_{ij} < x_{opt}$	$y_{ij} = 0.8 + 0.2\frac{(x_{sat} - x_{ij})}{(x_{sat} - x_{opt})},\ x_{opt} < x_{ij} < x_{sat}$
Optimal $[y_{opt}]$	$y_{ij} = 1, x_{opt} < x_{ij}$	$y_{ij} = 1, x_{opt} < x_{ij}$

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