



Problems and Priorities of Strengthening Economic Security Using it Management: Structural Modeling Approach

Maryna Nehrey * 

*Corresponding Author, Department of Economic Cybernetics, National University of Life and Environmental Science of Ukraine, Kyiv, Ukraine. Email: marina.nehrey@gmail.com

Larysa Zomchak 

Department of Economic Cybernetics, Ivan Franko National University of Lviv, Lviv, Ukraine. Email: lzomchak@gmail.com

Nataliia Klymenko 

Department of Economic Cybernetics, National University of Life and Environmental Science of Ukraine, Kyiv, Ukraine. Email: nklimenko@nubip.edu.ua

Iryna Volovelska 

Department of Economics and Management of Industrial and Commercial Business, Ukrainian State University of Railway Transport, Kharkiv, Ukraine. Email: velya71@mail.ru

Julia Pichugina

Department of Economics and Entrepreneurship, Odessa I.I.Mechnikov National University, Odessa, Ukraine. Email: judi22@ukr.net

Abstract

The article examines the multiaspected problem of ensuring economic security. An analysis of challenges and threats to Ukraine's economic security during 2010-2019. Strategic goals of economic security have been set. The study of the relationship between public debt, foreign direct investment, and economic growth allows assessing the characteristics of economic security. A system of structural equations is proposed to study the relationship between GDP, public debt, and foreign direct investment. The result of economic security, which can be achieved by achieving the goal, can be considered increased resilience to internal and external factors.

Keywords: Economic security, Finance, Structural model, Industrial, Investment, Innovation, IT management.



Introduction

The economic security of the country is one of the components of national security. It plays a significant role in ensuring sustainable economic development, implementing effective social policies, maintaining an appropriate level of competitiveness in an international economic interdependence. The essence of economic security is that it is the material basis of national sovereignty and determines the real possibilities for other types of security.

According to the Ministry of Economy of Ukraine, in 2010-2019 the economic security of Ukraine was in the zone of unsatisfactory condition. The average value of the level of economic security for 10 years was 40 percent, in 2019 - 43 percent, and the first half of 2020 - 41 percent.

The main components of economic security are financial security, industrial security, investment and innovation security, international economic security, macroeconomic security.

Literature review

The study of economic security is one of the topical issues, and special attention is paid to the issues of economic security of individuals, enterprises, society and the state. (Brown & Bowman, 2020) investigated the issues of economic security and dignity. The issues of assessing and ensuring economic security are discussed in (Gryshova et al., 2020), (Greer, 2021), (Hacker et al., 2014), (Kahler, 2004), (Shumilo et al., 2021).

Economic security has different aspects, their research has been carried out in many papers. In particular financial security investigated in (Brychko & Olejarz, 2019), (Davydenko et al., 2019), (Kaminskyi & Versal, 2018), (Lukianenko & Dadashova, 2016), industrial security in (Petrunenko et al., 2021), (Starychenko et al., 2020), (Zhylynska et al., 2020), investment and innovation security in (Ramazanov et al., 2020), (Hryhoruk et al., 2021), (Matviychuk et al., 2019), (Stepnicka et al., 2020), (Zherlitsyn et al., 2021) international economic security in (Odehnal & Neubauer, 2020), (Vlasenko et al., 2020), (Zakharova et al., 2020), macroeconomic security in (Guryanova et al., 2020), (Heiets et al., 2006), (Merkulova et al., 2018).

Methodology

Various methods are used to measure the state of economic security: monitoring of the main socio-economic indicators and comparing them with the limit values; expert evaluation; scenario analysis; optimization; game-theoretic; multidimensional statistical analysis; theory of artificial neural networks, etc.

The comparative approach is based on a comparison with the indicators of analog countries. Such indicators are comparability of economic development; comparative solvency of the population; coverage of social expenditures by wages; the level of shadowing of the

economy; export (import) dependence of the economy; concentration of commodity exports (imports); duration of export operations; attractiveness of investing; protection of investors' interests and others.

The advantage of the comparative approach is a comprehensive assessment of economic security. Its disadvantage is the difficulty of comparison, associated with the analysis of different environments of countries.

A structured approach to the assessment of economic security involves the analysis of its functional components. The main disadvantage of this approach is the uncertainty of the distribution of the weight of the components of economic security.

The targeted approach to assessing economic security involves the harmonization of goals and methods to achieve these goals, namely the assessment of the degree of provision of conditions for sustainable development. The advantage of this approach is the simplicity of interpretation of the evaluation of the results. The targeted approach allows for preventive measures.

The paper considers the tripartite links between public debt, foreign direct investment, and Ukraine's GDP over the past 20 years (1999-2019). Also, in the model as independent variables are used data on unemployment, %, population, million people, exports of goods and services, million US dollars, foreign exchange reserves, million US dollars, inflation rate, %, openness of the economy, %. Data were obtained from the World Bank website in the section World Development Indicators (Worldbank, 2021).

Results

Economic security assessing: challenges, threats, priorities

The level of economic security is extremely fluid in time, the nature and list of challenges and threats change frequently. Therefore, it is objectively necessary to develop a mechanism for assessing the state of economic security and consistently adjusting the country's strategic national priorities. The assessment of the economic security of Ukraine during 2010-2019 presents in Tabl 1.

Table 1. Assessment of economic security

| Security | Average value of the security assessment | Challenges and threats |
|--------------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial security | 42% | low level of budgetary discipline; a significant amount of the state budget deficit; insufficient level of financial inclusion; unresolved issues regarding assets and financial liabilities in the temporarily occupied territories of Ukraine; high level of shadowing of the economy; loss of budget revenues due to tax evasion; inconsistency of legal regulation of relations in the tax sphere; insufficient development of long-term lending; a significant |

| | | |
|------------------------------------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | share of non-performing loans in the loan portfolio of banks; functioning of the pension system in the conditions of high demographic load; low level of stock market liquidity; the spread of the phenomenon of legalization of proceeds from crime. |
| Industrial security | 53% | deindustrialization of the economy; loss of part of industrial potential; low level of resource efficiency of the economy; low level of introduction of the newest technologies of production; unsatisfactory technical condition and level of protection of critical infrastructure facilities; legislative irregularities in the field of critical infrastructure protection; high depreciation of fixed assets in the main types of economic activity; the presence of a share of foreign capital in strategic sectors of the economy; excessive penetration of imports into the domestic market; loss of potential in high-tech industries; insufficient efficiency of state regulation in the field of natural monopolies; environmental degradation and climate change; inefficient waste management; lack of production of a full cycle of products critical to human life. |
| Investment and innovation security | 32 | lack of favorable conditions for attracting investment; lack of a mechanism for evaluating foreign direct investment; the imperfection of regional and purposeful image investment policy; poorly developed innovation infrastructure; lack of favorable conditions for the creation and development of technology companies and innovative enterprises, startups; unsatisfactory condition of research infrastructure facilities; insufficient funding for scientific, scientific, technical and innovative activities; the insufficient amount of fixed capital financing; lack of effective economic incentives; insufficient level of protection of intellectual property rights; illegal directions to domestic technological developments and innovations by foreign entities; low protection of property rights; corruption. |
| International economic security | 34 | insufficient rates of diversification of trade flows of Ukraine; use of economic instruments of influence by the Russian Federation; dysfunctional structure of trade flows; high level of import dependence of the economy; increasing the number of protectionist measures applied by foreign states; underdeveloped foreign trade infrastructure; tan access of goods and services to the EU market; risks of export restrictions in case of introduction of new carbon taxes for Ukrainian goods. |
| Macro-economic security | 38 | slowing down the world economy in the context of the COVID-19 pandemic; reduction of economic activity in the state; preservation of risks of intensification of inflation and exchange rate fluctuations in the conditions of existence of monopoly markets; low level of well-being of the population; significant uneven distribution of income; intensive labor migration processes; high unemployment; high level of informal employment; low growth rates of labor productivity. |

Ensuring economic security in the strategic development of the country is a multifaceted complex problem that involves:

- active management actions on the part of public authorities with the aim of sustainable economic development;
- the dominance of preventive measures in ensuring economic security;
- continuous improvement of methods of combating illegal economic activity.

Ensuring economic security, considered in a strategic context, is possible only if a set of measures is combined, which includes a wide range of areas of interrelated development of the economy and society, both in the domestic and international spheres. The main tasks to ensure economic security are presented in Table 2.

Table 2. Economic security development strategy

| Security | Strategic security objectives |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial security | building an effective model for combating crimes in the economic sphere; reducing the state budget deficit and strengthening cooperation with international financial organizations; implementation of the minimum standard of the Plan to counteract the erosion of the tax base; creating conditions for increasing the involvement of long-term funding; reducing the level of non-performing loans and increasing the stability of the banking system; preservation of the institutional independence of the National Bank of Ukraine; intensification of the development of the national stock market; protection of the national financial system from the legalization of proceeds from crime; minimization of investor risks; ensuring a reduction in the cost of borrowed funds for the needs of the state; reforming the Ukrainian insurance market; ensuring the functioning of the three-tier pension system; development of public procurement |
| Industrial security | expansion of domestic and foreign markets for industrial products; introduction of a separate system of management and organization of economic processes in the occupied territories; restoring the potential of high-tech economic activities in industry; providing financial and institutional conditions for the creation of industrial ecosystems, accelerated development of Industry 4.0; creating opportunities for the development of own production of a full cycle of critical products; improving procedures for conducting investigations in the field of trade defense; development of industrial engineering and production of complex industrial equipment; reduction of regulatory load; development of quality infrastructure, attraction of domestic and foreign investments in modernization and development of critical infrastructure facilities; attracting domestic and foreign investment in the modernization and development of high-tech enterprises; simplification of access of national producers to natural resources and deepening of their processing with the involvement of modern technologies; introduction of regular monitoring of the competitive environment in commodity markets in Ukraine; ensuring the independence of the Antimonopoly Committee of Ukraine; increasing the transparency of state-owned enterprises; formation and updating of fuel and energy balance indicators in the medium term; increasing the level of resource efficiency of the economy, reducing energy and resource intensity; improvement of legislation on waste management; introduction of the principles of circular environmentally friendly production |
| Investment and innovation security | development of the institutional system of investor support; introduction of a system for assessing the impact of foreign investment on national security; development of the mechanism and realization of the state support of introduction of the newest technologies developed in Ukraine; creating conditions for small and medium enterprises to invest in research activities; ensuring a comprehensive verification of the origin of foreign investment in strategic objects of state importance; ensuring an adequate level of protection of intellectual property rights; intensification of measures for timely detection and termination of illegal directions to domestic technological developments and innovations by foreign entities and prevention of their unauthorized leakage abroad; improving the legal protection of property rights; introduction of economic incentives and support mechanism for domestic enterprises; creation of favorable conditions for the generation and commercialization of completed scientific developments and for the production of innovative products; introduction of effective economic mechanisms of stimulation of subjects of innovative activity to introduction of the newest technologies; introduction of the "open innovation" model; ensuring inclusiveness and implementation of a new system of evaluation of subjects of scientific, technical and educational activities; ensuring international cooperation in the field of innovation and scientific and technical activities; introduction of instruments of state regional policy aimed at increasing the investment attractiveness of regions |
| International economic security | carrying out economic reforms; legislative stimulation of enterprise competition; identification and counteraction to the instruments of influence on the economic security of Ukraine used by the Russian Federation in order to weaken it; implementation of measures to counteract attempts to sell goods and services on the international markets from the temporarily occupied territories of Ukraine; improving sanctions policy; ensuring monitoring of the effectiveness of the implementation of the applied sanctions; ensuring a rapid response to violations by foreign states of trade defense investigations into Ukrainian exports; creation of a system for counteracting image losses and campaigns to discredit Ukraine on world markets; ensuring the appropriate level of representation of state interests in international organizations; expansion of international trade and economic relations; deepening economic integration with the EU; ensuring the protection of the rights and interests of |

| | |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Ukraine in the trade and economic sphere; support and development of foreign economic relations at the multilateral and bilateral levels with strategic partners; intensification of the processes of adaptation of Ukrainian technical regulations to EU legislation |
| Macro-economic security | implementation of structural changes in the economy and industry by stimulating the development of a circular economy and digitalization; creation of new jobs with the maximum level of intellectual involvement; continuation of the policy of inflation targeting taking into account the need to ensure the economic development of the country; increasing the efficiency of cooperation between the National Bank of Ukraine and the Cabinet of Ministers of Ukraine to ensure macroeconomic stability and economic development; ensuring the preservation of the floating regime of the national currency; creating conditions for raising the standards of decent work; ensuring coverage of the population with medical services to the required extent; carrying out measures aimed at the return and reintegration of migrant workers |

Tasks should be formed not only at the strategic level, but also when planning individual programs and projects, which should meet the objectives of the country's economic security strategy and indicate the following:

- what risks are expected during the implementation of the program and how they can be compensated;
- exactly what requirements of security strategies are implemented in this program;
- what are the indicators of the limit values established for these;
- requirements, and to what extent the implementation of the corresponding program ensures the achievement of fixed values or approximation to them.

Economic security structural modeling

The investigation of the relationship between public debt, foreign direct investment and economic growth allows to assess the characteristics of economic security. In order to study the relationships between GDP, public debt and foreign direct investment, a system of structural equations (1) is proposed, which consists of three equations:

$$\begin{aligned}
 GDP_t &= a_0 + b_1 FDI_t + a_2 UR_t + a_3 POP_t + \varepsilon_{1t}, \\
 PD_t &= a_0 + b_1 GDP_t + a_2 EXP_t + a_3 RSV_t + \varepsilon_{2t}, \\
 FDI_t &= a_0 + b_1 PD_t + a_2 INF_t + a_3 OPN_t + b_2 GDP_t + \varepsilon_{3t},
 \end{aligned}
 \tag{1}$$

where GDP – real GDP per capita, US dollars;

PD – public debt, million US dollars;

FDI – foreign direct investment, million US dollars;

UR – unemployment rate, %;

POP – population, million people;

EXP – exports of goods and services, million US dollars

RSV – gold and foreign exchange reserves, million US dollars;

INF – inflation rate, %;

OPN – indicator of economic openness, % .

The structural econometric model (1) investigate the impact of foreign direct investment on gross domestic product (GDP), the impact of gross domestic product on public debt, as well as the impact of public debt and GDP on foreign direct investment.

For investigation the relationships between analytical data, we use a system of simultaneous equations, in which we recognize the variables as follows: dependent variables are denoted by y , independent variables x with the corresponding indices:

$$\begin{aligned} y_1 &= a_{10} + b_{11}y_3 + a_{12}x_1 + a_{13}x_2 + \varepsilon_{14}, \\ y_2 &= a_{20} + b_{21}y_1 + a_{22}x_3 + a_{23}x_4 + \varepsilon_{24}, \\ y_3 &= a_{30} + b_{31}y_2 + a_{32}x_5 + a_{33}x_6 + \varepsilon_{34}, \end{aligned} \quad (2)$$

where GDP – y_1 ; PD – y_2 ; FDI – y_3 ; UR – x_1 ; POP – x_2 ; EXP – x_3 ; RSV – x_4 ; INF – x_5 ; OPN – x_6 .

Thus, the system of simultaneous equations consists of three equations, in which there are 3 resulting variables (y) and 6 factor variables (x), which affect the resulting variable. However, several endogenous variables in some equations become exogenous variables in other equations, which indicates that this system of equations can be considered a system of simultaneous equations of the simulative econometric model, which we will study in the course of work. Thus, the classical least squares method cannot be used to study the relationships between these features, which complicates the task somewhat.

The first equation of the simulative model allows us to study the impact of foreign direct investment on economic growth. Increasing foreign direct investment is likely to accelerate economic growth, while the accumulation of public debt will slow economic development and reduce FDI inflows into the country. Thus, in this model, the value of GDP per person is influenced by FDI, as well as other selected variables, namely the unemployment rate and population.

The second equation of the system shows the interaction between gross domestic product per capita and public debt. This part of the equation explains how public debt operates at a certain value of GDP per person, as well as such factor variables as exports and total reserves.

The third equation of the model considers the determinants of foreign direct investment. Public debt has a significant negative impact on foreign direct investment, as its growth harms the “vision” of a foreign investor and creates negative expectations for the future economy, resulting in reduced FDI inflows. However, some scientists see the opposite positive relationship in this. In addition, inflation and the openness of the economy can also to some extent affect foreign investment and are therefore included in the analysis. But this indicators does not explain the foreign direct investment, that’s why the GDP was also included into the equation.

Before estimating of the unknown parameters of the model and applying the necessary method of analysis, we check whether the data of the equation are identified. For this, we use the mandatory condition of identification (order condition) - the number of exogenous

variables removed from the equation must be not less than the number of endogenous variables it contains, reduced by one: $k - k_i \geq m_i - 1$.

Table 3. Verification of the identification of the equations of the simulative model of economic security

| № of equation | The total number of exogenous variables in the simulative model (k) | The number of exogenous variables in a separate model equation (k _i) | Total number of endogenous variables in simulative models (m) | The number of endogenous variables in a separate equation of the model (m _i) | Check the equation $k - k_i \geq m_i - 1$ | Conclusion |
|---------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|----------------|
| 1 | 6 | 2 | 3 | 2 | $6 - 2 > 2 - 1$ | overidentified |
| 2 | 6 | 2 | 3 | 2 | $6 - 2 > 2 - 1$ | overidentified |
| 3 | 6 | 2 | 3 | 3 | $6 - 2 > 3 - 1$ | overidentified |

The results in Table 3 show that all three equations of the system are over-identified, ie for some structural parameters we can get more than one value. This suggests that the two-step least squares method can be used for such equations.

For estimation of the unknown parameters of the simulative model, we use the two-step least squares method, given that all our equations are overidentified.

To begin, repeat the recording of the original model in abbreviated form in a condensed form (3):

$$\begin{aligned}\tilde{y}_1 &= \pi_{10} + \pi_{11}x_1 + \pi_{12}x_2 + \pi_{13}x_3 + \pi_{14}x_4 + \pi_{15}x_5 + \pi_{16}x_6, \\ \tilde{y}_2 &= \pi_{20} + \pi_{21}x_1 + \pi_{22}x_2 + \pi_{23}x_3 + \pi_{24}x_4 + \pi_{25}x_5 + \pi_{26}x_6, \\ \tilde{y}_3 &= \pi_{30} + \pi_{31}x_1 + \pi_{32}x_2 + \pi_{33}x_3 + \pi_{34}x_4 + \pi_{35}x_5 + \pi_{36}x_6,\end{aligned}\quad (3)$$

In this case, the analysis is performed not for the actual values of the resulting features (y), but for their theoretical values (\tilde{y}).

$$\begin{aligned}\tilde{y}_1 &= 5794 + 47.5x_1 - 0.07x_2 + 0.05x_3 - 0.004x_4 + 0.79x_5 - 25.7x_6, \\ \tilde{y}_2 &= 681023 + 10606x_1 - 15.7x_2 + 0.09x_3 - 0.8x_4 + 74.2x_5 - 297.1x_6, \\ \tilde{y}_3 &= -26179 - 630.2x_1 + 0.6x_2 + 0.02x_3 + 0.21x_4 - 2.6x_5 - 5.62x_6,\end{aligned}\quad (4)$$

We use the previously obtained equations to find the appropriate theoretical values of endogenous variables (\tilde{y}), which will be necessary for further analysis. Substituting the theoretical values of the resulting variables into structural equations, we estimate the parameters of structural equations by the method of two-step least squares:

$$\begin{aligned}y_1 &= 22440.7 + 0.19y_3 + 44.32x_1 - 0.45x_2, \\ y_2 &= 12659.2 + 60.31y_1 - 1.51x_3 - 1.93x_4,\end{aligned}\quad (5)$$

$$y_3 = 1052.25 - 0.09y_2 + 21.88x_5 - 14.98x_6 + 3.54y_2.$$

The constructed structural model is adequate and can be used to forecast economic security.

Discussions

Estimation of model parameters allows to reach the following conclusions:

- 1% reduction in the unemployment rate will increase real GDP per capita by \$ 44.3;
- an increase in foreign direct investment of \$ 1 million will increase GDP per capita by \$ 0.19;
- an increase in exports of goods and services by \$ 1 million will reduce public debt by \$ 1.51 million;
- an increase in real GDP per capita by \$ 1 will increase public debt by \$ 60 million;
- 1% increase in inflation will reduce FDI by \$ 21.88 million.

Strengthening economic security can be considered the most priority consequence of the functioning of the financial market and its segments in terms of studying the integration interaction between them.

Conclusion

One of the important conditions for the sustainable development of the national economy is the timely response to threats from environmental factors and the definition of clear methods for assessing the level of threats to the state by one or another factor.

The creation of an effective system of economic security makes it possible to identify threats to national economic interests promptly and to prevent damage to the socio-economic system as a whole.

The result of ensuring economic security, which can be obtained by achieving the goal can be considered to increase resistance to internal and external factors.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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