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Economic Theory

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ASSESSMENT OF ECONOMIC RISKS TO SECURE DEVELOPMENT OF UKRAINE

Abstract

The article studies the issue of secure development of Ukraine, with a focus on risks and their assessment within the country's economic security framework. The author argues that a comprehensive assessment of the country's state of security cannot be performed without taking into consideration, measuring and continuously monitoring risks as an integral component of socio-economic development of countries in the modern conditions. The author develops a toolkit for quantitative measurement of risks, which determine the country's vulnerability and decrease its resilience in a volatile security environment. The proposed risk assessment algorithm is applied in practice to examine the economic dimensions of risk and to provide a composite estimate of the level of economic risk. Research findings prove that the concept of secure development of countries should be based on the examination, systematization, assessment, and continuous monitoring of risks in order to ensure the country's utmost adaptability to conditions caused by the emerging threats and risks.

Key Words:

security; secure development; threat, risk; risk indicator; risk assessment.

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5 figures, 8 tables, 50 references.

Introduction

The modern security environment is characterized by increased levels of uncertainty and volatility, making it impossible to accurately predict and forecast events, phenomena and changes in the ongoing processes. Therefore, it is imperative for countries to continuously enhance the instruments and approaches used in its analysis and strategic planning to ensure national security, in particular its economic component.

The analysis of secure development involves the identification of trends in socio-economic phenomena and processes, the understanding of their contributing factors, and the assessment of the impacts of interactions among international economic actors on the resilience of economic development. Changes in the parameters of security environment, which manifest themselves as deviations from the established development trajectories, equilibriums, or projected future states, are identified as risks to security of development. These risks should be assessed in order to either prevent them from evolving into real threats or transform them (given all necessary measures are taken) into new opportunities for resilient socio-economic development of the national economy and society.

Problem Statement and Literature Review

Uncertainty and instability are direct consequences of globalization, which have a first-hand impact on the secure development of countries, communities and individuals (Rodrik, 1999; Stiglitz, 2009). As a result, the level of vulnerability to economic events, in particular economic crises, is contingent upon the economic insecurity of countries, groups and individuals (Scholte, 2000). Currently, security is a relevant and highly-discussed issue among both local and foreign scientists. Some researchers (Vlasiuk, 2011; Kharazishvili, 2019; Hrybinenko,

2020; Kravchuk, 2020) emphasize the systemic and complex nature of the security concept, which predetermines the specifics of «state of security» assessments and the formation of the respective models of security provision. On the other hand, in-depth investigations into separate components of the economic security system, including financial security (Baranovskyi, 2004; Varnalii, 2020), debt security (Chentukov et al., 2021), social security (Novikova, 2018), foreign trade security (Khaustova & Hryhorova-Berenda, 2013), and other aspects, make it possible to differentiate various indicators within the economic security framework based on the degree and nature of their impact.

Modern transformations intensify the need to build flexible systems of security interactions and find ways to settle the problems of regional and global security (Lishchynskyi & Lyzun, 2020), to take into consideration the impact of geoeconomic determinants on the state of national economic security systems (Fedorenko et al., 2017), and to assess strong causal links between the Sustainable Development Goals, the international economic policy and the economic security of states and firms (Osaulenko et al., 2020).

Risk monitoring and risk assessment, carried out using various measurement instruments, play an important role in economic security provision. The proposed methods primarily involve multivariate assessments, which entail the systematization of security indicators and subsequent construction of composite security indices (Hrybinenko et al., 2020; Hubarieva, 2015; Iefimova et al., 2020; Kyzym et al., 2018; Order of the Ministry of Economic Development and Trade of Ukraine No. 1277 of October 29, 2013) or a composite risk index (Wang, 2022). These assessment instruments can be complemented with threshold values set for both the security indicators and the composite security index with the help of statistical techniques. This enables the determination of security levels and the identification of risk zones (Kharazishvili & Dron, 2014). The second group of instruments includes methods of security modelling, which are based on using the instruments of correlation and regression analysis (Mogyorósi et al., 2022), forecasting and scenario analysis (Pilarski, 2020).

The concept of secure development rests not only on the results of measuring the level of security, but also on the examination, systematization, assessment, and continuous monitoring of risks in order to ensure the country's utmost adaptability to the conditions caused by the emerging threats and risks. The concept of risk (threat, danger) in the security system includes both the assessment of risks and the development of risk management mechanisms (Sichyokno, 2018). At that, risk assessments are predominantly based on expert estimates. They are probabilistic in nature and serve as a foundation for developing systems of measures aimed at prevention of threats and mitigation of their adverse effects (Hales, 2016). Expert estimates can be complemented with quantitative measures obtained through utilization of risk modelling techniques (Ramazanov, 2012), thus forming a basis for strategic planning.

In contrast to risk-based assessment, there is a concept of reliability-based (also known as resilience-based or sustainability-based) assessment. This approach predominantly employs composite assessment methodology, which is based on the construction of composite indices for analyzing the level of the country's development security.

As noted by some scientists (Heyerdahl, 2022; Petersen, 2012), the risk assessment theory and the security management concept are indeed tightly interrelated. The former involves perceiving threats as risks, classifying them and assessing the scale of their impact, as well as determining the risk perception capability. The latter approach views security as a state that is opposite to risk propagation and vulnerability to its impact. At that, both risk assessment and security assessment depend on the context and the subject being studied. This is a rather complicated process subject to influence of many factors (Ciută, 2009; Boholm et al., 2016; Battistelli & Galantino, 2019). Security, however, is mostly viewed through assessment of threats, which, in their turn, bear the risks of insecurity and, thus, need to be predicted and managed.

Regarding specific approaches to risk consideration, the majority of empirical research focuses on the establishment of systems for identification and assessment of risks at the national level. In this case, the entities exposed to risks are countries or regions (Reznikova et al., 2020; Nunes-Vaz et al., 2014). These countries or regions are recognized as having distinct characteristics, depending on the strategic visions of national security, and serve as an important element in the mechanism of ensuring national resilience and countering vulnerabilities of development (Reznikova et al., 2022).

The Ukrainian economy faces several key vulnerabilities, which directly arise from the risks to resilient and secure development and impede security enhancement. These vulnerabilities are associated with imbalances in the financial system, macroeconomic disproportions, lack of financial resources, losses of state budget, low competitiveness of the national economy, insufficient protection of the national economy, insufficient and raw-resources-oriented investments, a decline in scientific and technical potential, depopulation, low well-being of the population, unfavourable conditions for a healthy lifestyle, decreasing cultural standards and deteriorating emotional state of the population, systemic weaknesses in environmental protection, insufficient public control over compliance with bio-security standards, systemic shortcomings in the sphere of energy security, inconsistency and incompleteness of reforms, low effectiveness of public authorities, and corruption (Decree of the President of Ukraine No. 392/2020 of September 14, 2022).

In view of the aforementioned situation, further research is needed to develop mechanisms of security provision. It is particularly important to build an effective system for preventing or providing early warnings for emerging risks and threats, on condition that consistent risk assessments and forecasting of the conditions in which they may arise and propagate are performed.

The goal of this study is to develop a toolkit for quantitative assessment of security risks, the practical application of which will enable the identification and measurement of the economic risks to secure development of Ukraine and their impact on the country's level of economic security.

The research problem lies in refining the techniques used to identify and evaluate security risks, which are an essential component of global economic development. These risks objectively arise due to uncertainty, incomplete information about certain events and an inability to accurately predict trends and parameters within the global economic environment. Although it is impossible to entirely eliminate risks, their monitoring and comprehensive assessment create preconditions for risk mitigation and facilitate well-informed and balanced decision-making.

Risk assessment enables the timely identification of both dangerous and promising tendencies in the development of the state and society, as well as helps in the identification of threats and vulnerabilities. Ultimately, this contributes to the formation of the state's strategic documents and crisis response plans, enabling their timely adjustment, and more. Considering the fact that risks to the state and society can originate in different spheres and produce different consequences, their analysis should be conducted comprehensively and on a systemic basis.

Research Results

The framework of this study offers a modified approach to measuring the risk of secure development of a country based on an algorithm comprising a sequence of stages.

The first stage involves the establishment of a system of quantitative risk indicators that reflect the results (impacts) of events in the security environment or changes in the operating conditions.

Considering the existing approaches, it would be expedient to ensure maximum correlation between the risk indicators and the global determinants of development as defined in the World Economic Forum's *Global Risks Report 2022* (World Economic Forum, 2022). Thus, we suggest classifying all risks into five groups: economic risks, social risks, geopolitical risks, technological risks, and environmental risks. Each group of risks will include a particular set of measurement indicators forming a dynamic system that can be adjusted in terms of composition.

The aim of *the second stage* is to classify the chosen risk indicators depending on whether the direction of their change (dynamics) signals an increase or decrease in insecurity (threats to resilience of economic development).

Thus, indicators of type R1 are those whose increasing value signals an increase in the level of resilience and security of development, resulting in a decrease in the level of risk, and vice versa. Indicators of type R2 are those whose increasing value leads to deterioration of conditions for secure development and an increase in the level of risk (Table 1). The indicator type will further affect the calculation of the composite level of risk.

Table 1

Classification of risk indicators

Indicator	Indicator of the type R1 (I_{R1})	Indicator of the type R2 (I_{R2})
Direction of impact	I_{R1} ↑, risk ↓, security ↑ I_{R1} ↓, risk ↑, security ↓	I_{R2} ↑, risk ↑, security ↓ I_{R2} ↓, risk ↓, security ↑
Types of indicators	GDP per capita, ratio of per capita GDP in Ukraine to per capita GDP in EU countries, share of high-technology exports, terms-of-trade index, level of domestic and external investment, level of innovativeness, level of competitiveness, level of per capita earnings	Level of inflation, level of unemployment, share of shadow economy, share of raw materials exports, exchange rate, level or external and domestic debt, poverty level, income differentiation, level of population aging, level of demographic burden, level of youth unemployment, country's losses due to migration

The aim of *the third stage* is to determine the time interval for analysis that is sufficient for identifying certain patterns in the dynamics. It is also necessary to establish a system of statistical data underlying the risk indicators that can be measured quantitatively, which would allow us to perform risk evaluation.

During the *fourth stage*, we assess the intensity of dynamics by calculating the respective chain coefficients of growth (or decay) for risk indicators (K_{grl}):

$$K_{gi} = \frac{I_t}{I_{t-1}} \quad (1)$$

Then, we carry out an aggregate assessment of the intensity of change over the entire time period by calculating the geometric mean for a dynamic series ($\overline{K_{gr}}$):

$$\overline{K_g} = \sqrt[m]{\prod_{t=1}^{n} K_{gt}} \quad (2)$$

where

m = the number of chain coefficients of growth (*m* = *n-1*)

n = the number of time periods.

At the *fifth stage*, the obtained coefficients are converted into quantitative and qualitative risk estimates using the proposed scale for risk evaluation (Table 2).

Table 2

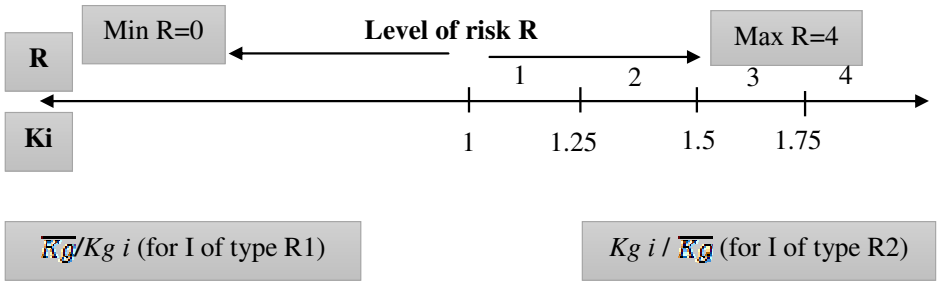
Evaluation scale for assessing the level of risk to secure development

Risk evaluation		Impact on security	Conversion algorithm (type R1) *Ki*	Conversion algorithm (type R2) *Ki*
Qualitative	Quantitative (score) *Ri*			
No risk	0	Minimal	$Kg\,i > \overline{Kg}$	$Kg\,i < \overline{Kg}$
Low	1	Acceptable	$1 < \frac{\overline{Kg}}{Kg\,i}$ <1.25	$1 < \frac{Kg\,i}{Kg}$ <1.25
Medium	2	Moderate	$1.25 \leq \frac{\overline{Kg}}{Kg\,i}$ <1.5	$1.25 \leq \frac{Kg\,i}{\overline{Kg}}$ <1.5
High	3	Unacceptable	$1.5 \leq \frac{Kg}{Kg\,i}$ <1.75	$1.5 \leq \frac{Kg\,i}{Kg}$ <1.75
Very high	4	Catastrophic	$\frac{\overline{Kg}}{Kg\,i}$ ≥1.75	$\frac{Kg\,i}{\overline{Kg}}$ ≥1.75

Figure 1 illustrates graphically the differences between risk identification and risk measurement for different types of indicators (R1 and R2).

Figure 1

The algorithm of quantitative risk evaluation



The integrated (composite) level of risk, *IR,* based on the system of indicators, is calculated according to the formula:

$$IR = \sum_{i=1}^{n} Ri \quad (3)$$

The quantitative score-based risk estimate can be supplemented with a calculation of the relative risk level in percent, *IR*(%), as follows:

$$IR(\%) = \frac{IR}{IRmax} * 100 \quad (4)$$

The obtained relative risk estimate can be converted with the help of the evaluation scale shown in Table 3 to obtain a qualitative risk estimate that characterizes the level of risk.

Table 3

Scale for composite relative level of risk

Level of risk	$IR(\%)$
No risk	$IR(\%) = 0$
Low	$0 < IR(\%) < 25$
Medium	$25 \leq IR(\%) < 50$
High	$50 \leq IR(\%) < 75$
Very high	$IR(\%) \geq 75$

The proposed toolkit was applied to assess the level of economic risk for secure development of Ukraine. To accomplish this, we developed a system of 16 economic risk indicators, including the following:

1. GDP per capita (in U. S. dollars) serves as a measure of socio-economic development: An increase in its value indicates an improvement in the standard of living and well-being of the population. A decrease in GDP per capita, on the contrary, reflects a decline in economic dynamics and deterioration in economic development conditions.

2. The ratio of the country's per capita GDP relative to that of the most developed countries: To assess the level of risk in Ukraine, we calculated the percentage ratio of Ukraine's per capita GDP to the corresponding indicator of EU countries. An increase in this ratio indicates increasing convergence in the development levels of the analyzed countries and an improvement in social and economic well-being.

3. The rate of inflation (%) reflects the dynamics of change in consumer prices. Moderate inflation within the range of 1% to 5% can be viewed as a factor, which stimulates demand and overall economic development. A higher rate can signal the emergence of risks and growing threats to resilient development.

4. The rate of unemployment (%): An increase in this rate signals the presence of crisis tendencies in economic development, in particular a decline in the labour market, a decrease in population incomes, and an increase in social tensions within society.

5. The share of shadow economy (in % of GDP): A substantial magnitude of this indicator poses a considerable threat to resilient economic growth, given that it remains constant or increases across most countries.

6. The share of raw materials exports (in % of total exports) measures the quality of the country's structure of export capacity: The predominantly raw-materials-oriented export structure in Ukraine is a threat to resilience of the country's development as it hinders its ability to fully leverage the advantages of foreign trade cooperation.

7. The share of high-technology exports (in % o total exports) is an indicator of the technological quality of the country's exports, reflecting its capacity to produce innovative products that are in demand in global markets. A low or decreasing share of this indicator signals technological backwardness and poses a threat to resilient development of the country.

8. The terms-of-trade index (calculated as a ratio of the growth rates in export and import prices) is a statistical measure of a country's efficiency in international trade. A value exceeding 100% and displaying a tendency to growth indicates an improvement in the country's terms of trade. Conversely, a value below 100% and showing a decreasing tendency signifies the deterioration in the terms

of trade, which can bear additional risks of decreasing efficiency in foreign trade cooperation.

9. Exchange rate dynamics of the national currency against the U.S. dollar (%) is a criterion of macroeconomic stability and national currency depreciation. High exchange rate volatility is a threat to resilient development.

10. The level of foreign investment in the economy (inbound FDI as a share of GDP, %) indicates a country's ability to attract foreign capital and stay attractive for foreign investors, which creates opportunities for promoting resilient economic development and technology and innovation adoption.

11. The level of domestic investment (gross fixed capital formation as a share of GDP, %) serves as a criterion to assess a country's capacity to invest in its own economic growth. A value below 15% is critically dangerous; a value exceeding 25% signifies increased potential for technological renovation and modernization of economic development. A tendency towards a decreasing share of gross fixed capital formation in GDP suggests a weakening investment component in economic development, which can pose a medium- and long-term threat to resilience.

12. The level of technological development (share of medium- and high-technology sectors in the industry structure, in %) is an indicator of the quality of technological structure of production and a criterion of industrial competitiveness. An increase in this indicator signifies an improvement in the quality of production structure and implementation of technological innovations, as well as emergence of opportunities for ensuring sustainable industrial development.

13. Rank (score) in the Global Innovation Index, which measures innovation competitiveness of a country. Higher positions and a tendency towards improvement indicate increasing capabilities for resilient economic growth.

14. Rank (score) in the Global Competitiveness Index, which measures a country's level of competitive advantages in the system of global economic relations.

15. The level of external debt (as % of GDP) is an internationally recognized indicator that measures a country's level of indebtedness. Its increasing value signals a growing external debt burden and disrupts the resilience of the country's development.

16. The level of domestic debt (as % of GDP) serves as a measure of the level of indebtedness within the country. An increase in its value also poses challenges to resilience.

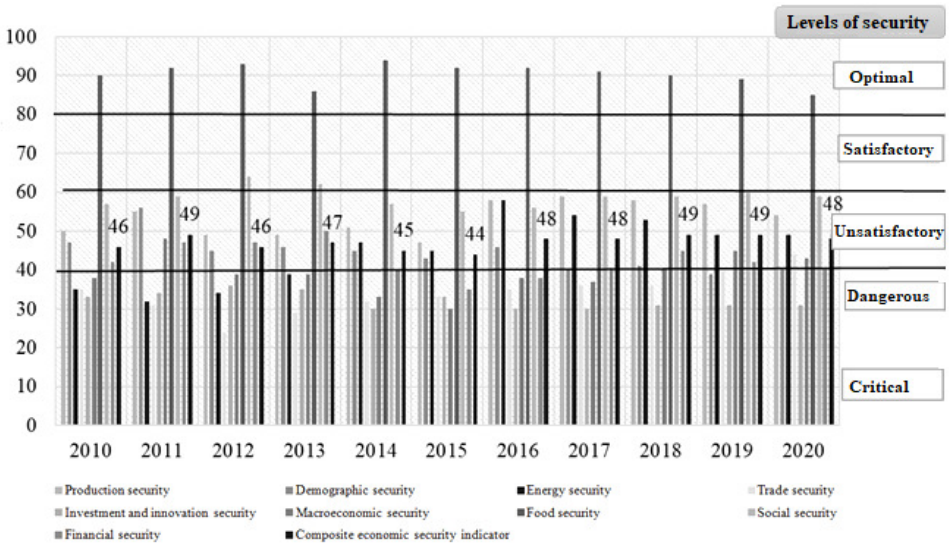
According to the Strategy of Economic Security of Ukraine for the period until 2025 (Decree of the President of Ukraine No. 347/2021 of August 11, 2021), the country's development conditions throughout the last decade, from 2010 to 2019, were insufficient to promote its own national economic interests. During

this period, its average composite level of economic security ranged between 44% and 49%, which corresponds to the «unsatisfactory» level, as defined in the «Methodical recommendations on calculating the level of economic security» approved by Order of the Ministry of Economic Development and Trade of Ukraine No. 1277 of October 29, 2013.

Figure 2 illustrates the dynamics of the composite security index and its separate sub-elements (or security components), which have been calculated by the Ministry of Economy of Ukraine (2020).

Figure 2

Economic security dynamics in Ukraine, in total and by component, 2010-2020



Source: constructed by the author based on data of the Ministry of Economy of Ukraine (2020), Order of the Ministry of Economic Development and Trade of Ukraine No. 1277 of October 29, 2013.

Thus, the composite level of security over the entire period under study has remained at the «unsatisfactory» level. Innovation and investment security was found to have reached the lowest level at 31% in 2020, which falls within the

«dangerous» range. Similarly, financial security and demographic security was equal to 40% in 2020, also falling within the «dangerous» range. Other components that were observed to be at the «unsatisfactory» level include macroeconomic security (43% in 2020), energy security (49%), foreign economic security (44%), production security (54%), and social security (56%). Among the rest of the components, only food security stands out as the only component that reached an «optimal» level, with a score of 85% in 2020, surpassing the threshold of 80%. The analysis reveals minimal changes in the dynamics of security index throughout the analysed time period. This finding was acknowledged in the Strategy, which notes that the persistence of all components of economic security at low levels carries a continuously high risk of large-scale destabilization phenomena, which can manifest themselves in economic development in the long run.

Table 4 presents dynamic series of indicators selected for assessment of economic risks over the period from 2012 to 2021.

Table 4

Economic indicators for measuring risks to secure development of Ukraine

Indicator	Unit of measurement	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
GDP per capita	U. S. dollars	4004.8	4187.7	3104.6	2124.7	2187.7	2638.3	3096.6	3661.5	3751.7	4835.6
GDP per capita	% of EU's per capita GDP	12.08	12.11	8.80	6.97	7.01	7.97	8.66	10.43	10.97	12.65
Level of inflation	%	0.57	-0.24	12.07	48.70	13.91	14.44	10.95	7.89	2.73	10.15
Level of unemployment	% of total workforce	7.53	7.17	9.27	9.14	9.35	9.50	8.80	8.19	9.13	8.88
Share of shadow economy	% of GDP (MIMIC method)	47.0	47.0	46.7	47.1	47.0	47.1	46.6	47.2	47.8	50
Share of raw-materials exports	%	43.37	45.32	49.098	54.454	56.267	56.758	55.474	59.627	61.6	59.8
Share of high-technology exports	%	5.27	4.58	4.25	3.90	3.58	3.19	3.29	2.75	2.70	2.20

Indicator	Unit of measurement	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Terms-of-trade index	%	94.85	94.57	91.20	83.59	83.41	84.80	84.43	84.34	88.58	…
Exchange rate	hryvnias per U. S. dollar	7.99	7.99	11.89	21.84	25.55	26.60	27.20	25.85	26.96	…
Level of investment (external)	% of GDP (inbound, stock)	37.05	36.57	37.33	50.54	51.1	42.57	35.82	35.22	33.48	…
Level of investment (internal)	% of GDP	21.72	18.49	13.40	15.93	21.72	19.95	18.59	14.89	7.51	…
Level of technological intensity of GDP	Share of high- and medium-technology sectors, %	34.97	41.98	31.14	30.69	29.89	27.40	28.84	28.10	…	…
Level of innovativeness	GII, rank	63	71	63	64	56	50	43	47	45	…
Level of competitiveness	GCI, rank	73	84	76	79	85	81	83	85	…	…
Level of debt (external)	External debt stocks, % of GNI	74.06	78.12	96.09	123.85	121.92	107.9	91.62	79.54	81.42	…
Level of debt (internal)	Total state debt, % of GDP	36.6	40.1	70.2	79.4	81	71.8	60.9	50.3	60.8	48.9

Source**:** constructed by the author based on data of the World Bank Open Data database (The World Bank, n. d.), UnctadStat (n.d.), Global competitiveness report 2011-2019 (World Economic Forum, n.d.); Global Innovation Index 2012-2021 (WIPO, n.d.).

Therefore, in the world economy, Ukraine remains to be the country with a low level of socio-economic development. Thus, Ukraine's GDP per capita was equal to $4,835.6 in 2021, which is 20.7% higher compared to 2012. Starting from 2015, this indicator has demonstrated a tendency to growth, having in-

creased by a factor of 2.28. At that, it remains to be 8 times lower than the average per capita GDP of $38,234 in EU countries.

Our calculations for the ratio of per capita GDP in Ukraine to that of the EU show that Ukraine's level of socio-economic development is only 12% of the EU's average level of per capita GDP. The situation has remained largely unchanged since 2012. A positive development, however, is that the gap has decreased from 7% in 2015 to 12.6% in 2020.

Taking into account the fact that the Ukrainian economy experiences an average annual growth rate of 2% to 3%, it can be argued that the country is at risk of continuously falling behind the levels of development seen in the European countries and the world as a whole. This is particularly concerning due to the fact that the annual rates of economic growth range between 3.7% to 3.9% for the global economy, 4.8% to 5% for developing countries, and 8% to 10% for certain individual countries (International Monetary Fund, 2022).

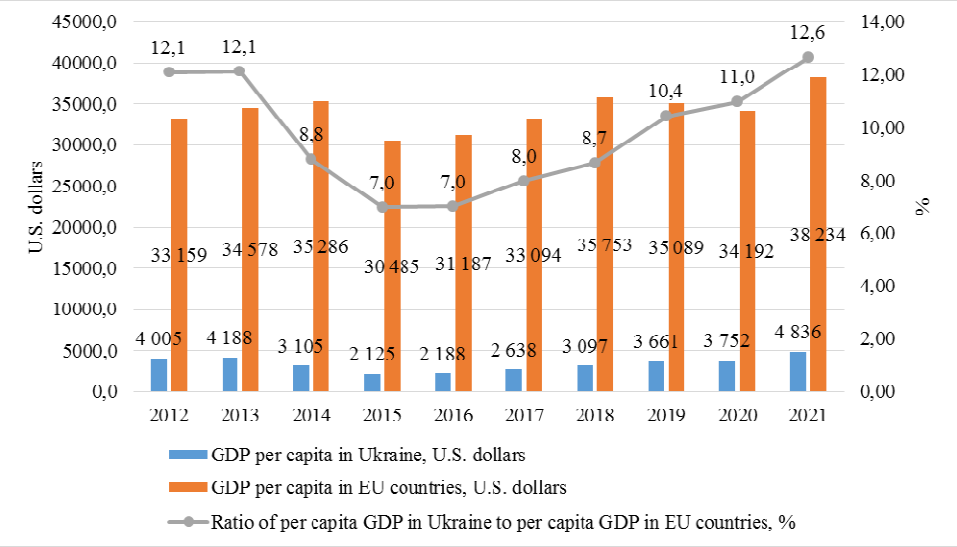
With respect to inflation dynamics, our analysis reveals that the rate of inflation has remained at a moderate level throughout 2016-2021, ranging between 14.4% in 2017 and 2.7% in 2020. This can be explained by the adoption of the inflation targeting regime by the National Bank of Ukraine (National Bank of Ukraine, 2021 April). The regime has enabled the bank to decrease inflation rates and reduce their volatility, following the approach implemented by 41 countries across the world. However, the rate of inflation is still four times higher in Ukraine compared to the 2.55% rate of inflation in the EU countries.

According to the ILO, the average level of unemployment over the period from 2012 to 2021 was 8.7%, with the highest rate of 9.5% observed in 2017. In 2020, the level of unemployment in Ukraine was 8.88%, which is close to the average EU level of 8.83% and lower than that in separate time periods. The National Bank of Ukraine considers this level to be close to the natural rate of unemployment (8.5%). The increasing economic activity will maintain the rate of unemployment at its current level, while increasing labour remuneration costs incurred by businesses can lead to its increase.

Next, the level of shadow economy represents one of the most significant risks to resilience of economic development in both Ukraine and other countries worldwide. In Ukraine, the high prevalence of the shadow economy results in a substantial under-collection of state budget revenues due to non-payment of taxes; distortions in domestic competition, as businesses operating in the shadow sector exploit various tax planning schemes, thus gaining greater competitive advantages over those in the formal economy; as well as an overall increase in corruption levels, which undermines trust in public institutions (The State Financial Monitoring Service of Ukraine, 2019).

Figure 3

Dynamics of GDP per capita in Ukraine and EU countries



Source: constructed by the author based on data of the World Bank Open Data database (The World Bank, n. d.).

For measurement and comparison of the levels of shadow economy across countries, international research uses the Multiple Indicators and Multiple Causes (MIMIC) method proposed by Schneider (Medina & Schneider, 2021).

A comparative analysis of the levels of shadow economy in Ukraine and several European countries calculated with application of the MIMIC method is shown in Table 5.

Thus, the share of the shadow economy in Ukraine has reached an estimated 50% of GDP. This indicator has remained persistently high throughout the entire period, growing by 6.5% in 2021 compared to 2012. The size of the shadow economy in Ukraine is nearly double the corresponding average indicator in the EU, which has shown a decreasing trend, having declined by 9.7% from 2012 to 2021. It should be noted, however, that the extent of «shadowing» processes varies within the EU economies. In the EU's «old» member countries, such as Germany, France and Austria, this indicator does not exceed 13%, whereas in the countries of recent waves of enlargement, including such CEE countries as Poland, Lithuania, Latvia, and Bulgaria, the level of shadow economy exceeds 20%. Its highest value was observed in Bulgaria at 32.4% in 2021, which is still only half of Ukraine's level.

Table 5

The levels of shadow economy in selected EU countries and in Ukraine

Year / Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Change over the period, %
Ukraine	47.0	47.0	46.7	47.1	47.0	47.1	46.6	47.2	47.8	50	6.5
EU (28)	19.3	18.8	18.6	18.3	17.9	17.3	16.8	16.3	17.9	17.4	-9.7
Germany	12.5	12.1	11.6	11.2	10.8	10.4	9.7	8.5	10.4	10.0	-19.8
France	10.8	9.9	10.8	12.3	12.6	12.8	12.5	12.4	13.6	13.1	21.5
Austria	7.6	7.5	7.8	7.1	8.2	7.8	6.7	6.1	7.2	6.9	-9.2
Poland	24.4	23.8	23.5	23.3	23.0	22.2	21.7	20.7	22.5	22.0	-9.8
Czechia	16.0	15.5	15.3	15.1	14.9	14.1	13.6	13.1	14.2	13.9	-13.0
Lithuania	28.5	28.0	27.1	25.8	24.9	23.8	23.0	21.9	23.1	22.9	-19.6
Latvia	26.1	25.5	24.7	23.6	22.9	21.3	20.2	19.8	20.9	20.2	-22.5
Bulgaria	31.9	31.2	31.0	20.6	30.2	29.6	39.8	30.1	32.9	32.4	1.6

Source**:** calculated by the author based on Elgin et al. (2021), Schneider (2022).

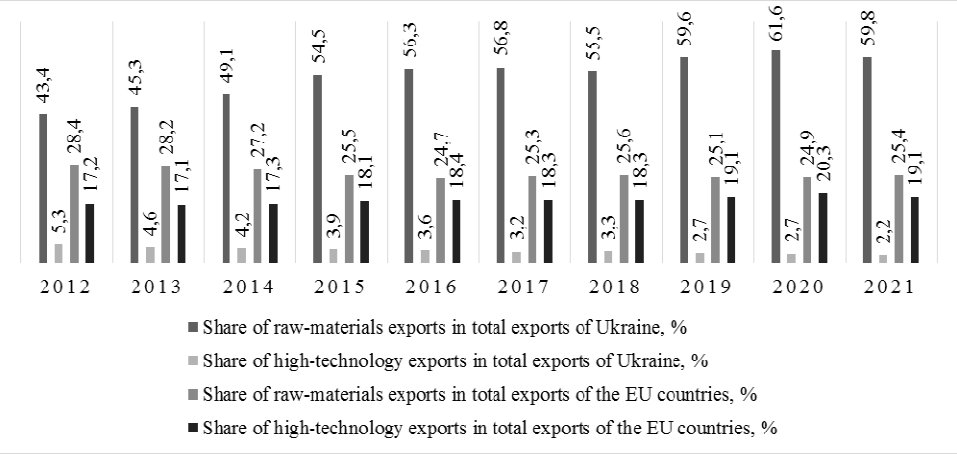
Another challenge for resilient development, which further exacerbates the risks, is the orientation of foreign trade toward raw materials and the low technological level of production and exports. This increases the country's reliance on technology and innovation imports (Figure 4). As a result, the continuous focus of Ukraine's industry on raw materials, which is amplified by the external military and political aspects in its relations with Russia, hampers economic growth and reduces incomes of economic actors.

In 2021, raw materials accounted for 60% of Ukraine's exports compared to 25.4% in EU countries. Furthermore, the share of raw materials exports in the EU has decreased from 28.4% in 2012 to 25.4% in 2021, whereas Ukraine, on the contrary, experienced a growing trend in raw materials exports, which have increased from 43.4% in 2012 to 59.8% in 2021. On the other hand, the share of high-technology exports in total exports of Ukraine is only 2.2%, in stark contrast to 19.4% seen in EU countries.

The terms of trade for Ukraine are unfavourable, with a tendency towards further deterioration. The terms-of-trade index has consistently remained below 100% from 2012 to 2020, indicating a declining trend. On the whole, the index has decreased by 6.27%, from 94.85% in 2012 to 88.58% in 2020.

Figure 4

Dynamics of raw-materials and high-technology exports in Ukraine and EU countries, %



Source**:** constructed by the author based on data of the World Bank Open Data database (The World Bank, n. d.).

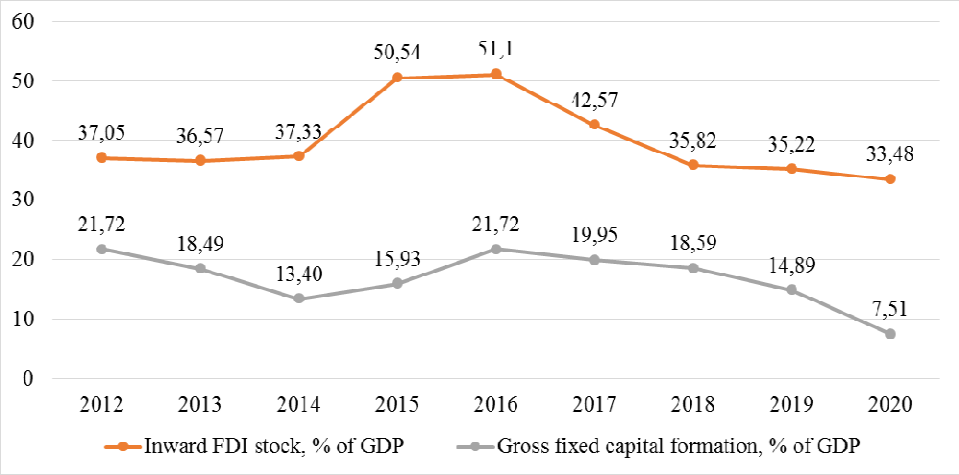
Devaluation of the national currency is another negative factor exacerbating the risks. In 2012, the average annual exchange rate was 7.99 hryvnias per U. S. dollars. In 2015, it has increased to 21.84 hryvians per U. S. dollar, reaching 26.96 hryvnias per U. S. dollar in 2021. This devaluation intensifies instability, threatens a decrease in real incomes denominated in the national currency and earnings of households and businesses, reduces their purchasing power, and fosters mistrust and negative economic expectations.

The lack of favourable conditions for attraction of investment and reinvestment creates preconditions for low rates of external and internal investment in the economy (Figure 5).

Starting from 2016, the share of gross fixed capital formation in GDP has decreased by 13.69%, from 21.73% in 2016 to 7.51% in 2020. This level is only half of the 15% threshold, which corresponds to a «critically dangerous» level. In comparison, the share of share of gross fixed capital formation in the GDP of EU countries was 22.08% in 2020, three times higher than that in Ukraine, with a range between 20% and 23% from 2012 to 2020. The size of the accumulated FDIs has decreased from 51.1% in 2017 to 33.48% in 2020, whereas the corresponding indicator for the EU countries has reached 77.88% of GDP in 2020, with stable growth dynamics. These patterns contribute to increased instability, making it impossible to implement the principles of resilient growth.

Figure 5

Dynamics of investment in the economy of Ukraine



Source: constructed by the author based on data of the World Bank Open Data database (The World Bank, n.d.).

The Ukrainian economy as a whole is characterized by low technological level of production. The share of the medium- and high-technology sector in the industry was estimated to be equal to 28% in 2019, which is a 7% decline compared to its share of 34.95% observed in 2010. In comparison, the corresponding indicator for the EU averaged at 41.1% in 2019.

Low competitiveness and a significant lack of innovative development also pose challenges to the resilience of economic development, as Ukraine occupies the lowest positions among EU countries in international rankings (Table 6).

Ukraine's positions in the Global Competitiveness Index have been declining since 2014. Despite an 8.66% increase in the country's score in 2019 compared to 2011, Ukraine lost 4 positions compared to 2011 and 9 positions compared to 2014. On a positive note, Ukraine has made progress in the Global Innovation Index, moving from the 65th position in 2011 to 45th position in 2020. The value of the index itself, however, has remained relatively stable, showing a minor increase of 3.74%. Thus, the loss of the remaining competitive advantages poses a significant economic threat to the country's security, as these advantages could potentially become the drivers of accelerated and resilient economic growth, bringing Ukraine to a level comparable to that of developed countries.

Table 6

Ukraine's positions in the rankings of Global Competitiveness Index and Global Innovation Index

Indicator		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Global Competitiveness Index	Score	52.5	54.3	53.1	54.3	52.9	52.5	53.9	57.0	57.0	…
	Rank	82	73	84	76	79	85	81	83	85	…
Global Innovation Index	Score	35.01	36.1	35.78	36.26	36.45	35.72	37.62	38.52	37.4	36.32
	Rank	60	63	71	63	64	56	50	43	47	45

Source: constructed by the author based on Global competitiveness reports, 2011-2019 (World Economic Forum, n.d.), Global Innovation Index, 2012-2021 (WIPO, n.d.).

Finally, the country's high levels of indebtedness play an important role in the proposed system of risk measurement indicators. In 2020, Ukraine's total external debt stood at 81.41%. Although this is lower than 123.85% recorded in 2015, it is higher than the 74.06% observed in 2016. The domestic state debt was 48.9% in 2020, which is lower than the 81% observed in 2016, but higher than its value of 36.6% in 2012.

In line with the proposed algorithm, we calculated the chain and average growth coefficients for the aforementioned indicators of economic risk. Subsequently, we calculated the ratios of these coefficients to measure the degree of variability and determine the corresponding levels of risk estimates. The results of generalized risk assessment based on main indicators are shown in Table 7.

Our findings show that the highest risk estimates were obtained for indicators observed in 2014 and 2015, which can be attributed to the beginning of the Russian military aggression resulting in subsequent territorial losses, as well as losses in production capacities, including fixed assets of industrial enterprises, access to strategic minerals, and human capital.

Over the period from 2016 to 2021, the observed changes in the risk indicators have been within the limits of the 1st group of risk, which corresponds to «low risk, acceptable impact on security level». There were three of such risk indicators in 2016, five in 2017, two in 2018, five in 2019, seven in 2020, and two in 2021. It is worth noting that, in 2020, there was a change in one indicator, specifically the level of internal investment, which scored 3 points, indicating a «high level of risk, unacceptable impact on security». Regarding the year 2021, it is important to mention that statistical data for most indicators were not available. However, the «level of inflation» indicator scored 4 points, corresponding to a «very high risk» level.

Table 7

Calculation of the levels of risk *Ri* by indicator

Indicator	2013	2014	2015	2016	2017	2018	2019	2020	2021
GDP per capita, U. S. dollars	0	2	2	0	0	0	0	0	0
Ratio of GDP per capita in Ukraine to GDP per capita in the EU, %	1	2	2	0	0	0	0	0	0
Rate of inflation, %	0	4	4	0	0	0	0	0	4
Rate of unemployment, %	0	2	0	1	0	0	0	1	0
Share of shadow economy, % of GDP	0	0	1	0	0	0	1	1	1
Share of raw materials exports, %	1	1	1	0	0	0	1	0	0
Share of high-technology exports, %	1	0	0	0	1	0	1	0	1
Terms-of-trade index, %	0	1	1	0	0	0	0	0	…
Exchange rate, hryvnias per U. S. dollar	0	2	3	1	0	0	0	0	…
Level of investment (external), % of GDP	0	0	0	0	1	1	1	1	…
Level of investment (internal), % of GDP	1	1	0	0	0	0	1	3	…
Technological intensity of the GDP, %	0	2	0	0	1	0	0	…	…
Level of innovativeness (GII)	0	1	0	1	1	1	0	1	…
Level of competitiveness (GCI)	0	1	0	0	1	0	0	…	…
Level of debt (external), % of GDP	1	1	2	0	0	0	0	1	…
Level of debt (internal), % of GDP	1	3	1	0	0	0	0	1	0

Note: «…» – statistical data not available.

Based on aggregating the data according to the algorithm, we calculated the composite level of economic risk (Table 8).

Our calculations reveal that the highest composite level of economic risk was observed in the years 2014 and 2015, which can be logically attributed to the onset of the Russian war of aggression against Ukraine, leading to partial loss of territories and production potential, increased unemployment, and forced migration of the population. In 2014, the composite economic risk level increased by a factor of 3.8 compared to the previous year, indicating a medium level of danger. In 2015, the composite risk level decreased by 29% compared to 2014, but still remained relatively high. From 2016 to 2018, the estimated level of risk was relatively low, indicating an acceptable level of impact on security.

Table 8

Calculations of the composite level of economic risk

	2013	2014	2015	2016	2017	2018	2019	2020	2021
IR	6	23	17	3	5	2	5	9	6
$IR(\%)$	9.38	35.94	26.56	4.69	7.81	3.13	7.81	16.07	18.75
Level	Low	Medium	Medium	Low	Low	Low	Low	Low	Low

The period from 2019 to 2021 has been marked by considerable growth in the composite risk index, which was caused by the growing threats to resilience of economic development due to the impact of the COVID-19 pandemic. Thus, in 2018, the IR was 3.13%, increasing by a factor of 2.5 (7.81%) in 2019, by a factor of 2.1 (16.07%) in 2020, and by a factor of 1.17 in 2021, indicating an increased level of threats and an accumulating negative impact on the security and resilience of economic development. During this period, major challenges for economic security were posed by the implementation of coronavirus restrictions as an instrument of reducing the level of morbidity and the spread of virus. This has negatively affected the economic development indicators, which demonstrated a decrease in production activity, reduced incomes, falling investment demand, decreasing volumes of foreign trade, etc.

The growing security threats in 2022 and 2023, which significantly increase the composite level of risk, are directly associated with the full-scale war waged by Russia against Ukraine. According to preliminary estimates of the State Statistical Service of Ukraine and the National Bank of Ukraine (2023), the country is expected to suffer significant economic losses, amounting to 30.3% of its GDP in 2022. In particular, Ukraine's losses due to Russia's aggression against objects of energy infrastructure alone are projected to range between 1.9% and 3.6% of GDP. At the same time, the rate of inflation in 2022 reached 26.6% compared to 10% in 2021, the level of unemployment increased to 26.1% against 8.9% in 2021, and the volume of merchandise exports declined by 35%. Economic projections for 2023 appear more optimistic, with a forecasted GDP growth of 0.3%. However, it should be noted that the economic situation and the associated economic risks are fully dependent on the potential scenarios of developments in military operations.

Conclusions

The proposed toolkit for assessing the level of risk to secure development of a country enables obtaining the quantitative and qualitative estimates of sustainable conditions for economic development, taking into consideration the impact of risks and threats. This method is based on the following algorithm: a) forming a system of quantitative risk indicators; b) classifying risk indicators based on the direction of their impact (positive or negative) on insecurity; c) assessing the intensities of change in risk indicators and comparing them relative to overall rate of change; d) calculating the quantitative risk estimates (using scores ranging between 1 and 4 points) and qualitative risk estimates (using grades such as «no risk», «low risk», «medium risk», «high risk», «very high risk») with the help of the proposed scale of variations; e) evaluating the quantitative composite risk index as a score in points and as a relative indicator in percent, and determining its level using the proposed evaluation scale («no risk», «low risk», «moderate risk», «high risk», «very high risk»).

The practical application of the developed toolkit enabled us to conduct an assessment of risks to secure development of Ukraine based on a systemic study of the impact of risk indicators and to additionally determine the composite risk level. Despite the fact that the comparison of development indicators for the Ukrainian economy with those of EU economies yielded negative results, Ukraine's composite level of security risk remains at the low and medium levels, demonstrating, however, a persistent tendency towards impact accumulation.

The application of the proposed algorithm in risk monitoring will facilitate the identification and adjustment of the adaptation or mitigation measures, which are necessary to ensure resilient socio-economic development. The methodology also enables to apply risk forecasting and to develop prospective risk scenarios in determining the directions for economic resilience building during both periods of martial law and post-war recovery of Ukraine's economy.

The prospects for future research are closely linked to potential refinement of the proposed methodology. In particular, the composition of measurement indicators that are used to estimate the composite level of economic risk could be improved. It would be feasible to take into account the risks of non-economic nature, such as social, technological, environmental, and others. Finally, respective forecasts could be developed as a prerequisite for identifying the scenarios of secure development of Ukraine in the post-war period.

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