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## **МОДЕЛЬ ПОВОЄННОЇ РЕКОНСТРУКЦІЇ ЕКОНОМІКИ УКРАЇНИ**

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**Анотація.** Метою роботи є аналіз чинників повоєнної реконструкції та побудова моделі для обґрунтування шляхів і перспектив економічного відновлення України з урахуванням міжнародного досвіду. У статті використано комплекс загальнонаукових та спеціальних методів дослідження: метод аналізу та синтезу – для вивчення впливу війни на економічний розвиток та процеси повоєнної відбудови; метод систематизації – для виявлення основних факторів повоєнної відбудови; економетричне моделювання – для перевірки зв'язку між економічним зростанням та окремими структурними факторами розвитку; метод узагальнення – для формулювання висновків щодо можливих напрямків повоєнної відбудови в Україні.

В статті систематизовано концептуальні підходи до повоєнної реконструкції економіки та визначено такі її ключові чинники: валове нагромадження капіталу як інвестиційна основа відновлення; розвиток переробної промисловості; рівень зовнішньої інтеграції економіки; здатність країни залучати прямі іноземні інвестиції; інфляція як показник макроекономічної нестабільності. Для емпіричного обґрунтування вибору стратегічних напрямів післявоєнної

відбудови України було побудовано панельну регресійну модель, що дозволила оцінити зв'язок між темпами економічного зростання та ключовими факторами повоєнної реконструкції економіки країн Східної Європи, Близького Сходу та Східної Азії. Визначено, що стратегія післявоєнної реконструкції України має спиратися на продуктивне інвестиційне нагромадження, розвиток переробної промисловості, модернізацію критичної інфраструктури, оборонно-технологічне оновлення, енергетичну й логістичну стійкість, а також на повернення та розвиток людського капіталу. Економетричне оцінювання уточнило цю гіпотезу: найбільш стійкий позитивний зв'язок із темпами економічного зростання має валове нагромадження капіталу, а частка переробної промисловості у базовій моделі також пов'язана з вищою динамікою зростання. Вплив експорту, прямих іноземних інвестицій та інфляції не є автоматичним і залежить від структури виробництва, макрофінансової стабільності, інституційного середовища й державної координації.

**Ключові слова:** економіка, модель, повоєнна реконструкція, інституційна рамка відбудови, промислова політика, стратегія відбудови, державна підтримка.

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## **POST-WAR ECONOMIC RECONSTRUCTION MODEL FOR UKRAINE**

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**Abstract.** The aim of this paper is to analyze the factors of post-war reconstruction and build a model to substantiate the ways and prospects of economic recovery of Ukraine, taking into account international experience. The article employs a complex of general scientific and special research methods: the method of analysis and synthesis was used to study the impact of the war on economic development and the processes of post-war reconstruction; the method of systematization made it possible to identify the main factors of post-war reconstruction; econometric modeling helped to verify the relationship between economic growth and individual structural factors of development; the

generalization method was used to formulate conclusions regarding possible directions of post-war reconstruction in Ukraine.

The article systematizes conceptual approaches to the post-war reconstruction of the economy and identifies the following key factors: gross capital accumulation as an investment basis for recovery; development of the manufacturing industry; level of external integration of the economy; the country's ability to attract foreign direct investment; inflation as an indicator of macroeconomic instability. To empirically substantiate the choice of strategic directions for post-war reconstruction in Ukraine, a panel regression model was constructed, enabling assessment of the relationship between economic growth rates and key factors of post-war reconstruction in Eastern Europe, the Middle East, and East Asia. It is determined that the strategy for the post-war reconstruction of Ukraine should be based on productive investment accumulation, development of the manufacturing industry, modernization of critical infrastructure, defense and technological renewal, energy and logistical sustainability, return and development of human capital. Econometric evaluation has refined this hypothesis: gross capital formation has the strongest positive relationship with economic growth rates, and the share of manufacturing in the baseline model is also associated with higher growth dynamics. The impact of exports, foreign direct investment, and inflation is not automatic; it depends on the structure of production, macrofinancial stability, the institutional environment, and government coordination.

**Key words:** economy, model, post-war reconstruction, institutional framework of reconstruction, industrial policy, reconstruction strategy, state support.

**Introduction.** The full-scale war has become a deep economic shock for Ukraine, the consequences of which go beyond the current reduction in production or destruction of infrastructure. Military actions have changed the spatial structure of the economy, increased the dependence of public finances on external support, caused losses of physical and human capital, worsened investment expectations and exacerbated the problem of long-term economic sustainability. Under such conditions, the issue of post-war reconstruction acquires practical and scientific importance, since it concerns choosing a development model that should ensure not merely a return to the pre-war state, but the formation of a more productive and sustainable economic system.

The scholarly study of the issue is grounded in research on the economics of war, institutional economics, and economic development, as well as scientific papers on the experience of post-war reconstruction in Eastern Europe, the Middle East, and East Asia. The Ukrainian case requires a separate analysis, as it combines large-scale destruction, security uncertainty, a high role of international support, a European integration vector, and the need to update the production structure.

**Task statement.** The problem of post-war reconstruction is central to the analysis of the economic development of countries following large-scale military conflicts. An analysis of modern Ukrainian and foreign studies has shown that this concept is multifaceted and ambiguous: in various studies, the emphasis is placed on both physical reconstruction and restoration of infrastructure, and on macroeconomic stabilization, restoration of state capacity, return of economic activity, social integration or long-term modernization. Such multidimensionality is due to the fact that war destroys not only material and intangible assets, but also leads to destabilization of the economy, destruction of human capital, social ties, institutional trust and the ability of the state to coordinate development.

In particular, World Bank experts define post-war reconstruction from the standpoint of restoring basic state functions, infrastructure, economic activity, and social conditions after a conflict [1] CSIS/AUSA experts define post-war reconstruction as a sequence of actions from stabilization to transformational transition and creation of conditions for long-term development [2] In the works of S. Barakat post-war reconstruction is considered as a process that combines the restoration of state capacity, aid coordination, risk management, and the transition to sustainable development [3]. Ukrainian authors note that post-war reconstruction

should be based on the development of high-potential clusters and the introduction of smart specialization [4], and also emphasize the importance of integrating science and innovation as key drivers of economic development [5].

The aim of this paper is to analyze the factors of post-war reconstruction and build a model to substantiate the ways and prospects of economic recovery of Ukraine, taking into account international experience. To attain this goal, the study addresses the following tasks:

- to systematize conceptual approaches to post-war reconstruction and identify its main factors;

- to develop a panel regression model to assess the relationship between economic growth rates and key factors of post-war economic reconstruction in countries of Eastern Europe, the Middle East and East Asia;

- to identify and empirically substantiate the choice of strategic directions of the state policy of post-war reconstruction of Ukraine.

The article employs a complex of general scientific and special research methods. In particular, the method of analysis and synthesis was used to study the impact of the war on economic development and the processes of post-war reconstruction. The method of systematization made it possible to identify the main factors of post-war reconstruction. Econometric modeling helped to verify the relationship between economic growth and individual structural factors of development. The generalization method was used to formulate conclusions regarding possible directions of post-war reconstruction in Ukraine.

**Results.** Analysis of the current socio-economic situation in Ukraine has shown that post-war reconstruction cannot be reduced to the mechanical restoration of destroyed facilities. The scale of physical damage, the partial loss of the production potential, demographic changes, labor shortages, fiscal dependence on external financing, and weakening investment activity indicate a deeper problem: the war has changed the very structure of the economy. According to RDNA5, Ukraine's needs for recovery and reconstruction amount to 587.7 billion USD over the next ten years [6]. Under such conditions, a return to the pre-war economic model cannot be a sufficient strategic goal.

Post-war reconstruction primarily means restoring what was. In the case of Ukraine, it is worth prioritising post-war reconstruction. Although these concepts are to some extent similar. In economic literature, international practice and economic policy have different natures and meanings. Since post-war reconstruction involves deep structural transformations of the country and involves using the war as an opportunity for modernization and innovation, which is actually observed, especially in the field of military and digital technologies in Ukraine.

The research concluded that post-war reconstruction is a broader concept that includes reconstruction and recovery, in particular: restoration of damaged housing, restoration of energy and water supply, restoration of infrastructure and return of the population, that is, the return of the country to pre-war functioning. However, the goal of post-war reconstruction is broader – it is the creation of a new, more powerful and more innovative economy, which involves economic reforms, institutional changes, spatial reconstruction of cities, social reforms and reconstruction of human capital, and European integration (Table 1).

As the analysis of economic history and international experience shows, the post-war development of the country's economy can be conditionally divided into three stages: providing humanitarian aid and support during the war; post-war reconstruction and restoration of the economy; and post-war reconstruction and structural modernisation of the economy. For example, if we study the history of Germany (FRG) after World War II, then first, thanks to the Marshall Plan, production was restored and launched there, the population was provided with housing, and then the Erhard and Adenauer Reforms were implemented, which included big institutional changes and reform of industrial policy, the development of a

social market economy and currency reform. The state relied on competition, actively fought monopolies, and carried out pension reform. In Germany, the economic system became a socio-economic one, finding ardent support for the reforms among ordinary Germans. "Adenauer compared the state to a football referee: it follows the rules, but does not play. Erhard abolished the planned economy, centralized prices, and old laws, acting gradually, without shock" [7].

Table 1

**Components of post-war reconstruction reforms**

| <b>Types of reforms</b>                                       | <b>Description</b>                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Economic reforms                                              | <ul style="list-style-type: none"> <li>– reforms in the field of economic policy;</li> <li>– development of new industries, in particular manufacturing industry;</li> <li>– digitalization;</li> <li>– promotion of business and processing industry development;</li> <li>– integration into global markets.</li> </ul> |
| Institutional reforms                                         | <ul style="list-style-type: none"> <li>– European integration;</li> <li>– judicial reform;</li> <li>– overcoming corruption;</li> <li>– public administration reform.</li> </ul>                                                                                                                                          |
| Spatial reconstruction & territorial communities' development | <ul style="list-style-type: none"> <li>– reconstruction of Ukrainian cities;</li> <li>– ensuring energy efficiency;</li> <li>– inclusiveness of territorial communities;</li> <li>– digitalization.</li> </ul>                                                                                                            |
| Environmental reforms                                         | <ul style="list-style-type: none"> <li>– demining of territories;</li> <li>– cleaning and restoration of natural resources;</li> <li>– green transformation.</li> </ul>                                                                                                                                                   |
| Social reforms                                                | <ul style="list-style-type: none"> <li>– reforming the education system;</li> <li>– reforming medicine and</li> <li>– psychological rehabilitation of the population;</li> <li>– development of a veteran support system;</li> <li>– development of human capital and</li> <li>– return of the population.</li> </ul>     |

*Source: developed by the authors*

Thanks to the German government's political and economic policies, it was possible to achieve the "German economic miracle" in a short time. Japan, which also chose the reconstruction model after World War II, was able to overcome economic backwardness and monopolism, carry out reforms of the public administration system, and educational reform in a short period of time, which allowed Japan to build a modern high-tech economy and become one of the international leaders. Like Japan, South Korea used the reconstruction policy after World War II to transition from an agrarian economy to an industrial one, and later to a post-industrial one.

To date, due to the complexity and multifaceted nature of post-war reconstruction as a concept, there is no single, universally accepted theory. Instead, several conceptual approaches have emerged, evolving from the concept of restoring economic potential (Economic Recovery Approach) after World War II to a comprehensive transformation of the economy through a combination of structural, institutional, sustainable development concepts and "Build Back Better", and later supplemented by the experience of reconstruction in the Balkans, the Middle East, etc.

In Ukrainian scientific literature, some scholars propose classifying post-war reconstruction in terms of traditional and innovative approaches [8]. But such an approach contradicts the integrated approach, which today dominates in Western research, in particular research by the World Bank, OECD and other international organizations. Table 2 considers the main conceptual approaches to defining post-war reconstruction from an evolutionary standpoint.

Table 2

**Classification of main concepts of post-war reconstruction**

| No | Coefficient                  | Main goal                                                                                                                                                             | Key directions and priorities                                                                                                                                                                                                                                                  |
|----|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Economic Recovery Approach   | Renew the economy to the pre-war level in the fastest possible way (countries of Western Europe, 1945-1950)                                                           | <ul style="list-style-type: none"> <li>– stabilization of the economy and public finances;</li> <li>– resumption of production, launch of industry;</li> <li>– ensuring employment;</li> <li>– restoration of infrastructure and logistics.</li> </ul>                         |
| 2  | Structural Reconstruction    | Restore the economy and restructure it in response to the new opportunities created by the war. (1980-1990).                                                          | <ul style="list-style-type: none"> <li>– structural reforms;</li> <li>– development of new sectors;</li> <li>– modernization of industry;</li> <li>– innovation;</li> <li>– integration into the global economy.</li> </ul>                                                    |
| 3  | Institutional Reconstruction | Rebuild the country, starting with reforms of state institutions                                                                                                      | <ul style="list-style-type: none"> <li>– rule of law;</li> <li>– independent judiciary;</li> <li>– fight against corruption;</li> <li>– efficient public administration;</li> <li>– transparent public finances.</li> </ul>                                                    |
| 4  | Sustainable Reconstruction   | Ensure economic growth, social justice, and environmental security                                                                                                    | <ul style="list-style-type: none"> <li>– green energy;</li> <li>– circular economy;</li> <li>– reduction of emissions;</li> <li>– social cohesion.</li> </ul>                                                                                                                  |
| 5  | Peacebuilding Reconstruction | Turn economic recovery into a tool for preventing new conflicts (the Balkan region and Africa, 1980-1990)                                                             | <ul style="list-style-type: none"> <li>– creation of jobs;</li> <li>– support for local small and medium-sized businesses;</li> <li>– reduction of inequality;</li> <li>– reintegration of veterans;</li> <li>– restoration of trust between the state and society.</li> </ul> |
| 6  | Resilient Reconstruction     | Form an economy capable of withstanding future crises (21st century)                                                                                                  | <ul style="list-style-type: none"> <li>– diversification of production;</li> <li>– building energy independence;</li> <li>– creation of digital infrastructure;</li> <li>– cybersecurity;</li> <li>– development of local value chains.</li> </ul>                             |
| 7  | Build Back Better (BBB)      | Rebuild better than it was (21st century). It is enshrined in international disaster recovery documents and is increasingly being applied to post-war reconstruction. | <ul style="list-style-type: none"> <li>– sustainable infrastructure;</li> <li>– green economy;</li> <li>– digitalization;</li> <li>– energy efficiency;</li> <li>– inclusiveness;</li> <li>– risk management of future crises.</li> </ul>                                      |

Source: developed by the authors based on [9-13]

Based on the in-depth analysis and generalization, it is proposed to define post-war reconstruction as a complex, multi-level and long-term process of restoration and structural transformation of the economic system after a military conflict, encompassing capital reconstruction, modernization of production and social infrastructure, institutional reform, human capital development, implementation of innovative and digital technologies, ensuring economic and environmental sustainability, as well as the formation of a new model of competitive, inclusive and safe development in accordance with the goals of sustainable development.

Therefore, in our deep conviction, Ukraine needs not just post-war recovery but post-war reconstruction for a number of objective reasons, namely: integration into the EU, ensuring energy sustainability and independence, digital transformation, reforming industrial policy, modernising industry, and ensuring the development of innovation and human capital. In our work, we offer an integrated model that reflects the modern conceptual understanding of post-war reconstruction and is consistent with the approaches of the European Union, the World Bank, the OECD, and other international institutions. This model can serve as a theoretical basis for further research into the post-war reconstruction of Ukraine, as it takes into account the main factors influencing the formation of a new competitive and sustainable economy.

In our model, we considered the factors of post-war reconstruction not only through the prism of classical models of post-war recovery but also by taking into account the unprecedented challenges Ukraine faced: a long war, large-scale destruction, and significant human losses. All this is accompanied by European integration, digital transformation, and the formation of a new security architecture. Figure 1 presents the main factors that, in our opinion, will influence post-war reconstruction, grouped by blocks.

The optimal framework for Ukraine is not a compensatory, but an investment-modernization model of reconstruction. Its content is that reconstruction should simultaneously restore basic infrastructure, form a new industrial base, increase productivity, strengthen institutions and integrate the economy into European production chains. In this sense, the most relevant is the experience of Japan and South Korea, where post-war recovery was not limited to foreign aid or budget stabilization, but was based on an active coordinating role of government, industrial development, technological renewal and export support. For Ukraine, such a model does not mean copying the Asian experience, since it operates in a different historical, security and European integration environment. It is rather about adapting its basic principle: government should not replace the market, but create conditions under which private investments are directed to productive sectors with a long-term effect on growth.

The methodological basis for such a strategy should be the principle of Build Back Better, that is, reconstruction not as a return to the previous state, but as a renewal of the economy at a higher level of sustainability, energy efficiency, technological capability and institutional quality [14]. For Ukraine, this principle has practical significance: a considerable share of the destroyed assets should not be recreated in their former technological form, especially in energy, industry, transport, and housing infrastructure. Reconstruction should be aimed not only at compensating for losses but also at reducing the economy's future vulnerability to military, energy, logistical, and financial shocks.

The proposed strategy should be based on two interrelated levels. The first is the institutional framework for reconstruction. Its basic elements should be the protection of property rights, the predictability of the regulatory environment, effective law enforcement, anti-corruption infrastructure, transparency in the use of reconstruction funds, and mechanisms for insuring military and political risks. Without these conditions, even significant international resources may have a short-term effect but fail to become a

sustainable investment process. Institutional quality is important not as a formal requirement of donors, but as an economic prerequisite: it is that which reduces transaction costs, increases investor confidence, and makes long-term investments rational.

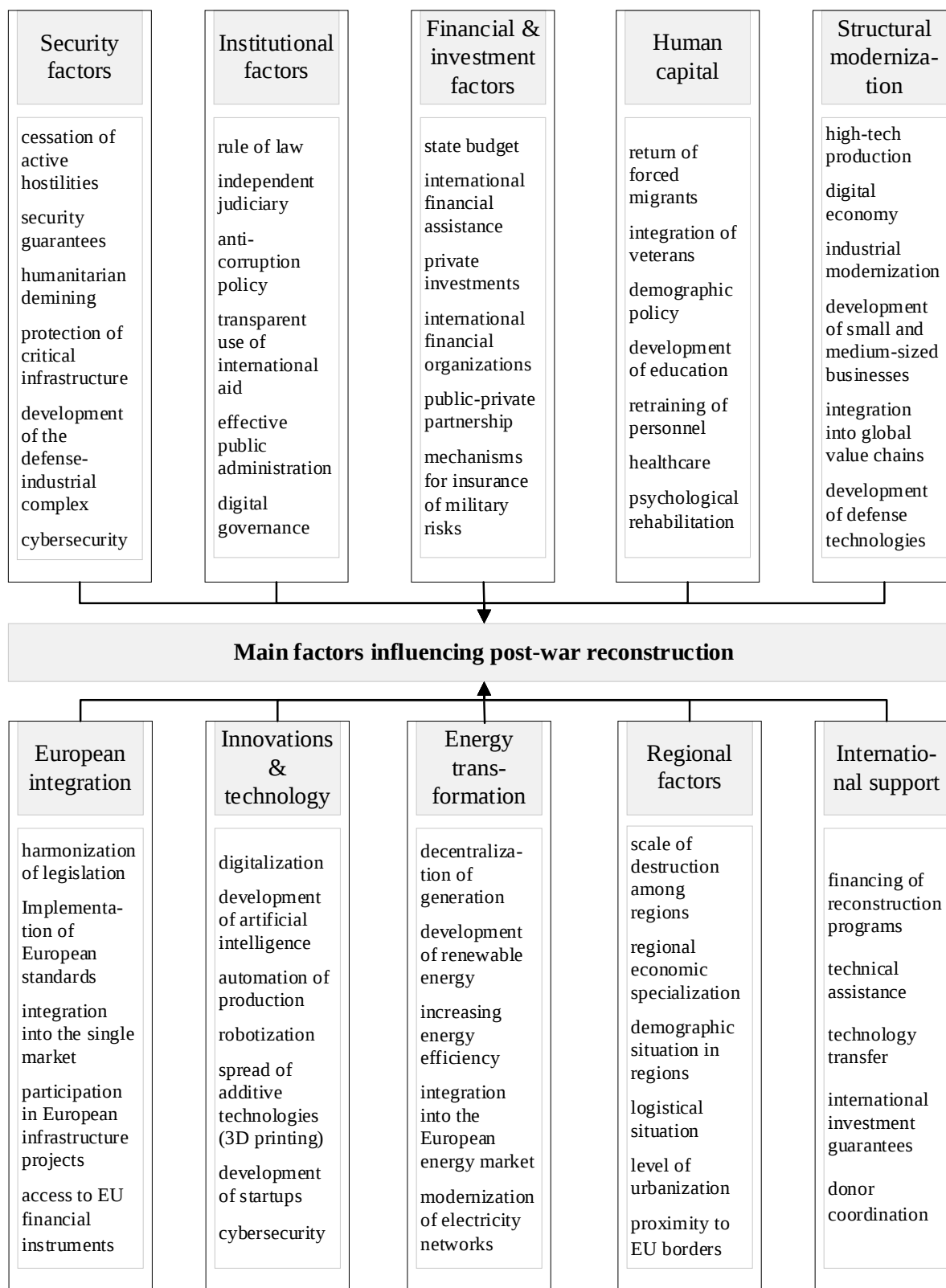


Fig. 1. Main factors influencing post-war reconstruction  
Source: developed by the authors

Therefore, the priority should not be to expand the number of reconstruction management bodies, but to create a single, transparent system of project coordination in which public, local, international, and private resources operate under the same rules.

The second level is a new type of industrial policy. It should not be aimed at administrative “revival of industry as a whole”, but at supporting sectors capable of creating added value, export potential and technology spillover effects. The defence-industrial complex can take a central place in this model. During war, it is here that engineering competencies, production of dual-use products, rapid implementation of innovations, and cooperation between the government, private companies and technological teams are concentrated. In the post-war period, this potential should be used as a bridge to broader industrial renewal – in mechanical engineering, electronics, unmanned systems, cybersecurity, energy equipment, logistics, materials science and high-tech processing. Historical experience confirms that military technologies can serve as the basis for civilian innovations, provided that a targeted technology transfer policy is implemented.

At the same time, industrial policy should be selective and disciplined. Government support should not be provided on the principle of preserving any enterprise, but rather through clear criteria: export potential, technological complexity, job creation potential, integration into EU supply chains, energy efficiency, and contribution to security resilience. Practical tools can be preferential financing of investment projects, state guarantees, military risk insurance, industrial parks, public-private partnerships, export credit, defense procurement with localization effect and support for research and development. Such a policy should avoid two extremes: a passive expectation that the market itself will restore the destroyed industrial base, and heavy-handed regulation, which creates risks of corruption and inefficient resource allocation.

A separate area should be energy and infrastructure sustainability. Energy recovery should combine the repair of damaged capacities with the decentralization of generation, the development of renewable sources, energy storage, smart grid solutions, and enhanced physical protection of critical infrastructure. Transport recovery should be linked to Ukraine’s export reorientation: modernization of railways, border infrastructure, port logistics, multimodal corridors, and technical integration with the EU market. Without this, industrial policy will remain limited, as production requires not only capital, but also energy, logistics, and access to external markets.

No less important is human capital. Reconstruction will require not only financing, but also workers, engineers, managers, builders, doctors, educators and technicians. Therefore, policies for the return of migrants, professional retraining, support for veterans, the restoration of education and the modernization of vocational training must be integrated into the economic recovery strategy. Human capital cannot be considered as a social add-on to reconstruction: without it, even funded projects may face staff shortages and low productivity.

Ukraine's reconstruction strategy should be based not on expanding the list of state programs but on a clear hierarchy of priorities. The priority areas should be those that simultaneously reduce the military vulnerability of the economy and form the basis of long-term growth: institutional trust and property protection, productive investment, industrial and defense-technological renewal, energy and logistical sustainability, restoration of human capital, integration into the production and financial mechanisms of the EU. With such logic, reconstruction ceases to be just compensation for losses and takes on the character of managed structural modernization.

To empirically substantiate the choice of strategic directions for Ukraine's post-war reconstruction, a panel regression model was constructed to assess the relationship between economic growth rates and key recovery factors in a group of post-conflict and transformation economies. This approach is appropriate given that Ukraine's reconstruction cannot be

considered in isolation from international experience: the success of reconstruction depends not only on the scale of foreign aid, but also on the state's ability to convert recovery resources into investments, modernization of production, and structural restructuring of the economy.

The empirical sample of the model covers 10 countries for the period 2000–2022: Bosnia and Herzegovina, Croatia, Serbia, Georgia, Rwanda, Iraq, Lebanon, Cambodia, Vietnam and Ukraine. The formation of such a panel of countries is based on the concept of a purposive sample, in which countries were selected on the criterion of having relevant historical experience in overcoming the consequences of military conflicts and large-scale destruction, as well as deep systemic transformation. We conventionally divided the sample into three clusters, which ensured the necessary variability of data in the research process:

- the first cluster is European and Balkan countries (Croatia, Bosnia and Herzegovina, Serbia, Georgia, and Ukraine). These are the countries closest to Ukraine in terms of institutional characteristics, geographical location, the peculiarities of the transition from a planned to a market economy, and the specifics of transformation processes in conditions of military conflicts or losses [15, 16];
- the second cluster is countries undergoing deep structural reconstruction (Rwanda, Cambodia, and Vietnam). These states have demonstrated the ability to radically transform their production structures and attract investment after catastrophic economic collapse and loss of human capital [17, 18, 19];
- the third cluster is countries of permanent instability (Iraq, Iran). Using these countries as examples, we sought to demonstrate in our study how chronic macroeconomic instability and weak institutions offset the effects of foreign aid [20, 21, 22].

The choice of these countries is due to their experience with military conflicts, post-conflict reconstruction, or deep transformation of the economic system. The use of panel data enables combining the cross-country and time dimensions of the analysis and partially accounting for persistent differences between countries that are not directly reflected in current macroeconomic indicators. In this study, the model has an auxiliary role: it can be used to test the relationship between economic growth rates and factors important to the modernisation trajectory of recovery.

The study's time horizon covers 2000–2022, ensuring a balanced panel. The 23-year period allowed for levelling the impact of short-term shocks in the model and highlighting long-term structural trends, which is critical for assessing the consequences of reconstruction, which can last for decades. The choice of the period 2000–2022 enabled analysis of both phases of intensive recovery and global economic shocks, in particular the 2008–2009 crisis and the COVID-19 pandemic, thereby testing the stability of economic growth models under different conditions. The end of the analysis period in 2022 allowed us to record a turning point for Ukraine - the beginning of a full-scale Russian invasion, since macroeconomic data from wartime have a high degree of error.

By combining cross-sectional and time-series information, panel data increased the degrees of freedom, improved estimation efficiency, and reduced the risk of multicollinearity compared with conventional time-series models.

The choice of variables is subordinated to the logic of studying the modernization trajectory of recovery and is based on the current consensus in the macroeconomic literature in transit and post-conflict economies. It is clear that this set of variables does not cover all prerequisites for recovery, but it allows us to isolate the impact of several economic channels.

Thus, gross capital formation reflects the investment base of recovery, without which the reproduction of production capacities and modernization of infrastructure are impossible. Modern empirical studies of reconstruction, in particular the World Bank Report (2022),

convincingly demonstrate that capital accumulation is a critical driver of growth in the first decades after the end of the conflict, compensating for the shock-induced loss of assets [23].

The share of manufacturing in GDP is used as a proxy for the economy's productive structure and technological complexity. According to current UNIDO research, it is the industrial sectors that are able to form longer value chains, technological innovation and more sustainable sources of employment, preventing the effect of “premature deindustrialization” that often accompanies economies with weak institutions [24].

Exports of goods and services characterize the level of external integration of the economy, and foreign direct investment – the country's ability to attract external private capital. For small open economies, the export-oriented model is the only reliable source of long-term growth, as the domestic market remains too narrow and depressed in the aftermath of the conflict.

Inflation is included in the model as a classic indicator of macroeconomic instability, which can limit investment activity and long-term growth. World Bank research highlights that high price volatility in fragile states acts as a tax on investment, limiting the business planning horizon [19].

This set of variables does not cover all the prerequisites for post-war reconstruction, but allows us to focus on those economic channels that are directly related to investment formation, production modernization, external integration and macro-financial stability. In a comparative analysis, these areas proved to be the most important for the transition from simple restoration of destroyed assets to long-term economic development.

The dependent variable in the model is the growth rate of real GDP. The explanatory variables used are gross capital formation, the share of manufacturing in GDP, exports of goods and services as a percentage of GDP, net inflow of foreign direct investment as a percentage of GDP, and inflation. The data are based on the World Development Indicators of the World Bank [25].

In general, the model looks like this:

$$GDPgr_{it} = \alpha_i + \beta_1 Inv_{it} + \beta_2 Man_{it} + \beta_3 Exp_{it} + \beta_4 FDI_{it} + \beta_5 Inf_{it} + \varepsilon_{it}$$

where  $GDPgr_{it}$  – the growth rate of real GDP of country  $i$  in year  $t$ ;  $\alpha_i$  – individual country fixed effect;  $Inv_{it}$  – gross capital formation as a percentage of GDP;  $Man_{it}$  – share of manufacturing in GDP;  $Exp_{it}$  – exports of goods and services as a percentage of GDP;  $FDI_{it}$  – net inflow of foreign direct investment as a percentage of GDP;  $Inf_{it}$  – annual inflation rate;  $\varepsilon_{it}$  – random model error.

The assessment was carried out using a fixed-effects model. The use of pooled regression was rejected because it would ignore country heterogeneity, leading to biased estimates. On the other hand, the use of a random-effects model requires the strict assumption that, in some cases, individual country characteristics are not correlated with the explanatory variables. This situation is explained by the fact that the countries in the sample differ significantly in historical development conditions, economic structure, scale of destruction, quality of public administration and nature of post-war recovery.

Therefore, in the context of our study, the use of fixed effects is, in our opinion, the only correct solution. Fixed effects allow us to account for persistent individual characteristics of countries that may affect the rate of economic growth but are not directly included in the list of explanatory variables. For example, factors such as geographical location, historical development, and institutional quality are either stable over time or change very slowly, but they directly affect both a country's ability to attract investment and its overall growth rate. The  $\alpha_i$  component “absorbs” this unobserved heterogeneity, allowing us to obtain pure, unbiased estimates ( $\beta$ ) of the impact of current macroeconomic efforts on economic recovery for each country. The adequacy of the choice of a fixed-effects model compared to random

effects is further confirmed by the result of the Hausman test. The calculations were performed using the GRET software (Gnu Regression, Econometrics and Time-series Library).

Therefore, the results of the model should be interpreted not as a universal assessment of post-war reconstruction, but as a test of statistical relationships between individual macroeconomic indicators. The results of the assessment of the basic model are given in Table 3.

Table 3

**Results of assessing the panel model with fixed effects**

| <b>Indicators</b>                      | <b>Coefficient</b> | <b>Standard error</b> | <b>t-statistic</b> | <b>p-value</b> |
|----------------------------------------|--------------------|-----------------------|--------------------|----------------|
| Constant                               | -9.184170          | 3.951870              | -2.3240            | 0.0212         |
| Gross capital formation                | 0.320318           | 0.128342              | 2.4960             | 0.0134         |
| Share of manufacturing industry in GDP | 0.447602           | 0.217354              | 2.0590             | 0.0408         |
| Exports of goods and services          | -0.003424          | 0.051353              | -0.0667            | 0.9469         |
| Foreign direct investment              | 0.116281           | 0.207560              | 0.5602             | 0.5760         |
| Inflation                              | -0.038468          | 0.034492              | -1.1150            | 0.2661         |

Source: calculated by the authors

It should be noted that the model captures statistical relationships among individual macroeconomic indicators but does not encompass all security, political, and institutional conditions of post-war reconstruction. The most pronounced positive relationship is with gross capital accumulation. The coefficient on this variable is positive and statistically significant at the 5% level (a standard criterion indicating successful economic development and implying 95% confidence in the result). An increase in gross capital accumulation by 1 percentage point of GDP in this specification is associated with an increase in the rate of real GDP growth of approximately 0.32 percentage points, other things being equal. For the analysis of Ukrainian reconstruction, this result is important primarily because it emphasizes the role of productive investment accumulation. Recovery cannot be reduced only to compensation for destroyed facilities or current budget financing; it requires investments in production capacities, infrastructure, technological renewal, and human capital.

The second statistically significant result in the baseline model is a positive coefficient on the share of manufacturing in GDP. This indicates a positive relationship between the economy's production structure and growth rates. This result is consistent with a comparative analysis of the experiences of Japan and South Korea, where post-war recovery was not limited to physical reconstruction but was accompanied by the formation of a new industrial base, technological renewal, and a gradual reorientation of exports. For Ukraine, this means that the recovery of the destroyed industry should be considered not as a mechanical return to the pre-war structure, but as part of a broader modernization policy.

The coefficients on exports and foreign direct investment in the baseline specification are not statistically significant. This does not rule out their importance for recovery, but it does show that higher levels of external openness or foreign capital inflows alone do not guarantee faster growth. Exports can only support growth if there is competitive production, logistical capacity, and the ability of firms to integrate into external markets. Similarly, foreign direct investment has different effects depending on the industry structure, the conditions for property rights protection, the quality of regulation, and the economy's ability to integrate external capital into domestic value chains.

The coefficient on inflation is negative but not statistically significant in the basic specification. This result does not allow us to draw a strong conclusion about the quantitative impact of inflation on economic growth in this sample, but it does not contradict the general macroeconomic logic: high inflation worsens investment expectations, reduces real

purchasing power, and increases uncertainty for businesses. For Ukraine, this means that macrofinancial stability is a necessary condition for recovery, but it cannot replace investment, industrial and institutional policies.

**Conclusions.** Overall, the results of the econometric assessment support the conclusion that the key for Ukraine should not be the simple attraction of financial resources, but their productive direction. Investment, the development of the manufacturing industry, export integration, and foreign direct investment can support recovery only under the conditions of coordinated public policy, institutional predictability, and the concentration of resources in sectors capable of creating long-term added value.

In this context, the most appropriate model for Ukraine is not a compensatory reconstruction model aimed only at restoring the pre-war state, but an investment and modernisation model, within which infrastructure reconstruction is combined with the formation of a new industrial base, the development of the defence-industrial complex, technological renewal and gradual export integration. The defence-industrial complex can serve as a transitional technological core of such a model, since it is in this sector that engineering competencies, innovations, the production of dual-use products, and practical experience in rapid technological implementation are concentrated during the war.

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