“Financial determinants of ensuring the resilience of Ukrainian regions”

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FINANCIAL DETERMINANTS OF ENSURING THE RESILIENCE OF UKRAINIAN REGIONS

Abstract

Financial resilience is the basis of economic development as it determines the ability of the financial system to efficiently perform its functions and ensure optimal resource allocation and the normal course of economic processes under the impact of macroeconomic shocks and endogenous risks. The article aims to assess financial resilience as a systemic component of ensuring the economic development of Ukrainian regions. The research methods include systemic and structural analysis (building an information and analytical model for studying financial resilience), clustering (grouping regions by the criterion of economic development), and risk theory and analysis of variance (identifying potential zones of financial resilience and its components). Data from the regions (oblasts) of Ukraine for 2015–2021 serve as the information and analytical basis of the study. The article reveals that in 2021 regions with better financial resilience (Zhytomyrska, Dnipropetrovska, Kyivska, Lvivska, Odeska, Kharkivska, Cherkaska, and Volynska oblasts) take leading positions in terms of economic development and more efficient use of exogenous and endogenous financial resources than the regions with low financial resilience (Chernivetska, Vinnytska, Khmelnytska, Donetska, Ternopilska, and Ivano-Frankivska oblasts). The study proves that enhancing financial resilience is a trigger and foundation for ensuring economic growth in the regions, especially amid macroeconomic shocks. Balancing the need to use financial resources to restore the economy (growth of production, consumption, and employment) while reducing the dependence of regional economies on external financial sources should become the main vector of policy to ensure the financial resilience of Ukrainian regions.

Keywords financial resilience, regions, risks, economic progress, shocks, determinants, Ukraine

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INTRODUCTION

The pandemic and, since 2022, Russia's war against Ukraine have increased economic instability and exacerbated problems in the system of state and local finance, which, in turn, have affected the financial resilience of the regions[1], provoking negative changes and limiting economic growth opportunities that will have long-term consequences for sustainable development. Restoring financial stability will not only mitigate negative challenges and risks but also ensure the responsiveness of the changing regional economies to new development opportunities. A modern vision of the development of Ukraine's regions should include: a) overcoming current challenges and problems and b) restoring/activating the processes of economic growth stimulation. The rapid ability of the socio-economic system to adjust and respond to changes will help ensure the recovery of regional economic growth, counteract current macroeconomic shocks, minimize disparities, and strengthen territorial cohesion. First, this refers to financial resilience

1 In this study, regions of Ukraine are defined as oblasts (according to the current legislation).

(the system's resistance and adjustment to changes to maintain the main parameters of its functioning and viability), which is determined by a high degree of sensitivity to changes in various determinants, including financial ones (factors that have a dominant impact on the resulting variable).

Given the permanent crises that have been the existential challenges to the economic development of Ukrainian regions in recent years, assessing the level of their resilience against external threats (shocks) and determining the degree of sensitivity and the nature of the impact of financial determinants on resilience are important tasks for regional policy considering the need to update the strategic development course.

1. LITERATURE REVIEW

Resilience in economics is a term that "owes" its origins to environmental studies, where this concept is used to describe the biological ability to adjust and develop under adverse conditions. In economics, approaches to the definition of resilience have changed over time: from its interpretation as a return of the system to a state of equilibrium (static approach) (Hill et al., 2012) to its definition as a dynamic process of continuous adjustment of the system in changing conditions (evolutionary approach) (Mayor et al., 2020; Kitsos et al., 2019).

Financial resilience is a crucial factor in financial well-being (Russell et al., 2020) and is related to an economic entity's ability to adjust to conditions caused by a financial shock (Mcknight et al., 2020; Sreenivasan, 2023) and recover without fundamentally changing its structure and functions (Folke et al., 2010; Holling, 1973). There is a strong correlation between the financial resilience of a system and the financial resources it possesses at a given moment, but financial resilience depends not only on the available financial resources but also on debt obligations and methods of managing the resource base (Deevy, 2021). Researchers emphasize the multifaceted nature of financial resilience as this term is used not only to study how the system responds to certain shocks but also covers the issue of its recovery from the crisis and adjustment to new circumstances (Linnenluecke, 2017; Upadhaya et al., 2020). Accordingly, in addition to applying crisis management tools in response to a shock, financial resilience is also achieved by implementing proactive measures to predict potential risks and strengthen weaknesses (Boin & Lodge, 2016; Steccolini et al., 2017).

The concept of financial resilience of territories in scientific discourse began to be actively used with the deepening and overlapping (one on top of the other) of large-scale permanent crises in the world (climate-related crises, the COVID-19 pandemic, war, and deterioration of the security situation, etc.) (Voznyak et al., 2023). In the process of analyzing the financial resilience of states against the impact of external factors, an increased attention was paid to the financial and economic resilience of regions and other subnational units (cities, communities), as their different capacities to withstand the same external challenges were revealed (Martin, 2012; Voznyak et al., 2021; Li et al., 2022). The financial resilience of a region is viewed as its ability to adjust to changes regardless of their nature and to use these events to continue its development (Oprea et al., 2020). In this context, researchers consider regional resilience as a process that includes several phases: resilience (indicates the sensitivity of the region's economy to economic shocks) → recovery (speed and comprehensiveness of the region's recovery) → repositioning (shows the degree of reorientation of production and changes in the structure of employment in the region and the impact of these changes on further economic development) → renewal (the degree of "renewal" of the region's economy) (Martin, 2012; Ilyash et al., 2021).

According to researchers, the financial and economic resilience of a state against the crisis does not guarantee a high level of resilience of the country's regions to these conditions (Martin, 2012), and their ability to withstand economic shocks varies significantly depending on the scale of the economy. Therefore, the reason for a region's sustainability should be sought in the "initial conditions" of economic development (Webber et al., 2018; Voznyak et al., 2022).

The range of determinants that define the level of financial resilience of a region and influence its

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change is quite broad and varies in nature. Some of them are exogenous and, importantly, fixed (access to markets, level of urbanization, place in the system of administrative and territorial organization, and historical and cultural factors), while others are structural (human capital, industry structure and specialization, demography, innovation, existing industrial base, and access to foreign markets). The factors that are inherently cyclical (e.g., economic productivity, investment activity) also serve as determinants of the financial resilience of regions (Fratesi et al., 2016; Oprea et al., 2020; Gajewski, 2023).

The World Bank systematically studies the issue of financial resilience of economic entities (Mahul et al., 2019; World Bank, 2022; World Bank, 2023). In formulating a comprehensive approach to developing ways to increase the resilience of territories and households in crisis conditions (disaster risk finance), World Bank researchers identify financial, physical, and social resilience as interrelated elements. The relationship between the two is dual, as risk-based financial decisions minimize the emergence of new risks and strengthen the physical and social resilience of the territory, and vice versa – a high level of physical and social resilience against shocks improves the financial resilience of the system. When studying ways to strengthen the financial resilience of a territory, they focus on the financial and operational readiness of the authorities to respond to challenges: financial readiness in the context of the established comprehensive instruments of financial support for beneficiaries and risk-sharing instruments; operational readiness in terms of the availability of channels for implementing the planned steps (Mahul et al., 2019; World Bank, 2023).

According to a study on the vulnerability of local economies to the COVID-19 pandemic in South America, the financial resilience of territories is determined by analyzing their development across five parameters: the resilience of the local business environment, labor market, local financial system, public administration system, and social services and communications system (Lupak et al., 2021; Hernandez Rosario, 2022). Taking these factors into account provides a holistic view of the possible risks to the financial resilience of the regions and allows them to mitigate their impact before the situation worsens. In conclusion, the author notes that the financial resilience of a region relies on its ability to, first, efficiently plan (including predicting negative shocks and determining the level of their impact on the local economy) and second, quickly redistribute and mobilize financial resources in crisis conditions, which lead to a change in development priorities.

The study of the financial and economic resilience of China's administrative units in the context of the financial crisis of 2008–2009, which covers a fairly long period (2003–2019) and aims at identifying the factors that ensure the resilience of the country's regions in the crisis and post-crisis recovery, is of particular interest (Li et al., 2022). Using a multilevel logistic regression model, the authors find heterogeneity in the resilience of the studied territories before the financial crisis and in the recovery. The main factors of financial and economic resilience of China's territories include the presence of an economic agglomeration, the level of development of the processing industry, education, infrastructure, financial development, investment in fixed assets, and fiscal spending on science, technology, and human capital. According to the results, the researchers emphasize two aspects. First, they identify the regions of the country that could be most affected by the next financial and economic shock. Second, they emphasize the need for an integrated approach of the state to the development of resilient economic systems (regions, cities, communities) and highlight areas of state support for regional development, the systemic implementation of which will result in strengthening the financial and economic resilience of regions, namely: industrial and infrastructure development, increased investment in research and development, and promotion of agglomeration systems.

Compared to international research, scientific studies on the economic resilience of Ukrainian regions are not systemic, and in the face of the recent increase in economic and security turbulence, such studies are quickly becoming irrelevant.

Given the ongoing crises that have recently accompanied the economic progress of Ukraine in general and its regions in particular (especially the war and the pandemic), restoring the economy

and revitalizing the activities of economic entities to achieve strategic development goals is an important task of financial and regional policy in the near future. Obviously, the current crisis situation in public finance is archly complex and unpredictable, so it is time to develop approaches, measures, and mechanisms to improve the directions of shaping and implementing financial policy and to develop scenarios for restoring economic growth in Ukrainian regions. Given the need to update the strategic course of regional development, assessing the level of their resilience against external challenges and threats and determining the nature of the impact of financial determinants on resilience are important tasks of modern financial and regional policy.

The article aims to assess financial resilience as a systemic component of ensuring the economic development of Ukrainian regions.

2. METHODOLOGY

Financial resilience as a systemic component of economic development is studied through a systemic-structural approach. The scientific discourse lacks a single unified system of indicators for both economic development and financial resilience. The available information and statistical base is limited, and data on the same indicators are often contradictory and may differ from source to source. Therefore, building an optimal, on the one hand, but complete and reliable, on the other hand, information and analytical model of indicators is a priority task in the process of studying financial resilience as a foundation for economic development.

The assessment of economic development is based on the principles of *comprehensiveness, systematicity, hierarchy, adequacy, unambiguity, and continuity*. The principle of accessibility is excluded because the methodology is not consistent, the structural elements of the indicator system may change depending on the available statistical base, and focusing on this principle will make it impossible to further improve the methodological approach.

The information-analytical system of indicators of regional economic development is represented by formula (1).

where ED_t^n is the economic development of the n region in the t period; ES_t^n is the economic stability of the n region in the t period; EE_t^n is the economic efficiency of the n region in the t period; $IDFC_t^n$ is the innovation development and foreign economic cooperation of the n region in the t period; $DSMB_t^n$ is the small and medium business development of the n region in the t period; LM_t^n is the labor market efficiency of the n region in the t period; DI_t^n is the infrastructure development of the n region in the t period; $IGRP_t^n$ is the GRP physical volume index of the n region in the t period, in prices of the previous year, %; $GRPpc_t^n$ is the GRP of the n region in the t period, UAH, per capita; $RGDP_t^n$ is the share of the n region in GDP in the t period, %; IMP_t^n is the industrial output index of the n region in the t period, as a % of the previous year; $IRMP_t^n$ is the volume of industrial output sold by the n region in the t period, UAH, per capita; IRM_t^n are the agricultural output indices of the n region in the t period, as a % of the previous year; IBP_t^n is the volume of construction works performed in the n region in the t period, UAH, per capita; IFT_t^n is the volume of freight turnover of road and rail transport of the n region in the t period, thousand tonne-kilometers, per 1,000 people; IRT_t^n are the indices of the physical volume of retail trade turnover of retailers of the n region in the t period, as a % of the previous year; $RRIP_t^n$ is the share of innovative products sold by

$$ED_t^n = \begin{Bmatrix} ES_t^n \\ EE_t^n \\ IDFC_t^n \\ DSMB_t^n \\ LM_t^n \\ DI_t^n \end{Bmatrix} = \begin{Bmatrix} IGRP_t^n & GRPpc_t^n & RGDP_t^n & & & & & & \\ IMP_t^n & IRMP_t^n & IRM_t^n & IBP_t^n & IFT_t^n & IRT_t^n & & & \\ RRIP_t^n & Exp_t^n & RExIm_t^n & RExp_t^n & RInUn_t^n & & & & \\ AMB_t^n & ASB_t^n & RRMB_t^n & RRSB_t^n & EmSM_t^n & & & & \\ ProdL_t^n & UnEm_t^n & Em_t^n & RAcDM_t^n & IRS_t^n & WA_t^n & RWIn_t^n & EnIn_t^n & \\ RUIn_t^n & RRIn_t^n & IAB_t^n & TH_t^n & & & & & \end{Bmatrix}, \quad (1)$$

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the n region in the t period in the total volume of industrial output sold, %; Exp_t^n are the growth rates of exports of goods of the n region in the t period, %; $RExIm_t^n$ is the ratio of exports to imports of goods of the n region in the t period; $RExp_t^n$ is the share of exports of goods of the n region in the t period in the country's total exports, %; $RInUn_t^n$ is the share of innovative industrial enterprises of the n region in the t period, %; AMB_t^n is the number of medium businesses in the n region in the t period, units, per 10,000 persons of the current population; ASB_t^n is the number of small businesses (including microenterprises) of the n region in the t period, units, per 10,000 persons of the current population; $RRMB_t^n$ is the share of the volume of products (goods, services) sold by medium businesses of the n region in the t period (in the total volume of products (goods, services) sold by business entities); $RRSB_t^n$ is the share of the volume of products (goods, services) sold by small businesses of the n region in the t period (including microenterprises) in the total volume of products (goods, services) sold by business entities; $EmSB_t^n$ is the number of employees in small businesses of the n region in the t period, as a % of the total number of employees; $ProdL_t^n$ is the aggregate labor productivity of the n region in the t period (ratio of GVA to the number of employees), UAH; $UnEm_t^n$ is the unemployment of the population aged 15-70 of the n region in the t period (according to the ILO methodology), as a % of the economically active population of the respective age; Em_t^n is the employment of the population aged 15-70 of the n region in the t period (according to the ILO methodology), as a % of the economically active population of the respective age; $RAcDM_t^n$ is the ratio of new hires to retirements in the n region in the t period; IRS_t^n is the real wage index of the n region in the t period, as a % of the corresponding period of the previous year; WA_t^n is the wage arrears in the n region in the t period, as a % of the payroll for the last month of the reporting period; $RWIn_t^n$ is the share of wages in the total income of the population of the n region in the t period, %; $EnIn_t^n$ is the employment in the informal economy in the n region in the t period, as a % of the employed population aged 15-70; $RUIn_t^n$ is the share of urban households with Internet access at home in the n region in the t period, as a % of the total number of such households; $RRIn_t^n$ is the share of rural households with Internet access at home in the n region in the t period, as a % of the total number of such households; IAB_t^n are the commissioned housing growth (decline) rates of the n region in the t period, as a % of the corresponding period of the previous year; TN_t^n is the total area of the housing stock of the n region in the t period, sq. m., per capita.

The information and analytical basis for the study of the financial resilience of regions includes a system of indicators structured into four components: (1) budgetary resilience, (2) financial sector resilience, (3) price resilience, and (4) investment efficiency (formulas 2 to 6).

$$FR_t^n = \begin{cases} BS_t^n \\ SFS_t^n \\ PS_t^n \\ InvA_t^n \end{cases}, \quad (2)$$

where FR_t^n is the financial resilience of the n region in the t period; BS_t^n is the budgetary resilience of the n region in the t period; SFS_t^n is the financial sector resilience of the n region in the t period; PS_t^n is the price resilience of the n region in the t period; $InvA_t^n$ is the investment efficiency of the n region in the t period.

$$f\left(BS_t^n\right) = f\begin{pmatrix} BR_t^n, TF_t^n, Dot_t^n, BF_t^n, IILB_t^n \\ IPDFO_t^n, CTLB_t^n, RIGR_t^n, \\ REA_t^n, EEA_t^n, RTGI_t^n \end{pmatrix}, \quad (3)$$

where BR_t^n is the budgetary efficiency[2] of the n region in the t period, UAH; TF_t^n is the tax independence[3] of the n region in the t period, coef.; Dot_t^n is the subsidization[4] of the n region in the t period, coef.; BF_t^n is the budgetary independence[5] of the n region in the t period; $IILB_t^n$ is the local budget revenue (without transfers) growth (decrease) rate of the n region in the t period, as a % of the previous year; $IPDFO_t^n$ is the personal income tax revenue growth (decrease) rate of the n

2 Revenues with transfers, per capita.

3 Ratio of tax revenues to revenues excluding transfers.

4 Ratio of transfers to total revenues including transfers.

5 Ratio of revenues without transfers to total revenues of local budgets.

region in the *t* period, as a % of the previous year; $CTLB_t^n$ are capital expenditures of the local budgets (without transfers from the state budget) of the *n* region in the *t* period, thousand UAH, per capita; $RIGR_t^n$ is the share of own revenues of the local budget (without transfers) of the *n* region in the *t* period in the revenues of the consolidated budget of Ukraine, %; REA_t^n is the share of expenditures on economic activity in the total expenditures of the *n* region in the *t* period, %; EEA_t^n is the share of expenditures on economic activity per capita of the *n* region in the *t* period; $RTGI_t^n$ is the share of local taxes and fees in local budget revenues (without transfers) of the *n* region in the *t* period, coef.

$$f\left(SFS_t^n\right) = f\begin{pmatrix} RUCr_t^n, RUGcr_t^n, RCA_t^n, \\ ROA_t^n, Dep_t^n, Cred_t^n, InR_t^n, \\ CCred_t^n, IpRed_t^n, InRCCr_t^n, \\ InRICr_t^n, AB_t^n, AFB_t^n \end{pmatrix}, \quad (4)$$

where $RUCr_t^n$ is the share of non-performing hryvnia loans to individuals (for real estate) in the *n* region in the *t* period, %; $RUGcr_t^n$ is the ratio of non-performing loans to gross loans in the *n* region in the *t* period; RCA_t^n is the ratio of regulatory capital to risk-weighted assets in the *n* region in the *t* period; ROA_t^n is the return on assets of banks in the *n* region in the *t* period; Dep_t^n are the volumes of deposits attracted by depository corporations (other than the NBU) and non-financial corporations in the *n* region in the *t* period, UAH, per capita; $Cred_t^n$ are the loans granted by depository corporations (other than the NBU) to non-financial corporations in the *n* region in the *t* period, UAH, per capita; InR_t^n are the interest rates of depository corporations (other than the NBU) on loans (weighted average annualized rates) in the *n* region in the *t* period, %; $CCred_t^n$ are the consumer loans granted by depository corporations (other than the NBU) to households for specific purposes in the *n* region in the *t* period, UAH, per capita; $IpRed_t^n$ are the mortgage loans granted by depository corporations (other than the NBU) to households for specific purposes in the *n* region in the *t* period, UAH, per capita; $InRCC_t^n$ are the interest rates of depository corporations (other than the NBU) on new consumer loans to households in the *n* region in the *t* period, by purpose, weighted average annualized rates, %; $InRICr_t^n$ are the interest rates of depository corporations (other than the NBU) on new mortgage loans to households in the *n* region in the *t* period, by purpose, weighted average annualized rates, %; AB_t^n is the number of ATMs in the *n* region in the *t* period, units, per 100,000 adults; AFB_t^n is the number of branches of commercial banks in the *n* region in the *t* period, units, per 100,000 adults.

$$f\left(PS_t^n\right) = f\left(ICP_t^n, \quad Inf_t^n, \quad GK_t^n\right), \quad (5)$$

where ICP_t^n are the consumer price indices of the *n* region in the *t* period, compared to the previous year, %; Inf_t^n is the inflation rate (consumer prices) of the *n* region in the *t* period, %; GK_t^n is the average annual official USD exchange rate in the *n* region in the *t* period, UAH/USD.

$$f\left(InvA_t^n\right) = f\begin{pmatrix} ICapI_t^n, CapI_t^n, \\ IFDI_t^n, IFDI_t^n \end{pmatrix}, \quad (6)$$

where $ICapI_t^n$ are the capital investment indices of the *n* region in the *t* period, as a % of the previous year; $CapI_t^n$ are the capital investments (excluding investments from the state budget) of the *n* region in the *t* period, UAH, per capita (cumulative total since the beginning of the year); $IFDI_t^n$ are the foreign direct investment (equity) growth (decline) rates of the *n* region in the *t* period, as a % of the beginning of the year; FDI_t^n are the foreign direct investment of the *n* region in the *t* period, USD, per capita (cumulative total since the beginning of the investment).

To build a series of empirical indicators of economic development of regions using the spatial-temporal approach, the systematic normalization of indicators of economic progress as catalysts and regressors is carried out by formula (7). Unlike classical approaches to rationing stimulants and destimulants, this method provides for considering the rank of regions (formula 8) for each indicator in a particular period of time. Accordingly, the consideration of the position of regions against the background of the system of indicators, on the one hand, and a specific period of time, on the other hand, rather than the maximization of the value of the catalyst indicator and the minimization of the regressor indicator in the aggregate of all regions is the main postulate of normalization.

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$$a_{it}^{n} == \begin{cases} \dfrac{x_{it}^{n}}{x_{i\lim}^{N}} \cdot k_{irang}^{n}, & x_{\lim}^{N} \geq x_{\max} \\ \dfrac{x_{i\lim}^{N}}{x_{it}^{n}} \cdot k_{irang}^{n}, & x_{\lim}^{N} \leq x_{\min} \end{cases}, \quad (7)$$

$$k_{itn}^{rank} = \frac{RANG_{it}^{n}}{Q_{it}}, \quad (8)$$

where a_{it}^{n} is the normalized value of the i indicator of the n region in the t period; x_{it}^{n} are the initial values of the i indicator of the n region in the t period; $x_{i\lim}^{N}$ is the threshold value of the i indicator among the N-set of regions in the t period; k_{itn}^{rank} is the rank coefficient of the n region by the i indicator in the t period; $RANG_{it}^{n}$ is the position of the n region by the i indicator in the t period; Q_{it} is the number of regions under study by the i indicator in the t period.

To construct the series of the empirical indicator of regional economic development in the projection of components, the following formula is used (9).

$$EDg_{tn}^{k} = \sqrt[j]{\prod_{i=1}^{j} a_{it}^{n}}, \quad (9)$$

where EDg_{tn}^{k} is the empirical value of the k component of economic development of the n region in the t period; j is the number of indicators in the component.

The weight impact of the components of regional economic development on the resulting variable is calculated based on *Principal Components*, while the combined indicator of regional economic development is calculated using formula (10).

$$Y_{nt}^{ED} = \sum EDg_{tn}^{k} \cdot w_{kt}, \quad 0 < Y_{nt}^{ED} < 1, \quad (10)$$

where Y_{nt}^{ED} is the value of the combined indicator of economic development of the n region in the t period; w_{kt} is the weight impact of the k component of regional economic development in the t period.

Understanding the financial resilience of regions as the ability to withstand risks and shocks of the external environment to ensure sustainable development of the territory and stable economic growth, the research approach is based on the assessment of financial risks associated with the probability of losses (financial resources or inability to fulfill financial obligations). Such risks may primarily be associated with changes in the financial system and transformations in the financial and economic environment (e.g., fluctuations in interest rates and exchange rates, changes in investment activity, etc.).

The methodological approach to studying the financial resilience of regions, which relies on the theory of risks, is based on the assessment of the economic effect and financial losses using the methodological tools of economic and mathematical analysis, in particular, the calculation of variance. Components of financial resilience and the levels of economic development of the regions are its elements (formulas 11-12).

$$EFR_{tn}^{k} = 1 - VAR\begin{pmatrix} BS_{t}^{n} \\ SFS_{t}^{n} \\ PS_{t}^{n} \\ InvA_{t}^{n} \end{pmatrix} | EDg_{tn}^{k}, \quad (11)$$

$$EFR_{tn}^{g} = 1 - VAR\left(\frac{FR_{t}^{n}}{ED_{t}^{n}}\right), \quad (12)$$

where EFR_{tn}^{k} are the empirical indicators of the k component of financial resilience of the n region in the t period; EFR_{tn}^{g} are the empirical indicators of financial resilience of the n region in the t period.

The value of the empirical indicator of regional financial resilience ranges from 0 to 1. Values close to 1 indicate a high degree of financial resilience, and vice versa.

3. RESULTS AND DISCUSSION

Using the structural-temporal approach, a series of components of the economic development of the regions of Ukraine for 2015–2021 was built to measure the empirical indicators (levels) of regional economic development. No region of Ukraine had an empirical value of economic development over 0.4 during the study period. In 2015, Khmelnytska (0.383), Kharkivska (0.364), Kyivska (0.352), Rivnenska (0.331), Dnipropetrovska

(0.325), Volynska (0.310), and Cherkaska (0.302) oblasts demonstrated the highest levels of economic development, which is determined by higher values of GRP (per capita), industrial production index (as a % of the previous year), volume of industrial output sold (per capita), and total labor productivity (ratio of GVA to the number of employed), compared to the other regions of Ukraine. The lowest values of the economic development indicator were recorded in Zakarpatska (0.229), Poltavska (0.222), Ternopilska (0.208), Kirovohradska (0.191), Vinnytska (0.189), Donetska (0.165), and Chernivetska (0.105) oblasts. In 2015, these regions of Ukraine had the lowest number of medium businesses, the smallest share of innovative products sold in total industrial output, the slowest rate of change in agricultural production, and the highest employment in the informal economy (Table 1). Notably, the situation did not change significantly in 2016-2017, except that Lvivska (0.297) and Zaporizka (0.306) oblasts were characterized by a high level of development in 2016, and in 2017 Odeska, Khmelnytska, Poltavska, Ivano-Frankivska, Zakarpatska, Volynska, Rivnenska, Luhanska, Zhytomyrska, Chernivetska, and Ternopilska oblasts were characterized by a low level of development (empirical indicators of economic development ranged from 0.116 to 0.217).

In 2019–2020, the largest group in terms of economic development included regions with a moderate economic development, in particular in 2019 – Zakarpatska (0.238), Ivano-Frankivska (0.236), Odeska (0.232), Khersonska (0.225), Sumska (0.224), Lvivska (0.223), Ternopilska (0.220), Cherkaska (0.217), Zaporizka (0.210), Poltavska (0.204), Rivnenska (0.202), and Kharkivska (0.200) oblasts; in 2021 – Rivnenska (0.295), Chernihivska (0.294), Poltavska (0.294), Zaporizka (0.292), Zakarpatska (0.272), Sumska (0.268), Khersonska (0.266), Mykolaivska (0.261), Luhanska (0.246), and Kirovohradska (0.245) oblasts.

During the spread of the pandemic and the transformational changes in regional economies, behavioral aspects have the greatest impact on the development of regional economies. For example, in

Table 1. Empirical indicators of economic development of Ukrainian regions: a compositional approach, 2015–2021

Regions	Periods/coefficients						
	2015	2016	2017	2018	2019	2020	2021
Vinnytska	0.189	0.184	0.221	0.201	0.142	0.232	0.219
Volynska	0.310	0.207	0.204	0.184	0.166	0.278	0.301
Dnipropetrovska	0.325	0.234	0.300	0.385	0.246	0.324	0.326
Donetska	0.165	0.262	0.258	0.225	0.190	0.231	0.212
Zhytomyrska	0.270	0.267	0.144	0.251	0.273	0.239	0.333
Zakarpatska	0.229	0.231	0.209	0.290	0.238	0.268	0.272
Zaporizka	0.244	0.306	0.254	0.260	0.210	0.284	0.292
Ivano-Frankivska	0.237	0.214	0.211	0.217	0.236	0.206	0.199
Kyivska	0.352	0.293	0.320	0.262	0.372	0.212	0.323
Kirovohradska	0.191	0.249	0.296	0.210	0.168	0.219	0.245
Luhanska	0.241	0.145	0.181	0.157	0.135	0.172	0.246
Lvivska	0.272	0.297	0.227	0.255	0.223	0.267	0.320
Mykolayivska	0.252	0.217	0.254	0.227	0.170	0.246	0.261
Odeska	0.246	0.240	0.215	0.266	0.232	0.274	0.314
Poltavska	0.222	0.228	0.211	0.183	0.204	0.223	0.294
Rivnenska	0.331	0.337	0.189	0.271	0.202	0.274	0.295
Sumska	0.260	0.295	0.255	0.196	0.224	0.215	0.268
Ternopilska	0.208	0.235	0.131	0.183	0.220	0.261	0.206
Kharkivska	0.364	0.214	0.222	0.195	0.192	0.239	0.313
Khersonska	0.253	0.295	0.317	0.260	0.225	0.220	0.266
Khmelnytska	0.383	0.241	0.214	0.280	0.297	0.295	0.218
Cherkaska	0.302	0.289	0.272	0.197	0.217	0.295	0.311
Chernivetska	0.105	0.116	0.137	0.142	0.248	0.284	0.219
Chernihivska	0.238	0.332	0.298	0.287	0.287	0.253	0.294

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2020, Dnipropetrovska, Khmelnytska, Cherkaska, Zaporizka, Chernivetska, Volynska, Odeska, and Rivnenska oblasts were characterized by the highest values of the empirical indicator of economic development, which is mainly determined by the economic resilience and economic efficiency components. In particular, indicators such as GRP (per capita), the region's share in GDP, as well as the volume of industrial output sold, and indices of the physical volume of retail trade turnover of retailers had the most significant impact on the economic development of regions with a high level of economic development. Instead, in 2021, the economic development of the regions with the highest rates – Zhytomyrska (0.333), Dnipropetrovska (0.326), Kyivska (0.323), Lvivska (0.320), Odeska (0.314), Kharkivska (0.313), Cherkaska (0.311), and Volynska (0.301) – is determined by the labor market efficiency and innovation development and foreign economic cooperation. These include the volume of construction work performed (per capita), the growth rate of exports of goods, the ratio of exports to imports of goods, the employment rate of the population aged 15-70, the real wage index, and the number of employees in small businesses.

In 2020–2021, some Ukrainian regions failed to implement adjustment mechanisms for regulating economic processes in the face of limited consumer demand and thus were characterized by low levels of economic development. In 2021, these were Khersonska, Kirovohradska, Sumska, Kyivska, Ivano-Frankivska, and Luhanska oblasts, and in 2022, Chernivetska, Vinnytska, Khmelnytska, Donetska, Ternopilska, and Ivano-Frankivska oblasts. They are characterized by low labor market efficiency, insignificant development of the small and medium business, lack of progress in innovation, and weak foreign economic cooperation. Accordingly, indicators such as the level of employment in the informal economy, the unemployment rate of the population aged 15-70, and the share of wages in total household income were the highest in 2021 for the identified regions compared to other oblasts, and indicators such as the ratio of exports to imports of goods, the share of innovative industrial enterprises, the volume of industrial output sold, and the commissioned housing growth (decline) rate were the lowest.

The study of the financial resilience of regions as the ability of the financial system to perform its functions efficiently and ensure the efficient allocation of resources and the normal course of economic processes under the influence of macroeconomic shocks and other risks requires an integrated approach in terms of two components – financial and economic. This systemic approach made it possible to assess financial resilience in the projection of three groups of regions distinguished by the criterion of the level of economic development in 2015–2021: adaptive (regions with the highest economic development indicators in a given period), moderate, and low levels (Table 2).

Table 2. Financial resilience in the context of groups of Ukrainian regions with different levels of economic development: a structural approach, %, 2015–2021

Components of financial resilience	Periods						
	2015	2016	2017	2018	2019	2020	2021
Regions with adaptive economic development							
Budgetary resilience	52.8	52.8	56.9	60.4	60.9	54.4	57.6
Financial sector resilience	36.7	27.8	36.9	30.1	27.5	20.6	36.4
Price resilience	66.5	61.8	62.4	58.8	54.2	34.6	56.2
Investment resilience	26.4	27.5	28.0	29.1	16.0	15.1	8.1
Regions with moderate economic development							
Budgetary resilience	49.2	49.5	51.6	58.9	56.7	54.4	47.0
Financial sector resilience	20.1	17.9	19.1	15.8	13.2	10.0	18.9
Price resilience	66.5	61.8	62.4	58.8	54.2	34.7	56.2
Investment resilience	23.4	20.1	15.0	22.8	20.4	15.5	7.1
Regions with low economic development							
Budgetary resilience	48.6	48.3	44.0	52.6	53.8	52.6	46.0
Financial sector resilience	15.1	12.0	12.3	14.2	8.2	6.3	14.0
Price resilience	66.5	61.8	62.4	58.8	54.2	34.6	56.3
Investment resilience	20.9	20.8	26.6	21.8	24.9	26.5	1.1

In 2015, the leading regions in terms of economic development had 3.6 pp higher budgetary resilience, 16.6 pp higher financial sector resilience, and 3 pp higher investment resilience than the regions with moderate development. The situation was similar in 2019. In particular, the budgetary resilience of the leading regions is 4.2 pp higher than that of the group of regions with a moderate development and 7.1 pp higher than that of the group with a low level of development; the investment resilience in 2019 in the group of leading regions was lower than in other groups, amounting to 16.0%.

During the period of the pandemic (2020–2021), budgetary resilience faced a decrease of 6.5 pp, 2.3 pp, and 1.2 pp, respectively, in all groups of regions, and financial sector resilience of 6.9 pp, 3.2 pp, and 2.9 pp, respectively. It is worth mentioning that in 2021, investment resilience decreased by 7 pp, 8.4 pp, and 25.4 pp, respectively, in all groups of regions. Instead, the use of adjustment mechanisms to restore the stability of the financial and economic system led to an increase in resilience in the regions with a high level of economic development (an increase in the measure of budgetary resilience by 3.2 pp and in financial sector resilience by 15.2 pp). In the regions with moderate and low levels of development, financial sector resilience improved by 8.9 pp and 7.7 pp, respectively, while budgetary resilience weakened by 7.4 pp and 6.6 pp, respectively.

Ensuring financial resilience in the post-crisis period requires fundamentally new approaches to managing the financial system to maintain its balance (increase the ability to accumulate and efficiently allocate financial resources) and reduce dependence on external factors in an unstable environment. Thus, in 2015, financial resilience in regions with a high level of economic development amounted to 41.3%, and in regions with a low level – 29.7% (Figure 1). The lowest empirical indicators of financial resilience for all groups of regions were in 2016 (37.6 %, 30.7 %, and 28.7 %) and 2020 (36.9 %, 32.8 %, and 29.1 %), and the highest – in 2017 (43.9 %, 33.0 %, and 31.3 %) and 2021 (42.1 %, 35.6 %, and 32.4 %).

Barriers to financial resilience in the regions are caused by the systemic causal impact of transformation measures due to the specific features of economic and financial processes in Ukraine. The rate of economic growth depends on the efficiency of solving internal structural problems with limited financial means. Improving the efficiency of the use of attracted financial resources and strengthening financial and economic autonomy, budgetary efficiency, and financial resilience are fundamental for the transition of the regions to balanced economic growth.

Ensuring financial resilience in the face of economic uncertainty depends on the efficiency of segmentation and systemic management of the

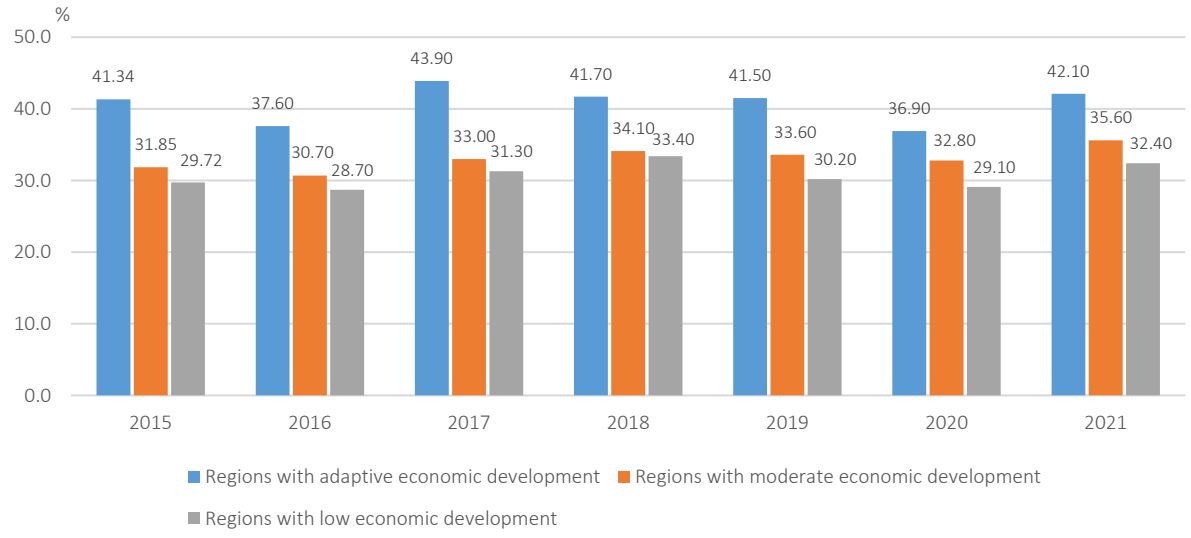

Figure 1. Empirical indicators of financial resilience of Ukrainian regions in the projection of groups with different development levels, %, 2015–2021

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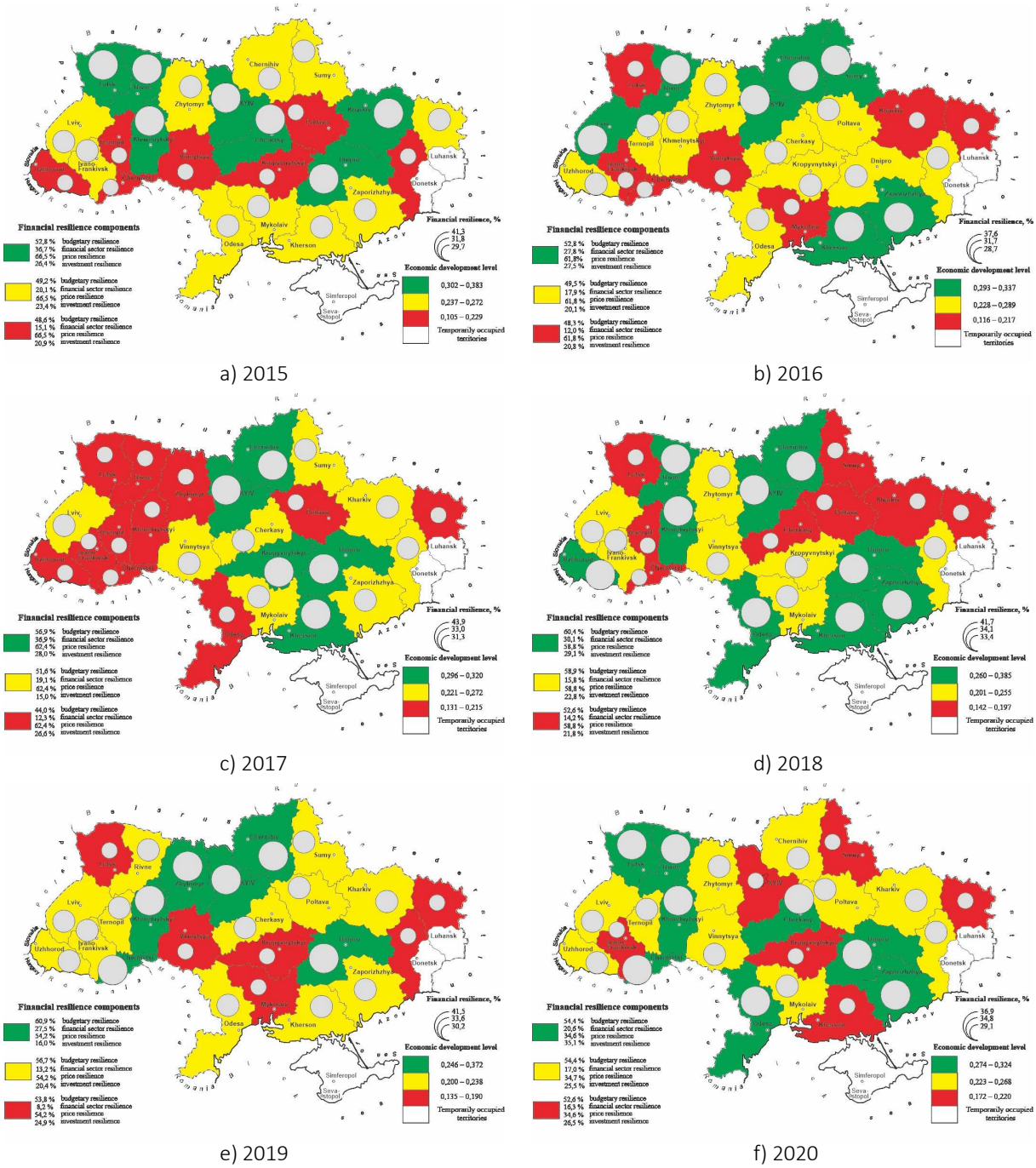
economic and financial systems. Given the dynamic and changing nature of external environment and unregulated fluctuations in liquidity, exchange rates, and money supply, the financial determinants of regional economies undergo dramatic transformations. Their impact on economic development is unpredictable, and it is particularly difficult to ensure the efficiency of anti-crisis mechanisms to minimize negative consequences. The development of stabilization mechanisms and effective levers to bolster the financial resilience of the regions will ensure their balanced development and stimulate rapid economic recovery in the post-crisis period. This is supported by the results of the empirical indicator of the financial resilience across different groups of regions in the dynamics in the projection of the levels of regional economic development in Ukraine (Figure 2).



Note: The level of economic development was graded against the leading region for each year of the study.

Figure 2. Financial resilience – economic development of Ukrainian regions, 2015–2020

Levels of economic development had different gradation limits for groups of regions in each period of the study (conducted against the leading region within each period of analysis). The study shows that financial resilience, considered here as the ability of a system to restore equilibrium in the dynamics, is the basis for the development of regions. Thus, the regions that were outsiders in terms of development in the current year demonstrated a higher degree of financial resilience in the subsequent year, thus ensuring the transition to the group of regions with a higher level of development.

The consequences of the financial and economic crisis (2014–2016) and the spread of the COVID pandemic (2020) have emphasized the need to change the model of regional economic development. Stable and balanced economic growth based on the modernization of the real sector requires the "use" of the financial system as a mechanism for regional economic development, expands the goals and objectives of the state's financial policy, and actualizes the need to strengthen the financial autonomy and self-sufficiency of the territories. Balancing the need to use external financial resources to restore stable growth rates and reduce the external financial dependence of the economic system in the face of macroeconomic shocks should be the main vector of the policy of ensuring the financial resilience of Ukrainian regions.

The state of the regional economies and the trend of ensuring their financial resilience in 2021 (Figure 3) confirms that the creation of a resilient financial system in line with the needs of the economy focused on the accumulation and efficient use of internal and external resources should be based on balanced economic development. In 2021, the regions of Ukraine that followed this principle (Lvivska, Kyivska, Odeska, Zhytomyrska, Cherkaska, Kharkivska, Dnipropetrovska, and Volynska oblasts) ensured that the synergies between financial resilience and economic development could be achieved.

For the leading regions in terms of economic development, the determinants that ensure financial resilience are budgetary, price, and financial sector resilience, and compared to the regions with a moderate level of development, these indicators differ significantly (for example, in 2015, the leading regions in terms of economic development had 3.6 pp higher budgetary resilience, 16.6 pp higher financial sector resilience, and 3 pp higher investment resilience than the regions with a moderate development). During the spread of the pandemic (2020–2021), the impact of the budgetary deter-

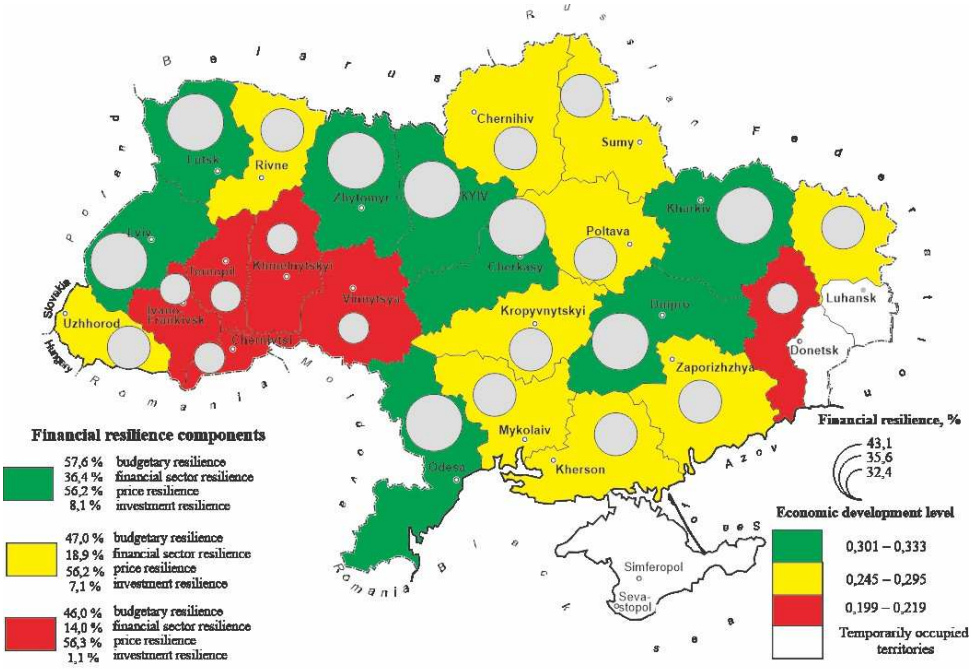


Figure 3. Financial resilience against the background of economic development of Ukrainian regions, 2021

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minant on financial resilience decreased by 6.5 pp, 2.3 pp, and 1.2 pp, respectively, in all groups of regions, and the financial sector resilience determinant decreased by 6.9 pp, 3.2 pp, and 2.9 pp, respectively. Interestingly, in 2021, investment resilience decreased by 7 pp, 8.4 pp, and 25.4 pp, respectively, for all groups of regions. Meanwhile, the implementation of adjustment mechanisms to regain the stability of the financial and economic system led to an increase in resilience in regions with a high level of economic development (an increase in the measure of budgetary resilience by 3.2 pp and in financial sector resilience by 15.2 pp).

The socio-economic turmoil that Ukraine is currently experiencing as a result of the war with russia has not only slowed down the country's development, but also led to the socio-economic regression of certain regions, which has become a real existential challenge for the country today. Further significant weakening of the financial resilience of regional economies will result in stagnation of the national economy as a whole. In such circumstances, it is particularly relevant to develop strategies for economic recovery of Ukrainian regions, taking into account financial resilience, the sensitivity of restoring its equilibrium to changes in financial determinants, and the nature of fluctuations in financial stability and economic processes in general.

Intensification of the industrialization, innovation, and technological progress, minimization of the risks to national and financial and economic security of the regions, preservation and development of business capacity, preservation and increase of industrial capital, etc. are the priority areas of regional economic policy implementation in the context of the war and post-war recovery. However, during the war, the statistical base for the study of economic processes is limited and sometimes inaccurate, reflected as the expert opinion, which is an obstacle to the development of efficient strategies for regional economic recovery. To avoid the negative consequences of the lack of complete and reliable information, economic recovery scenarios can be built based on forecast estimates as scenario data after 2021. Thus, Figure 3 shows the degree of financial resilience of Ukrainian regions in 2021 against the background of their economic development. Taking into account economic losses starting from February 2022 and 2021 data, it is possible to obtain scenarios of regional economic recovery based on trend and pessimistic projections. An optimistic projection is not acceptable in today's realities because of the high statistical error.

The empirical study shows that in the projection of possible financial risks (challenges, dangers, threats), the financial resilience of territories can be conditionally divided into three zones: absolute resilience, the zone of financial instability, and the critical condition of the financial system (financial crisis) (Figure 4). Regions in the zone of absolute financial resilience are characterized by substantial financial resources, while their economic development is either balanced or adaptable to growth. The zone of financial instability is determined by the average level of financial risks because of real and potential challenges, as well as possible financial losses, and a decrease in GRP and business entities' income, which ultimately leads to low or no economic development. Regions with a high level of financial risks (real financial threats) and significant financial losses of gross revenues and own financial resources typically experience economic regression accompanied by a financial and economic crisis and stagnation of the regional economy. The developed model of financial resilience interpretation as a determinant of economic development of Ukrainian regions in the face of shocks serves as a basis for shaping strategies and scenarios of economic recovery.

It is worth mentioning that similar studies on the financial and economic resilience of Chinese regions during the financial crisis of 2008–2009 (Li et al., 2022) show a correlation and dependence between the level of the regions' ability to respond effectively to the crisis and their financial development (a 1% increase in the level of financial development (LNFIN) of a region increases the resilience by 4.4 times). Researchers point to such determinants of the region's financial development as investments in fixed assets and budget spending on science and technology, which have the greatest positive correlation with the resilience of the territory. At the same time, the study also reveals a positive impact of infrastructure development on the financial resilience of territories. In Ukraine, as in China, the issue of infrastruc-

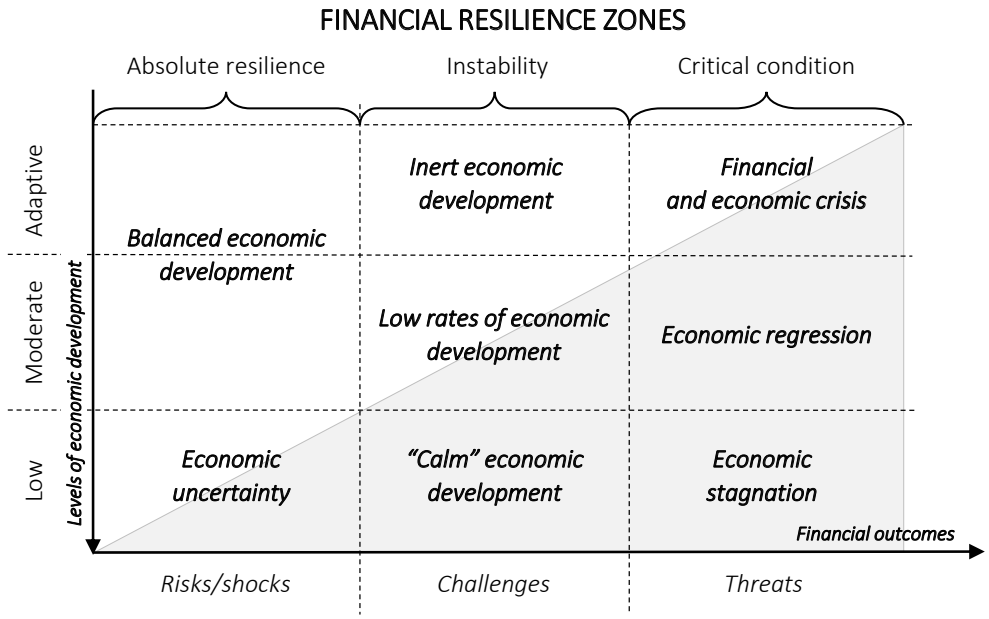

Figure 4. Clustering of regions: a system of "financial stability – macroeconomic shocks – development" criteria

ture development is closely related to the amount of financial resources allocated for this purpose from the state and local budgets, so the relationship between the level of regional resilience and the financial resources allocated to infrastructure projects is clearly visible.

Meanwhile, numerous studies on the resilience of EU countries during the pandemic show that the determinants of resilience include building productive capacity, improving the efficiency of the business sector, and developing human capital (Oprea et al., 2020; Hernández Rosario, 2022; Gajewski, 2023). At the same time, establishing efficient management processes, ensuring a high level of competitiveness of industrial and economic complexes, and promoting sustainable and balanced development of the real sector of the economy are impossible without a reliable financial base (Kitsos et al., 2019; Mayor, 2020).

CONCLUSION

The aim's article was to assess financial resilience as a systemic component of ensuring the economic development of Ukrainian regions. The study of the financial resilience as the ability of the financial system to effectively perform its functions, ensure the effective distribution of resources and the normal course of economic processes under the influence of macroeconomic shocks and other risks is carried out in the context of two components (financial and economic). It was found that budgetary, price, and financial sector resilience are determinants that ensure financial resilience The empirical study shows that in the projection of possible financial risks (challenges, dangers, threats), the financial resilience of territories can be conditionally divided into three zones: absolute resilience, the zone of financial instability, and the critical condition of the financial system (financial crisis). Regions in the zone of absolute financial resilience are characterized by substantial financial resources, while their economic development is either balanced or adaptable to growth. The zone of financial instability is determined by the average level of financial risks because of real and potential challenges, as well as possible financial losses, and a decrease in GRP and business entities' income, which ultimately leads to low or no economic development. Regions with a high level of financial risks (real financial threats) and significant financial losses of gross revenues and own financial resources typically experience economic regression accompanied by a financial and economic crisis and stagnation of the regional economy.

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Identifying the nature of fluctuations and the degree of sensitivity of economic growth components to changes in the determinants of financial resilience in the face of increasing shocks is a promising area for further research. The results obtained will serve as a basis for drawing up scenarios for the economic recovery of regions, considering their ability to accumulate financial resources, adjust to the impact of new financial risks and threats, and ensure balanced economic development.

AUTHOR CONTRIBUTIONS

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Funding acquisition: Halyna Voznyak, Olha Mulska, Halyna Kaplenko, Danylo Sorokovyi, Khrystyna Patytska.
Investigation: Halyna Voznyak, Olha Mulska, Danylo Sorokovyi, Khrystyna Patytska.
Methodology: Halyna Voznyak, Olha Mulska.
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Supervision: Danylo Sorokovyi,
Validation: Olha Mulska, Halyna Kaplenko, Khrystyna Patytska.
Visualization: Olha Mulska.
Writing – original draft: Halyna Voznyak, Olha Mulska, Halyna Kaplenko, Danylo Sorokovyi, Khrystyna Patytska.
Writing – review & editing: Halyna Voznyak, Olha Mulska, Halyna Kaplenko, Khrystyna Patytska.

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