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Duality of the nature of the impact on the local economic development of the de-occupied territories of infrastructure restoration

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Purpose. The purpose of the study is to substantiate the dual nature of the interaction between the restoration of infrastructure and the local economic development of the de-occupied territories on the basis of assessing their direct and inverse impacts and determining the nature of such interaction within the concept of a closed chain of coherence.

Methodology. The methodological basis of the study is a combination of conceptual, factorial, indicative and matrix approaches to assessing the interaction between infrastructure restoration and local economic development. The methods of theoretical generalization, logical modeling, comparative and causal analysis are used to develop the concept of the dual nature of interaction and substantiation of a closed chain of coherence. The indicative approach is used to form a system of calculated indicators, matrix method \u2012 for estimating the intensity of coherent relationships and typologizing coherence channels. The study was implemented in the form of a three-stage assessment using the data of the Ivankiv territorial community for 2022-2024; In the absence of the necessary statistical information, relevant proxy indicators are applied.

Results. The study substantiates the need for a consistent assessment of the impact of infrastructure restoration on local economic development and local economic development on infrastructure restoration, followed by a comprehensive interpretation of the results obtained from the standpoint of the concept of a closed chain of coherence and the dual nature of interaction. It has been established that in the Ivankiv territorial community this interaction has an asymmetric character: at the initial transformation iterations, the decisive role infrastructural recovery, while further intensification of small business, the return of the population and investment activities formed the prerequisites for the transition of local economic development to the role of a source of resources for subsequent reconstruction cycles. This confirms the dual nature of the impact, which is manifested in the consistent change of functional roles of infrastructure restoration and local economic development.

Originality. The scientific novelty of the study lies in substantiating the concept of the dual nature of interaction between the restoration of infrastructure and the local economic development of de-occupied territorial communities. A three-stage approach to assessment has been developed and empirically tested, which provides a consistent transition from the analysis of individual areas of influence to the determination of the nature of their interaction as a manifestation of the dual nature of a single process of territorial development.

Practical value. The practical significance of the research results lies in the possibility of using the proposed approach to assess the interaction between infrastructure restoration and local economic development during strategic planning of the post-war recovery of territorial communities. The results obtained can be used by local governments to determine investment priorities, identify key channels of coherence, and assess the ability of the local economy to support further processes of restoration and formation of prerequisites for self-sustaining territorial development.

Keywords: infrastructure restoration; local economic development; coherence; dual nature; impact assessment; de-occupied communities; Restoration of territories

Introduction

For more than four years, Russia's full-scale armed aggression against Ukraine has led to significant destruction of critical, socio-economic and other infrastructure, significantly limiting the opportunities for local economic development of territorial communities. The situation is especially difficult in the de-occupied communities, where, along with the need to eliminate the consequences of primary destruction,

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there is a need to restore facilities that suffer new or repeated damage as a result of air attacks by the aggressor state. Migration of the population, mobilization, shortage of labor resources, reduction of economic activity, reduction of the revenue base of local budgets and lack of financial resources significantly complicate the recovery processes. At the same time, the unsatisfactory state of infrastructure hinders the development of entrepreneurship, attracting investments and returning the population, forming a vicious circle of interrelated problems.

Despite the scale of destruction and the growing need for reconstruction, Ukraine has not yet formed a comprehensive state policy for the restoration of territories that would determine long-term priorities, criteria for the priority of project implementation, and approaches to assessing their socio-economic effectiveness. Existing state programs, regulations, as well as developed Development Strategies at the national and regional levels, mainly regulate the mechanisms for planning, financing or implementing individual measures, but do not provide a systematic approach to managing recovery processes at the level of territorial communities.

Under such conditions, communities are forced to independently form priority areas of recovery, consolidating them in development strategies, and increasingly actively use international aid opportunities, state funding mechanisms, and fundraising tools. At the same time, the practical implementation of infrastructure projects largely depends on the availability of specific sources of funding, state priorities, requirements of international partners or areas of individual support programs, which often determines their sequence and scale. At the same time, the issue of assessing the impact of infrastructure restoration on local economic development remains unresolved. In most cases, it is limited to the direct results of the implementation of individual projects, while their short- and long-term impact on community development, as well as their impact on further opportunities for infrastructural restoration, are practically not analysed. Taken together, this reduces the validity of strategic and investment decisions and does not allow for the formation of a systematic approach to planning the post-war restoration of territories.

The development of such a systematic approach, which requires an assessment of the impact of infrastructure restoration, cannot be limited to the analysis of the direct results of the implementation of individual projects and their contribution to local economic development. It is equally important to consider how the achieved level of local economic development affects further opportunities for infrastructure recovery. It is this interdependence that determines the dual nature of influence, in which the restoration of infrastructure acts as a factor in the economic development of the territory and depends on its results. As a result, an interdependent cycle of “infrastructure restoration – local economic development – infrastructure investments” is formed, the continuity and self-sufficiency of which determines the community’s ability to move from post-war recovery to sustainable development. Therefore, the study of the relationship between the restoration of infrastructure and local economic development in the context of the duality of its nature is a necessary prerequisite for the formation of scientifically grounded approaches to making strategic, including investment, decisions on the restoration of the de-occupied territories.

Literature review

The analysis of modern scientific research on the post-war development of the de-occupied territories indicates the formation of several interrelated areas dedicated to the problems of their local economic development, infrastructural development and recovery during the war or after its completion. These areas develop mainly autonomously, which does not allow to comprehensively explain the interdependence of the processes of infrastructure restoration and local economic development, but

provides an opportunity to build a theoretical and methodological framework for assessing the duality of the nature of the impact of infrastructure restoration on local economic development.

The first direction is related to the development of the concept of local economic development (hereinafter referred to as MERD). In the works of the (World Bank., 2006) and modern Ukrainian researchers Varchenko O., Krysanov D., Varchenko O. (Varchenko, 2025), Volosyuk M. V. (Volosyuk, 2022), Puhachevska K. Y., Feier O. V. Kot, M. M. (Puhachevska, 2024), local economic development is considered as a complex process based on the partnership of local governments, business and the public and aimed at forming a competitive local economy, increasing the investment attractiveness of the territory and improving the quality of life of the population. Particular attention is paid to strategic planning, assessing the potential of territories and determining their competitive advantages, applying differentiated approaches to community development, stimulating entrepreneurship and attracting investments. At the same time, Storonyanska I., Patytska K., Dub A. (Storonyanska, 2022) focus on the transformation of the concept of local economic development in wartime, emphasizing the need for its integration into the system of strategic planning for community development, transition from emergency response to long-term development, effective management of the resource potential of territories and the use of anti-crisis tools to support the local economy.

The second direction is represented by studies in which infrastructure is considered as one of the key factors of economic growth and socio-economic development of territories. In the works of foreign scientists Familoni K. A. (Familoni, 2004), Anand P. B. (Anand, 2005), Srivastava H. K., Mujoo R., Singh S. K., Singh V. L. (Srivastava, 2023), the positive impact of the development of transport, energy, social and other infrastructure on the productivity of the economy, investment attractiveness, employment of the population and quality of life has been proved. Infrastructure investments are seen as a catalyst for long-term economic growth, especially in developing countries or recovering from crisis phenomena.

In the Ukrainian scientific literature, this direction became especially relevant after the start of the full-scale war. The research focuses on the problems of restoration of critical, transport, social and other infrastructure, its features and transformation, determining priorities for its reconstruction to ensure the economic sustainability of territories. In particular Moroz N., Kosyk V. (Moroz, 2025) analyse the problems and priority areas of restoration of Ukraine's infrastructure, Kyzym M., Trushkina N. (Kyzym, 2025), substantiate the decisive role of critical infrastructure in the post-war development of the regional economy. Mykytenko V. V. (Mykytenko, 2023) considers the strategic foundations of the development of critical infrastructure as the foundations of the economic stability of the state. Deacon Yu. H., Lyashenko P. A., Romakhova O. O. (Deacon, 2026). focus on the need for comprehensive development of the socio-economic infrastructure of the de-occupied and affected territories of Ukraine.

A separate area is the study of post-war reconstruction of territories, which focuses on the need for comprehensive and integrated reconstruction planning, coordination of the activities of the state, local governments, international partners and civil society. Analytical and methodological developments Biliavska H., Ovcharenko T., Dehtiarova I., Malko Y., Tymoshchuk O., Kulinich O. (Biliavska, 2024), Kornilyuk A., Toryanyk V., Kurylo V., Radchenko I., Borsuk D. (Kornilyuk, 2025) detail the practical mechanisms for implementing this approach, focusing on the development of the institutional capacity of territorial communities, integrated recovery planning, improvement of the public investment management system, coordination of stakeholders and increasing the absorption capacity of communities.

Scientific research develops these approaches at the conceptual level. In particular, in the works of Danylenko A. I., Yershova H. V. (Danylenko, 2023),

post-war recovery is considered as a complex process of structural modernization of the economy, which involves long-term strategic planning, overcoming systemic economic imbalances, developing a competitive environment, stimulating high-tech production and using the best world experience. Sushchenko O. M., Kulish H. I. (Sushchenko, 2026) develop this approach, focusing on the concepts of resilience, Building Back Better, and Building Forward Better, according to which recovery should ensure not only the reproduction of lost potential, but also the formation of sustainable socio-economic systems through the integration of the principles of sustainable development, digitalization, innovative financial mechanisms, and multi-level interaction of stakeholders. The position of Heyets V. (Heyets, 2025) acquires conceptual significance for the development of this scientific direction, who substantiates the need to consider the post-war recovery not as a reproduction of the pre-war economic model, but as the creation of a new economy based on modern technologies, institutional transformations, European standards of development and the use of positive international experience.

Despite significant scientific achievements in each of the above areas, in the scientific literature they are mostly considered separately. The vast majority of studies analysed the impact of infrastructure on economic development or individual aspects of local economic development or post-war reconstruction of territories. At the same time, the issues of interdependent, two-sided impact of infrastructure restoration and local economic development, as well as its quantification as a single interconnected process, remain insufficiently studied. It is this scientific gap that necessitates the development of methodological approaches to assessing the dual nature of such impact and their use as an analytical basis for making strategic and investment decisions on the restoration of the de-occupied territories.

Methodology

To achieve the goal of the study, a complex of general scientific and special research methods was applied. Theoretical generalization and comparative analysis are used to systematize scientific approaches to assessing the relationship between infrastructure restoration and local economic development in the context of post-war restoration of territories. Logical modelling and causal analysis are used to substantiate the cause-and-effect relationships between the processes under study. The indicative approach is used to form a system of calculated indicators, the matrix method is used to assess the intensity of coherent relationships and typology of coherence channels, and the methods of generalization and interpretation are used to determine the nature of interaction between infrastructure restoration and local economic development.

The research methodology is implemented in the form of a three-stage assessment, which provides a consistent transition from the analysis of individual areas of influence to the determination of the nature of their interaction. The construction of systems of calculated indicators was carried out on the basis of the functional classification of types of socio-economic infrastructure and the systematization of factors of local economic development in accordance with their role as drivers of the development of the territory. To ensure the comparability of results at all stages, a single study period (2022–2024) was used, while the assessment was carried out with different time logic: the first stage was based on the analysis of the dynamics of indicators within the study period, while the second was based on the comparison of the base (2022) and current (2024) states. In cases of absence or incompleteness of official statistical information, relevant proxy indicators were used, which made it possible to preserve the logic of evaluation and the comparability of the results obtained. **The purpose of the study** is to assess the direct and indirect impact of infrastructure restoration on the local economic development of the de-occupied territories as manifestations of its dual nature.

Results and Discussion

The Ivankiv settlement territorial community of the Vyshhorod district of the Kyiv region is one of the typical examples of the post-war restoration and development of the de-occupied territories of Ukraine. From the first days of full-scale aggression in 2022, the community was temporarily occupied for 36 days, suffering significant destruction of housing, transport, communal, social and administrative infrastructure. After the de-occupation, dozens of restoration projects are being actively implemented in the Ivankiv territorial community, significant amounts of financial resources from international partners are being attracted, social and engineering infrastructure facilities are being modernized, state compensation programs for damaged housing are being implemented, and a new investment portfolio for community development is being formed.

At the same time, the experience of the Ivankiv territorial community demonstrates a problem typical for most of the affected, including de-occupied, territories of Ukraine. Despite significant investments in recovery, the implementation of a large number of projects, and the positive dynamics of the reconstruction of individual facilities, the results achieved are not always transformed into sustainable economic growth, increasing the well-being of the population, the competitiveness of the territory, or the formation of sufficient internal resource potential to support further recovery processes. Increasingly, de-occupied communities are operating in conditions of a persistent imbalance between the scale of investments in recovery and the effectiveness of local economic development.

One of the reasons for these processes is that the effectiveness of recovery projects is mainly assessed by indicators of physical restoration of infrastructure, the development of financial resources, or the achievement of individual sectoral results. On the other hand, the analysis of how the restored infrastructure has a long-term impact on local economic development and the extent to which the formed economic potential of the community is able to ensure further restoration of infrastructure without constant external funding remains unaddressed.

To form effective strategies for the restoration and long-term development of the de-occupied territories, it is necessary to analyze the relationship between the processes of infrastructure restoration and local economic development, assessing their mutual impact. The basis for such an analysis can be the author's concept of a closed chain of coherence "restoration of infrastructure – local economic development – investment in infrastructure" (Hrechana, 2025). Its essence lies in the formation of a two-way relationship between infrastructure restoration and local economic development, within which infrastructure restoration stimulates economic activity (direct impact), while the development of the local economy provides a resource base for further financing and expansion of infrastructure (reverse impact). Under favorable conditions, such interaction acquires a cyclical character, within which each subsequent cycle strengthens the previous one, ensuring the continuity of resource generation, the accumulation of multiplier effects and the formation of long-term positive trends in the development of the territory (Zablodska 2025). Thus, the concept of a closed chain of coherence details the mechanisms of mutual influence between infrastructure restoration and local economic development, defining tools, channels and sequence of their implementation, creating the basis for assessment and strategic planning of recovery processes.

The practical implementation of the proposed approach is carried out through a consistent assessment of both areas of interaction between infrastructure restoration and local economic development. For this purpose, it is envisaged to sequentially perform three interrelated stages, each of which is aimed at solving a separate research issue:

First stage. What did the restoration of infrastructure give to the activation of the MER? To get an answer to this question, the impact of the restoration of socio-economic infrastructure on local economic development is assessed.

Second stage. Has local economic development formed a resource basis for further infrastructure restoration? The impact of local economic development on the further restoration of socio-economic infrastructure is being assessed.

Third stage. What is the nature of the interaction of both areas of influence in the context of the formation of prerequisites for further self-sustaining development? The generalization and interpretation of the results of the previous stages from the standpoint of the concept of a closed chain of coherence is carried out, which allows moving from the assessment of individual areas of influence to determining the nature of their interaction as a single process of territorial development.

At the first stage of the study, we will assess the impact of the restoration of the socio-economic infrastructure of the Ivankiv settlement territorial community on its local economic development for the period 2022-2024. Its purpose is to determine to what extent the implemented measures for the restoration of certain types of infrastructure contribute to the intensification of economic processes, the formation of new development opportunities and the strengthening of the resource potential of the community.

The assessment is carried out using the author's methodological approach to assessing the impact of the restoration of socio-economic infrastructure on the local economic development of the de-occupied territories, which is based on the use of a system of indicators grouped by types of infrastructure and relevant areas of local economic development. The construction of the system of indicators is based on the use of indicators of the socio-economic development of the territory for the formation of aggregate (second-order, complex?) indicators that characterize the cause-and-effect relationships between individual types of infrastructure and the corresponding directions of the MERD. The selection and calculation of indicators are carried out taking into account the principle of the triad of evaluation, according to which each indicator is interpreted through the prism of the interaction of operational (functional changes), economic (transformation mechanism) and effective (achieved effect) levels of impact, as well as information availability of data from open analytical sources.

Thus, taking into account the structure of destruction, the scale of restoration work and the availability of analytical information, the residential, housing and communal, educational and medical infrastructure of the Ivankiv territorial community was selected for assessment. It was these types of infrastructure that suffered the greatest damage and were actively restored in 2022-2024. and have a direct impact on the formation of local economic development. Digital infrastructure was not included in the assessment system, as the main destruction concerned mobile communication towers, the restoration of which was carried out by telecommunications operators. In addition, the current program documents of the Ivankiv territorial community do not provide for individual measures or projects of digital transformation, which makes it impossible to form a representative system of indicators for assessing this type of infrastructure.

Transport infrastructure was also outside the assessment despite the presence of significant damage, including bridges and roads. Their restoration was outside the sphere of managerial and financial responsibility of the community, as it was carried out within the framework of state and regional programs. Under such conditions, the restoration of transport infrastructure cannot be correctly interpreted as a result of the implementation of local recovery policies or a direct factor of the MERE. The system of indicators and analytical data for the assessment are given in Table. 1.

Table 1

**Assessment of the impact of the restoration of the infrastructure of the Ivankiv territorial
community on local economic development**

Indicators	Intermediate indicators / Calculation formula	2023	2024	Deviation
<i>residential infrastructure</i>				
Housing Restoration Index (<i>IVZh</i>), %	Restored residential buildings (<i>KVB</i>), units	1884	2154	270
	Damaged / destroyed residential buildings (<i>KZB</i>), units	2300	2342	42
	$IVZh = KVB/KZB \times 100$	81,91	91,97	10,06
Housing Investment Multiplier (<i>MZhI</i>)	Δ General fund budget revenues (excl. transfers) (<i>DZB</i>), <i>UAH mln</i>	8,26	11,04	2,78
	Δ Housing investments (<i>ZhI</i>), <i>UAH mln</i>	64,89	8,90	-55,99
	$MZhI = DZB / ZhI$	0,13	1,24	1,11
Housing Market Attractiveness Recovery Ratio (<i>KVPR</i>)	Average market value of housing in the Ivankiv TC (<i>SVZh_{Ivankiv}</i>), <i>USD/m²</i>	480	550	70
	Average market value of housing in Kyiv Oblast (<i>SVZh_{Kyiv Oblast}</i>), <i>USD/m²</i>	800	825	25
	$KVPZh = SVZh_{Ivankiv} / SVZh_{Kyiv Oblast}$	0,60	0,67	0,07
<i>housing and communal infrastructure</i>				
Utilities Facility Restoration Index (<i>IVOZh</i>)	Restored utilities facilities (<i>KVOZh</i>), units	13	18	5
	Damaged / destroyed utilities facilities (<i>KZOZh</i>), units	20	21	1
	$IVOZh = KVOZh/KZOZh \times 100$	65,00	85,71	20,71
Capital Investment Priority Index (<i>IPKI</i>)	Share of capital expenditure on utilities restoration in current budget capital expenditure (<i>ChKV_{cur}</i>)	0,72	0,44	-0,29
	Share of capital expenditure on utilities development, 2021 baseline (<i>ChKI₂₀₂₁</i>)	0,6		-
	$IPKI = ChKV_{cur} / ChKV_{2021} \times 100$	120,35	198,02	77,67
Utilities Expenditure Dominance Ratio (<i>KDV_u</i>)	Share of utilities expenditure in current budget expenditure (<i>ChVB_{cur}</i>)	0,29	0,02	-0,27
	Share of utilities expenditure in baseline expenditure (<i>ChVB₂₀₂₁</i>)	0,03		-
	$KDV_u = ChVB_{cur} / ChVB_{2021}$	10,19	0,77	-9,43
<i>educational infrastructure</i>				
Educational Space Resilience Index (<i>IROP</i>)	Restored EI* (<i>KVZO</i>), units	12	14	2
	Damaged / destroyed EI (<i>KZZO</i>), units	15	15	0
	EI with shelter (<i>KZOU</i>), units	17	17	0
	Total number of EI (<i>KZO</i>), units	29	29	0
	$IROP = KVZO/KZZO \times KZOU/KZO \times 100$	46,90	54,71	7,82
Education Expenditure Dominance Ratio (<i>KDV_e</i>)	Share of current budget expenditure on education (<i>ChVBO_{cur}</i>)	0,51	0,53	0,02
	Share of baseline expenditure on education (<i>ChVBO₂₀₂₁</i>)	0,55		-
	$KDV_e = ChVBO_{cur} / ChVBO_{2021}$	0,92	0,96	0,04
Education Multiplier (<i>EM</i>)	Δ General fund budget revenues (excl. transfers) (<i>DZB</i>), <i>UAH mln</i>	8,26	11,04	2,78
	Δ Investment effort in education, <i>UAH mln</i>	1,41	72,84	71,429
	$EM = DZB / IZO$	5,86	0,15	-5,71

Continuation of table 1

Indicators	Intermediate indicators / Calculation formula	2023	2024	Deviation
<i>medical infrastructure</i>				
Medical Infrastructure Resilience Index (IRMI)	Current number of medical facilities and outpatient clinics (KMA_{cur}), units	11	11	0
	Baseline number of medical facilities and outpatient clinics (KMA_{2021}), units	11		-
	Current number of doctors (KL_{cur}), persons	58	65	7
	Baseline number of doctors (KL_{2021}), persons	72		-
	Current number of visits (KV_{cur}), units	105816	118225	12409
	Baseline number of visits (KV_{2021}), units	137 400		
	Current number of signed declarations (KD_{cur}), units	19278	21320	2042
	Current number of signed declarations (KD_{2021}), units	22861		
	$IRMI = KMA_{cur}/KMA_{2021} \times KL_{cur}/KL_{2021} \times KV_{cur}/KV_{2021} \times KD_{cur}/KD_{2021}$	0,52	0,72	0,20
Healthcare Expenditure Dominance Ratio (KDV_m)	Share of current budget expenditure on healthcare ($ChVBM_{cur}$)	0,065	0,053	-0,01
	Share of baseline (2021) expenditure on healthcare ($ChVBM_{2021}$)	0,071		-
	$KDV_m = ChVBM_{cur}/ChVBM_{2021}$	0,92	0,74	-0,18
Medical Multiplier (MM)	Δ General fund budget revenues (excl. transfers) (DZB), UAH mln	8,259	11,042	2,783
	Δ Investment effort in healthcare (IZOZ), UAH mln	7,67	-4,10	-11,765
	$MM = DZB/IZOZ$	-1,16	n/a	-

Source: Compiled by the authors based on the data from URL: <https://stat.gov.ua>, Ivankiv Settlement Council (2023), Ministry of Finance of Ukraine (2026), U-LEAD with Europe. (2026), Ivankiv Settlement Council (2023), Ivankiv Settlement Council (2024).

A preliminary analysis of the estimated indicators by types of infrastructure shows significant differences both in the scale of their restoration and in the nature of the impact on local economic development. Housing infrastructure demonstrates the most pronounced positive effect. The growth of the housing recovery index, the increase in the housing investment multiplier and the gradual restoration of the attractiveness of the housing market indicate that the reconstruction of the housing stock is no longer limited to compensation for losses. prerequisites for the return of the population, the revival of investment activity and the restoration of the local real estate market. This gives grounds to consider residential infrastructure as a *multiplicative* factor of local economic development.

Housing and communal infrastructure has different models of impact. Despite the significant increase in the index of restoration of housing and communal services facilities and the increase in the priority of capital investments, the reduction in the share of current budget expenditures indicates the completion of the most resource-intensive phase of recovery and a gradual transition to the stage of stable functioning. Therefore, its impact should be interpreted as *basic (functional)*, since housing and communal infrastructure plays a system-forming role, creating the necessary conditions for the continuous functioning of the economy, but does not generate an independent multiplier effect.

The growth of the index of resilience of the educational space occurs simultaneously with the stabilization of budget support for education, while the educational multiplier decreases due to the outstripping growth of investment costs.

This indicates that the effect of investments in the restoration of education is delayed and is realized mainly through the development of human capital, and not direct economic growth. The infrastructure plays *a complementary role with the predictors of multiplication*, as it creates prerequisites for the transition from complementary to multiplicative influence in subsequent development cycles.

The medical infrastructure demonstrates a gradual increase in the level of functional sustainability due to an increase in the number of doctors, visits and declarations. At the same time, the share of budget expenditures on health care is slightly reduced, and the medical multiplier is not formed due to the negative dynamics of investments in the industry. The impact of medical infrastructure has *a basic (functional)* character and performs a supporting role, ensuring the preservation of human potential and social sustainability of the community.

Thus, the results of the first stage show that different types of infrastructure perform different functions in the formation of a coherent cycle of territorial development. Residential infrastructure acts as its driver, initiating multiplicative processes of economic activation. The educational infrastructure enhances the formed effects, forming predictors of their further multiplication. Housing, communal and medical infrastructures provide a system-forming and supporting basis for the functioning of the community, creating the necessary environment for the implementation and preservation of the achieved restoration results. Such a multi-channel understanding of the impact of infrastructure restoration on the MED determines the logic of the next stage of the study.

Within the second stage, it is necessary to find an answer regarding the ability of local economic development to support the further cycle of infrastructure restoration. To do this, it is proposed to use a system of indicators similar in terms of construction principles. In contrast to the first stage, the assessment base is the factors-drivers of the MERD, for which a system of indicators is formed that characterizes their ability to generate resource flows for further restoration of infrastructure. The selection of calculated indicators, as at the previous stage, is carried out according to the principle of the evaluation triad, considering their information availability and the possibility of bringing them to a comparable form. To assess the impact of infrastructure restoration on the MED, the logic of assessment shifts in time: if the impact of infrastructure restoration was analyzed in a certain time interval, then the assessment of the reverse impact is based on a comparison of the baseline (2022 as the beginning of the transformation of local economic development) and current states. This is due to the fact that the factors of local economic development characterize not individual recovery events, but the accumulated transformation of the economic capacity of the community, which is formed throughout the period under study. Therefore, the system of indicators and analytical data for the assessment are given in Table. 2.

The operationalized scorecard, although it reflects the resource capacity of individual factors to ensure further infrastructure restoration, is only an intermediate analytical basis for assessing the impact of local economic development on infrastructure restoration. Its data create a framework for building the Coherent Intensity Matrix, which allows you to move on to the screening of the elements of this relationship, transforming the detected relationships into clearly measured channels of influence. The matrix is formed by the calculated indicators of the Ministry of Economic Development (highlighted in the table) and restoration indicators, which show the speed and scale of reconstruction of destroyed infrastructure facilities and are calculated as a ratio of the number of restored and damaged/destroyed facilities.

Taking into account the different scales of restoration work and the impact on the Ministry of Economic Development, the infrastructure facilities of the Ivankiv territorial community were classified into two groups for assessment: residential infrastructure – as a separate type that acts as a driver of recovery, and basic municipal infrastructure – as an aggregate type that forms the functional framework

Table 2

Assessment of the Impact of Local Economic Development on the Restoration of the Infrastructure of the Ivankiv Territorial Community

Indicators and metrics	Data and formulas		Calculation result
	2022	2024	
Economic growth			
Number of active business entities (<i>Kasg</i>), units	2055	2 149	
Working-age population (<i>Chpn</i>), persons	13342	14228	
Business Activity Ratio, %	$K_{ba} = \Delta Kasg / \Delta Chpn * 100$		0,30
Territorial fiscal return (<i>FVT</i>), UAH	130023	140861	
Territorial Fiscal Return Index, %	$I_{fvt} = FVT_{2024} / FVT_{2022} * 100$		108,34
Total budget revenue per capita (<i>Zdb1</i>), UAH	8104	8780	
Per-capita Income Growth Index, %	$I_{dlm} = Zdb1_{2024} / Zdb1_{2022} * 100$		108,35
Household income			
PIT amount, UAH mln	178,302	152,847	
Total budget revenue (<i>Zdb</i>), UAH mln	231,557	250,858	
Budget Structure Ratio, %	$K_{sb} = (PIT/Zdb*100)_{2024} - (PIT/Zdb*100)_{2022}$		-16,07
PIT per capita (<i>PDI</i>), UAH	6240,88	5249,95	
Average district PIT (<i>PDsr</i>), UAH	5199,13	7100,39	
Fiscal Leadership Ratio, %	$K_{fl} = (PDI/PDsr*100)_{2024} - (PDI/PDsr*100)_{2022}$		-46,10
Number of persons requiring social support (<i>Ksp</i>), persons	1750	2253	
Social Support Index, %	$I_{sp} = Ksp_{2024} / Ksp_{2022} * 100$		128,74
Demographics			
Resident population (<i>Chn</i>), persons	28570	29114	
Demographic Stability Index, %	$I_{ds} = Chn_{2024} / Chn_{2022} * 100$		101,9
Number of women (<i>Chzh</i>), persons	15114	12895	
Gender Profile Ratio, %	$K_{gp} = (Chzh/Chn*100)_{2024} - (Chzh/Chn*100)_{2022}$		-8,61
Number of registered IDPs (<i>Kvpo</i>), persons	739	942	
Migration Profile Ratio, %	$K_{mp} = (Kvpo/Chn*100)_{2024} - (Kvpo/Chn*100)_{2022}$		0,65
Economic activity			
Number of applications to the employment centre (<i>KZ</i>), persons	1184	405	
Labour Resource Activation Ratio, %	$K_{atr} = (KZ/Chpn*100)_{2024} - (KZ/Chpn*100)_{2022}$		-6,03
Labour Resource Ratio, %	$K_{tr} = (Chpn/Chn*100)_{2024} - (Chpn/Chn*100)_{2022}$		2,17
Single tax amount (<i>IeP</i>), UAH mln	24,764	52,816	
Local taxes and fees amount (<i>MP</i>), UAH mln	37,171	72,256	
SME Fiscal Return Ratio, %	$K_{fv} = (IeP/MP*100)_{2024} - (IeP/MP*100)_{2022}$		6,47
Investment activity			
Budget expenditure on equipment purchase and new construction (<i>Vvid</i>), UAH mln	62,838	48,57	
Budget capital expenditure (<i>Vkp</i>), UAH mln	79,373	111,23	
Investment Transformation Index, %	$I_{it} = (Vvid/Vkp*100)_{2024} - (Vvid/Vkp*100)_{2022}$		55,15
Tax Capacity Index (<i>Ip</i>)	1,4	1,3	
Δ Tax Capacity Index, %	$\Delta Ip = (Ip_{2024} - Ip_{2022}) * 100$		-10
Number of project applications submitted (<i>Kz</i>), units	15	29	
Project Activity Index, %	$I_{pa} = Kz_{2024} / Kz_{2022} * 100$		193,33

Source: Compiled by the authors based on the data from URL: <https://stat.gov.ua>, Ivankiv Settlement Council (2023), Ministry of Finance of Ukraine (2026), U-LEAD with Europe (2026), Ministry for Communities, Territories and Infrastructure Development of Ukraine (2026), Ivankiv Settlement Council (2023), Ivankiv Settlement Council (2024), DREAM Platform. (2026).

of the community. Basic municipal infrastructure group unites the affected facilities of housing and communal services, education, healthcare, administrative, cultural and sports infrastructure. This approach provides statistical comparability of calculations and allows you to assess the restoration of a single functional framework of the community. Thus, after the relevant calculations, the Indicator of Restoration of Residential Infrastructure (*IVINF*) amounted to 91.97%, while for the basic municipal infrastructure – 81.48%

The key element of the Coherent Coupling Intensity Matrix is the coefficient of intensity (*Kint*), which makes it possible to identify the degree of sensitivity of infrastructure processes to changes in local economic development. It is calculated by the formula:

$$Kint = IVINF_i / FDMER_i,$$

were

IVINF_i is the value of the *i*-th indicator of infrastructure restoration;

FDMER_i is the value of the *i*-th factor-driver of the MER.

The values of the *Kint* coefficients obtained in the process of calculations make it possible to verify the density of interaction between economic incentives and the infrastructural response, forming an analytical basis for building the Coherent Relationship Intensity Matrix (Table 3).

To interpret the results obtained within the Matrix, a typology of coherence channels was carried out, which is based on a comprehensive assessment of three characteristics of each channel: reaction intensity, consistency and consistency. Depending on their combination, the channels were classified as

stimulating – reflect the developmental nature of interaction – both *Kint* are positive, exceed 1 (threshold value) and demonstrate the systemic response of both types of infrastructure;

Table 3

Coherent Relationship Intensity Matrix

MER factors-drivers		Residential infrastructure		Basic municipal infrastructure	
<i>Name</i>	<i>FD_{MER}</i>	<i>IV_{INF}</i>	<i>K_{INT}</i>	<i>IV_{INF}</i>	<i>K_{INT}</i>
<i>Economic growth</i>					
Business Activity Ratio	0,30	91,97	306,57	81,48	271,60
Territorial Fiscal Return Index	108,34	91,97	0,85	81,48	0,75
Per-capita Income Growth Index	108,35	91,97	0,85	81,48	0,75
<i>Household income</i>					
Budget Structure Ratio	-16,07	91,97	-5,72	81,48	-5,07
Fiscal Leadership Ratio	-46,10	91,97	-2,00	81,48	-1,77
Social Support Index	128,74	91,97	0,71	81,48	0,63
<i>Demographics</i>					
Demographic Stability Index	101,9	91,97	0,90	81,48	0,80
Gender Profile Ratio	-8,61	91,97	-10,68	81,48	-9,46
Migration Profile Ratio	0,65	91,97	141,49	81,48	125,35
<i>Economic activity</i>					
Labour Resource Activation Ratio	-6,03	91,97	-15,25	81,48	-13,51
Labour Resource Ratio	2,17	91,97	42,38	81,48	37,55
SME Fiscal Return Ratio	6,47	91,97	14,21	81,48	12,59
<i>Investment activity</i>					
Investment Transformation Index	55,15	91,97	1,67	81,48	1,48
Δ Tax Capacity Index	-10	91,97	-9,20	81,48	-8,15
Project Activity Index	193,33	91,97	0,48	81,48	0,42

Conventions: types of coherent relationship stimulating; extractive; compensatory

Source: compiled by the authors.

extractive \u2012 characterize the depletion of infrastructure potential under the influence of economic activity \u2012 both *Kint* are negative, exceed modulo 1 (threshold value) and demonstrate a systemic response of both types of infrastructure.;

compensatory – reflect the adaptive response of the infrastructure to limited internal economic resources – both *Quint* demonstrate an extremely strong positive reaction at low values of the MERP driver.

The analysis of the Coherence Intensity Matrix showed that *the stimulating* channels of coherence are formed mainly under the influence of demographic and investment factors. In particular, the return of the population (migration profile coefficient), the activation of small and medium-sized enterprises (the coefficient of fiscal return of SMEs) and investment transformation form stable positive impulses for the restoration of both residential and basic municipal infrastructure. the transition of the community from compensation for losses to the formation of internal drivers of development. *Extractive* channels are primarily associated with budgetary and labor factors, when the growth of economic activity is not accompanied by a proportional reproduction of infrastructure potential, which indicates its partial depletion. *Compensatory* channels were identified in terms of business activity and labor resources, where even with relatively weak economic drivers, there is an extremely strong reaction of the infrastructure, which characterizes the adaptive mechanism for supporting recovery processes.

Thus, the results of the first and second stages of the assessment showed that the interaction between infrastructure restoration and local economic development is implemented through a system of interconnected coherence channels, each of which reflects a separate mechanism for transforming economic resources into recovery processes. At the third stage of the study, the results obtained should be summarized in order to determine the nature of the interaction of both areas of influence. And this requires a transition from their consistent assessment to interpretation as interrelated components of a single process of territorial development.

A consistent assessment of direct and reverse impacts allows for a comprehensive characterization of the relationship between infrastructure restoration and local economic development. At the same time, determining the nature of this interaction requires not an isolated analysis of individual areas of influence, but their joint consideration within a single coherent cycle. It is this approach that makes it possible to move from the statement of interdependencies to the understanding of the mechanism of their formation and reproduction.

In the process of territorial reconstruction, each subsequent transformational iteration in the coherent plane of “infrastructure restoration – local economic development – investments in infrastructure restoration” gradually levels the boundary between direct and reverse impacts. At the same time, these areas of influence are not implemented synchronously. At the initial iterations, the impact of infrastructure restoration on local economic development is dominant, while the reverse impact is formed gradually, as the impact of infrastructure restoration is formed gradually, as the impact of infrastructure restoration is accumulation of the economic potential of the community and its transformation into resources for further recovery.

A feature of post-war recovery is also the large-scale attraction of external investment resources. For the Ivankiv territorial community, such sources are state programs, international technical assistance, donor organizations, charitable foundations, and private business. They provide an outstripping pace of infrastructure recovery, creating the necessary prerequisites for the launch of subsequent transformational iterations. At the same time, as the local economy develops, there is a gradual shift of the resource base from external sources to the internal economic potential of the community.

Under such conditions, it is advisable to consider direct and reverse influences not as independent objects of analysis, but as interrelated manifestations of the dual

nature of a single process of territorial development. Duality lies not only in the mutual impact of infrastructure restoration and local economic development, but also in the successive changes of their functional roles within each transformational iteration. It is this logic that ensures the transition from recovery, which is mainly supported by external resources, to self-sustaining development, in which local economic development becomes a source of resources for subsequent reconstruction cycles.

Thus, in the context of the dual approach, it can be argued that the Ivankiv territorial community has formed an asymmetric nature of interaction between infrastructure restoration and local economic development. In the initial transformation iterations, the restoration of housing infrastructure played a decisive role, which, due to large-scale external financial support, created prerequisites for the return of the population, the activation of small businesses and the attraction of investments. It is these factors at the second stage of the study that were identified as the main stimulating channels of coherence, which indicates the gradual formation of the internal economic potential of the community. At the same time, housing and communal, educational and medical infrastructure ensured the functional stability of the coherent cycle, maintaining the conditions for consolidating the achieved results. Thus, local economic development is gradually moving from the role of an object of influence to the role of a source of resources for subsequent transformational iterations. It is in such a consistent change of functional roles of infrastructure restoration and local economic development that the dual nature of their interaction is manifested, which ensures a gradual transition from investment-driven recovery to economically supported development of the territory.

Conclusions and Directions for Further Research

The study has substantiated the dual nature of the relationship between infrastructure restoration and local economic development in de-occupied territories, demonstrated through the interaction between the two areas of influence in the Ivankiv settlement territorial community for the period 2022–2024. The sequential three-stage assessment from the impact of infrastructure restoration on local economic development, through the reverse impact of local economic development on further infrastructure restoration, to the interpretation of both areas within the concept of a closed chain of coherence made it possible to move beyond an isolated analysis of individual effects and to characterize the interaction as a single, self-reinforcing process of territorial development.

The results confirm that this interaction in the Ivankiv community is asymmetric rather than synchronous. At the initial transformational iterations, the restoration of infrastructure and residential infrastructure in particular played the decisive role, supported largely by external financial resources and generating a pronounced multiplier effect on economic activity. Housing and communal, educational, and medical infrastructure performed complementary and system-forming functions, sustaining the conditions necessary to consolidate the results achieved. As recovery has progressed, however, factors of local economic development the return of population, the activation of small and medium-sized enterprises, and investment transformation have increasingly formed the stimulating channels of coherence, indicating a gradual shift of local economic development from an object of infrastructure-driven influence to a source of resources for subsequent reconstruction cycles. It is precisely this consistent change in functional roles that constitutes the dual nature of the interaction and marks the transition from investment-driven recovery toward self-sustaining, economically supported territorial development.

The proposed methodological toolkit combining an indicative approach to constructing systems of calculated indicators with a matrix-based typology of coherence channels (stimulating, extractive, and compensatory) has practical value for local self-government bodies engaged in strategic planning of post-war recovery. It enables the identification of investment priorities, the assessment

of a community's capacity to sustain further restoration from its own economic potential, and the diagnosis of channels through which infrastructure investment either depletes or reinforces local development resources, rather than relying solely on indicators of physical infrastructure reconstruction.

At the same time, the study has certain limitations that define directions for further research. First, the assessment is based on the case of a single territorial community, and future work should extend the proposed methodology to a broader sample of de-occupied and war-affected communities with differing scales of destruction, resource endowments, and access to external funding, in order to test the robustness and generalizability of the identified coherence typology. Second, the current indicator system deliberately excludes transport and digital infrastructure due to data limitations and the division of managerial responsibility between community and state levels; incorporating these infrastructure types particularly as digital transformation programs expand would allow for a more complete picture of the coherence cycle. Third, the three-year observation window, dictated by the availability of post-invasion data, should be extended as longer time series become available, enabling dynamic and lagged analysis of how quickly the reverse impact of local economic development on infrastructure restoration strengthens over successive transformational iterations. Finally, further research could usefully develop the Coherent Relationship Intensity Matrix into a decision-support tool for example, by establishing differentiated threshold values for *Kint* across infrastructure and community types to support the prioritization of investment and donor-funding decisions in the strategic planning of the post-war restoration of Ukraine's de-occupied territories.

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Заблодська І. В., Гречана С. І. Дуальна природа впливу відновлення інфраструктури на місцевий економічний розвиток деокупованих територій

Мета. Метою дослідження є обґрунтування дуальної природи взаємодії між відновленням інфраструктури та місцевим економічним розвитком деокупованих територій на основі оцінювання прямого та зворотного впливів їх і визначення характеру такої взаємодії в межах концепції замкнутого ланцюга когерентності.

Методологія. Методологічну основу дослідження становить поєднання концептуального, факторного, індикативного та матричного підходів до оцінювання взаємодії між відновленням інфраструктури та місцевим економічним розвитком. Використано методи теоретичного узагальнення, логічного моделювання, порівняльного та каузального аналізу для розвитку концепції дуальної природи взаємодії та обґрунтування замкнутого ланцюга когерентності. Індикативний підхід застосовано для формування системи розрахункових показників, матричний метод – для оцінювання інтенсивності когерентних зв'язків і типологізації каналів когерентності. Дослідження реалізовано у формі триетапного оцінювання на основі використання даних Іванківської територіальної громади за 2022–2024 рр. за відсутності необхідної статистичної інформації застосовано релевантні проксі-показники.

Результати. У дослідженні обґрунтовано необхідність послідовного оцінювання впливу відновлення інфраструктури на місцевий економічний розвиток і місцевого економічного розвитку на відновлення інфраструктури з подальшою комплексною інтерпретацією отриманих результатів з позицій концепції замкнутого ланцюга когерентності та дуальної природи взаємодії. Установлено, що в Іванківській територіальній громаді ця взаємодія має асиметричний характер: на початкових трансформаційних ітераціях визначальну роль відігравало інфраструктурне відновлення, тоді як подальша активізація малого підприємництва, повернення населення та інвестиційної діяльності сформували передумови для переходу місцевого економічного розвитку до ролі джерела ресурсів наступних циклів відбудови. Це підтверджує дуальну природу впливу, що проявляється в послідовній зміні функціональних ролей відновлення інфраструктури та місцевого економічного розвитку.

Оригінальність. Наукова новизна дослідження полягає в обґрунтуванні концепції дуальної природи взаємодії між відновленням інфраструктури та місцевим економічним розвитком деокупованих територіальних громад. Розроблено та емпірично апробовано триетапний підхід до оцінювання, який забезпечує послідовний перехід від аналізу окремих напрямів впливу до визначення характеру їхньої взаємодії як прояву дуальної природи єдиного процесу територіального розвитку.

Практична цінність. Практичне значення результатів дослідження полягає в можливості використання запропонованого підходу для оцінювання взаємодії між відновленням інфраструктури та місцевим економічним розвитком під час стратегічного планування повоєнного відновлення територіальних громад. Отримані результати можуть бути використані органами місцевого самоврядування для визначення пріоритетів інвестування, ідентифікації ключових каналів когерентності, оцінювання спроможності місцевої економіки підтримувати подальші процеси відновлення та формування передумов самопідтримуваного територіального розвитку.

Ключові слова: відновлення інфраструктури, місцевий економічний розвиток, когерентність, дуальна природа, оцінювання впливу, деокуповані громади, відновлення територій.

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