

Diagnosics and modeling of optimization of tax potential of territorial communities of Lviv region in conditions of martial law

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Objective. To assess the tax capacity of the territorial communities of Lviv Oblast under martial law, to measure the scale of the region's fiscal polarization, to verify empirically the link between the local tax base and the investment activity of communities, and to justify a matrix model of the tax optimization strategy for community development.

Methodology. The study draws on official data of the Finance Department of Lviv Oblast State Administration and open-data portals for 2025-2026 for all 73 communities of the oblast. Structural, correlation-regression and analysis-of-variance methods are applied, together with inequality measurement tools (the Lorenz curve, the Gini coefficient, the decile ratio), positioning of communities against the equalization thresholds (0.9 and 1.1) and matrix positioning in the coordinates of tax base versus investment activity.

Results. Deep fiscal polarization is revealed: the gap between the maximum (Sokilnyky, 2.86) and minimum (Strilky, 0.16) index values reaches 17.9 times, the Gini coefficient equals 0.296 and the decile ratio is 6.9 : 1, while 55 communities (75.3 %) receive the base grant. The elasticity model $\ln K = 2.839 + 0.848 \cdot \ln I$ ($R^2 = 0.428$; $p < 0.001$) shows that a 10 % rise in the tax capacity index is associated with an 8.5 % rise in the share of capital expenditure, and the investment activity of donor communities exceeds that of critically subsidized ones by 3.8 times.

Originality. For the first time the tax capacity of all 73 communities of the oblast is assessed on wartime data with an econometric verification of the taxation-investment link; a strategy matrix of tax optimization for community development and a scheme-model of its implementation are developed.

Practical value. The results can be used to differentiate the policy of strengthening the tax base of communities and to improve the equalization mechanism.

Keywords: tax capacity, tax capacity index, territorial community, local taxes and fees, horizontal equalization, fiscal polarization, investment activity, strategy matrix, Lviv Oblast.

Introduction

The tax capacity of local authorities is the foundation of their financial autonomy and a key parameter of the system of inter-budgetary relations: it is the tax capacity index that determines whether a community receives a basic grant or, conversely, transfers part of its revenue to the state budget in the form of a reverse grant (Budget Code of Ukraine, 2010, Articles 98–100). Full-scale war has significantly distorted the tax base of local self-government: from 1 October 2023, personal income tax (PIT) on the pay of military personnel is channeled in full to a special fund of the state budget (Law of Ukraine No. 3428-IX, 2023), which has deprived local authorities of their most dynamic source of revenue during the war. At the same time, migration, the relocation of businesses to western regions and the uneven nature of economic recovery have widened intra-regional disparities in the tax base.

The problem, however, is not limited to the mere existence of the disparity. What is of fundamental importance is whether the weakness of the tax base translates into a community's inability to finance its own development. If such a link is persistent and quantifiable, fiscal polarization ceases to be a static state and takes on the character of a self-perpetuating mechanism: a low tax base limits capital expenditure; a lack of investment perpetuates infrastructural and economic backwardness; and this, in turn, narrows the tax base for the following period. This is precisely why the empirical verification of the link between taxation and

investment activity in local authorities is not a secondary but a central task in assessing tax capacity.

The Lviv region, which comprises 73 local authorities and combines the functions of a logistical hub, a border area and a recreational region, serves as a prime testing ground for studying these relationships. Despite the availability of official data, a comprehensive picture of the tax capacity of the region's local authorities during the war period — including the normative positioning of local authorities relative to equalization thresholds, a quantitative measurement of polarization, and an econometric assessment of its consequences for development — has not yet been established, which explains the relevance of this study. The study employs methods of structural, comparative, correlation-regression and variance analysis, tools for measuring inequality (the Lorenz curve, the Gini coefficient, the decile ratio) and matrix positioning of local authorities.

Literature review

The theoretical and methodological foundations for researching the tax potential of local authorities are thoroughly explored in the monograph by Kh. Patytska (Patytska, 2019), which sets out the approaches to increasing tax potential in the context of the fiscal autonomy of local budgets and analyses the practice of property taxation in Ukraine and EU countries. Models of financial equalization in international practice are systematized in the work by I. Storonyanska, L. Benovska (Storonyanska, 2020), whilst the theoretical foundations of the financial and economic capacity of local authorities are set out in the article by L. Kvasniy, O. Lobyk (Kvasniy, 2023).

The military dimension of the issue is actively explored in the domestic literature. Of key importance to this study is the work by I. Storonyanska, L. Benovska (Storonyanska, 2023), which analyses the consequences of redirecting personal income tax from military personnel's pay to the state budget for the horizontal equalization system and demonstrates that linking the tax capacity index to the single tax renders the system vulnerable to structural shifts during wartime. The specific features of ensuring the financial capacity of local authorities are examined in (Kolyada, 2024), whilst the formulation and implementation of budgets under martial law are addressed in (Radionov, 2023). Tools for ensuring the budgetary sustainability of local authorities, in particular using the example of the Lviv region, are modelled in a collective monograph edited by H. Voznyak (Voznyak, 2023). An assessment of the level of capacity of local authorities in the Lviv region during wartime is devoted specifically to them (Khirivskyi, 2024) and an analysis of the impact of local taxes and charges on the resource potential of the region's local authorities (Khirivskyi, 2025), according to which the average annual growth in local taxes was maintained even during the war years.

In the international literature indexed in Scopus and Web of Science, the conceptual framework for assessing tax capacity has been developed within the 'tax capacity-tax effort' approach: a stochastic bound on tax capacity was proposed in (Fenochietto, 2013), whilst an expanded cross-country analysis of tax capacity and tax effort was carried out in (Le, 2012). A taxonomy of subnational governments' tax autonomy was developed by the OECD (Dougherty, 2019), whilst current trends in the development of tax capacity, including the digitalization of administration and property taxation, are summarized in (Benitez, 2023). A synthesis of empirical findings on the impact of fiscal decentralization on the economic and social parameters of regional development is presented in (Martinez-Vazquez, 2017), which specifically highlights the problem of accurately measuring decentralization and the endogeneity of estimates.

Of fundamental importance to the formulation of this study's research question is the work by (Gadenne, 2017), which, using data from Brazilian municipalities, demonstrates that it is precisely the increase in tax (rather than transfer) revenues of local authorities that translates into the expansion and improvement of public infrastructure, whereas an equivalent increase in grants does not produce such an effect. This forms the theoretical hypothesis tested in this article: a local authority's investment activity should be a function of its own tax base, rather than the total volume of budgetary resources.

At the same time, existing studies provide only a fragmentary picture of the intra-regional dimension of tax capacity during the wartime period: there is no comprehensive coverage of all local authorities in the region with up-to-date data; the normative positioning of local authorities in relation to horizontal equalization thresholds is not combined with a measurement of distributional inequality; the link between the tax base and communities' investment activity is, as a rule, merely postulated rather than quantitatively assessed; optimization tools are rarely differentiated by typological groups of communities and do not take the form of an operationalized strategic model. This article is devoted to addressing precisely this aspect of the overall problem.

Aim of the study

The aim of this article is to assess the tax capacity of local authorities in the Lviv region under martial law, to conduct a quantitative analysis of the extent of fiscal polarization in the region, to empirically verify the relationship between the tax base and the investment activity of local authorities, and to substantiate a matrix model for a tax optimization strategy for their development.

Methodology

The key indicator of the study is the community budget's tax capacity index, which, in accordance with Article 100 of the Budget Code of Ukraine, is defined as the ratio of personal income tax (PIT) revenue per inhabitant of the relevant budget to the corresponding average figure:

$$I = (PIT_municipality / Population) / (PIT_national / Population), \quad (1)$$

where $PITg$ and $PITb$ represent personal income tax revenue to the local authority budget and to the comparison base budgets, respectively; Pg and Pb represent the resident population of the local authority and the comparison base, respectively. An index value of less than 0.9 constitutes grounds for granting the community a basic subsidy (80 per cent of the amount required to reach a value of 0.9), whilst a value greater than 1.1 constitutes grounds for withholding a reverse subsidy (50 per cent of the excess) (Budget Code of Ukraine, 2010).

These regulatory thresholds are used as criteria for classifying communities into four tax-raising capacity zones: I — 'donors' (index above 1.1); II — 'self-sufficient' (0.9–1.1); III — 'moderately subsidized' (0.5–0.9); IV — 'critically subsidized' (less than 0.5). An additional division of the subsidized segment of the population based on the 0.5 threshold reflects the extent of dependence on transfers.

The degree of inequality in the distribution of tax-raising capacity is measured by the Gini coefficient using the rank-based formula:

$$G = 2 \cdot \Sigma(i \cdot ti) / (n \cdot \Sigma ti) - (n + 1) / n, \quad (2)$$

where ti denotes the values of the indicator ranked in ascending order; n denotes the number of local authorities. The coefficient was calculated for three indicators: the tax capacity index, own revenue per capita, and the share of capital

expenditure. Additionally, the decile ratio was calculated — the ratio of the mean value of the index in the upper and lower decile groups.

The relationship between the tax base and the investment activity of local authorities was assessed in three stages. In the first stage, Pearson's (r), Spearman's (ρ) and Kendall's (τ) correlation coefficients were calculated between the tax capacity index I and the share of capital expenditure K as an indicator of investment activity; for r , a 95 per cent confidence interval was constructed using Fisher's z -transformation. In the second stage, a linear regression model $K = a + b \cdot I$ was estimated, for which the Breusch–Pagan test for heteroscedasticity and the Jark–Beer test for the normality of the residuals were conducted. Since the distribution of the index is significantly right-skewed, a logarithmic model was constructed in the third stage, the coefficient of which has a direct economic interpretation of elasticity:

$$\ln K = \alpha + \beta \cdot \ln I + \varepsilon, \quad (3)$$

where β is the elasticity of the community's investment activity with respect to tax capacity, i.e. the percentage increase in the share of capital expenditure in response to a one-per-cent increase in the index. The robustness of the estimates was tested by excluding outliers and adding a spline component at a threshold of 0.9 (to test the hypothesis of a structural break in the relationship at the point where subsidies cease). Differences in investment activity between typological groups were tested using one-way analysis of variance (ANOVA), the non-parametric Kruskal–Wallis test and Welch's test.

To operationalize the results, a matrix of strategic positioning of local authorities was developed along the 'tax base – investment activity' coordinates. The x-axis represents the tax capacity index with a normative threshold of $I = 0.9$, whilst the y-axis represents the share of capital expenditure with a median regional threshold. The intersection of these thresholds forms four quadrants (A, B, C, D), each of which corresponds to a distinct type of fiscal and investment behavior on the part of the local authority and, accordingly, to a distinct tax optimization strategy.

In addition, an auxiliary regression of own revenue per capita D against the tax capacity index ($D = c + d \cdot I$) has been estimated. The relative residuals of this model are interpreted as a measure of the structural bias in the index: a positive deviation indicates that the local authority mobilizes more own revenue than its index predicts, i.e. the current indicator, based exclusively on personal income tax, underestimates its actual tax capacity due to local taxes and charges — land tax, the single tax and property tax (Tax Code of Ukraine, 2010, Chapters XII–XIV).

The data set comprises official figures from the Finance Department of the Lviv Regional State Administration (Finance Department of the Lviv Regional State Administration, 2026): the communities' tax capacity index for 2025, own revenue per capita (Q1 2026), the share of capital expenditure (Q4 2025), as well as national open data portals (Ministry of Digital Transformation of Ukraine, 2023; Ministry of Finance of Ukraine, 2026) and materials from the state external financial audit (Accounts Chamber of Ukraine, 2025). The calculations cover all 73 local authorities in the region and were carried out in Microsoft Excel; the complete set of input data, calculation formulas and the charts generated from them are provided in the accompanying file.

Results and Discussion

Assessing a region's tax potential first and foremost requires an analysis of the statistical profile of the communities' tax capacity. The distribution of the tax capacity index for the 73 communities in Lviv Oblast in 2025 reveals significant intra-regional differentiation. The mean value of the index is 0.76, and the median

is 0.66; the fact that the median is significantly lower than the mean indicates a right-skewed distribution (skewness coefficient 2.27; kurtosis coefficient 7.02) — a concentration of high values in a small group of leading communities. The coefficient of variation reaches 61.8 per cent, indicating statistical heterogeneity in the population, whilst the gap between the maximum (Sokilnytska community — 2.86) and minimum (Strilkivska community — 0.16) values is 17.9 times. It is precisely this distribution pattern that determines the subsequent methodological choice: a logarithmic, rather than a linear, specification is appropriate for assessing relationships.

Visualizing the indices, arranged in ascending order, in comparison with the normative thresholds for horizontal equalization (Fig. 1) translates the statistical characteristics into the context of budgetary legislation and demonstrates the extent to which the 73 communities are unevenly distributed across the normative regimes.

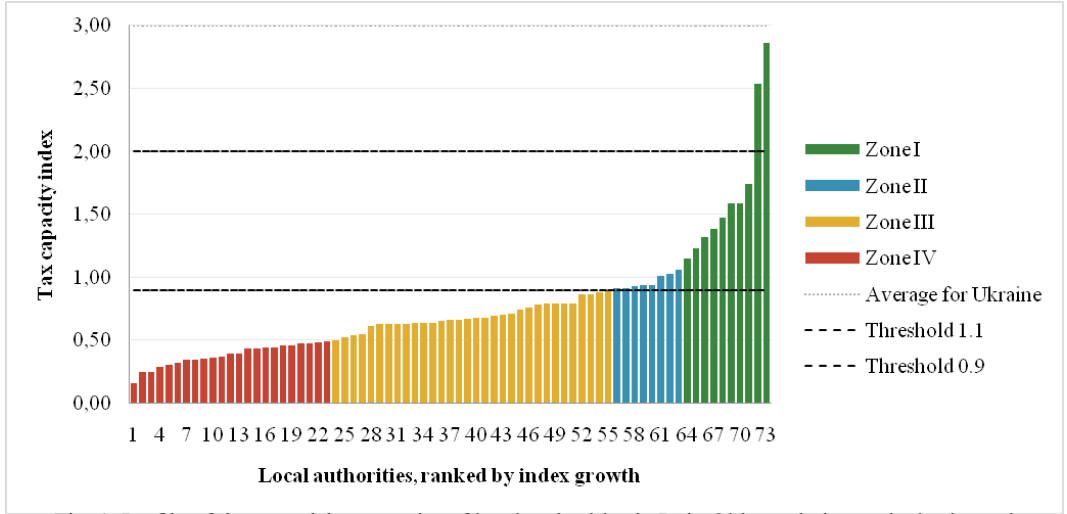


Fig. 1. Profile of the tax-raising capacity of local authorities in Lviv Oblast relative to the horizontal equalization thresholds, 2025.

Source: compiled by the authors based on data from the Department of Finance of the Lviv Regional State Administration, 2026.

Figure 1 illustrates a structural imbalance: only 10 local authorities (13.7 per cent) exceed the 1.1 threshold and are payers of a reverse grant, 8 local authorities (11.0 per cent) are in the neutral zone, whilst 55 local authorities (75.3 per cent) have an index below 0.9, i.e. they are recipients of a basic grant. The distribution curve is flat across the entire range from 0.16 to 0.9 and rises sharply only in the last ten positions: more than two-thirds of the total are ‘pushed’ towards the lower end of the scale. Almost a third of the communities (23; 31.5 per cent) fall within the critical subsidy zone with an index below 0.5 — their tax base is more than half as weak as the average benchmark. Quantitative characteristics of the identified zones, supplemented by indicators of own revenue and capital expenditure, are summarized in Table 1.

At the same time, Table 1 presents calculated values that demonstrate a distinctive feature, namely that regional differences are pervasive: moving from Zone I to Zone IV, the tax capacity index falls by a factor of 4.5, own revenue per capita by a factor of 4.9, and the share of capital expenditure by a factor of 3.8. The synchronization of these three series is the first indication that tax weakness is not merely a fiscal phenomenon, but extends to a community’s ability to finance development. At the same time, grouping by zones uses discrete classes and does not

Table 1

Tax capacity zones of local authorities in Lviv Oblast, 2025

Zone (criterion I)	Communities	Share, %	Average index	Index range	Own revenue, UAH per capita	Capital expenditure, %	Status in equalization
I — ‘donors’ (I > 1.1)	10	13.7	1.687	1.15–2.86	6,762	33.7	reverse subsidy payers
II — ‘self-sufficient’ (0.9–1.1)	8	11.0	0.966	0.91–1.06	3,226	15.9	outside the equalization mechanism
III — ‘moderately subsidized’ (0.5–0.9)	32	43.8	0.693	0.50–0.89	2,704	13.3	recipients of the basic grant
IV — ‘critically subsidized’ (I < 0.5)	23	31.5	0.377	0.16–0.49	1,388	8.9	recipients of the basic grant
Total for the region	73	100.0	0.760	0.16–2.86	2,902	15.0	×

Source: calculated by the authors based on data from the Finance Department of the Lviv Regional State Administration (2026).

show how unevenly tax capacity is distributed within the population. This gap can be filled by constructing a Lorenz curve (Fig. 2).

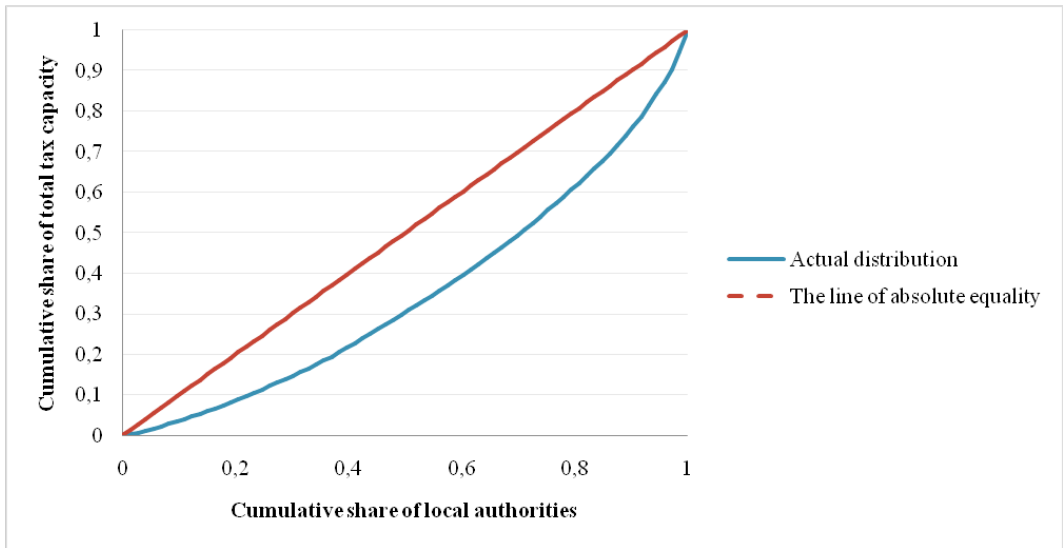


Fig. 2. Lorenz curve for the distribution of tax capacity among local authorities in Lviv Oblast, 2025.

Source: compiled by the authors based on data from the Department of Finance of the Lviv Regional State Administration, 2026.

Overall, the trend in taxes and levies in the Lviv region for the period 2020–2025 provides a framework for further analysis: if the resources for community development are increasingly dependent on local taxes, then the question of how evenly tax capacity is distributed among communities—and whether it translates into investment activity—becomes critical. This is the focus of the study, which draws on a comprehensive snapshot of 73 communities for the year 2025.

The area between the Lorenz curve and the line of absolute equality (Fig. 2) corresponds to a Gini coefficient of 0.296, whilst the decile ratio stands at 6.9 : 1 — the average tax capacity of the top ten per cent of communities is almost seven times that of the bottom ten per cent; the ten leading local authorities account for 30.4 per cent of the region's aggregate index. A comparison of Gini coefficients across three indicators reveals a rise in inequality along the budgetary chain: 0.296 for the tax capacity index, 0.312 for own revenue per capita, and 0.360 for the share of capital expenditure. Inequality in development appears to be significantly greater than inequality in the tax base, which is a direct argument in favor of the hypothesis that the relationship between them is reinforcing rather than neutral.

The spatial structure of polarization is distinct. The donor zone comprises the communities in the suburban belt of Lviv (Sokilnytska, Murovanska, Solonkovska, Pidberiztsivska, Obroshynska and others), where logistics facilities, trade and relocated businesses are concentrated, as well as — the tourism- and recreation-oriented Slavaska community (2.54). In contrast, the critically subsidized zone comprises mainly the mountainous communities of the Turka district (Strilkivska — 0.16, Borynska and Turka — 0.34 each) and the peripheral communities of the Saryi Sambir district (Biskovytska and Dobromylska — 0.25 each, Khyrivska — 0.29). Thus, the polarization has a clear center-periphery configuration, and the question is whether it is reinforced through the investment channel.

A critical factor in assessing a territory's tax capacity is determining the strength of the link between taxation and investment activity within the community. Correlation analysis confirms the existence of a moderate positive relationship between tax capacity and the share of capital expenditure: the Pearson correlation coefficient is $r = 0.661$ (95 per cent confidence interval 0.509–0.774; $p < 0.001$), Spearman's correlation coefficient = 0.65, and Kendall's coefficient = 0.48. The similarity between the parametric and rank-based estimates suggests that the

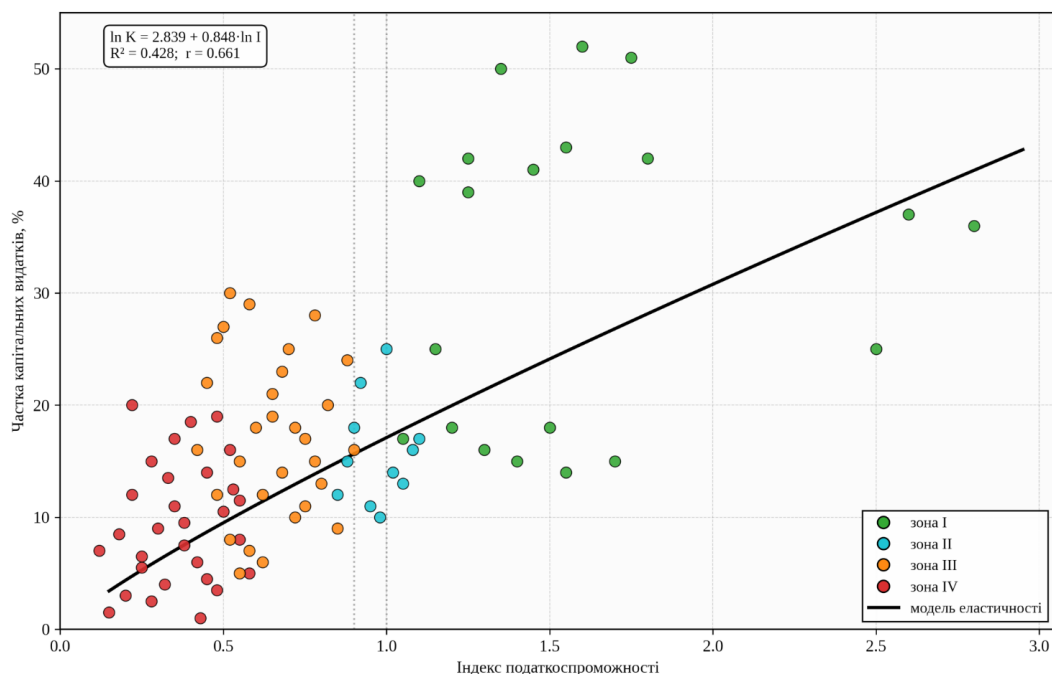


Fig. 3. Relationship between tax capacity and investment activity of local authorities in Lviv Oblast

Source: compiled by the authors based on data (Finance Department of the Lviv Regional State Administration, 2026).

relationship is not an artefact of a few extreme observations, but is reproduced at the level of the communities' ordinal positions. A graphical representation of the relationship, together with a fitted curve, is shown in Fig. 3.

The configuration of the scatter plot in Fig. 3 has two important features. Firstly, the dispersion increases as the index value rises: in the group of weak local authorities, the share of capital expenditure ranges from 1.4 to 20 per cent, whilst in the group of donor local authorities, it ranges from 14 to 52 per cent. This indicates heteroscedasticity, confirmed by the Breusch–Pagan test for the linear model ($p < 0.01$), and implies that high tax capacity creates an opportunity, rather than a guarantee, for investment. Secondly, the growth in investment activity slows as the index rises; that is, the relationship is concave rather than linear. Both these features justify the transition to the logarithmic specification (3); the results of the estimation of both models are compared in Table 2.

Table 2
Results of the regression analysis of the relationship between tax capacity and investment activity in local authorities in the Lviv region (n = 73)

Parameter	Linear model $K = a + b \cdot I$	Logarithmic model $\ln K = \alpha + \beta \cdot \ln I$
Coefficient for the predictor	$b = 15.219$	$\beta = 0.848$
Standard error	2.048	0.116
t-statistic	7.43	7.29
p-value	< 0.001	< 0.001
Free term	$a = 3.425$	$\alpha = 2.839$
Coefficient of determination R^2	0.437	0.428
F-statistic	55.23	53.17
Breusch–Pagan test (p)	< 0.01 (heteroscedasticity)	0.052 (homoscedasticity)
Jark – Bera test (p)	< 0.001 (residuals are non-normal)	0.615 (residuals are normally distributed)
Interpretation of the coefficient	a 0.1 increase in the index adds 1.5 percentage points to the share of capital expenditure	a 10 per cent increase in the index increases the share of capital expenditure by 8.5 per cent
Assessment of the specification	acceptable, but with a violation of the assumptions	Preferred specification

Source: calculated by the authors based on data from the Finance Department of the Lviv Regional State Administration, 2026.

As can be seen from Table 2, both models are statistically significant at the $p < 0.001$ level; however, the logarithmic specification has a significant advantage: its residuals are homoscedastic (Breusch–Pagan test, $p = 0.052$) and normally distributed (Jark—Bera test, $p = 0.615$), whereas the linear model violates both assumptions of classical regression. Therefore, a meaningful interpretation should be based precisely on the elasticity: $\beta = 0.848$ means that a 10 per cent increase in the tax capacity index is accompanied by an average increase of 8.5 per cent in the share of capital expenditure. An elasticity value close to one, but not statistically distinct from it given the current precision of the estimate, indicates an almost proportional transfer of tax capacity to investment activity. The tax base explains approximately 43 per cent of the variation in the share of capital expenditure; the remainder is attributable to factors not covered by the model — grant and subvention funding, the structure of the budgetary network, and administrative capacity.

The robustness of the estimate obtained has been tested in three ways. Firstly, excluding the two outliers (the Sokilnytska and Slavska communities) does not weaken but strengthens the relationship: r increases to 0.702, and the slope of

the linear model rises to 21.84; that is, the result is not due to the influence of outliers. Secondly, the addition of a spline component at a cut-off value of 0.9 proved to be statistically insignificant ($t = 1.02$; $p = 0.31$); consequently, the hypothesis of a structural break in the relationship at the point where subsidies cease has been rejected: the mechanism by which the tax base is transformed into investment operates in the same way for both subsidized and non-subsidized communities, albeit with different starting points. Thirdly, analysis of variance confirms the significance of intergroup differences (ANOVA: $F = 26.09$; Kruskal–Wallis test: $H = 28.23$; in both cases $p < 0.001$). Communities that do not require a basic grant ($I = 0.9$) allocate an average of 25.8 per cent of their budget to capital expenditure, compared with 11.4 per cent in grant-receiving communities — a 2.25-fold difference that is statistically significant according to Welch’s test ($t = 4.21$; $p < 0.001$), whilst between the extreme zones I and IV it reaches 3.8 times.

The almost linear relationship between the index and own revenue per capita ($r = 0.968$) warrants special attention. The auxiliary regression $D = 7.0 + 3828.8 I$ explains 93.7 per cent of the variation in own revenues, confirming the dominance of personal income tax in the structure of communities’ own revenues. At the same time, an analysis of the relative residuals of this model allows for a quantitative assessment of the structural bias in the current indicator: the standard deviation of the residuals is 13.6 per cent, and their range is from 43.6 per cent to +40.0 per cent, with deviations exceeding ± 15 per cent in nine local authorities. The communities with the largest positive deviations are Novoyarychivska (+40.0 per cent), Shchyretska (+37.7 per cent), Shehynivska (+37.2 per cent) and Belzska (+27.3 per cent): they generate significantly more own revenue than their index predicts, as land tax, the single tax and property tax play a significant role in the structure of their revenue base – factors which the index, calculated solely on the basis of personal income tax, simply does not take into account. Consequently, the argument that the capacity of communities with a significant land and property

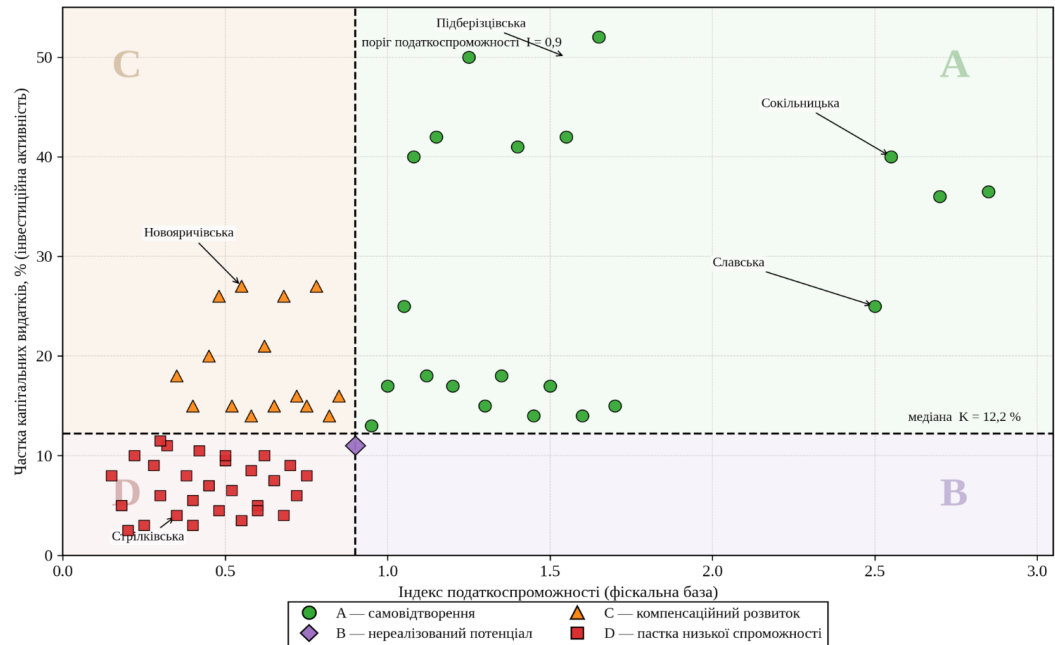


Fig. 4. Matrix of strategic positioning of local authorities in the Lviv region on the ‘tax base – investment activity’ axis, 2025.

Source: compiled by the authors.

component is systematically underestimated is quantitatively confirmed, and the scale of the discrepancy (up to 40 per cent) is sufficient to change a community's status within the equalization system.

The established correlation is an average statistical pattern and does not, in itself, indicate what a specific community should do. To operationalize the results, a matrix has been constructed to position communities along the 'tax base – investment activity' axis, where the vertical threshold is set at a normative index value of 0.9, and the horizontal threshold at the regional median share of capital expenditure of 12.2 per cent (Fig. 4).

The distribution of communities across the quadrants in Fig. 4 is extremely uneven and is in itself highly significant. Quadrant B ('unrealized potential') is

Table 3

Matrix of tax optimization strategies for the development of local authorities

Investment activity (share of capital expenditure K)	Low tax capacity ($I < 0.9$) — recipients of the basic grant	High tax capacity ($I \geq 0.9$) — self-sufficient local authorities and donors
High ($K \geq 12.2$ per cent)	C — 'compensatory development' 21 communities (28.8 per cent); average index 0.65; share of capital expenditure 18.0 per cent; own revenue 2,593 UAH per inhabitant. Communities invest more than their own tax base allows, relying on transfers, subventions and project funding. The model is effective but unsustainable: it depends on external resources and does not expand the community's own tax base. <i>Strategy:</i> converting investment into the tax base — linking capital projects to the creation of jobs and taxable assets, rather than solely to social infrastructure. <i>Priority areas:</i> 1, 3	A — 'self-sustainability' 16 communities (21.9 per cent); average index 1.42; share of capital expenditure 27.6 per cent; own revenue 5,419 UAH per inhabitant. A strong tax base is consistently converted into investment, and investment broadens the base. A closed loop of positive feedback; this includes all 10 donor communities and 6 self-sufficient communities. <i>Strategy:</i> maintaining the tax base and protecting it from erosion — quality of administration, relevance of the tax base, and replication of best practices in neighboring communities. <i>Priority areas:</i> 2, 4
Low ($K < 12.2$ per cent)	D — 'low capacity trap' 34 communities (46.6 per cent); average index 0.50; share of capital expenditure 7.4 per cent; own revenue 1,882 UAH per inhabitant. The largest and most problematic quadrant: a weak foundation provides no resources for development, whilst a lack of development perpetuates the weakness of the foundation. This includes all 17 communities in Zone IV with the lowest indices and 17 communities in Zone III. <i>Strategy:</i> breaking the vicious circle from the outside — a concentrated investment drive combined with inter-municipal cooperation in administration, as it is economically unviable for small communities to maintain a fully-fledged tax service on their own. <i>Priority areas:</i> 1, 2, 3, 4	B — 'unrealized potential' 2 communities (2.7 per cent); average index 0.93; share of capital expenditure 11.6 per cent; own revenue 3,366 UAH per inhabitant. This quadrant is virtually empty, which is a result in itself: a strong tax base almost always translates into investment activity. The few exceptions are explained by the predominance of current expenditure and the maintenance of an extensive budgetary network. <i>Strategy:</i> reorientation of the expenditure structure — development budget, medium-term planning of capital investments. <i>Priority blocks:</i> 3, 4

Source: developed by the authors.

virtually empty — only two communities (2.7 per cent) fall into it. This is the strongest visual argument in favor of the identified correlation: in the Lviv region, there are virtually no communities with a strong tax base and, at the same time, low investment activity; in other words, a strong tax base almost always translates into development. In contrast, Quadrant D (‘the low-capacity trap’) is the largest — comprising 34 communities, or 46.6 per cent of the total; in other words, almost half of the region’s communities are in a situation where a weak tax base fails to provide the resources for development, whilst the lack of development perpetuates the weakness of the base. Quadrants A (16 communities; 21.9 per cent) and C (21 communities; 28.8 per cent) occupy an intermediate position. The key characteristics of the quadrants and the corresponding tax optimization strategies are summarized in Table 3.

The fundamental difference between the proposed matrix (Table 3) and the typology based on tax capacity zones (Table 1) lies in the introduction of a second — outcome-based — dimension. The zonal typology answers the question of how much resources a local authority has, whereas the matrix shows how these resources are used, and therefore leads to different management decisions for local authorities with the same index. A comparison of the two classifications confirms this: the 32 communities in Zone III were divided almost equally between quadrants C (15 communities) and D (17 communities), whilst the 23 communities in Zone IV were divided between C (6) and D (17). In other words, within a single tax capacity zone, there are communities that find the resources for development and those that do not; consequently, a set of tools standardized for the zone would be equally inappropriate for them.

The matrix captures the state of a community at a specific point in time, whereas tax optimization is a process of transition between quadrants. The logic of such a transition is described by a model diagram that integrates diagnosis, positioning, the selection of tools and a feedback mechanism (Fig. 5).

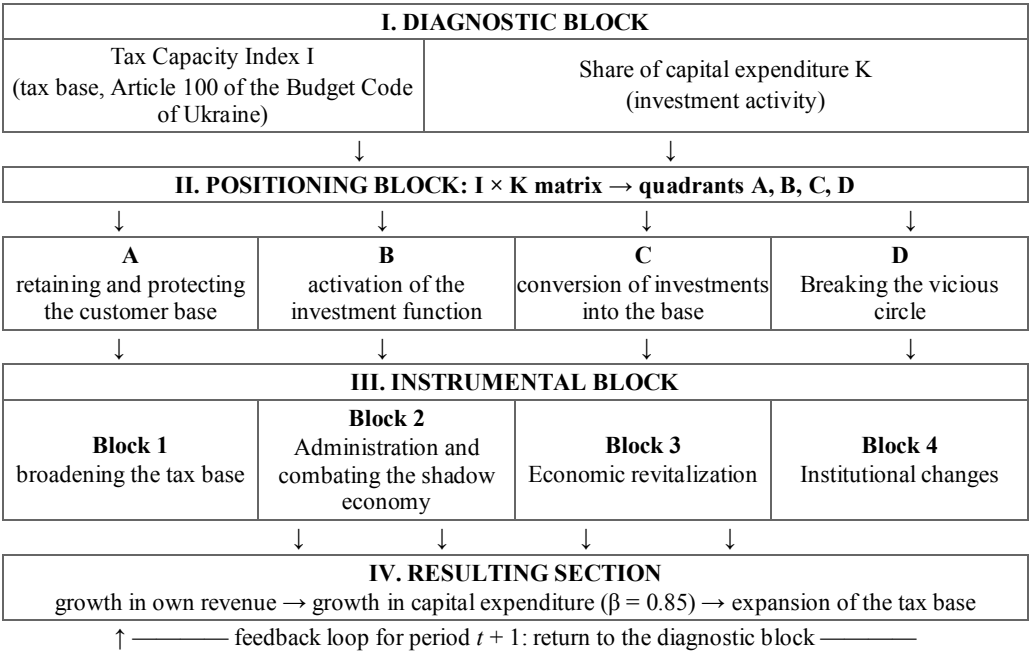


Fig. 5. Schematic model of a tax optimization strategy for the development of a local authority
Source: developed by the authors.

The logic of the model (Fig. 5) is cyclical rather than linear. The diagnostic block records two measurable parameters — the tax capacity index and the share of capital expenditure. The positioning module classifies the community into one of the quadrants of the matrix, thereby identifying not a general list of desirable measures, but a specific bottleneck: for quadrant A, this is the threat of erosion of the existing tax base; for B, the gap between resources and their utilization; for C, dependence on external funding; and for D, the self-perpetuating nature of the lag. The instrumental block assigns a subset of four functional groups of tools to each bottleneck. The resultant block closes the loop: the increase in own revenue, through the estimated elasticity $\beta = 0.85$ (), is transformed into an increase in capital expenditure; and this, provided it is linked to the creation of taxable assets, broadens the tax base for the following period. It is precisely the presence of this feedback loop that explains why quadrant D is a steady state rather than a temporary one: without an external impulse, the loop operates to perpetuate the lag. The substantive content of the model's functional blocks is presented in Table 4.

Table 4

Toolkit for optimizing local authorities' tax capacity by functional block

Tool block	Key instruments	Regulatory and institutional framework	Priority quadrants
1. Broadening the tax base	inventory of land and property; updating of the statutory monetary valuation; phased transition to a value-based (ad valorem) property tax model; tourist levy in recreational communities	Tax Code of Ukraine, Chapter XII; decisions of local councils	C, D
2. Administration and combating the shadow economy	GIS audit of taxable properties; automated monitoring of payments; electronic services for taxpayers; information sharing with the State Tax Service	Tax Code of Ukraine; municipal IT solutions	A, D
3. Economic revitalization	industrial parks; public-private partnerships; support for relocated businesses; support for SMEs (flat-rate tax); linking capital projects to job creation as the basis for personal income tax	legislation on industrial parks and PPPs	B, C, D
4. Institutional changes	expansion of the tax capacity index base (inclusion of the single tax and land tax); fair compensation for the 'military' personal income tax withheld; abandonment of the averaged regional indicator when allocating additional subsidies; inter-municipal cooperation in administration	Budget Code of Ukraine, Articles 64, 98–100 (amendments)	A, B, D

Source: developed by the authors.

The prioritization of instruments (Table 4) is determined by the positioning quadrant. For communities in Quadrant A, blocks 2 and 4 are decisive — maintaining the tax base through quality administration and protection against institutional risks, primarily the consequences of the recalculation of the reverse grant in the first post-war year. For communities in Quadrant B, Block 3 is key, combined with a reorientation of the expenditure structure towards the development budget. For communities in Quadrant C, blocks 1 and 3 are priorities: existing investment activity must be linked to the creation of taxable assets; otherwise, once external funding runs out, the community will shift to Quadrant D. For communities in Quadrant D, a combination of all four blocks is required, with mandatory inter-municipal

cooperation in administration, as it is economically unviable for a community with own revenues of around 1,900 UAH per resident to maintain a fully-fledged local tax administration service on its own.

The results obtained are consistent with the findings of previous studies of communities in the Lviv region, whilst refining them. Thus, in the study (Khiriivskiy, 2024), the Skhidnytska, Ivano-Frankivska and Pidberiztsivska communities were identified as leaders based on the integrated capacity indicator; based on a purely tax-related measure in our study, the leading communities are Sokilnytska, Slavska and Pidberiztsivska, whilst Skhidnytska has an index of only 0.63. This discrepancy is explained by the composition of the indicators (overall capacity also encompasses non-fiscal parameters) and the data period, and confirms the need to distinguish between the concepts of a community's overall capacity and its fiscal capacity. It is telling that, in the proposed matrix, the Skhidnytsia community falls into quadrant C: despite its low index, it exhibits a share of capital expenditure of 26.4 per cent – precisely the type of behavior that one-dimensional typologies fail to distinguish. The observed continued growth in local taxes during the war years (Khiriivskiy, 2025) does not contradict the identified polarisation: growth is concentrated in strong communities, which in turn widens the distribution.

A comparison with the findings of (Storonyanska, 2023) is particularly illuminating; this study presents the distribution of local budgets in Lviv Oblast according to the tax capacity index for 2022–2023. According to those data, the share of budgets with an index below 0.5 stood at 41 per cent in 2022 and 42 per cent in 2023, whilst according to our calculations, by 2025 it had fallen to 31.5 per cent. Such a comparison requires caution, as the aforementioned study uses a regional average rather than the average of individual local authorities' indices; however, the general trend is telling: following the transfer of the 'military' personal income tax to the state budget, the upper part of the distribution contracted more sharply than the lower part, with the result that the relative positions of the weakest local authorities formally improved. This means that the observed reduction in the group of critically subsidized local authorities is largely a statistical effect of a change in the basis of comparison, rather than the result of a real strengthening of their tax base — a conclusion that follows directly from the authors' caveat regarding the vulnerability of the equalisation system linked to the single tax.

The identified methodological flaw in the tax capacity index corresponds to the logic of the 'tax capacity–tax effort' approach (Fenochietto, 2013; Le, 2012): some local authorities with a low index have underutilised tax potential in property taxation, which the current indicator fails to capture. Our study provides a quantitative measure of this: the range of relative residuals from 43.6 per cent to +40.0 per cent shows that, for nine local authorities in the region, the discrepancy between observed and actual capacity exceeds ± 15 per cent and is therefore capable of altering their status within the equalization system. This reinforces the argument (Storonyanska, 2023) regarding the need to broaden the index's basis, following the example of countries that use total tax revenue or tax capacity. In terms of the OECD taxonomy (Dougherty, 2019), Ukrainian local authorities possess genuine autonomy specifically with regard to local taxes (rates within the limits set by the Tax Code of Ukraine), so blocks 1–2 of the proposed toolkit are aimed at increasing tax effort, whilst block 3 is aimed at expanding capacity itself.

The estimated elasticity $\epsilon = 0.848$ is consistent with the finding (Gadenne, 2017) that an increase in local authorities' own tax revenues is converted into public infrastructure to a significantly greater extent than an equivalent increase in transfers. Our data replicate this result in a different way: the presence of a large Quadrant C (21 communities), where high investment activity is combined with a weak own revenue base, shows that external funding is capable of temporarily supporting capital expenditure, but does not in itself broaden the tax base and therefore does not

move the community into Quadrant A. This is also consistent with the generalization (Martinez-Vazquez, 2017) that the positive effects of decentralization are realized primarily when revenue autonomy, rather than merely expenditure autonomy, is in place, and with international recommendations on building tax capacity through the digitalization of administration and the strengthening of property taxation (Benitez, 2023). Practical confirmation of the significance of the institutional framework is provided by the finding (Storonyanska, 2023) that local budgets in the Lviv region lose around 15 per cent of their additional grant due to the application of an averaged regional tax capacity indicator — a mechanism which, given the observed level of intra-regional polarization, is systemically unfair.

The limitations of the study should be noted. Firstly, the analysis is based on a cross-section of data from 2025–2026 and does not cover the full panel dynamics of the index for 2021–2024. Secondly, the Gini coefficient is calculated using unweighted index values, without weighting by the population size of the communities; therefore, it characterizes inequality between communities rather than between residents of the region. Thirdly, regional open data portals sometimes publish the tax capacity index relative to the regional average, rather than the national average, as stipulated in Article 100 of the Budget Code of Ukraine; this does not affect the relative ranking of communities or the elasticity estimates; however, it requires caution when directly comparing the absolute values of the index with the normative thresholds of 0.9 and 1.1. Therefore, before making management decisions, it is advisable to cross-check the figures against the official calculation by the Ministry of Finance of Ukraine. Fourthly, the estimated relationship is statistical and should not be interpreted as causal: the presence of a reverse effect of investment on the tax base, as incorporated into the model, requires separate verification using panel data.

Conclusions and directions for further research

This article presents a comprehensive assessment of the tax capacity of all 73 local authorities in Lviv Oblast based on data from the wartime period, combining the normative positioning of local authorities relative to horizontal equalization thresholds with a quantitative measurement of fiscal polarization. The region's tax landscape proved to be deeply polarized: with an average index value of 0.76, the gap between the most extreme communities is 17.9 times, the Gini coefficient is 0.296, and the decile ratio is 6.9 : 1. Only 10 local authorities (13.7 per cent) act as donors to the equalization system, whilst 55 local authorities (75.3 per cent) receive a basic grant, 23 of which are in the critical grant dependency zone. Polarization follows a distinct center-periphery pattern: tax-raising capacity is concentrated in the suburban belt of Lviv and in recreational centers, whilst mountainous and peripheral border communities consistently lag behind.

The relationship between taxation and investment activity in communities has been verified econometrically. In particular, the elasticity of the share of capital expenditure with respect to the tax capacity index is 0.848 ($p < 0.001$): a 10 per cent increase in the tax base is accompanied by an 8.5 per cent rise in investment activity. The estimate is robust to the exclusion of outliers and shows no structural break at the normative threshold of 0.9. The increase in the Gini coefficient along the budget chain — from 0.296 for the tax base to 0.360 for capital expenditure — indicates that fiscal inequality is not being mitigated but is intensifying at the stage of development financing, thereby perpetuating the 'low capacity trap'.

The methodological approach to assessing the structural bias of the current tax capacity index has been refined: it is proposed to measure this as the relative residual of the regression of own revenue per capita against the index. The range of residuals from 43.6 per cent to +40.0 per cent shows that the index, calculated

solely on the basis of personal income tax, systematically underestimates local authorities with a significant land and property component in their tax base. For nine local authorities, the deviation exceeds ± 15 per cent and is capable of altering their status within the equalization system, which highlights the need to broaden the index's basis to include the single tax and land tax.

A matrix for a tax optimization strategy for the development of a local authority is proposed within the 'tax base – investment activity' framework, along with a model for its implementation featuring a closed-loop feedback mechanism. Unlike existing one-dimensional typologies, the matrix complements the resource dimension with a performance dimension and therefore differentiates management decisions for local authorities with the same tax capacity index. Its application has shown that almost half of the region's communities (34; 46.6 per cent) are situated in the 'low capacity trap' quadrant, whilst the 'unrealized potential' quadrant is virtually empty (2 communities). Consequently, the key problem facing the region is not the inefficient use of the existing tax base, but its absence, and policy should focus on creating the tax base, rather than merely improving its administration.

The scientific and applied foundations for developing a toolkit to optimize the tax capacity of local authorities have been further developed: it is structured around four functional blocks — broadening the tax base, administration and combating the shadow economy, economic revitalization, and institutional changes — differentiated according to the quadrants of the positioning matrix. The model describes this choice as a cyclical process with feedback, in which the increase in capital expenditure must be linked to the creation of taxable assets; otherwise, investment activity will not translate into a broadening of the tax base in the following period.

Further research should focus on constructing a panel analysis of the tax capacity dynamics of local authorities in the region for 2021–2026, which will enable the identified relationship to be tested for causality using fixed-effects models and the effect of the 'military' personal income tax levy to be assessed as a quasi-natural experiment. The second area involves assessing local authorities' tax efforts using the stochastic frontier method, which will make it possible to distinguish between low capacity and low mobilization of existing potential. The third involves simulation modelling of the consequences of broadening the tax base through the single tax and land tax for the configuration of basic and reverse subsidies. The fourth is to supplement the positioning matrix with a third dimension (administrative capacity or the volume of project funding attracted), capable of explaining that part of the variation in investment activity which the current model does not cover.

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Назаркевич І. Б., Шульц Е. П. Діагностика та моделювання оптимізації податкового потенціалу територіальних громад Львівщини в умовах воєнного стану

Мета. Оцінити податкову спроможність територіальних громад Львівської області в умовах воєнного стану, кількісно виміряти масштаби фіскальної поляризації регіону, емпірично верифікувати зв'язок податкової

бази з інвестиційною активністю громад та обґрунтувати матричну модель стратегії податкової оптимізації їхнього розвитку.

Методологія. Інформаційну базу становлять офіційні дані Департаменту фінансів Львівської ОДА та порталів відкритих даних за 2025-2026 рр. по всіх 73 громадах області. Застосовано методи структурного, кореляційно-регресійного та дисперсійного аналізу, інструментарій вимірювання нерівності (крива Лоренца, коефіцієнт Джині, децильне співвідношення), позиціонування громад щодо порогів вирівнювання (0,9 і 1,1) та матричне позиціонування в координатах «податкова база — інвестиційна активність».

Результати. Виявлено глибоку фіскальну поляризацію регіону: розрив між максимальним (Сокільницька — 2,86) і мінімальним (Стрілківська — 0,16) значеннями індексу сягає 17,9 раза, коефіцієнт Джині становить 0,296, децильне співвідношення — 6,9:1; 55 громад (75,3%) є отримувачами базової дотації. Побудована модель еластичності $\ln K = 2,839 + 0,848 \cdot \ln I$ ($R^2 = 0,428$; $p < 0,001$) засвідчує, що зростання індексу податкостроможності на 10% супроводжується збільшенням частки капітальних видатків на 8,5%, а середня інвестиційна активність громад-донорів у 3,8 раза перевищує показник критично дотаційних громад.

Оригінальність. Уперше здійснено суцільне оцінювання податкової спроможності 73 громад області за даними воєнного періоду з економетричною верифікацією зв'язку оподаткування та інвестиційної активності; розроблено матрицю стратегії податкової оптимізації розвитку громади та схему-модель її реалізації.

Практична цінність. Результати придатні для диференціації політики зміцнення податкової бази громад і вдосконалення механізму горизонтального вирівнювання.

Ключові слова: податкова спроможність, індекс податкостроможності, територіальна громада, місцеві податки і збори, горизонтальне вирівнювання, фіскальна поляризація, інвестиційна активність, матриця стратегій, Львівська область.

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