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SFA MODELING AS A TOOL FOR DIAGNOSING THE EFFICIENCY OF BUDGET EXPENDITURES FOR INCLUSIVE COMMUNITY DEVELOPMENT

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ABSTRACT

The study is devoted to the problems of inclusive development at the level of local communities of Ukraine, which is of particular importance in the context of demographic changes and the consequences of hostilities. The need for a comprehensive assessment of the effectiveness of budget support for social inclusion, with an emphasis on children brought up in single-parent families, is substantiated. Such an assessment should take into account not only the completeness of the financial support specified in the passports of budget programs, but also the ability to implement them and the degree of direct connection with the beneficiaries. To achieve the goals of the study, the method of stochastic boundary analysis (SFA) was applied, which makes it possible to separate inefficiency from random perturbations by dividing stochastic components into symmetric (random) and asymmetric (associated with inefficiency). Two models have been developed (in the R environment): to assess the effectiveness of budget support for social inclusion and to analyze the inclusion of children from single-parent families in community development programs. This allows us to identify communities with the most efficient use of budget resources, as well as those where the potential for inclusive development remains unrealized. Testing of modeling on practical data revealed two key results: Ukraine lacks the full amount of data necessary to model the preliminary assessment of budget expenditures related to inclusive development; The current structure of budget program passports does not integrate personnel and institutional expenditures with the measures implemented by them, and the available data are excessively aggregated, fragmented, and incompatible between communities. The proposed approach can be used as an analytical tool for the formation of state policy of social inclusion and assessment of the effectiveness of relevant budget programs at the local level, as well as a basis for improving the implementation of inclusive development policy in the field of local self-government in Ukraine.

Keywords: Stochastic Frontier Analysis (SFA), budget expenditures, budget expenditure efficiency, budget expenditure efficiency assessment, inclusive community development, public financial resources, budget program passports, social transfers, public finance audit

JEL Classification: C13, E61, R58

INTRODUCTION

Inclusive development across all world regions refers to growth strategies that ensure equitable benefits for all members of society, with a focus on identifying the specific needs of population groups defined by particular characteristics such as age, gender, economic status, capacity for self-organization, disability, or dependency. Inclusive development broadens the concept of *inclusive growth* by emphasizing not only higher aggregate output generated by the economic participation of various social groups but also social integration, equality, and quality of life for vulnerable populations whose interests were previously overlooked.

In Ukraine, public financial resources are concentrated within the budgetary system. The main instrument for implementing public policy objectives is the program-based budgeting method (PBB), designed to enable continuous assessment of the achievement of concrete socio-economic outcomes resulting from public expenditures within

policy goals through the execution of annual budget programs, whose effects extend to local self-government as well. However, the practice of PBB implementation indicates the need for further refinement, given the low level of attainment of expected results. This underscores the importance of continued research into tools for improving the effectiveness of budget programs.

In the context of inclusive development, which implies the full participation of all population groups in the social, economic, and political life of communities, the study of methodological and practical aspects of instruments for the formulation and implementation of budget programs in Ukraine becomes particularly significant.

The efficiency of public financial resource utilization in Ukraine's challenging conditions should, in line with the principle of subsidiarity within communities, include the provision of inclusion as a prerequisite for sustainable development. In this context, the economic efficiency of budget expenditures aimed at ensuring inclusion refers to the delivery of inclusive services or infrastructure at the lowest possible resource cost without compromising quality or coverage. At the same time, the assessment of budget expenditure efficiency as a component of public finance auditing should also take into account the capacity of implementing entities to ensure effectiveness and the aforementioned economic efficiency through the proper implementation of activities and provision of inclusive services. Therefore, in this study, we propose to consider the efficiency of expenditures for the implementation of budget programs as consisting of the economic efficiency defined in paragraph 6 of Article 7 of the Budget Code of Ukraine and the efficiency understood as the capacity of implementers to achieve the desired impact on the inclusive and sustainable development of communities through the results of budget programs. A necessary condition for ensuring the effectiveness of inclusive development and one of the directions of public finance auditing is the ex-ante assessment of the impact of budget expenditures, prior to their planning, on specific beneficiaries of inclusive development.

Since the budget program is a key element of the program-target method (PTM) and is used in local government budgets, the assessment concerns such components of its annual passport as the goal, objectives, and performance indicators. The titles and codes of budget programs are defined by budget classification, and their formulation is currently standardized among communities. However, not all implementing entities within communities possess the managerial and financial qualifications necessary to ensure the programming of inclusive development for specific beneficiaries. Conducting ex-ante assessments of budget program passports when planning the performance and efficiency of budget expenditures, taking into account the needs of inclusive beneficiaries among community residents, supports the capacity of responsible program implementers. Achieving the goals of state policy on the medium-term inclusive development of communities largely depends on the application of modern analytical tools in the annual ex-ante assessment of inclusion assurance. The stochastic frontier analysis (SFA), used to model the preliminary assessment of the content of a budget program passport, can be applied both by experts and by community representatives without specialized education. We propose a model for the preliminary assessment of the content of budget program passports concerning measures that contribute to building an inclusive environment for inclusion beneficiaries. This model can be used in specialized unified software incorporating benchmarks from different communities to perform an ex-ante evaluation of the criteria met by the content of a planned budget program passport.

For the assessment of inclusive development, international organizations have established a framework of criteria that is practically implemented in response to global challenges and international commitments undertaken by Ukraine within the framework of the Sustainable Development Goals and indicators up to 2030 (Cabinet of Ministers of Ukraine, 2025). The preliminary evaluation of budget programs must also take into account the requirements enshrined in the Charter of Fundamental Rights of the European Union (European Union, 2012) and the United Nations Convention on the Rights of the Child (United Nations Human Rights, 1989). These documents emphasize human dignity as the supreme value that must underlie managerial decisions, including budgetary expenditures. The principles of human-centered and gender-oriented approaches are gradually being integrated into the Ukrainian budgetary process; however, the question arises as to how consistently they are implemented in the formation of budget programs, particularly with regard to indicators reflecting the impact of budget expenditures on the development of an inclusive environment.

In global practice, inclusive development necessarily considers the prospective outcomes of public financial resource use and often involves trade-offs: for example, investing in universally accessible infrastructure (such as barrier-free environments, roads with ramps, or accessible schools) may initially increase budgetary expenditures but, in the long term, can reduce social costs and stimulate broader economic activity, leading to improved economic performance (and increased community budget revenues) over time. Thus, local infrastructure projects financed under programs such as water supply, roads, and healthcare facilities aimed at improving access to quality infrastructure and services generate not only socially significant but also economic effects through enhanced economic activity, while simultaneously receiving greater community support (World Bank Group, 2025).

At the same time, the participation of the community itself, through its representatives, in the development and implementation of such infrastructure-oriented programs is of crucial importance (Dushkova & Ivlieva, 2024). However, as A. Bachfischer et al. (2023) note, disability inclusion programs at the community level are generally considered "economically efficient" provided they maintain a balance between broad integration of measures and limited resources. Nevertheless, community representatives (as evidenced by research conducted in Latin America) often lack the necessary knowledge to adequately participate in the design and implementation of programs involving expenditures aimed at inclusive development.

Global Infrastructure Hub of the World Bank (2025) distinguishes the following groups of beneficiaries when programming expenditures for inclusive development: (a) low-income individuals; (b) individuals of specific gender groups; (c) persons with disabilities; and (d) others. For the purposes of this study, taking into account the specific conditions of Ukraine, we propose to identify an additional group of inclusion beneficiaries within communities – "children from single-parent families."

The use of Stochastic Frontier Analysis (SFA) for the preliminary assessment of the effectiveness of budget program implementation, which simultaneously considers both economic efficiency and the capacity of program implementers, has determined the following research questions:

1. Justification of SFA as a method for the preliminary assessment of comprehensive efficiency in ensuring the inclusive development of communities.
2. Modeling of a unified ex-ante evaluation of the content of budget program passports, taking into account the needs of community beneficiaries in inclusive development.

LITERATURE REVIEW

Researchers agree that programming should be used as a budget expenditure management tool for development. Recent publications emphasize that well-designed inclusive budget expenditure programs, whether financed by public or private funds, can be economically efficient by ensuring sustainable development rather than being viewed solely as social transfers (Krysovatyy et al., 2024).

Some financial scholars even justify the need to introduce inclusion-oriented budgeting as an innovative public finance management technology that combines elements of program-targeted, participatory, and gender-oriented approaches. In this context, "inclusion-oriented budgeting" is defined as mechanisms for engaging citizens in the formation, use, and control of public financial resources to ensure equal opportunities and strengthen state resilience (Kizyma et al., 2021).

Scholars distinguish between economy (minimizing inputs to achieve a specific result) and economic efficiency (achieving a specific impact per unit of expenditure). Therefore, studies on inclusive development often apply economic efficiency analysis in the sense of achieving budgetary savings through synergistic outcome effects, as well as cost–benefit analysis to determine priority directions for budget expenditures. R. J. Brent (2023), based on a comparison of the application of these two types of analysis in the field of healthcare, argues that the pursuit of efficiency through economy under budget constraints places politically declared and approved measures at unjustified risk, since underfunded initiatives may not be implemented due to fiscal incapacity. In contrast, cost–benefit analysis allows for forecasting both current fiscal capacity and long-term impact, as even in the case of budget sequestration, it identifies alternatives with higher benefit-to-cost ratios. In the absence of budgetary constraints, cost–benefit analysis allows the selection of the most feasible alternative with net benefits.

Impact becomes particularly important when addressing the needs of population groups emerging due to changes in their usual environment, for example, during armed attacks or climate disasters. In the case of inclusion in education, M. Pawlik et al. (2025) emphasize that assessing the efficiency of expenditures for inclusive needs resulting from climate change (for instance, ensuring the evacuation of students and access to education during flooding in Japan) requires proper programming based on adequate data on the beneficiaries of these expenditures and on the contextual processes shaping the environment in which the planned expenditures are made. The inclusiveness of communities implies cooperation among all community members to create a safe and inclusive environment (Meier et al., 2024).

To link expenditures with benefits using econometric methods at the national level, Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are applied to manage data and measure the local economic efficiency of communities and their regional associations. Researchers concur that for the analysis of large datasets related to regional entities, SFA has a methodological advantage (Sultana et al., 2023). The fundamental superiority of parametric SFA methods compared

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to nonparametric DEA methods lies in SFA's ability to statistically control for a large number of factors that may influence the evaluation outcome. Moreover, nonparametric DEA methods encounter difficulties in processing more than one input when the number of input data points is small. Conversely, when a large number of inputs are used, a significant proportion of observations may be classified as efficient, which complicates the ranking of countries in terms of efficiency (Hrytsenko et al., 2021).

The study by M. F. Castro et al. (2025) applied panel SFA to municipal expenditures on social services in Italy (2015–2018) and found that institutional quality (e.g., low corruption levels, strict rule of law) critically influences local economic development by increasing the effectiveness of expenditure impacts. Furthermore, the prospects for building strong institutions improve through the engagement of previously discriminated population groups in governance (Montero & Medina-Garzón, 2021). The development of decentralized economic diversity within the framework of inclusive decentralization policy demonstrated positive results in ensuring community resilience in Switzerland (Aerni, 2021).

The literature also indicates that many evaluations of inclusive development, including those conducted at the community level, remain descriptive or qualitative. A. Olaghere et al. (2023) propose an analytical approach that first determines the reliability of each individual analytical or research result based on the methodological robustness of the applied technique, evaluated on a reliability scale. These individual reliability scores are then incorporated into the overall assessment of any synthesized conclusion, particularly regarding inclusion, obtained through meta-aggregation.

A review of publications on the topic shows that the assessment of narrow indicators of current efficiency (such as cost reduction, output growth, or plan fulfillment) must, in order to measure inclusion impact, also account for indicators determined by broader governance factors characterizing the implementation context of programs. This environment includes requirements for implementing "green policies" (Ren et al., 2024), financial shocks resulting from changes in international policy (Shvets et al., 2025), and the digitalization of the environment in which public spending is organized, such as public procurement (Azarenkova et al., 2020) or smart city development (Lee et al., 2023). These findings confirm the earlier statement regarding the necessity of considering contextual and qualitative environmental indicators (e.g., the level of green policy integration, trust in international partners and associated geopolitical risks, the availability of resources and capable implementers for transitioning to digital procedures in the budgeting process) when evaluating the efficiency of program-based expenditures and their implementation conditions.

For the digital analysis of inclusion within local communities based on the indicators of budget programs in Ukraine, inclusively sensitive indicators have not yet been fully developed, which also determines the purpose of this study. To reduce the descriptiveness of budget expenditures on inclusive development, researchers combine financial assessment (expenditure data) with social outcomes (Newman & Thomson, 1989), ensuring consideration of both the cost of achieving inclusion results and the impact on the region's economic development potential and subsequent local government budget revenues. For instance, recommendations on expenditures for creating inclusive infrastructure emphasize that both the costs and benefits associated with inclusion should be taken into account (Organisation for Economic Co-operation and Development, 2024).

T. Ogon (2009) outlined a theoretical model for applying the program-target method in the budget process, though without considering the specifics of institutional rule formation by budgeting entities in their interaction during the development of budget program performance assessment methods in Ukraine. Subsequent numerous Ukrainian publications, throughout the lengthy process of implementing and adapting budget programs for full-scale use at the local budget level, have mainly focused on the methodology of current and ex-post evaluation of the relationship between program goals and achieved results in the field of budget management (Kotina et al., 2018; Illiashenko et al., 2015; Horyn, 2020; Rudyk, 2023). However, they do not specify a methodology for preliminary evaluation of budget expenditure efficiency, considering the formation of program structures for local communities to ensure inclusive development in the medium term, which would contribute to creating a clear, unified algorithm for applying evaluation parameters in practice.

Accordingly, within the scope of research on inclusive development at the community level, the study of modern analytical methods for using digital tools in the preliminary assessment of the impact of local budget expenditures on inclusion, based on the current structure of budget program passports in Ukraine, fills an existing research gap.

AIMS AND OBJECTIVES

The purpose of the article is to develop universal models for the preliminary assessment of inclusion measures in the passports of budget programs, which can be used to analyze the impact of budget expenditures on the inclusive develop-

ment of communities. The models are based on the Stochastic Frontier Analysis (SFA) method, which enables the evaluation of efficiency using data from a sample of communities and can serve as the foundation for a unified computer program for preliminary assessment. Programming is essential for the adequate interpretation of the full efficiency of budget expenditures in ensuring the inclusive development of communities.

The objectives of the article are as follows:

1. To construct an algorithm for assessing the impact of budget program indicators on the development of inclusion as a component of public finance auditing.
2. To test the panel evaluation by constructing a model using SFA and checking the quality of data available in Ukraine for territorial communities.

METHODS

Methodological approaches to modeling the assessment of impact on inclusive development as a key component of sustainable development at the community level concern the content of the passport of a specific annual budget program of the community. To achieve the stated goal and address the scientific tasks, both general scientific and specialized methods were applied in the research.

In particular, methods of logical analysis, synthesis, and generalization were used to deepen the understanding of the components of a universal approach to evaluating the effectiveness of budget expenditures aimed at inclusive community development. The systemic approach, as well as methods of grouping and concretization, were employed to identify the specific features of using budget programs as an instrument within a comprehensive system for assessing the efficiency of local budget expenditures oriented toward ensuring inclusion. For the quantitative evaluation of expenditure efficiency, the SFA (Stochastic Frontier Analysis) method was applied, which made it possible to account for the influence of heterogeneous factors on achieving inclusive goals. The construction of the corresponding mathematical models was carried out using computer programming tools in the R language. To visualize the results, a graphical method was applied, which contributed to the illustrative presentation of efficiency distribution and community benchmarking.

The existing budget programs of communities are coded according to the Standard Codes of Program Classification and the more detailed Codes of Program Classification of Expenditures and Lending of the Local Budget, while the components of the program passport forms are standardized in Ukraine. We propose a methodology based on an algorithm combining the components of preliminary assessment, which includes not only the financial support of the budget program and the achievement of its planned performance indicators, but also the compliance of implementation conditions, taking into account the capacity of its executors.

This methodology consistently covers the components of the preliminary assessment of the effectiveness of the budget program implementation and the respective planned budget expenditures aimed at ensuring inclusive development in local communities through the application of the SFA method to three components of the preliminary assessment. We define the following components of the assessment algorithm:

1. The quality of the environment in which the budget program is implemented – the presence of capable institutions.
2. The sensitivity of the budget program indicators to the inclusion needs of identified beneficiaries.
3. The level of financial support for the budget program, including the completeness of the planned budget expenditures' execution during the fiscal year.

Such an assessment covers the initial conditions for the effective implementation of a budget program after its passport is drafted and serves as the basis for its approval, revision, or rejection with subsequent improvement.

Therefore, a preliminary assessment of the content of the community budget program passport aimed at ensuring its effectiveness should include an evaluation of institutional capacity to implement the objectives of public policy within the community, an analysis of the sensitivity of the components of the budget program passport to inclusion, and an assessment of the financial capacity of the local budget to fund the budget program for the year and in the medium term within the framework of the community development plan (Figure 1).

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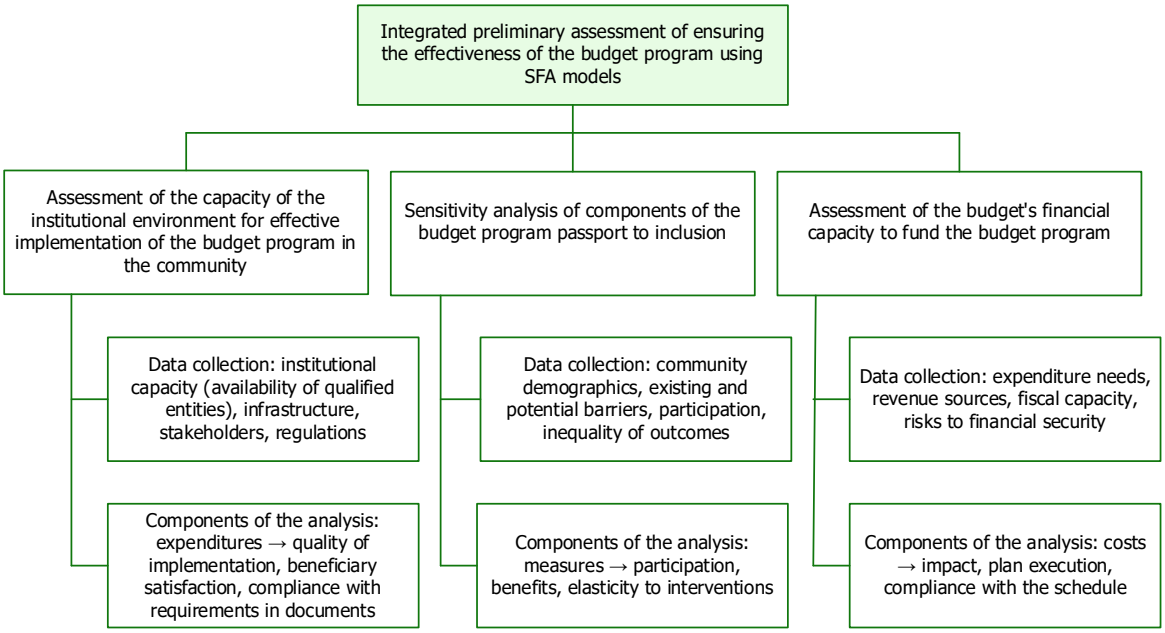

Figure 1. Components of a preliminary assessment of the budget program's efficiency.

For all components of the preliminary assessment, a unified model of stochastic frontier analysis (SFA) of community efficiency will be developed, combining both the efficiency of financial provision and the efficiency of achieving declared results. The model is based on a log-linear production function of public services (outputs), taking into account both input resource variables and contextual factors that influence the capacity to achieve these results (Ondrich & Ruggiero, 2001). Such a model enables the simulation of the transformation process of budgetary financial resources into program outcomes while separating the impact of random factors from systematic inefficiency. This provides an analytical basis for assessing the capacity of the local government to implement budget programs within the institutional environment of communities characterized by heterogeneous implementation conditions.

Before constructing the model, a data preprocessing stage is carried out, including logarithmic transformations, normalization, and variable encoding. The model parameters are estimated using the maximum likelihood method, which ensures the simultaneous consideration of all variables and reduces parameter bias. To calculate individual efficiency estimates by areas of budget program implementation, the Jondrow et al. approach is applied, which allows for the estimation of the conditional distribution of inefficiency based on observed data (Jondrow et al., 1982). This approach makes it possible to determine not only the average efficiency level under the model but also to construct individual profiles for each direction of the budget program that inform decision-making. In the final stage, the obtained results are analyzed: rankings of directions are compiled, benchmarks are identified, and statistically significant deviations are determined.

To program the preliminary assessment of the budget program implementation, a specified SFA model formula for the quantitative evaluation of the budget program's efficiency will be used. An example of the analysis will be developed in the context of Sustainable Development Goal 1, "No Poverty", and the related public policy objective, "Support for families with children in difficult life circumstances." Within this objective, a specific aspect of inclusive development is considered through the needs of such beneficiaries of budget expenditures as "single-parent families or families lacking one or both parents, or those with incomplete or insufficient parental care", aimed at ensuring their inclusion in community life. Accordingly, the objective of the budget program coincides with the public policy goal "Support for families with children in difficult life circumstances." An additional prerequisite for constructing the evaluation model for these inclusion beneficiaries is the existing childcare policy implemented by representatives of local self-government in Ukraine, reflected in the presence of dedicated structural units and departments for child welfare within the executive bodies of local self-government.

The SFA model for the preliminary assessment of the content of a community budget program's passport reflects three groups of variables for a given community and allows consideration not only of the total planned budget expenditures but also of the program implementation conditions. Within the assessment, the emphasis is placed not only on general performance indicators of output and quality (impact) but also on indicators of inclusive access, particularly concerning families with children raised by a single parent or lacking adequate parental care.

SFA modeling is carried out according to the following steps (Coelli et al., 2005).

Building the SFA model:

$$\ln(Y_i) = \beta_0 + \sum_{k=1}^{K} \beta_k \ln(X_{ki}) + \sum_{m=1}^{M} \gamma_m Z_{mi} + v_i - u_i \quad (1)$$

where: i – community index (i = 1, 2, …, N) for which the efficiency of the budget program implementation is assessed; Y_i – baseline indicator of the efficiency of the budget program in the community implementation:

- *in the first model: the total number of products (services provided, activities conducted) financed from the budget;*
- *in the second model: the share of single-parent families among the program beneficiaries;*

$\ln(Y_i)$ – logarithmic transformation of the dependent variable to ensure linearity of the model; X_{ki} – k-th input variable (k = 1, 2, …, K) for community i, reflecting the amount of resources or costs, which are linked with the implementation of the inclusion tasks in the budget program; X_{1i} – staff salary costs; X_{2i} – infrastructure costs; β_k – elasticity parameters that show the impact of each input variable X_k on the result Y, that is, how much the efficiency will change when the resource changes by 1%; Z_{mi} – m-th contextual variable (m = 1, 2, …, M) for community i, which characterizes the conditions for implementing the budget program (and is often absent in the current passports of budget programs for the local community's budgets in Ukraine): Z_{1i} – type of community by population; Z_{2i} – community income indicator; Z_{3i} – the presence of partnership mechanisms to ensure the achievement of the state policy objective from alternative sources; γ_m – coefficients reflecting the strength of the influence of contextual factors on efficiency; $v_i \sim N(0,\sigma_v^2)$ – symmetric random noise; $u_i \sim N^+(0, \sigma_u^2)$ – a one-sided inefficiency term, interpreted as potential efficiency losses within the set of planned expenditures and measures.

The efficiency of community *i* is calculated as:

$$TE_i = exp(-u_i) \quad (2)$$

where $0 < TE_i \leq 1$.

A value of *TEi* = 0 indicates a complete inability of community *i* to effectively achieve the declared components of the budget program passport.

TEi = 1 means that community *i* is fully efficient.

TEi < 1 implies the existence of efficiency losses, i.e., potential improvement is possible without an increase in resources, provided that processes, management, or program implementation capacity are better organized.

Estimation of variation parameters

To estimate the quality of the model, the variance of random noise is further calculatedσ_v^2, inefficiency varianceσ_u^2, share of inefficiency in total variation:

$$\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} \quad (3)$$

The value γ→1 indicates a high proportion of inefficiency in the total variation.

Calculating average performance scores

Average expected inefficiency:

E[ui] (4)

Average technical efficiency (за JLMS – Jondrow, Lovell, Materov, Schmidt):

$$E[exp(-u_i)] \quad (5)$$

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Checking statistical tests for inefficiency

Logarithmic LR test

To test the significance of inefficiency:

$$LR = -2 \cdot (ln\, L_0 - ln\, L_1) \sim \chi_q^2 \quad (6)$$

where: L_0 – log-likelihood of the model without inefficiency; L_1 – log-likelihood of the SFA model; q – number of restrictions (usually q=1);

Compared to the critical value $\chi_{q,\alpha}^2$.

Coelli skewness test

Residual asymmetry test:

$$z = \frac{\hat{\mu}_3}{\hat{\sigma}^3} \quad (7)$$

where $\hat{\mu}_3$ – third central moment of the residues; $\hat{\sigma}$ – standard deviation of residuals;

The *p*-value is calculated from the standard normal distribution and is used to test the hypothesis of symmetry.

Interpretation of efficiency

$TE_i = 1$: the community is operating fully effectively;

$TE_i < 1$: there is inefficiency – potential for improvement;

The closer the TE value is to 1, the higher the performance for given resources.

Significant efficiency losses may indicate management problems, program inadequacy, or lack of institutional capacity.

When developing the preliminary assessment methodology for its programming using the SFA method and conducting an analysis of the existing budget program passports for communities in Ukraine, we immediately identified a lack of data necessary to account for inclusive development.

The analysis of the inclusiveness of budget programs involves the practice of incorporating indicators that characterize the beneficiaries of the program's implementation. This characterization should not be indirect but rather direct – that is, it should include an exact indicator of beneficiaries requiring inclusion (most often expressed as a percentage of the population of a specific community) and the services they receive in the form of support within the overall composition of the program's beneficiaries. Additionally, to determine the integral efficiency, it is advisable to assess the current levels of participation of beneficiaries with additional inclusion needs, the presence of their representatives, and the existing feedback mechanisms between the beneficiaries themselves and their representatives. Particular attention should be paid to identifying inequalities in the outcomes of budget program implementation among different groups of beneficiaries — in our case, among single-parent families with children.

The full implementation of the models and their integration into a computer-based assessment program available to local self-government creates a space for proposing amendments to the content of local budget program passports, in order to ensure a preliminary evaluation of their effectiveness in promoting the inclusive development of communities, which will be discussed in the "Discussion" section of this paper.

Empirical data on the typical content and structure of local budget programs were obtained from the official websites of territorial communities. At the same time, it was difficult to select even the data presented in this article from at least twenty communities across Ukraine, because: (a) some communities stopped publishing budget program passports and even budget decisions after 2022; (b) the available content of budget program passports does not provide for the identification of inclusion beneficiaries among performance indicators, particularly children, even when such groups are reflected in the structure of executive bodies of the communities. Additionally, communities neither publish nor, apparently, properly collect indicators concerning inclusion beneficiaries among the population in connection with the measures targeted at them, and these indicators are also absent from budget program metrics. Accordingly, data on the share of beneficiaries in the assessment modeling were aggregated as averages from the State Statistics Service of Ukraine. The regulation of

the process of community budget expenditures is determined by the current legal and regulatory framework and by the policy of the Ministry of Finance of Ukraine aimed at unifying the use of the program-target method in budget processes directly at the level of territorial communities, as well as maintaining and strengthening decentralization.

RESULTS

We have developed two SFA models for assessing the performance indicators of budget program implementation in a community: (a) in the first model, the total number of products (services provided, events conducted) aimed at ensuring inclusion funded from the budget (*events_total*); (b) in the second model, the share of beneficiaries requiring budget expenditures to ensure inclusion (*inclusion_share*). The data for modeling were collected from the official websites of communities selected by the authors based on the availability of publications on the passports of local self-government budget programs. A total of 20 communities in Ukraine were selected (Table 1), a significant proportion of which are located in the Ternopil oblast (name of the administrative region of Ukraine).

Table 1. Community characteristics and parameters of inclusive development.

Center of the local community	Community type (rural-centered – 0 / settlement-centered – 0,5 /town-centered – 1)	Average monthly salary in the region, UAH	The presence of partnership mechanisms to ensure the goals of public policy (absence of related powers – 0, one public authority – 0,5, several executive authorities - 1)	Yearly salary costs for staff ensuring inclusion, UAH thousand	Yearly expenses for facilities and infrastructure, UAH thousand	Total number of events/ services, units	Share of inclusion beneficiaries among the community population, %
Kremenets	1	11455	0.5	765.09	166.91	2	17.2
Vyshnivets	0.5	11455	1	363.33	68	100	17.9
Terebovlia	1	11455	0.5	20	54.4	87	17.2
Pidhaichi	1	11455	0.5	21900	1005	7000	17.2
Zaliztsi	0.5	11455	0.5	3984	66	110	17.9
Borshchiv	1	11455	1	1396.5	103.24	20	17.2
Antoniny	0	12352	0.5	115	104.1	116	17.9
Hrebinky	0.5	15152	1	974.8	112.95	135	17.9
Mykulyntsi	0.5	11455	1	41	50	2	17.9
Pidvolochysk	0.5	11455	0.5	362.3	404.5	320	17.9
Zavodska	0.5	11455	0.5	1322	28	7	17.9
Shatsk	0.5	11735	1	248.7	100	140	17.9
Zymne	0	11735	1	484.7	145.9	650	17.9
Liublynets	0.5	11735	0.5	3117	305	74	17.9
Kalynivka	0.5	15152	1	221.9	445.1	51	17.9
Baikivtsi	0	11455	1	100	1000	250	17.2
Ivanivka	0	11395	1	890.6	3939.2	1100	17.9
Vel. Berezovytsia	0.5	11455	1	990	150	30	17.9
Velyki Birky	0.5	11455	0.5	32	22.974	100	17.9
Skoryky	0	11455	1	585	16.5	4	17.9

We have a reservation regarding the data, which concerns the current lack of adequate representation of measures related to inclusion – both of children and, in particular, of single-parent families with children – in the passports of community budget programs, reports on the implementation of budget program passports, budget execution reports, and reports on the activities of child and youth services. Therefore, the preliminary data on the activities conducted were collected and interpreted independently by the authors from the official community web pages.

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Modeling a preliminary assessment of community inclusion activities involves evaluating their effectiveness based on two key indicators: the number of inclusion-related events, products, and services implemented (*events_total*), and the share of beneficiaries (specifically, single-parent families) requiring inclusion within the community (*inclusion_share*).

To evaluate the performance efficiency of communities based on the number of events and activities conducted to ensure inclusion for single-parent families with children (*events_total*) (hereinafter Model 1), and based on the indicator of the share of inclusion needs within the community (*inclusion_share*) (hereinafter Model 2), a Stochastic Frontier Analysis (SFA) model of the Normal-Half Normal type was applied, estimated by maximizing the log-likelihood function using the BFGS method in the R environment.

The deterministic part of the models included the following independent variables:

- log(*personnel_costs*) – logarithm of personnel costs;
- log(*infra_costs*) – logarithm of expenditures on facilities and infrastructure.

Contextual variables are taken into account in the inefficiency modeling *(u_i)*:

- *avg_salary$_i$* – average salary by region (oblast);
- *community_type$_i$* – type of community (rural, settlement, urban);
- *partnerships* – the presence of partnership mechanisms for the implementation of state policy (the existence of one or several structural units of executive authorities, such as child and family services and the respective departments or divisions of local councils responsible for issues related to children).

Formal structure of Model 1:

$$log(events\_total_i) = \beta_0 + \beta_1 log(personnel\_costs_i) + \beta_2 log(infra\_costs_i) + v_i - u_i \quad (8)$$

Formal structure of Model 2:

$$log(inclusion\_share_i) = \beta_0 + \beta_1 log(personnel\_costs_i) + \beta_2 log(infra\_costs_i) + v_i - u_i \quad (9)$$

where: events_total$_i$ – number of events in the community i, inclusion_share$_i$ – the indicator of the share of the population requiring inclusion events within the community i, $v_i \sim \mathcal{N}(0, \sigma_v^2)$ – symmetric random noise, $u_i \sim |\mathcal{N}(Z_i\delta, \sigma_u^2)|$ – one-sided inefficiency depending on the vector Z_i of context variables.

$$Z_i = [1, avg\_salary_i, community\_type_i, partnership_i]$$

Inefficiency dispersion model:

$$log(\sigma_{u_i}^2) = \delta_0 + \delta_1 \cdot avg\_salary_i + \delta_2 \cdot community\_type_i + \delta_3 \cdot partnership_i \quad (10)$$

$$\sigma_{u_i}^2 = exp(Z_i^T \delta),\ Z_i = [1, avg\_salary_i, community\_type_i, partnership_i] \quad (11)$$

Model 1 Estimation Results

The estimated coefficients for the deterministic part are given in Table 2.

Table 2. Estimated coefficients for the deterministic part of model 1. Note: * significant at the 5% level. *(Source: developed by the authors with R*

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
(Intercept)	1.072	1.610	0.666	0.506
log(personnel_costs)	0.140	0.246	0.570	0.569
log(infra_costs)	0.807*	0.321	2.510	0.012

The only statistically significant variable in the deterministic part is log(*infra_costs*) (p = 0.012), indicating a substantial positive impact of infrastructure investments on the effectiveness of program implementation. A 1% increase in infrastructure expenditures is associated with an approximately 0.81% growth in the number of events, "ceteris paribus." Personnel expenditures are not statistically significant (p = 0.569).

Next, we perform an auxiliary regression to model the variance of inefficiency based on the residuals from the previous model.

Table 3 shows the coefficients in the inefficiency variance equation.

Table 3. Coefficients in the inefficiency variance equation of Model 1. *(Source: developed by the authors with R)*

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
(Intercept)	1.632	4.864	0.336	0.737
avg_salary	-0.00013	0.00038	-0.331	0.741
community_type = 0.5	0.800	1.141	0.702	0.483
community_type = 1	1.833	1.820	1.007	0.313
partnership = 1	0.705	1.056	0.667	0.504

In the inefficiency variance equation, the variable *community_type* exhibits positive coefficients, indicating a potential increase in inefficiency dispersion in urban communities compared to rural ones. However, the p-values (0.483 for type 0.5 and 0.313 for type 1) do not allow for statistically robust conclusions regarding the significance of this effect. This suggests a possible marginal relationship that requires further verification using a larger sample.

Estimation of variation parameters:

$\sigma_u^2 = 4.548$, $\sigma_v^2 = 0.732$, $\gamma = 0.861$.

The coefficient γ = 0.861, indicating a significant proportion of inefficiency in the total variation.

Average efficiency estimates:

1. Average expected inefficiency: $\mathbb{E}[u_i] = 1.702$. This indicates a noticeable level of efficiency losses on average across the sample of communities.
2. Average efficiency according to Johndrow-Lovell-Meadows-Smith (JLMS): $\mathbb{E}[e^{-u_i}] = 0.320$ indicates significant variation between communities and confirms the existence of a large potential for improving the effectiveness of budget programs implementation for inclusive development.

Inefficiency tests:

Logarithmic LR test: $\chi^2 = 3.08 < \chi^2_{0.05,5} = 10.37$ (there is no reason to reject the hypothesis of no inefficiency (at the 5% level).

Coelli skewness test: z = −0.83, p = 0.407 – no residual asymmetry was detected.

The model allows authorities to identify communities with the lowest level of event implementation efficiency, taking into account resource provision and social characteristics.

The diagram (Figure 2) presents technical efficiency assessments (JLMS) for 20 territorial communities.

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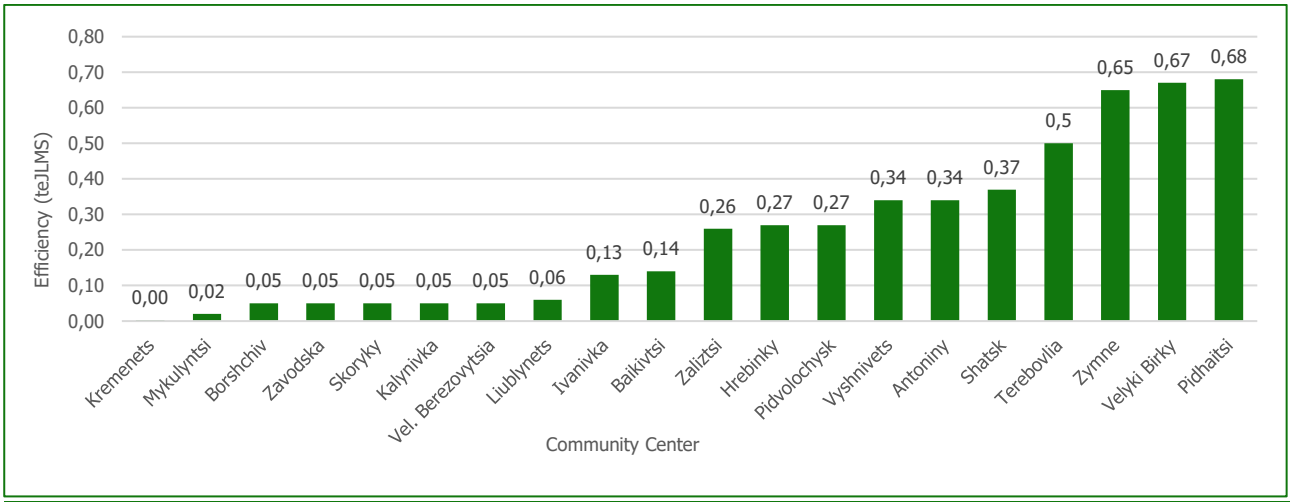

Figure 2. Assessment of the efficacy of community activities by the number of events held.

The *X*-axis shows the names of the communities, and the *Y*-axis shows the estimated efficiency (TE_{JLMS}) in the range from 0 to 1. Values closer to 1 indicate higher efficiency, i.e., the community demonstrates a greater result (number of activities) at a given level of expenditure.

The most efficient communities were: Pidhayetska, Velykobirkivska, Zymnivska – with efficiency over 0.65, Terebovlyanska also showed a high value – 0.5.

The lowest level of efficiency is in the communities: Kremenetska, Mykulynetska, and Borshchivska, with efficiency less than 0.05.

These results indicate significant variation in efficiency across communities under the same or similar cost conditions. Thus, the SFA model allows us to identify potential for improving the efficiency of resource management and the organization of activities at the local level.

Model 2 Estimation Results

The estimated coefficients for the deterministic part are given in Table 4.

Table 4. Estimated coefficients for the deterministic part of model 2. *(Source: developed by the authors with R)*

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
(Intercept)	2.885*	0.000	8.698e+10	0.000
log(personnel_costs)	0.000	0.000	1.917	0.064
log(infra_costs)	0.000	0.000	0.000	0.911

Only personnel costs have marginal statistical significance (p = 0.064), indicating their possible (albeit weak) impact on the level of inclusion.

This suggests that within the framework of the implementation of budget programs, personnel costs are more relevant for ensuring inclusion than infrastructure expenditures.

Table 5 shows the coefficients in the inefficiency variance equation.

Table 5. Coefficients in the inefficiency variance equation of Model 2. *(Source: developed by the authors with R)*

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.68002	0.000	-2.1785e+22	<2.2e-16
avg_salary	-0.00069	0.000	-3.7254e+14	<2.2e-16
community_type = 0.5	-37.33759	0.000	-2.2103e+23	<2.2e-16
community_type = 1	5.71990	0.000	8.4218e+31	<2.2e-16
partnership = 1	2.63559	0.000	6. 2592e+22	<2.2e-16

All contextual variables are statistically significant, indicating a strong influence of socio-economic factors on the level of inefficiency in achieving inclusion.

1. Average salary (*avg_salary*) has a negative effect (β = -0.00069; p < 0.001), which indicates: the higher the community income, the lower the probability of inefficient use of resources to ensure inclusion.
2. Community type (*community_type*) has a differential impact:

- for category 0.5 (settlement) – negative effect (β = -37.33759).
- for category 1 (urban) – strong positive effect (β = 5.71990), indicating increasing inefficiency.

3. Partnership approach (*partnership*) has a positive effect (β = 2.63559), which means that with additional partnerships, there is an increase in inefficiency, probably due to the complexity of coordination.

These results confirm the significance of the socio-economic characteristics of a community on its inefficiency results, but due to the experimental assessment of the data, we recommend further exploring this line of analysis on a larger sample and higher-quality data collected by communities specifically for this type of analysis.

Estimation of variation parameters:

$\sigma_u = 0.0023$,Fig. $\sigma_v^2 \approx 0$, $\gamma = 1$.

All variation in the model is due to inefficiency, not random noise.

Average efficiency estimates:

1. Average expected inefficiency: $\mathbb{E}[u_i] = 0.03829$. This means that communities on average lose only 3.8% of their efficiency potential, which is a minimal level of inefficiency.
2. Average efficiency according to JLMS: $\mathbb{E}[e^{-u_i}] = 0.963$. This indicates a very high average level of efficiency, as the value is close to 1.

Inefficiency tests:

Logarithmic LR test: $\chi^2 = 457.4 > \chi^2_{0.1,5} = 14.3$ (the model with stochastic inefficiency is statistically better than OLS (at the 10% level).

Coelli skewness test: $z = -1.87$, $p = 0.061$ – the test results indicate a certain asymmetry of the residuals; however, at the 5% significance level, this asymmetry is not statistically confirmed; at the 10% significance level, the hypothesis of symmetry may be questioned.

The model allows identifying communities with the lowest level of efficiency in ensuring the inclusion of children from single-parent families using budget funds, taking into account resource provision and social characteristics.

Figure 3 shows the level of calculated indicated efficiency of territorial communities according to the *inclusion_share* (JLMS) indicator for 20 territorial communities. The *X*-axis shows the names of the communities, and the *Y*-axis shows the efficiency value $TE_{JLMS} \in [0,1]$.

Most effective communities (efficiency = 1): Antoniny, Zymne, Shatsk, Pidvolochysk, Skoryky, Zavodska, Liublynets, Hrebinky, Kalynivka, Vel. Berezovytsia, Vyshnivets, Velyki Birky, Ivanivka, Mykulyntsi, etc.

Slightly lower efficiency (≈0.96): Kremenets, Terebovlia, Pidhaichi, Baikivtsi, Borshchiv.

A high average level of technical efficiency demonstrates the success of communities in achieving inclusion, given the available resources. Both models indicate that infrastructure expenditures have a positive effect on the implementation of inclusion-related activities. At the same time, contextual characteristics of communities (type, presence of partnerships, average salary) do not have a decisive impact on technical efficiency within the sample. This may reflect other factors not included in the model or the influence of external conditions during the wartime period.

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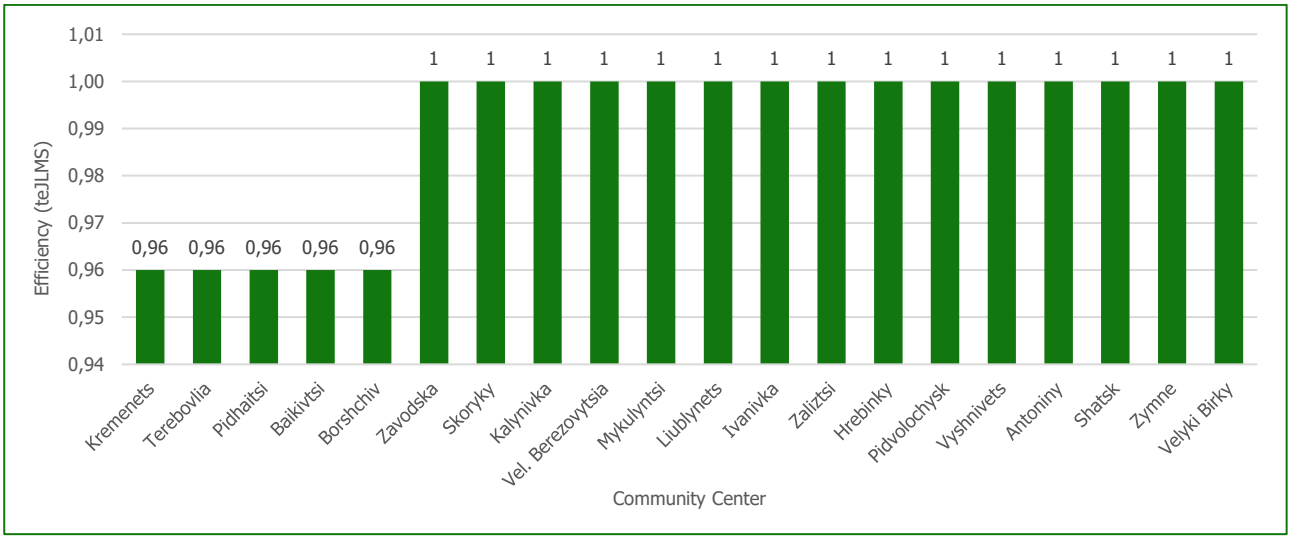

Figure 3. Estimation of the efficiency of community activities based on the share of the population in need of inclusion.

Both models allow for:

- identifying the most efficient communities in implementing activities and achieving inclusion;
- detecting efficiency reserves in the management of budget programs;
- using the estimates as an analytical basis for developing new indicators in local budget program passports.

When assessing the adequacy of indicators for SFA, low data quality and gaps in the available local budget program passports were observed. Preliminary analysis of budget program passports, which are intended to serve the interests of community beneficiaries, shows that the overall volume of budget expenditures on staffing units is often reported separately, while staffing units associated with work with children are difficult to distinguish. Some passports report expenditures on activities, but it is not always possible to identify expenditures specifically directed toward ensuring inclusion. Thus, in the budget program passports, public financial expenditures on personnel responsible for inclusion and the inclusion-related activities they carry out are not linked. At the same time, a high level of expectations regarding administrative efficiency was recorded, including a 100% positive trend in indicators such as document approval or letter processing – these indicators allow assessment of the organization of internal procedures but do not show a connection with activities aimed at inclusive community development. Therefore, it should be noted that the data presented in previous budget passports are largely procedural in nature and do not allow for a comprehensive assessment of the social effectiveness of program implementation.

At the same time, budget program passports of communities do not provide detailed information on expenditures related to the institutional coordination of activity implementation or the facilitation of interaction with other actors for achieving the objectives of state inclusion policy within a single passport and in the context of implementing a specific state policy goal. Furthermore, it is necessary to include contextual variables in the passport indicators that reflect the external environment of budget program implementation, in particular: the size of the population in the community requiring inclusion measures, the income level of the community population, and the degree of cross-sectoral interaction – i.e., the availability of capable implementers for inclusion activities.

Particular attention should be given to performance indicators that reflect the achieved (social) effect for inclusion beneficiaries (in our modeling example, children from single-parent families) rather than merely the volume of processed requests or the provision of administrative services. Focusing exclusively on procedural indicators creates a risk of formalism and reduces the validity of conclusions regarding the effectiveness of program activities. An adequate equation of efficacy requires consideration of changes in beneficiary status, the degree of social integration achieved through budget program activities (products), reductions in beneficiary vulnerability, and similar outcomes.

As a result, despite the detailed (officially approved) classification of local budget programs in Ukraine and the breakdown of their four groups of performance indicators – costs, output (product), effectiveness, and quality – the current content of budget programs and the approach to their design require more comprehensive programming for a full cost-benefit analysis under constrained budgetary resources. Specifically, this entails more consolidating budget programs by integrating particular

activities and the management into a single program aligned with budget policy, which would include inclusion indicators for beneficiaries as well as the context of budget program implementation.

Such an enhancement of budget program content would enable panel analysis using the SFA model properly and the application of computerized preliminary assessments to ensure the comprehensive effectiveness of budget programs for community members with diverse needs.

Based on the results obtained, we propose adding the following additional performance indicators to the existing groups of performance indicators in budget program passports – "output," "effectiveness," and "quality" – to enable a comprehensive assessment of the effectiveness of expenditures on inclusive development at the local government level:

1. The share of beneficiaries of inclusion (families with children raised by a single parent, in our case) covered by the budget program expenditures, relative to the total number of program beneficiaries (families in difficult life circumstances), as an output performance indicator.
2. An accessibility index of program outputs for low-mobility population groups – an efficiency performance indicator.
3. The frequency and/or percentage of involvement of representatives of vulnerable groups in providing feedback is an efficiency performance indicator.
4. The dynamics of reduction in the number of denials of assistance due to bureaucratic or procedural barriers is a quality performance indicator.

Integrating these variables allows for expanding the scope of preliminary budget program assessments with an emphasis on the equitable distribution of program outcomes and identifying causes of implementation inefficiency not only related to insufficient financial resources but also to their uneven impact on different beneficiary groups. Beneficiary profiling should be conducted based on demographic characteristics, assessment of vulnerability, and identification of access barriers (physical, digital, legal, and economic) to services funded by the budget. Thus, the proposed method for analyzing preliminary effectiveness of budget expenditures for inclusive community development ensures alignment of financial efficiency with the principle of community social inclusion.

DISCUSSION

To date, Ukrainian authors have not applied SFA modelling to budget expenditures on inclusion. The use of DEA for efficiency assessment relative to achieved benefits makes it possible to reveal under-performance at given levels of expenditure, as illustrated, for example, in (Lee at al., 2024). In contrast, we employ a parametric SFA model in order to identify and emphasise potential avenues for improving expenditure efficiency not only through adjustment of planned allocations but also through explicit interrogation of context.

In (Teodoru & Vermeulen, 2023), the authors highlight the potential of the SFA method to more precisely isolate the true efficiency of social spending; our article extends this line of argument by motivating the need to embed the parameters required for SFA assessment directly into budget programmes, which have previously not been assessed with regard to the conditions of their implementation. Tymchenko et al., pointing to the lack of indicators that capture the effect of budget programmes on inclusive development for their beneficiaries – including indicators required for gender-responsive budgeting currently mandatory for central budget fund managers in Ukraine – propose an analysis of the dynamics and structure of central government expenditure on child social protection using data on the number of children covered and per-child outlays (Tymchenko et al., 2025). In our study, we stress that the inclusion context, together with the capacity of each community, must be incorporated into specially collected data used for programming budget expenditures.

A more granular structuring of data is therefore required from responsible programme executors at the territorial community level to enable such context-sensitive efficiency analysis.

CONCLUSIONS

This article set out to develop universal models for the preliminary assessment of inclusion measures embedded in budget programme passports, using SFA as a basis for programming a unified procedure of ex-ante efficiency evaluation. The constructed SFA-based approach demonstrates that automation of preliminary assessment can compensate for the insufficient analytical capacity of local governments, while at the same time respecting the principle of unity of the budget system set by the Budget Code of Ukraine. The pilot modelling and data test confirm that, despite detailed programme passports, a full SFA

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frontier for inclusion-related expenditure remains infeasible at present due to the limited set of context-sensitive indicators available in local budget programmes.

For practical implementation, a unified SFA-based preliminary assessment and secure inter-community data exchange would enable system-level public finance auditing and evidence-based recommendations for policy and resource allocation. Such a programmed assessment reveals improvement areas, low-impact zones, and feasible reallocation scenarios capable of increasing performance within existing fiscal sources. As the panel-test task of the article showed, the main bottleneck is the lack of harmonised indicators between the communities that capture the context and the realised effects of inclusion spending.

Accordingly, the results justify the following steps:

1. Expand programme passports with indicators enabling SFA of programme context and beneficiary coverage to determine efficiency.
2. Harmonise data structure to SFA requirements and form an inter-community programme database for programmed ex-ante assessment.
3. Embed impact-oriented indicators reflecting actual changes in community life rather than procedural compliance only.
4. Carry out an approbation of the programmed preliminary assessment with explicit linkage to inclusive development based on the enriched data.

These steps are consistent with the paper's objectives to (i) construct an assessment algorithm for inclusion-linked budget programmes within public finance auditing and (ii) test panel-based SFA modelling using data available for Ukrainian territorial communities. Together, they provide a tractable pathway to operationalising programmed, context-aware efficiency assessment of inclusion expenditures in local budget governance.

Recent authoritative research on the efficiency of social and inclusion-related public spending underscores the need to move beyond single-equation or purely radial frontier models toward panel, spatial, and heterogeneity-aware SFA specifications and hybrid SFA-SBM/DEA two-stage frameworks that incorporate explicit context variables, non-radial slacks, and distributional consequences. In line with these advances, further research work on this topic should test such enriched frontier designs on harmonised multi-community microdata and benchmark their diagnostic value against prevailing audit-style performance frameworks that ignore context.

A second possible research vector is infrastructural: the construction of interoperable, programme-level data architectures and secure inter-community data exchanges that permit automated ex-ante SFA-based assessment in real time. The piloting of AI-assisted tools for programmable preliminary evaluation would supply decision-makers with high-frequency, context-corrected evidence to identify efficiency gaps and to design fiscally neutral reallocations with measurably higher inclusion impact.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

REFERENCES

1. Aerni, P. (2021). Decentralized economic complexity in Switzerland and its contribution to inclusive and sustainable change. *Sustainability, 13*(8), 4181. https://doi.org/10.3390/su13084181
2. Azarenkova, G. M., Buriachenko, A., & Zhyber, T. (2020). Anticorruption efficacy in public procurement. *Financial and Credit Activity: Problems of Theory and Practice, 2*(33), 66–73. http://dx.doi.org/10.18371/fcaptp.v2i33.206412

3. Bachfischer, A., Barbosa, M. C., Rojas, A. A. R., Bechler, R., Schwienhorst-Stich, E.-M., Kasang, Ch., Simmenroth, A., & Parisi, S. (2023). Implementing community-based inclusive development for people with disability in Latin America: A mixed methods perspective on prioritized needs and lessons learned. *International Journal for Equity in Health, 22*, 147. https://doi.org/10.1186/s12939-023-01966-8

4. Brent, R. J. (2023). Cost-benefit analysis versus cost-effectiveness analysis from a societal perspective in healthcare. *International Journal of Environmental Research and Public Health, 20*(5), 4637. https://doi.org/10.3390/ijerph20054637

5. Cabinet of Ministers of Ukraine. (2025). Tasks and indicators for achieving sustainable development goals in Ukraine until 2030. https://www.kmu.gov.ua/storage/app/sites/1/ind.80/bookmtd-goalsalbum110pagesok-3.pdf

6. Castro, M. F., Guccio, C., Romeo, D., & Vidoli, F. (2025). How does institutional quality affect the efficiency of local government? An assessment of Italian municipalities. *Economia Politica, 42*, 1–29. https://doi.org/10.1007/s40888-025-00359-0

7. Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). An introduction to efficiency and productivity analysis (2nd ed.). Springer Science & Business Media. https://dl.icdst.org/pdfs/files/3a67240be4e2274e4c95655ec16931de.pdf

8. Dushkova, D., & Ivlieva, O. (2024). Empowering communities to act for a change: A review of the community empowerment programs towards sustainability and resilience. *Sustainability, 16*(19), 8700. https://doi.org/10.3390/su16198700

9. European Union. (2012). European Charter on Fundamental Human Rights. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012P/TXT

10. Horyn, V. P. (2020). Debatable issues of the essence and criteria for evaluating the efficiency of budget management. *Economics and the State, 5*, 155–160. https://doi.org/10.32702/2306-6806.2020.5.155

11. Hrytsenko, K., Hrytsenko, A., & Mogilina, A. (2021). Assessing the efficiency of health care system functioning. *Economic Analysis, 31*(4), 5–18. http://dx.doi.org/10.35774/econa2021.04.005

12. Illiashenko, T. O., Illiashenko, K. V., & Kotenko, N. V. (2015). Program-target financing of local budget expenditures: Debatable issues of efficiency evaluation. *Global and National Problems of Economy, 5*, 857–862.

13. Jondrow, J., Lovell, C. K., Materov, I. S., & Schmidt, P. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. *Journal of Econometrics, 19*(2–3), 233–238. http://dx.doi.org/10.1016/0304-4076(82)90004-5

14. Kizyma, A., & Lobodina, Z. (2021). Transformation of budgeting technologies in the context of ensuring inclusive sustainable growth of the state. *World of Finance, 1*(66), 24–37. https://doi.org/10.35774/sf2021.01.024

15. Kotina, H. M., Stepura, M. M., & Rudyk, N. V. (2018). Measuring efficiency in the public finance management system: World experience and implementation in Ukraine. *Economics of Development, 2,* 49–61.

16. Krysovatyy, A., Ptashchenko, O., Kurtsev, O., & Ovagim, A. (2024). The concept of inclusive economy as a component of sustainable development. *Problemy Ekorozwoju, 19*(1), 164–172. https://doi.org/10.35784/preko.5755

17. Lee, J., Babcock, J., Pham, T. S., Bui, T. H., & Kang, M. (2023). Smart city as a social transition towards inclusive development through technology: A tale of four smart cities. *International Journal of Urban Sciences, 27*(sup1), 75–100. http://dx.doi.org/10.1080/12265934.2022.2074076

18. Lee, L. W., Chiu, Y. H., Liu, F. P., Lin, T. Y., & Chang, T. H. (2024). Valuating the efficiency of social security and healthcare in OECD countries from a sustainable development. *Cost Effectiveness and Resource Allocation, 22*(1), 53. https://doi.org/10.1186/s12962-024-00555-y

19. Meier, S., Bertelmann, L., & Wissenbach, L. (2024). Inclusive Localities: Perspectives on Local Social Policies and Practices (p. 250). Verlag Barbara Budrich. https://doi.org/10.3224/84743017

20. Montero, S., & Medina-Garzón, A. M. (2021). Inclusive leadership and local economic development: Perspectives from Latin American peripheral regions. *Handbook on City and Regional Leadership*, 266–279. http://dx.doi.org/10.4337/9781788979689.00025

21. Newman, B. A., & Thomson, R. J. (1989). Economic growth and social development: A longitudinal analysis of causal priority. *World Development, 17*(4), 461–471. https://doi.org/10.1016/0305-750X(89)90255-6

22. Ogon, T. H. (2009). Program-target method and efficiency of budget programs. Finance of Ukraine, 7, 20–29. http://irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Fu_2009_7_3.pdf

23. Olaghere, A., Wilson, D. B., & Kimbrell, C. (2023). Inclusive critical appraisal of qualitative and quantitative findings in evidence synthesis. *Research Synthesis Methods, 14*(6), 847–852. https://doi.org/10.1002/jrsm.1659

24. Ondrich, J., & Ruggiero, J. (2001). Efficiency measurement in the stochastic frontier model. *European Journal of Operational Research, 129*(2), 434–442. http://dx.doi.org/10.1016/S0377-2217(99)00429-4

25. Organisation for Economic Co-operation and Development (OECD). (2024). Inclusive infrastructure: Scaling-up local investment in the United States. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/02/inclusive-infrastructure-scaling-up-local-investment-in-the-united-states_dd507433/4c8c6c4e-en.pdf

26. Pawlik, M., Takabatake, T., Shiroshita, H., Jayaratne, R., Haddad, H., Kitagawa, K., & Hasegawa, N. (2025). Agent-based modelling for flood evacuation as inclusive disaster risk reduction: Pilot participatory action research with 11- and 12-year-old children from a Japanese school.

DOI: 10.55643/fcaptp.1.66.2026.5030

International Journal of Disaster Risk Reduction, 117, 105180. https://doi.org/10.1016/j.ijdrr.2025.105180

27. Public-Private Infrastructure Advisory Facility (PPIAF). (2025). Project planning, development and delivery. https://inclusiveinfra.gihub.org/action-areas/project-planning-development-and-delivery

28. Ren, Y., He, X., Jiang, Q., Zhang, F., & Zhang, B. (2024). Advancing high-quality development in China: Unraveling the dynamics, disparities, and determinants of inclusive green growth at the prefecture level. *Ecological Indicators, 169,* 112898. http://dx.doi.org/10.1016/j.ecolind.2024.112898

29. Rudyk, N. V. (2023). Program-target budgeting at the level of local budgets for sustainable community development. *Investments: Practice and Experience, 11*, 44–51. https://doi.org/10.32702/2306-6814.2023.11.44

30. Shvets, N., Kovalenko, Y., Kostiuk, V., Chala, V., Romanchukevych, V., & Babenko, A. (2025). Financial provision of peace and justice in Ukraine in the context of achieving the sustainable development goals. *Financial and Credit Activity: Problems of Theory and Practice, 1*(60), 82–93. https://doi.org/10.55643/fcaptp.1.60.2025.4607

31. Sultana, S., Hossain, M. M., & Haque, M. N. (2023). Estimating the potato farming efficiency: A comparative study between stochastic frontier analysis and data envelopment analysis. *PLOS ONE, 18*(4), e0284391. https://doi.org/10.1371/journal.pone.0284391

32. Teodoru, I. R., & Vermeulen, M. R. (2023). Spending Efficiency and Reforms: France. International Monetary Fund. https://doi.org/10.5089/9798400236334.018

33. Tymchenko, O., Buriachenko, A., Dehtiarova, N., & Tsiupa, O. (2025). Redesign of budget programs based on a human-centered approach in an inclusive environment. *Finance of Ukraine, 2,* 27–42. https://doi.org/10.33763/finukr2025.02.027

34. United Nations Human Rights. (1989). Convention on the Rights of the Child. https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child

35. World Bank Group. (2025). Community and Local Development. https://www.worldbank.org/en/topic/communitydrivendevelopment#3

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МОДЕЛЮВАННЯ SFA ЯК ІНСТРУМЕНТ ДІАГНОСТИКИ ЕФЕКТИВНОСТІ БЮДЖЕТНИХ ВИДАТКІВ НА ІНКЛЮЗИВНИЙ РОЗВИТОК ГРОМАД

Дослідження присвячене проблематиці інклюзивного розвитку на рівні місцевих громад України, що набуває особливої ваги в умовах демографічних змін і наслідків воєнних дій. Обґрунтовано необхідність комплексної оцінки ефективності бюджетної підтримки соціальної інклюзії з акцентом на дітей, яких виховують у неповних сім'ях. Така оцінка має враховувати не лише повноту фінансового забезпечення, визначеного в паспортах бюджетних програм, а й спроможність їх реалізації та ступінь безпосереднього зв'язку з бенефіціарами. Для досягнення цілей дослідження застосовано метод стохастичного граничного аналізу (SFA), який дає змогу відокремити неефективність від випадкових збурень за рахунок поділу стохастичних складових на симетричну (випадкову) та асиметричну (пов'язану з неефективністю). Розроблено дві моделі (в середовищі R): для оцінки ефективності бюджетної підтримки соціальної інклюзії та для аналізу включення дітей із неповних сімей до програм розвитку громад. Це дозволяє виокремити громади з найбільш ефективним використанням бюджетних ресурсів, а також ті, де потенціал інклюзивного розвитку залишається нереалізованим. Апробація моделювання на практичних даних виявила два ключові результати: в Україні відсутній повний обсяг даних, необхідних для моделювання попередньої оцінки бюджетних видатків, пов'язаних з інклюзивним розвитком; чинна структура паспортів бюджетних програм не інтегрує видатків на персонал і діяльність інституцій із реалізованими ними заходами, а наявні дані є надмірно укрупненими, фрагментованими та несумісними між громадами. Запропонований підхід може бути використаний як аналітичний інструмент для формування державної політики соціальної інклюзії та оцінки ефективності відповідних бюджетних програм на місцевому рівні, а також як основа для вдосконалення реалізації політики інклюзивного розвитку в царині місцевого самоврядування України.

Ключові слова: стохастичний граничний аналіз (SFA), видатки бюджету, ефективність видатків бюджету, оцінка ефективності видатків бюджету, інклюзивний розвиток громад, публічні фінансові ресурси, паспорти бюджетних програм, соціальні трансферти, аудит публічних фінансів

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