

The Fiscal Self-Sufficiency of Romania's LAU and the Optimal Population Threshold for Amalgamation

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Abstract

This paper examines the fiscal sustainability of Romania's administrative-territorial units (ATUs, corresponding to the EU regional LAU level) and evaluates whether territorial consolidation through merger represents a viable instrument for increasing their fiscal self-sufficiency (the ratio of own revenues over necessary expenses).

The methodology combines two-way fixed-effects econometric models with iterative territorial consolidation simulations at population thresholds ranging from 0 to 40,000 inhabitants (in steps of 2,500). Simulated LAU fiscal behavior is estimated retroactively, and scenarios are evaluated through an opportunity score weighing self-sufficiency parameters while penalizing excessively large surface areas. Responses across development regions and across rural and urban environments are further analyzed using Spearman tests. A statistical mathematical model is also proposed to estimate the optimal population threshold without relying on the more cumbersome iterative method.

Depending on the chosen method of estimating resulting personnel costs (whether a singular administrative apparatus of similar size is appropriate for the new LAU or if it's size must be correlated with the resulting population), the optimal population threshold changes. Three scenarios are simulated and the resulting optimal thresholds and savings differ while also suggesting that the current rural city halls are overinflated. Regions also respond differently to the amalgamation effort, converging differently on mean self-sufficiency and self-sufficient LAU coverage. The mathematical instrument produces similar thresholds for the same three scenarios.

With a rational and well-chosen estimation tactic, the merger effort produces a generally auto-sufficient administrative map with no change to taxation, fiscal policy or population distribution. Because of the difference in convergence rate across regions, a targeted reform policy should be implemented region-wide alongside the amalgamation, addressing the unique challenges each region faces.

Keywords

Fiscal sustainability, LAU self-sufficiency, administrative reform, mergers, regional disparities, Romania

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Introduction

Romania currently faces a budget deficit of 7.65% of GDP for 2025 and an austerity package that raises an uncomfortable but necessary question: how many of the country's 3,000+ LAU can justify their existence as independent administrative entities, given the populations they serve and the costs they generate? This study aims to fill a gap in the literature by empirically evaluating consolidation as a remedy, using budgetary execution data for all Romanian LAUs (2014–2024) combined with demographic and geographic data.

Romania's rural areas, which predominantly consists of communes, face severe structural deficiencies: lack of infrastructure for drinking water, gas, education, healthcare, and sanitation (Petrescu-Mag et al., 2022). These conditions drive emigration of working-age populations, leaving behind an aging demographic (Burlacu, et al., 2022). Non-agricultural sectors are underdeveloped, and public policies, including EU Cohesion Policy programs, are effectively designed for and captured by urban centers with the administrative capacity to access and implement them (Muntele et al., 2021).

As a result, few communes can cover their operational needs from own revenues, and many cannot even cover personnel costs (Istrate & Muntele, 2024). A persistent depopulation trend in favor of the Bucharest-Ifov region and other urban centers has destabilized the fiscal base, labor force, and economic prospects of the regions left behind (Dentinho & Serbanica, 2020).

Three hypotheses are tested:

Hypothesis 1: Consolidation of LAUs increases their fiscal profitability (the net gain in own revenues relative to necessary expenditures per inhabitant)

Hypothesis 2: There exists an optimal population threshold at which LAUs achieve a reasonable combination of served population, fiscal self-sufficiency, and administrative surface area.

Hypothesis 3: Romania's development regions face structurally different fiscal pressures, reflected in different regional responses to the effects of consolidation.

The paper is structured as follows: Section 1 reviews the European and national context and the comparative evidence on administrative fragmentation; Section 2 describes the research methodology, data, and consolidation simulation approach; Section 3 presents the results and the mathematical instrument for threshold estimation; Section 4 discusses the findings. The paper concludes with policy implications.

1. Literature Review

At the European level, NUTS-2 regions are the primary unit for EU cohesion policy and the only level eligible for structural funds. Studies consistently reveal significant disparities between regions, particularly regarding fiscal sustainability and administrative capacity (Ionescu et al., 2021). At the LAU level, the tier closest to citizens, an urban-rural conflict prevails, with lagging areas suffering structural difficulties, inequality, and administrative inefficiency (Perancho et al., 2025), while working-age populations migrate toward urban centers (Ghio et al., 2023).

Following the 2008 financial crisis, several European countries pursued territorial reform, including Greece, Denmark, Germany, Latvia, and Estonia, to strengthen local fiscal sustainability through economies of scale. Romania moved in the opposite direction: since 1991, 235 new LAU divisions have occurred, driven by political, cultural, or electoral motivations, without systematic assessment of long-term fiscal viability. The minimum population requirement of 1,500 inhabitants post-separation failed to anticipate subsequent demographic decline, leaving many newly created units structurally incapable of financing their own administration (Stănuș, 2021).

Comparative European evidence confirms the pattern. In Portugal, municipal fragmentation increased central transfer costs and prevented economies of scale (Tavares & Rodrigues, 2015). In Slovakia, units below 1,000 inhabitants lack sufficient and specialized personnel, and delegated responsibilities go unmet (Bryson, 2008). In Germany, units below 3,000 inhabitants are financially weak, politically marginal, and dependent on property taxation that accelerates urban migration (Kallert & Dudek, 2025). In Latvia, units below 4,000 inhabitants show the lowest per-capita revenues, the highest subsidy dependence, and the steepest depopulation rates (Nipers et al., 2017).

Romania's rural communes follow the same trajectory: deindustrialization, fragmented agriculture, a vicious cycle of poverty and infrastructure degradation, and institutional helplessness that deepens structural disadvantage (Mikulcak et al., 2015).

2. Research Methodology

2.1 Research objectives and hypotheses

This study aims to fill a gap in the literature by empirically evaluating consolidation as a remedy, using budgetary execution data for all Romanian ATUs (2014–2024) combined with demographic and geographic data.

We run three scenarios, one which assumes the current personnel costs are rational and correctly dimensioned for the current population, one which assumes the same but excluding the budget data for LAUs below 25 000 citizens and one which assumes that a singular administrative apparatus of the same size as the already existing ones is appropriate to govern over a larger surface area.

2.2 Data source and processing

Budgetary data comes from the Ministry of Development, covering all Romanian LAUs from 1999–2024, restricted to 2014–2024. Three dependent variables are constructed: own revenues; necessary expenditures (personnel costs, goods and services, and debt interest; and a fiscal self-sufficiency index A = own revenues / necessary expenditures. A value above 1 indicates a LAU can cover its essential costs from own revenues; below 1 signals structural dependence on central transfers.

Population data comes from the 2011 and 2021 national censuses, with annual estimates for 2014–2024 obtained via linear interpolation and extrapolation. Geographic data comes from ANCP GeoPackage files, used to determine geographic adjacency between LAUs (a prerequisite for consolidation simulations) and to produce cartographic visualizations of results.

A two-way fixed-effects panel regression is used to isolate unit-specific effects (institutional capacity, fiscal policy, local economic base) from time-specific effects (macroeconomic shocks, legislative changes). For revenues and necessary expenditures, the log-log (1) specification is used, while for the self-sufficiency index, the semi-log form (2) is used given its smaller range of variation.

$$\ln(Y_{it}) = \beta \cdot \ln(P_{it}) + \alpha_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where:

Y_{it} = the budgetary variable of LAU i in year t

P_{it} = the population of LAU i in year t

α_i = the unit effect of the LAU, accounting for its unique fiscal pressure and profile

β = the model's coefficient, understood as an elasticity measure (1% change in population results in $\beta\%$ change in the variable)

γ_t = the temporal effect, account for economic shocks or events common to all LAUs

ε_{it} = residual

$$A_{it} = \beta_A \cdot \ln(P_{it}) + \alpha_{Ai} + \gamma_{At} + \varepsilon_{Ait} \quad (2)$$

For each population threshold τ (ranging from 0 to 40,000 in steps of 2,500), LAUs below the threshold are marked as consolidation candidates. They are grouped iteratively under two constraints: all members must belong to the same county and must be geographically adjacent. Groups expand until the cumulative population meets or exceeds τ , or no adjacent candidates remain. Isolated LAUs below the threshold are assigned to the nearest same-county group with the smallest total population. Budgetary indicators are aggregated by summing revenues and expenditures across member LAUs. Personnel costs are modeled using (3), regressed on the original data and excluding unit effects, under the assumption that consolidated units would rationalize administrative staffing to match their new population size. For the same-size administrative apparatus approach, personnel costs are calculated with a weighed average of the comprising units' personnel cost weighed by their population.

$$\ln(ChP_{it}) = \beta \cdot \ln(P_{it}) + \gamma_t \quad (3)$$

Each scenario and year combination is scored by an opportunity index (4) and averaged for years 2014 and 2024 to account for a heavily inflated payroll in years 2019–2022. The optimal threshold is the one maximizing this score (5).

$$k_t = \frac{10^4 \cdot \beta_A \cdot \bar{A}_t \cdot A_{x>1,t}}{\bar{S}} \quad (4)$$

$$K = \frac{k_{2014} + k_{2024}}{2} \quad (5)$$

Regional response to the amalgamation effort will be tested using a Spearman convergence test (Spearman, 1904), which will highlight if regions converge differently in the procentual coverage of self-sufficient LAUs and average self-sufficiency.

3. Results

3.1 The iterative method

The number of LAUs decreases drastically even for low population thresholds, indicating that there are many underpopulated units (Fig. 1). Not all estimation methods produce positive results, as including the sub-25k units generates a pattern of over-expenditure, while the other methods generate substantial savings on personnel costs. The decreased marginal effect for both self-sufficiency and savings can be observed in a section for 2024 (Figure 2), which favors the argument that bigger thresholds are not necessarily appropriate nor beneficial if surface is taken into account.

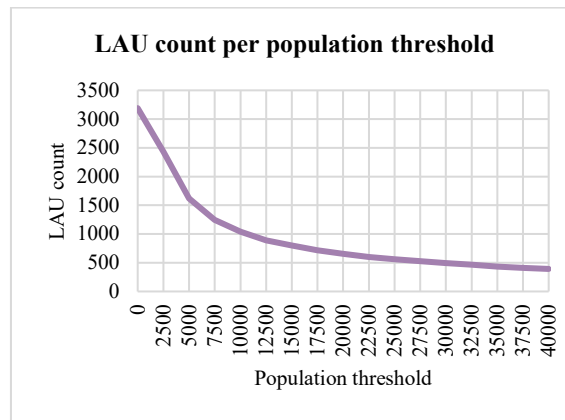


Figure no. 1. LAU count per population threshold

Source: Extracted from the resulting data computed over the budgetary reports from MDLPA

The intrinsic mean deficit is estimated as the difference of mean revenues and expenses, computed from the model regressions using (6) and the mean values for population, and own revenues or necessary expenses. These, along with the final scores, are illustrated in Fig. 3. The optimal population thresholds are 2500, 5000 and 12500 respectively. The intrinsic mean deficit reduces around the optimal threshold, however the full data set simulation method produces bigger deficits than the unmodified situation, while the other two produce reduced deficits.

$$\overline{\Delta Y} = \beta * \frac{\bar{Y}}{\bar{P}} * \overline{\Delta P}, \quad \text{where } \overline{\Delta P} = 1 \text{ person} \quad (6)$$

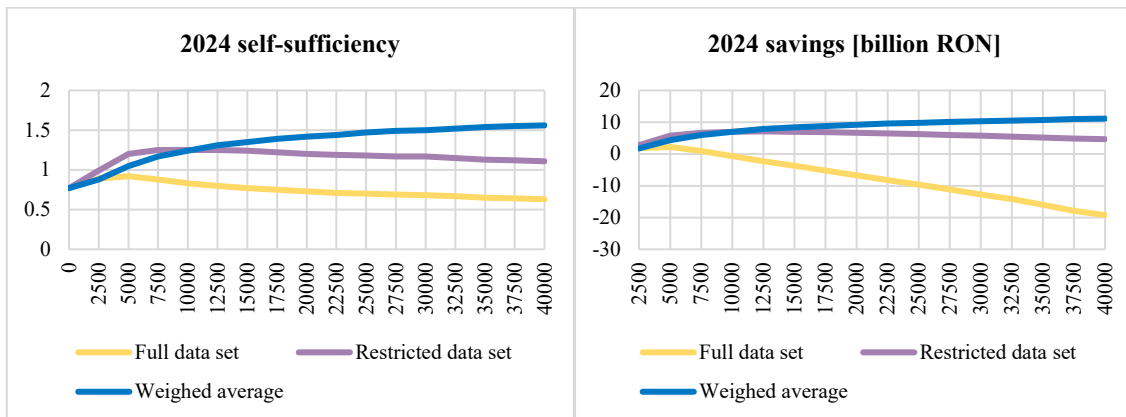


Figure no. 2. – A 2024 section for self-sufficiency and savings for each method

Source: Extracted from the resulting data computed over the budgetary reports from MDLPA

Isolating the LAUs that correspond to each region, a Spearman convergence test was conducted which revealed that regions respond differently to the merger effort. Some unfavorable regions showed big steps in self-sufficiency, while others improved slowly starting from an already good position. The distribution of originally self-sufficient LAUs is also not the same across regions, with a significant presence in North-West, West, Center, South-Muntenia.

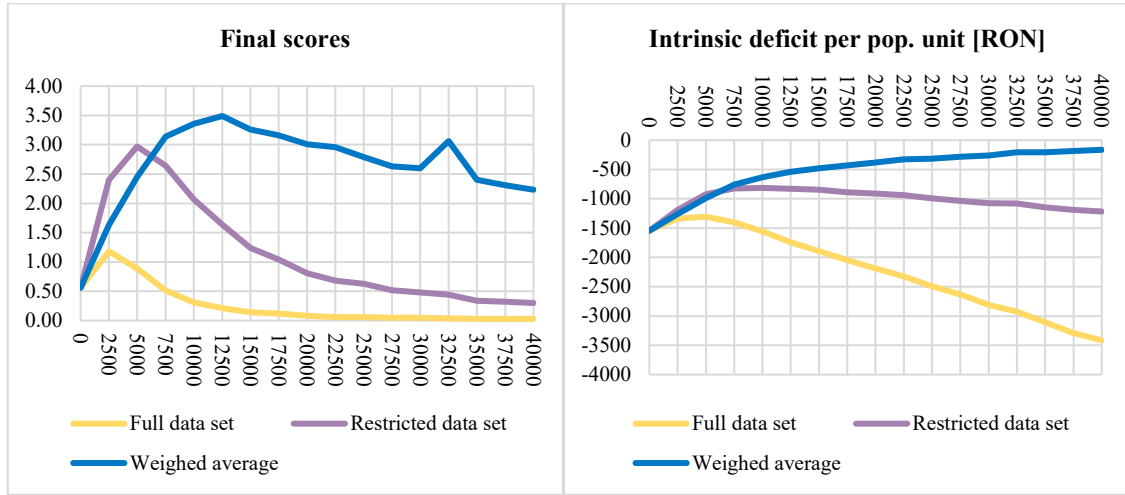


Figure no. 3. Final scores and intrinsic deficit per threshold for all methods

Source: Extracted from the resulting data computed over the budgetary reports from MDLPA

3.2 The mathematical instrument

Since testing all thresholds is time-costly even for automated tools, the question arises whether the optimal threshold can be estimated through a statistical mathematical instrument, taking into account the criteria by which LAUs were merged and the way they were evaluated. To derive an analytical formula for the optimal threshold configurable with the parameters of any given state, the annual score formula is rewritten and simplified as a function of threshold and selected year (7).

$$k(\tau, t) = \frac{10^3 \cdot \bar{A}(\tau, t) \cdot A_{x>1}(\tau, t)}{\bar{S}(\tau)} \quad (7)$$

On the original dataset with N LAUs, the following values or series are computed:

- the total population $P(t)$ and the maximum population of a LAU $P_{max}(t)$ for each year t
- the function $p_1(x < \tau) = \Phi(\tau, t)$, representing the cumulative frequency of LAUs with population below τ in year t , for $\tau \in [0, P_{max}]$
- the function $p_2(x < \tau) = \Phi_{p,A \geq 1}(\tau, t)$, representing the cumulative frequency of LAUs with population below τ in year t , but with self-sufficiency ≥ 1 , for $\tau \in [0, P_{max}]$
- the function $P_{<\tau}(\tau, t)$, representing the total population of all LAUs with population below τ in year t , for $\tau \in [0, P_{max}]$
- The total surface area of the state S
- the function $\bar{V}_{<\tau}(\tau, t)$, representing the mean own revenue per LAU for all LAUs with population below τ in year t , for $\tau \in [0, P_{max}]$
- the function $\bar{C}_{<\tau}(\tau, t)$, representing the mean necessary expenditures per LAU for all LAUs with population below τ in year t , for $\tau \in [0, P_{max}]$
- the function $\bar{CP}_{<\tau}(\tau, t)$, representing the mean personnel costs per LAU for all LAUs with population below τ in year t , for $\tau \in [0, P_{max}]$.
- The global mean self-sufficiency $\bar{AG}(t)$ and the maximum self-sufficiency $A_{max}(t)$ for each year t
- the function $a(x < \alpha) = \Phi_A(\alpha, t)$, representing the cumulative frequency of LAUs with self-sufficiency below α in year t , for $\alpha \in [0, A_{max}]$

- k) the function $\sigma_A(a, t)$, representing the standard deviation of self-sufficiencies for all LAUs with self-sufficiency below α in year t , for $\alpha \in [0, A_{max}]$

As these are computed on the original data set in a non-continuous matter, a suitable resolution for τ and α must be chosen. In our case, we used a resolution of 100 for τ and 0.01 for α .

If the method of personnel costs recalculated through estimation using the two-way fixed-effects model is desired, the dataset will be filtered to include the LAUs considered representative of the desired behavior, and the personnel cost model regression is performed, yielding β_{cp} and the set of temporal effects γ_t .

If the method of personnel costs weighted-averaged across the amalgamated LAUs is desired, the function $\overline{CPP}_\tau(\tau, t)$ is computed, representing the mean personnel costs per LAU for all LAUs with population below τ in year t , weighted by the population of the LAUs, for $\tau \in [0, P_{max}]$.

We denote $N_{<\tau}(\tau, t) = N \Phi(\tau, t)$ as the number of LAUs with population below τ , iar $N_{\geq\tau}(\tau, t) = N(1 - \Phi(\tau, t))$ as the number of LAUs with population greater than or equal to τ . Since the goal of amalgamation is to form LAUs with a minimum population of τ , the number of newly formed LAUs is estimated as:

$$N_{new}(\tau, t) = \frac{P_{<\tau}(\tau, t)}{\tau} \quad (8)$$

The mean surface area per threshold and year is expressed as:

$$\bar{S}(\tau, t) = \frac{S}{N_{new}(\tau, t) + N_{\geq\tau}(\tau, t)} \quad (9)$$

The average LAU with population below the threshold will have the following mean self-sufficiency in year t :

$$\bar{A}_{LAU}(\tau, t) = \frac{\bar{V}_{<\tau}(\tau, t)}{\bar{C}_{<\tau}(\tau, t)} \quad (10)$$

We estimate the mean own revenues and mean necessary expenditures of the newly formed LAUs as follows:

$$\bar{V}_{new}(\tau, t) = \frac{N_{<\tau}(\tau, t) \bar{V}_{<\tau}(\tau, t)}{N_{new}(\tau, t)} \quad (11)$$

For the simulated personnel cost method, we use:

$$\bar{C}_{new}(\tau, t) = \frac{N_{<\tau}(\tau, t) (\bar{C}_{<\tau}(\tau, t) - \overline{CP}_{<\tau}(\tau, t)) + N_{new}(\tau, t) \tau^{\beta_{cp}} e^{\gamma_t}}{N_{new}(\tau, t)} \quad (12)$$

And for the weighted-averaged personnel costs method we use:

$$\bar{C}_{new}(\tau, t) = \frac{N_{<\tau}(\tau, t) (\bar{C}_{<\tau}(\tau, t) - \overline{CP}_{<\tau}(\tau, t)) + \overline{CPP}_\tau(\tau, t)}{N_{new}(\tau, t)}$$

The mean self-sufficiency for the newly formed LAUs then becomes:

$$\bar{A}_{LAU_new}(\tau, t) = \frac{\bar{V}_{new}(\tau, t)}{\bar{C}_{new}(\tau, t)} \quad (13)$$

We adjust the global mean self-sufficiency by removing the amalgamated LAUs and adding the newly formed LAUs for a given year t and threshold τ given:

$$\bar{A}(\tau, t) = \frac{N \bar{AG}(t) - N_{<\tau}(\tau, t) \bar{A}_{LAU}(\tau, t) + N_{new}(\tau, t) \bar{A}_{LAU_new}(\tau, t)}{N_{\geq\tau}(\tau, t) + N_{new}(\tau, t)} \quad (14)$$

A normal distribution of the newly generated self-sufficiency is assumed, centered around $\bar{A}_{LAU_new}(\tau, t)$ and with a standard deviation of $\sigma_A(1, t)$. The number of LAUs that become self-sufficient is estimated as:

$$N_{new, A \geq 1}(\tau, t) = \frac{N_{new}(\tau, t)}{2} \left(1 + \operatorname{erf} \left(\frac{\bar{A}_{LAU_new}(\tau, t) - 1}{\sigma_A(1, t)} \right) \right) \quad (15)$$

where $\operatorname{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-x^2} dx$ (Gauss error function)

The share of self-sufficient LAUs is estimated as:

$$A_{x>1}(\tau, t) = \frac{N \left(1 - \Phi_A(1, t) - \Phi_{P, A \geq 1}(\tau, t) \right) + N_{new, A \geq 1}(\tau, t)}{N_{\geq \tau}(\tau, t) + N_{new}(\tau, t)} \quad (16)$$

The final score is calculated as the average over a set of representative years selected according to the specifics of each year, excluding years deemed atypical:

$$K(\tau) = \text{average}(k(\tau, t)), \quad \text{selected } t \quad (17)$$

$K(\tau)$ is computed for $K(\tau)$ for $\tau \in [0, P_{max}]$ and we select $\tau_{optimal}$ where $K(\tau_{optimal}) = \max$.

4. Discussions

Structural factors play a significant role in LAU budgets: units react proportionally to population fluctuations, but different fiscal bases or expenditure profiles can produce opposite self-sufficiency outcomes at the same population size. Average profitability is negative across all simulated scenarios, meaning necessary expenditures grow faster than own revenues per inhabitant, a consequence partly of VAT being collected centrally and redistributed, rather than accruing directly to LAUs. Profitability improves as the minimum population threshold rises, driven by two effects: heavily deficit-ridden communes are eliminated, and urban centers gain greater weight in the consolidated system.

Comparing the three modelling variants, the weighted-average and restricted-simulation approaches both generate meaningful savings, while the unrestricted simulation produces higher personnel costs than the baseline, illustrating that reproducing system-wide administrative behavior in new units creates oversized apparatuses. The restricted variant yields self-sufficiency values close to 1 (a realistic minimum), while the weighted-average variant yields higher values but may reflect oversized existing rural administrations. The true optimum lies between the two and the administrative reality must be balanced with the need for savings. Self-sufficiency with minimal impact should be the guideline for any future policy.

The optimal thresholds identified are 2,500 inhabitants (unrestricted simulation), 5,000 (restricted simulation), and 12,500 (weighted average). Beyond these thresholds, marginal self-sufficiency gains diminish while administrative surface areas grow unmanageably. The gap between the 5,000 and 12,500 thresholds provides evidence of rural administrative oversizing. The mathematical model also produces similar results, with a maximum of one step error: 3600, 4400 and 10000. The differences are explained by the territorial constraints that guide the merger algorithm (LAUs must remain whole and must be adjacent), which are absent in the instrument.

Regions along Romania's development axis, connecting the Black Sea coast through Bucharest, southern Transylvania, and westward to Timișoara, corresponding to the South-East, South-Muntenia, Bucharest-Ilfov, Centre, and West regions, which show higher baseline self-sufficiency. Consolidation produces a relatively smaller relative gain here, as these regions already contain more developed urban and rural centers. The North-West, North-East, and South-West Oltenia regions show lower baseline self-sufficiency but achieve the largest relative gains after consolidation, suggesting their primary fiscal burden lies in administrative overhead rather than structural economic weakness.

Conclusions

All three hypotheses are confirmed. Consolidation increases profitability; an optimal population threshold exists; and regions respond differently, reflecting structurally distinct fiscal pressures. A uniform national consolidation policy applied at a single threshold would produce unequal effects, as regions outside the development axis require complementary regional fiscal policies addressing their economic base, not just their administrative structure. Consolidation is a necessary, efficient but insufficient instrument.

Choosing the right method to estimate personnel costs also greatly influences the result of the amalgamation. Using the unmodified general behavior resulted in higher costs with no self-sufficiency improvement, while restricting the resulting city hall size proved to have great benefits. The grouping algorithm may also be insufficient, as it does not take into account the cultural, geographic, and infrastructural differences between adjacent LAUs. Romania's referendum requirement also poses a major threat to the success of such effort, as any territorial reorganization must pass the population's vote.

Other limitations include the exclusion of redistributed VAT from own revenues, which removes a part of the LAU's true fiscal capacity, and the omission of transition costs, particularly the need for secondary service points in larger merged territories lacking adequate public transport. Future research should incorporate VAT redistribution into the revenue model and disaggregate own revenue composition by county and region to better calibrate optimal thresholds to local economic profiles.

Generative Artificial Intelligence (GenAI) usage statement:

Claude Sonnet 4.6 by Anthropic was used to generate the Python scripts used to process the data and results. LeapSpace by Elsevier was used to search for relevant articles during literature review. No generative AI was used in the writing of the manuscript.

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