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Estimating the Fiscal Impacts of the Proposed Georgian LSG Reform

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1. Summary

The Government of Georgia (GoG) is currently preparing a new Local Self Government Code that will introduce significant modifications to the structure of local-self-governments (LSGs) in Georgia. Currently, Georgia has 63 LSGs (excluding Tbilisi and those areas not under Georgian control). If the proposed law is approved in Parliament, it would increase the number of LSG units dramatically: according to the GoG, by 2015 there would be close to 120 LSGs, and by 2018, approximately 240 LSGs overall. At time of writing, the draft Code was still under discussion by the GoG, prior to its introduction to Parliament.

This policy proposal has generated considerable debate, particularly with respect to its eventual costs. Thus, as a contribution to the policy reform process prior to its finalization and introduction to the Parliament, in August 2013 the G3 program contracted the International School of Economics at Tbilisi State University (ISET) to carry out a study of the fiscal implications of the GoG's proposal to increase the number of municipalities.[1] In designing the study, G3 consulted with the Ministry of Finance (MoF), which agreed to provide ISET with all of the necessary fiscal data on LSG revenues and expenditures. The ISET researchers, too, conferred with the MoF on the data sources and also with representatives of the Ministry of Regional Development and Infrastructure (MRDI) on the scope and timing of the proposed territorial reform.

The proposed reform is motivated by the so-called Subsidiarity Principle, calling for a maximal decentralization of governmental administration, as local governments are arguably better informed about local circumstances and can therefore make decisions that better fit local preferences and needs. The advantages of subsidiarity are not necessarily monetary, but may, for example, come in the form of higher legitimacy of government decisions. At the same time, according to the theory of fiscal federalism, an LSG should only execute those government functions that are primarily of local relevance, as the decentralized management of tasks that span larger regions typically gives rise to inefficiencies. For instance, so-called spillover effects lead to an undersupply of governmental services, as some local governments can have a free-ride on the public services that are provided by their neighboring municipalities.

[1] Other aspects of the GoG's proposed reform, like the establishment of regional unions of LSGs, village councils, and the changes in LSG competencies and responsibilities, are not taken into account in this study.

In response to concerns about the increase in the costs, in the draft Code circulated by MRDI, there are provisions to limit the number of LSG employees. According to MRDI, at the end of 2012 there were approximately 13,000 direct employees of the LSGs. The reform includes a formula-based limit on the maximum number of direct LSG employees in each municipality. Indeed, the proposed formula would result in limiting the total number of employees in 240 LSGs to 13,000 (i.e. redistributing the existing positions).

In this study, we estimate what the annual additional cost will be of dividing the existing set of 62 LSGs (without Tbilisi or Batumi) to create either 124 or 248 LSGs in total (i.e., dividing the existing LSGs by two or by four on average).[2] Comparative research on local self-governments, which is cited in this study, consistently shows that dividing LSGs into smaller units can increase the overall operating costs, owing to a large component of fixed costs in service provision, i.e., the costs associated with having an "installed capacity" to provide services. Often the fixed costs will outweigh possible savings through decreasing returns to scale in the provision of public services, which are observed in many countries. In addition, the analysis looks at the impact of the GoG's proposed measure to limit the number of employees in each LSG.

We find that Georgia is similar to other countries in these respects: increasing the total number of LSGs will incur some savings in the variable costs, but these savings are outweighed by the increased fixed costs. Thus, the research results presented here show that in Georgia, there is a clear policy trade-off between having smaller LSGs, which would be closer to voters and service users, and the higher overall costs of a larger number of LSGs. Specifically, we show that total costs of LSG service production in Georgia are made up of a fixed cost component, and a variable cost component that grows exponentially in the number of citizens served; that also grows exponentially in the geographical extension (measured in square kilometers); that grows linearly according to the population density. The parameters of the relationship between the LSG costs and these three variables are estimated econometrically.

[2] The econometric analysis is based on expenditure data of 62 Georgian municipalities for the years 2010-12 and characteristic data (population, area, etc.). Batumi, due to its outstandingly high budget, is excluded from the analysis as a statistical outlier.

We apply our methodology to four different policy scenarios, which reflect the ongoing discussions about the reform proposal, i.e., the number of new LSGs that will be created (a total of about 120 LSGs or about 240 LSGs); and the possibility of putting limits on the number of LSG employees.[3]

- In Scenario 1, we divide each of the existing 62 LSGs by 4 to create 248 LSGs overall. We assume that there are no restrictions on LSG personnel expenditures. The country-wide increase in the yearly running costs would then be about 709 million lari.
- In Scenario 2, we again divide each of the existing 62 LSGs by 4 to create 248 LSGs overall, but we assume that the total number of direct LSG employees would remain constant. In this case, we estimate the country-wide increase of the annual running costs to be about 384 million lari.
- In Scenario 3, we divide each of the existing 63 LSGs into 2 to create only 126 LSGs overall, while we assume no restrictions on the personnel costs. The result is an estimated country-wide cost increase of about 169 million lari.
- Finally, Scenario 4 assumes a division of each of the existing LSGs by 2 and again a restriction of personnel costs. This leads to a country-wide cost increase of about 67 million lari.

2. The LSG reform

Currently, there are 65 local self-governments (LSGs) in Georgia. A policy reform proposal that has been developed by the Ministry of Regional Development (1), if approved by the Parliament, will possibly increase the number of LSGs to a number close to 240 (5). The exact number of new LSGs to be created is not stated in the draft LSG Code, which only provides guidelines for restructuring.[4] The primary criteria for the formation of LSGs are population density and the number of inhabitants (see (1), Article 22). If the population density of a region is up to 10 people per square kilometer, the LSG will require at least 2000 inhabitants. If the density is 10-30 people per km, then the LSG is required to have at least

[3] These estimations do not include "transitional" costs for new buildings, equipment, training of new LSG employees, etc., nor do they include cost of additional functions that may be assigned to LSGs under the reform.

[4] We refer to the English translation of the draft law of June 2013. Since June, a newer version of the draft law was circulated, but it looks as if the aspects that are central to our study, i.e., the number of LSGs to be established through territorial reform, were not changed.

5000 inhabitants, and so on. The entire rule for forming new LSGs according to density is summarized in Table 1.[5]

Table 1. The population density rule for forming new LSGs.

Density (people per km^2)	Number of inhabitants must be
<10	≥ 2.000
10-30	≥ 5.000
30-50	≥ 10.000
> 50	≥ 15.000

The draft LSG Code also sets upper limits for the number of civil servants that can be employed by the newly formed LSGs ((1), Article 55, Clause 3). These limits depend on the number of voters (citizens aged 18 and older) living in the LSG. However, in the most recent version of the draft Code, the rule as stated in (1) was modified. Instead of capping the number of employees, it proposes to restrict the number of LSG employees through the following formula:

$$N = 30 + \frac{v}{500} \qquad (2.1)$$

where N is the maximal number of employees of the LSG and v is the number of registered voters living in the LSG.

3. Assumptions underlying the Cost Estimate

The goal of our study is to estimate the implications of the proposed reform for the overall cost of providing public services at the LSG level. The specific question we want to answer is: What will be the total annual running costs of the LSGs after the reform is implemented if public services are provided at the average level of the years 2010-2012? To respond to this question, we have to make certain assumptions:

[5] There can be exceptions to the rule if its strict application would lead to remote settlements being far from the administrative center of the municipality. In such cases it is possible to form LSGs that have fewer than 2000 inhabitants (see (1), Article 22, Clause 3).

Revenue changes

Regardless of any impact the reform has on tax revenues, all public services must be paid by the people of Georgia in one way or another. The impact on tax revenues has technical importance for the state budget, but from an economics perspective they are largely irrelevant. With regard to the economic impact, the central question is whether LSG public services can be provided in the new situation more or less efficiently than previously. Therefore we restrict the analysis to the expenditure side of the LSG budgets.

Immaterial benefits

The classical view in the literature on fiscal federalism is that the local level of government should execute only those government functions that are primarily of local relevance, because the decentralized management of tasks that span over larger regions typically gives rise to inefficiencies.[6] There are ample examples of inefficiencies resulting from too much decentralization. For instance, so-called spillover effects lead to an undersupply of services by LSGs if these services have a regional impact, as local governments can have a free-ride on the efforts made by the neighboring municipalities (see (11)).

In contrast, the *Subsidiarity Principle* calls for the decentralization of government. This is primarily based on the assumption that local governments are better informed about local circumstances. The advantages of subsidiarity are not necessarily monetary and may also be immaterial. For example, policy decisions may be perceived to be more legitimate if they are made locally, which may, in turn, affect the acceptance of a decision within the local population (cf. (3), Chapter 1). Obviously, the Subsidiarity Principle should only be applied as long as the advantages of decentralized governance outweigh the resulting inefficiencies. This rule does not, however, lead to a level of decentralization that everybody agrees on, as the non-monetary benefits from subsidiarity are hardly quantifiable and remain controversial (cf. (3), Chapter 1).

We restrict ourselves to estimating the cost of running LSGs after the implementation of the reform, and ignore any possible non-monetary advantages that might result. This study will provide an estimate of

[6] This opinion was already expressed in the 18th century by the American Founding Father Alexander Hamilton (1755-1804) (see (14), Chapters 1 and 11).

what the price of subsidiarity is, while political decision makers must determine how much they are willing to pay for it.

Level of services

After the reform is implemented, the level of public services provided to the people of Georgia by LSGs may not be the same as it is now. This is obviously cost-relevant, as a reduction of services can easily lead to cost reduction. For a valid comparison it is thus necessary to make the assumption that the level of services remains the same. Only under this assumption can the fiscal impact of the reform be determined.

Transition costs

In addition to changes in the costs of providing public services, it can be expected that there will be certain one-time costs that accrue due to the transition from the old to the new system. Estimating these transition costs would call for a largely different methodology than that used for the estimation of the running costs. In this study, therefore, we will restrict ourselves to the running costs. One should also bear in mind that, as a result of neglecting the transition costs, the true total cost of the proposed reform may be higher.

Regional unions

In our cost estimation, we will assume that the new institution of the "regional LSG unions" will not take over either those tasks prescribed in (1), Article 73, Clause 2, or any tasks delegated by the LSGs according to (1), Article 74, Clause 2. As it was pointed out in (5), the subsidiarity gains from the reform will be lower the more functions are withheld from the LSGs and kept at the higher level of government layer. From the point of view of the efficiency/subsidiarity trade-off, the tasks that remain on the regional union level can be considered "neutral".

Caps on the number of employees

Regarding the caps on the number of employees, we will look at two scenarios. In what we term the "optimistic scenario", the rule as given by Formula (2.1) takes effect. In that case, the total number of direct employees of the LSGs would remain approximately the same as it is now (about 13,000), and it is assumed that this number of employees is sufficient to provide the same level of public services on average as in the years 2010-2012. This implies that there is considerable potential for productivity gains that can and will be realized. In the "pessimistic scenario", we assume that the cap will not be effective or not be part of the reform.

4. Estimating the Costs of Providing Public Services

4.1. The Cost Function

A cost function gives the cost of a production process as a function of relevant variables (see (12), p. 25).[7] These variables are primarily the amounts of the produced outputs, but other factors that have an influence on production costs – like input prices – may also be arguments of the function (see (7), p. 15). Every production process that can be described by a production function, i.e. a function that describes the levels of (possibly multiple) outputs as a function of the amounts of inputs used, has a cost function. This is due to the so-called "duality" between cost and production, allowing a cost function to be derived from any well-specified production function (see (7), Chapter 9; (12), p. 45).

Also the production of public services is a production process that can be described by a production function and hence by a cost function. The outputs of the production process may be approximated by (amongst many other things):

- the number of citizens served in a public office,
- the total length of the roads that are maintained,
- the number of children to whom preschooling is provided,
- the amount of people protected by fire brigades.

When the production process is for services, not goods, then the amounts of outputs are usually measured relative to a certain time span. So one would consider the "number of citizens served in a public office over a year" and "the total length of roads that are maintained within a year" and so on. The inputs of such a production process can be approximated by (amongst many other things):

[7] Formally, a cost function with n cost-relevant variables is a function $C : R \times R \times \ldots \times R \to R$.

- the number of employees working for the public entity providing the services,
- the endowment with electronic equipment,
- the number of buildings available (adjusted by size and quality),
- the availability of cars and special machinery (e.g. construction vehicles and fire trucks).

The representation of a production process by a production function and the derivation of the associated cost function is by no means restricted to private enterprises or industrial production processes. On the contrary, there is an extensive body of literature applying this approach to services (see (10)) and to public entities (e.g. hospitals (15), public education (13), and public theatres (16)).

4.2. Choosing the Functional Form

Many different functional forms for production functions can be found in the literature, like the Cobb-Douglas production function (see (7), pp. 326-33), the Leontief production function (see (7), pp. 333-342), and the Gutenberg production function (see (7), pp. 342-354). The production functions are closely connected to the associated cost functions, and many properties of a particular production function carry over to the cost function. For example, the cost function associated with a Cobb-Douglas production function is itself a Cobb-Douglas function.

Most common in empirical estimates of cost functions is the assumption that the underlying production process is of a Cobb-Douglas type (see (2), Chapter 3; (8)).

If $x_1 \ldots x_n$ are the cost-relevant variables, then this functional form is given by

$$C(x_1, \ldots, x_n) = x_1^{\alpha_1} \cdot \ldots \cdot x_n^{\alpha_n}$$

where the parameters $\alpha_1 \ldots \alpha_n$ are assumed to be from the interval [0,1].

This function has many appealing mathematical properties. For example, the value of the sum of exponents (the expression $\sum_{i=1,\ldots,n} \alpha_i$) immediately reveals whether the production process has constant, increasing, or decreasing returns to scale.

It is a frequently expressed criticism, however, that in many instances the Cobb-Douglas functional form is chosen primarily because of its mathematical convenience, not because it fits the underlying economic process particularly well (see, for example, (4)).

For the purpose of estimating the cost function of Georgian LSGs, the Cobb-Douglas form has the decisive disadvantage that there are no fixed production costs. Fixed production costs are those costs that accrue just from providing the capacity to produce something, even if no actual production takes place (see (7), p. 15). Even if an LSG were formed in a region without inhabitants, roads, and any other cost-relevant factors, just the sustenance of the entity will cause some costs. As we do not want to exclude fixed costs in our estimation by choosing a functional form that would – regardless of the data used for estimation – lead to fixed costs of zero, we have decided against the Cobb-Douglas form.
Instead, we will estimate a polynomial functional form of the type

$$C(x_1, \dots, x_n) = \alpha + \beta_1 x_1 + \dots + \beta_n x_n \tag{4.1}$$

where $x_1 \dots x_n$ are derived from data on cost-relevant factors, and $\alpha, \beta_1, \dots, \beta_n$ are parameters of the function. In the econometric estimation, we will estimate values for α and for $\beta_1, \dots, \beta_n$.

In the optimistic scenario, when we assume that the number of employees will remain the same, the left hand-side of (4.1) will only include those costs that are not directly associated with employees (like salaries). So essentially, in this case we are estimating the cost function of only the non-personnel costs of the LSGs. In the pessimistic scenario, the left hand-side of (4.1) will incorporate the total costs of providing public services on the LSG level, including the costs for employees.

The functional form (4.1) is very flexible. By choosing a polynomial function, we do not dictate through the functional form that there will be a positive fixed cost: in the estimation it is not ruled out that $\alpha = 0$. Moreover, the x_i may be the squared or even the cubic values of data, so that we can take into account possible non-linearities.

In fact, the polynomial functional form can mimic a Cobb-Douglas function. By the *Theorem of Taylor*, every function which can be differentiated arbitrarily often (as it is the case for the Cobb-Douglas function) can be arbitrarily closely approximated by a polynomial function ((6), p. 10).
The parameters of the function (4.1) will be estimated with an econometric regression. We are not going to describe the mathematical details of that method – (2) provides a comprehensive introduction

to regression techniques. The general idea is that we estimate values for α and for $\beta_1, \dots, \beta_n$ based on the given data for the 62 current LSGs.

For a valid regression, it has to be tested which set of variables $x_1 \dots x_n$ has the highest explanatory power for the total costs of an average LSG. Moreover, there are various different estimation methods, like the standard Ordinary Least Square, the more sophisticated Generalized Least Square, Maximum Likelihood, Fixed Effect estimations and Random Effect estimations, and many others.

Statistical indicators reveal the quality of the particular configuration chosen in a regression. Such indicators are the famous R^2 and various tests for misspecifications of the model. Essentially, the optimal specification and the best estimation technique have to be determined through trial and error. How we got to our specific functional form will be described in more detail in Section 7.1. Section 6 describes the data on which we will base the regression.

5. The Costs of Providing Public Services after the LSG reform is Implemented

Once we have estimated values for the parameters α and $\beta_1, \dots, \beta_n$ in the equation (4.1), we can use this information for estimating the cost of providing public services (at the current level) as a function of the number of LSGs. The value of α has special relevance for this, because it corresponds to the fixed production cost, i.e. the cost that needs to be paid just in order to provide the capacity to deliver public services.

If a new LSG were to be established, then the value of α needs to be paid per year even if the explanatory variables on the right hand-side of (4.1) would all be 0. Even if an LSG were to have no land, no population etc., α would still have to be paid.

The variable production costs, which enter the total cost with the coefficients

$$\beta_1, \dots, \beta_n$$

could be neglected for the total cost estimation if they entered linearly (because the total number of people, land etc. does not change through the reform). If there will be non-linearities, as it turns out to be the case in our estimation, ignoring the variable cost would create a bias. Therefore they need to be taken into account as well.

6. The Data

The analysis is based on a database that contains budgetary, demographic, and geographic information on 63 Georgian municipalities for the years 2010, 2011, and 2012.[8] The budgetary data of each municipality are structured both according to functional[9] and line item categories, and all entries are adjusted by the GDP deflator and expressed in 2012 prices. As far as non-budgetary information is concerned, the database contains per year figures for each LSG on the characteristics provided in Table 2 below.

Table 2: Non-budgetary characteristics of the LSGs

Characteristic:
Population
Area
Population below poverty line
Population of age 0-6
Population of age 6-18
Total length of roads
Population living in urban areas

6.1. Scenarios

The analysis features two different scenarios, a pessimistic and an optimistic one. In the pessimistic scenario, it is assumed that there will be no cap on the number of employees, either because the capping rule cannot be enforced, or because it is dismissed in the upcoming parliamentary process. In this case, personnel expenditures are treated in the same way as any other expenditures of the LSGs, i.e. they are assumed to depend on explanatory variables like population and area in the same way as other costs.

[8] Tbilisi and those regions that are currently not under Georgian control were excluded.
[9] Functional categories are also called programmatic categories.

In the optimistic scenario, it is assumed that the total cost for directly employed staff will not be affected by the reform, and the sum of salaries and other expenditures associated with employees will remain constant.

Table 3 shows how much of the average total expenditures is comprised by personnel costs. The first line shows the mean value of the total cost including personnel expenditures. Here, the average cost of an LSG in the three years under consideration is 13.788 million lari. If one takes out salaries and other costs for employees, this amount goes down to 10.956 million lari (the second line). The Figure also indicates the standard deviation of the total costs with and without personnel expenditures.

Table 3: Summary of data including Batumi

Variable	**Mean (in million lari)**	**Std. Dev. (in million lari)**
Real total cost	13.788	24.575
Real total cost without personnel expenditures	10.956	21.708
Number of observations	189	

For obtaining the cost without personnel expenditures, we subtracted from the total cost the complete line item “wages and salaries”. Moreover, from the line item “goods and services” we subtracted the subcategories “travelling allowances”, “office costs”, “expenses for furniture, uniforms, and personal hygiene items”, “maintenance of transport equipment and technology”, and “expenses of other goods and services”.

Arguably, not all of these expenditures are solely determined by the number of employees. For example, even if the reform does not increase the number of employees, one might expect office costs to increase if the same number of employees is now distributed over geographically separated workplaces as there would be less synergy. Because we want to estimate the costs of the reform “conservatively”, we assume that all of these costs remain constant.

6.2. The impact of Batumi

The size and the structure of the budget of Batumi is very different from any other LSG in Georgia. Table 4 shows the 15 Georgian municipalities that had the highest total costs in the year 2012. The two columns show the total costs (including personnel expenditures) and the population of the municipality, respectively.

Table 4: The 15 LSGs with the largest total cost in 2012

Municipality	Real total cost (in million lari)	Population (in thousands)
Batumi	183	126
Kutaisi	61	197
Rustavi	48	123
Gori	47	146
Akhaltskikhe	43	49
Zugdidi	32	178
Poti	31	48
Kobuleti	30	93
Mestia	25	15
Mtskheta	20	58
Bolnisi	20	78
Marneuli	20	130
Gardabani	20	100
Chiatura	20	76
Gurjaani	19	70

Batumi, with a population of 126,000 people, has a budget of 183 million lari. Kutaisi and Zugdidi, with populations of 197,000 and 178,000 people, respectively, have budgets of 61 and 32 million lari. So even though their populations are larger than Batumi's, their budgets are just about one-third and one-sixth of Batumi's. Gori has a larger population than Batumi's, yet its budget size is just one-quarter. Rustavi and Marneuli have population numbers close to Batumi, but their expenditures are drastically lower. The citizens of Marneuli are served with a budget of only 20 million lari, less than one-ninth of Batumi's expenditures.[10]

Thus, Batumi is a statistical outlier (see (9), pp. 99-102). It is common practice in econometrics to remove such abnormal observations because they are exceptions that do not represent the relationship under consideration. If outliers remain in the data, they can heavily influence the result of the analysis because of their extreme values.

[10] The difference between Batumi and the other LSGs was even more drastic in the years 2010 and 2011. For sake of simplicity we have not included these.

That this is true for Batumi becomes clear when looking at Batumi's impact on the average total costs of LSGs. In Table 3 above, the average total cost including Batumi was 13,788,450 lari; however, without Batumi, Table 5 below shows the average total cost is only 11,108,290 lari. If we look at the "optimistic scenarios", i.e. holding personnel costs constant, the numbers are 10,956,090 lari and 8,613,536 lari, respectively.

Table 5: Summary of data without Batumi

Variable	**Mean (in million lari)**	**Std. Dev. (in million lari)**
Real total cost	11.108	12.593
Real total cost without personnel expenditures	8.613	11.456
Number of observations	186	

We will solve this problem by removing Batumi from the data. While this improves the statistical quality of the regression, it also makes our estimation of cost implications more conservative, as including Batumi forcefully drives up the average cost of providing public services in LSGs (see also Subsection 7.3 on page 22).

7. Regressions

7.1. The pessimistic scenario

The regression output for the pessimistic scenario, i.e. when personnel expenditures are allowed to increase, is shown in Table 6 below.

Table 6: Estimation Results: Pessimistic Scenario

Variable	**Coefficient**	**Standard Error**
Squared Population	0.852**	0.133
Squared Area	0.001*	0.000
Population Density	12244.301**	4476.850
Intercept (α)	4893.430**	826.199
Number of Observations	186	
R^2	0.686	

Here the explained variable is the total cost C of an LSG, while the explanatory variables are x_1 = squared population, x_2 = squared area, and x_3 = population density. We estimate the values of the constant and the coefficients α and $\beta_1, \ldots, \beta_n$ of the cost function

$$C(x_1, x_2, x_3) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \quad (7.1)$$

and the estimated values of these parameters are given in the column denoted “Coefficient” in Table 6.

The constant α in equation 7.1, the fixed production cost of public services, corresponds to the intercept of the regression. Two asterisks at the estimation results denote that the estimation has a statistical significance of more than 99%, and one asterisk means that the statistical significance is higher than 95%. This means that the probability that α is in fact 0 is below 1% (actually, as cannot be seen in the table, the statistical significance of α higher than 99.9%). Likewise, the two asterisks at the squared area means that the probability that the squared area has in fact no influence on the cost is less than 5% (in fact, it is just 2.4%, corresponding to a statistical significance of 97.6%).

The statistical significance is above 95% for all coefficients of explanatory variables. In general, a significance level of 95% or higher is considered to be flawless, while even significance levels of 90% are sometimes accepted.

In Table 6, the R^2-value of 0.686 means that 68.6% of the variation of the cost can be explained by the variation of the explanatory variables. This is an exceptionally good value. An R^2 higher than 0.5 is generally considered to be fine (cf. (9), p. 39-42).

The choice of explanatory variables is the outcome of a long process of trials and errors. In the scatter plot shown in Figure 1, the vertical axis displays the total cost, while the horizontal axis denotes the population. Each dot in the graph corresponds to one municipality/year-combination. The red line illustrates the relationship between the number of people and the total cost, which can be approximated by a quadratic function.

Figure 1: A scatterplot of total cost and population

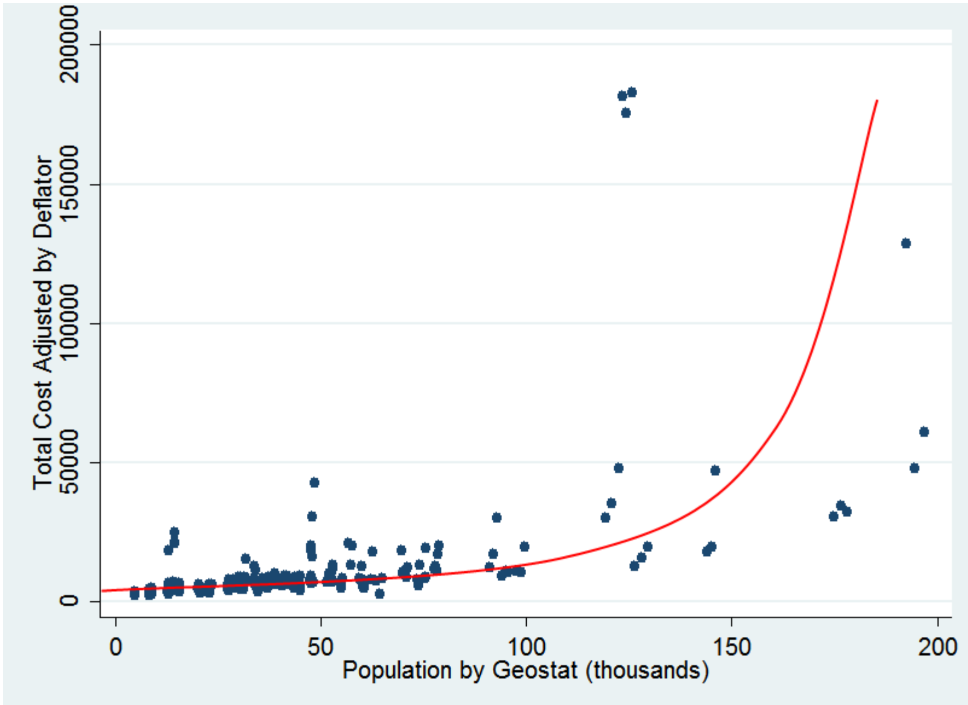
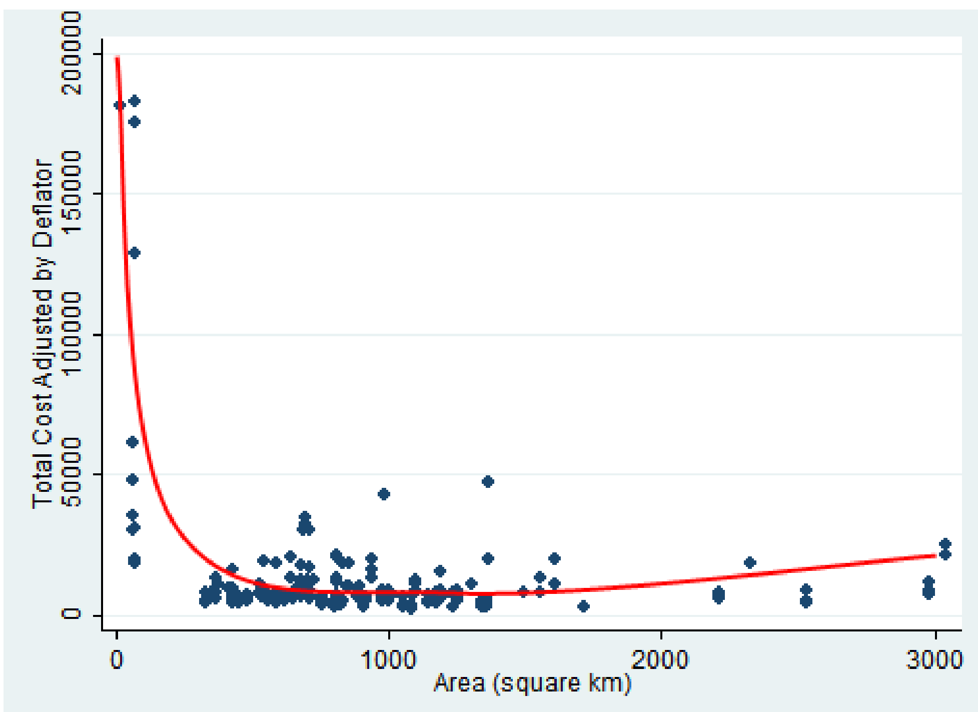


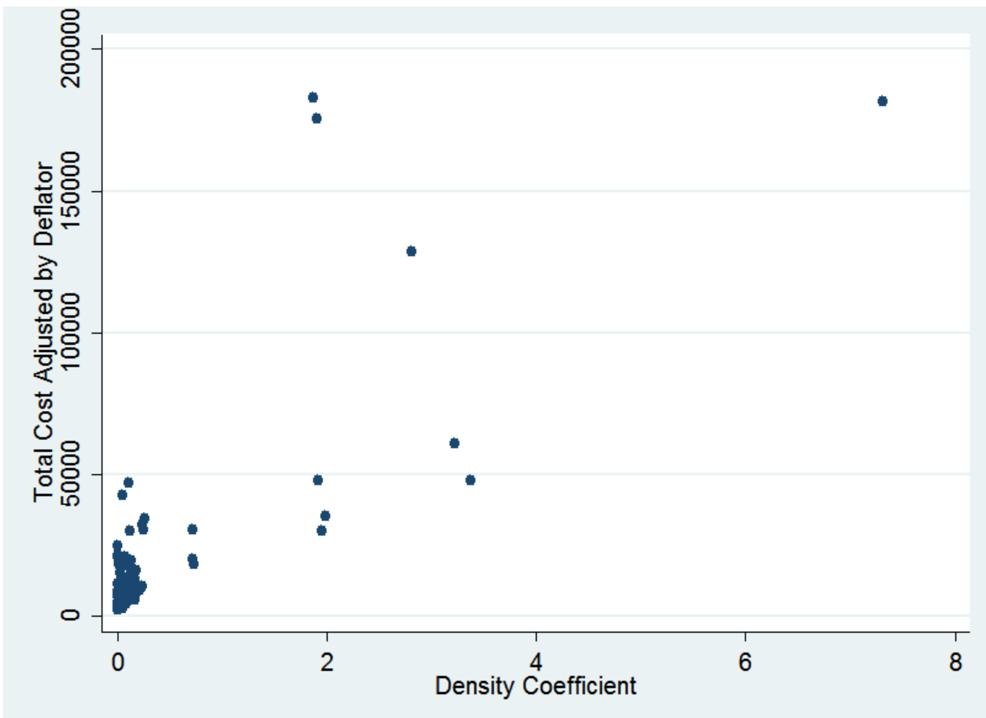
Figure 2: A scatterplot of total cost and area



Similarly, in Figure 2 the vertical axis displays the total cost, but here the horizontal axis denotes the area of an LSG. Again, the plot suggests a non-linear relationship between both variables.

The regression shown in Table 6 is adjusted for heteroscedasticity of the data. Heteroscedasticity means that the variance of a variable is correlated with the size of that variable. That there is a heteroscedasticity problem with the total cost can intuitively be seen in Figure 3: the dispersion of total cost is increasing with the population density of LSGs.

Figure 3: A scatterplot of total cost and population density



Heteroscedasticity can bias the estimated variances of the variables, which is detrimental for the significance level of a regression (though it does not bias the estimated values). Also a formal indicator, the Breusch-Pagan test, suggests that the data are heteroscedastic (for background information on this test, see (9), p. 276). The hypothesis that there is no heteroscedasticity is rejected with a probability of almost 1. Heteroscedasticity can be corrected by computing the robust variances according to Huber and White (cf. (9), pp. 350-352), and this was done in all our regressions.

Another common concern about regressions is the so-called multicollinearity problem. If two or more of the explanatory variables are highly correlated with one another, the estimation will be biased. As it turns out, however, the correlations between the explanatory variables are unproblematic. As a rule of thumb, one does not need to be worried about multicollinearity if all correlation coefficients are from the interval [-0.9,0.9], and in our case the maximal correlation is 0.55 (between squared population and population density).[11]

7.2. The optimistic scenario

The same regression as before (i.e. with the same explanatory variables), but with personnel expenditures deduced from the total costs, is given in Table 7.

Table 7: Estimation Results: Optimistic Scenario

Variable	**Coefficient**	**Standard Error**
Squared Population	0.735**	0.131
Squared Area	0.001*	0.000
Population Density	10914.888**	4430.234
Intercept (α)	3043.166**	816.355
Number of Observations	186	
R^2	0.637	

As can be seen, the value for α has moved from 4,893,430 lari to 3,043,166 lari. All coefficients are significant on very high levels. As before, the value for R^2 is reasonable and the heteroscedasticity problem is taken care of by a Huber and White correction of the variances. For illustrative purposes, in the next section we do the same regressions again without removing Batumi from the database.

7.3. The regressions with Batumi

The next two regressions, shown in Tables 8 and 9, estimate the cost function (7.1) without ignoring Batumi. We display these regression outputs here to illustrate the effect of removing Batumi from the data.

[11] We also computed the so called variance inflation factor (VIF), a test for the severeness of multicollinearity. For all variables the VIF is far below 5, which is a generally accepted threshold. For background information on the VIF, see (9), p. 90.

Table 8: Estimation Results: Pessimistic scenario without removing Batumi

Variable	**Coefficient**	**Standard Error**
Squared Population	0.631**	0.189
Squared Area	0.001	0.001
Population Density	23700.161**	1849.528
Intercept (α)	5320.095**	1519.325
Number of Observations	189	
R^2	0.634	

The values for α in both scenarios are higher than in the corresponding regressions without Batumi, while the coefficients for the squared population and the squared area are lower. This implies unambiguously that the increase in the running costs caused by the reform would be estimated considerably higher if Batumi remains in the data.

Table 9: Estimation Results: Optimistic scenario without removing Batumi

Variable	**Coefficient**	**Standard Error**
Squared Population	0.549**	0.170
Squared Area	0.001	0.001
Population Density	20776.295**	1661.671
Intercept (α)	3416.053**	1365.007
Number of Observations	189	
R^2	0.621	

8. Interpretation of the Results

Given the available information, the estimated values are the most likely values for the parameters, but they are not certain. Due to the limited information and because there are always errors in the available data, in our approach all unknown numbers of interest are random variables. If all factors affecting the costs of each LSG were known and fully reliable data were available on each of them, one could compute the true values without any uncertainty. However, as this is not the case, any estimation must be stochastic in nature, and therefore it is possible (and likely!) that the true values of the estimated variables deviate positively or negatively from their estimates. The estimates in this report are the most likely values given the available information, not more and not less.

8.1. The fixed production costs

Under the pessimistic scenario (the regression shown in Table 6), when the expenditures for personnel is assumed to behave in the same way as all other cost components, an average LSG has fixed production costs of 4,893,430 lari. In other words, according to our estimate, just the existence of an average LSG, even if "it is not doing anything", yields annual costs of about 4.9 million lari.

It is important to stress that these are the expenditures that cannot be attributed to any of those explanatory variables listed in Table 2 and not only to those that were actually used in our regression. We systematically tried out different configurations of the potential explanatory variables listed in Table 2. We came up with the combinations of explanatory variables of the regressions in Tables 6 and 7 because they have the highest explanatory power for the variation of the total cost – under the restriction that the regression is statistically sound (R^2, multicollinearity etc.). So, if, as a result of the reform, the average value of any of the variables in Table 2 changes, this would not change our estimation of the fixed production cost.

In the optimistic scenario (the regression in Table 7) where personnel costs are kept constant, the fixed production costs are estimated to be 3,043,166 lari. These are the estimated annual running costs that in the optimistic scenario have to be paid for sustaining an average LSG. So, if there will be 20 new LSGs then, according to our estimation, there will be 20 times 3,043,166 lari of additional fixed costs under the optimistic scenario; if there will be 100 new LSGs, there will be 100 times 3,043,166 lari of additional fixed costs under the optimistic scenario, and so on.

8.2. Changes in the variable production costs

If there were no non-linearities in the regression (no squared population and no squared area), we would only have to consider the fixed production costs, because the overall variable costs would not be affected by how big the LSGs are. The total number of inhabitants, the total amount of land etc. would be the same both before and after the reform. Because the costs of running each LSG would be strictly proportional to the number of people and the amount of land it has, the total variable cost of all LSGs would remain the same, regardless of how Georgia is divided into LSGs.

Yet, as it turns out, the cost function is not linear in all its arguments, and so we have to take into account how increasing the number of LSGs also affects the variable production costs. As we cannot cover all the possibilities about how new LSGs will be formed as a result of the law, we have to restrict ourselves to scenario analyses.

We look at two benchmark scenarios of how the existing municipalities could be split up. In the first scenario, each given LSG splits up into two new municipalities. In the second scenario, each current LSG splits up into four new municipalities. Under these assumptions, we compute what we call the population effect and the area effect, namely the impact on the (variable part of the) total production costs that results from splitting up the population and the land, respectively.

Let us illustrate by an example how we compute the population effect for a municipality that has 50,000 citizens under the pessimistic scenario. Measured in thousands, 50,000 inhabitants are just 50. The squared population is then 2,500. According to the regression in Table 6, the coefficient of the squared population is 0.85. So, for this LSG, the part of the total expenditures "caused" by the population is

$$2500 \cdot 0.85 \cdot 1000 = 2{,}125{,}000$$

lari, where the factor of 1000 on the left hand side comes from the fact that the costs are measured in thousands of lari.

Assume that this LSG would be split up into four new LSGs. For each of the new municipalities the "population costs" would be

$$156 \cdot 0.85 \cdot 1000 = 132{,}600$$

lari. Taken together, the new LSGs would therefore have a cost of 530,400 lari. So the population effect of splitting up the LSG results in a cost reduction of 2,215,000 lari - 530,400 lari = 1,594,600 lari.

We have done this exercise for all 62 currently existing LSGs that were included in our analysis and computed an average population effect of 2,594,182 lari if each of them splits up into 4 new municipalities. Analogously, we can compute the average area effect, which is 642,787 lari. The results for all scenarios are stated in Table 10.

Table 10: Average annual running cost change per LSG under different scenarios

Scenario	Fixed production cost	Population Effect	Area Effect	Total Effect
Pessimistic split by 2	4,893,430	- 1,729,454	- 428,525	2,735,451
Pessimistic split by 4	14,680,290	- 2,594,182	- 642,787	11,443,321
Optimistic split by 2	3,043,166	- 1,505,643	- 446,152	1,091,371
Optimistic split by 4	9,129,498	- 2,258,464	- 669,228	6,201,806

8.3. The total cost change

Based on these data, we can compute the change in total running costs of all LSGs under all four scenarios. The result is given in Table 11. Depending on how many LSGs there will be, with 248 municipalities being the maximum scenario and 124 being the minimum scenario, the additional total running cost of all LSGs is estimated to be between 67,665,002 lari and 709,485,902 lari.

Table 11: Estimated changes of total annual running costs

Scenario	Total effect per LSG	Total cost change
Pessimistic split by 2	2,735,451	169,597,962
Pessimistic split by 4	11,443,321	709,485,902
Optimistic split by 2	1,091,371	67,665,002
Optimistic split by 4	6,201,806	384,511,972

Returning to our discussion on the assumptions of the estimations, in Section 3 above, it is important to keep in mind that all these numbers assume that the level and the quality of public services will be on the same level as they are currently. Future running costs would, of course, be influenced by improving or worsening the level and quality of services.

For evaluating the proposed reform, it is decisive which likelihoods one assigns to the different scenarios (of course, it is also possible that the outcome of the reform will be somewhere between two of the four scenarios considered here). Arguably, whether or not one expects this reform to be beneficial for Georgia depends on these likelihoods.

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