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Abstract

The aim of the paper is to develop a procedure that allows policy makers to make an ex-ante assessment of a general compulsory amalgamation policy, providing quantitative indications about the possible financial effects. The amalgamation of small municipalities is a widespread practice all over the world. This policy is based on the assumption that local public service provision is characterized by economies of scale and economies of scope. However, population size is not the only determinant of economies of scale, which depend on many other factors. For these reasons, the expected effects of any amalgamation program are uncertain, and ex-post empirical analyses are unable to offer unambiguous indications to policy makers since all programs differ.

After a brief discussion of the relevant issues concerning amalgamation, we present the procedure used to simulate the economics and administrative effects of a general compulsory amalgamation policy. The procedure is tested with reference to the municipalities of Veneto, a region of Italy and we provide the results of a number of simulations under alternative amalgamation policies. The main result is that amalgamation policies based only on the a priori rule that small municipalities should merge may be very inefficient because the expenditure reduction following an amalgamation policy may depend to a considerable extent on other territorial and socio-economic characteristics of the municipalities involved.

KeyWords: Tax municipality; amalgamation; local government expenditure; economies of scale

JEL Codes: H11; H72; H77; R51

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1 Introduction

Municipal amalgamation is a widespread practice all over the world.[1] The key driver of this policy is the assumption that local public service provision is characterized by economies of scale and scope, meaning that a reduction in per capita expenditure or a lower tax and debt burden can be realized by amalgamating small municipalities. However, this argument has many shortcomings.

A number of empirical studies, such as by Breunig and Rocaboy (2008), Solé-Ollé and Bosh (2005) and Bonisch et al. (2011), confirm the existence of a U-shaped municipal per capita expenditure curve.[2] Others such as Sampaio de Sousa et al. (2005) and Gimenez and Prior (2007) conclude that municipal efficiency increases almost linearly with population size.[3] In contrast, the study by Loikkanen and Susiluoto (2005) suggests that small municipalities are more efficient.[4] These contrasting results are not entirely driven by the different socio-economic contexts examined, as they also reflect the different techniques and methods used in the analyses.

However, the key criticism of the standard approach to amalgamation is that population size is not the sole determinant of economies of scale, which depend on many other factors.[5] For these reasons, a vast amalgamation program involving only small and preconceived municipalities may prove unsatisfactory, since it could result in an increase in public expenditure.

The effects of municipal amalgamation are usually evaluated after the amalgamation and, even in this case, empirical analysis is unable to offer unambiguous statements to policy makers.

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[1] For a review of international experience, see Fox and Gurley (2006). A recent overview of amalgamation and financial sustainability in local government is available in two special issues of *Public Finance and Management* (Vol. 13, Nos. 2 and 3, 2013, guest editors Brian Dollery and Bligh Grant), which collects many contributions from all over the world. Others recent contributions about Europe are collected in a special issue of *Local Government Studies* (Vol. 36, No. 2, 2010).

[2] The study by Breunig and Rocaboy (2008) refers to French municipalities, and was based on a multiple regression model and a semi-parametric technique. The optimal municipal dimension was 400 inhabitants only. Solé-Ollé and Bosh (2005) analyzed Spanish municipalities by means of a piecewise linear model, and found that per capita expenditure is minimum at 5,000 inhabitants. Using *DEA*, Bonisch et al. (2011) analyzed municipal expenditure in Saxony-Anhalt. Their results show that the most efficient municipalities are those with a population size of about 8,000.

[3] Sampaio de Sousa et al. (2005) analyzed the efficiency of Brazilian municipalities. Gimenez and Prior (2007) investigated Spanish municipalities.

[4] The existence of a positive linear relationship between efficiency and population size can be attributed to a number of preliminary assumptions. In examining the expenditure behavior of 353 Finnish municipalities, Loikkanen and Susiluoto (2005) excluded municipalities with fewer than 2,000 inhabitants, and omitted general administration costs, which are usually more subject to economies of scale.

[5] See Andrews et al. (2002).

This paper develops a procedure that allows policy makers to make an ex-ante assessment of a general compulsory amalgamation program, giving them quantitative indications of the possible financial and administrative effects of such a program. The method is case-specific, since it is elaborated on the basis of the specific institutional, financial and structural characteristics of the local administrations to be amalgamated.

Since population size cannot be considered as the only parameter that triggers the amalgamation procedure, a number of alternative amalgamation policies must be defined in order to implement an amalgamation program. These policies will represent a crucial part of the analysis.

For each amalgamation policy, the proposed procedure will provide indications of the expected administrative impacts of the reform, in terms of the number and size of the local administrations involved in the amalgamation program.

However, the main purpose of the procedure is to assess the expected financial impact of the program, evaluated in terms of expenditure reduction. This task involves not only estimating a municipal expenditure function, but also defining spatial relationships between municipalities, the amalgamation criteria used by policy makers and, in particular, the method used to compute the expected financial gain.

The paper is organized as follows: in the second section, we discuss the key questions that justify the ex-ante assessment of municipal amalgamation and explain our reason for concentrating on compulsory amalgamations. The procedure used to simulate the economic and administrative effects of a compulsory amalgamation policy is presented in the third section. In Sections 4 and 5, we estimate an expenditure function and discuss the presence of economies of scale in the municipalities of the Veneto Region, located in northeast Italy, and report the results of simulations carried out using four alternative amalgamation policies.

2 The expected impacts of municipal amalgamations: the relevant issues

2.1 From voluntary to compulsory amalgamations

Oates's fundamental study on decentralization highlighted the importance of preference heterogeneity in determining the optimal local government dimension (Oates, 1972). In a heterogeneous context, the higher the concern about democracy and compliance with local preferences, the lower the optimal government dimension will be. The relevance of this aspect appears to be clear, considering the huge fragmentation of local government that occurred in many Central and Eastern European countries after 1990.[6]

A policy that encourages voluntary amalgamations provides compliance with local preferences and the success of the initiative. Hanes and Wikström (2010) showed that voluntary amalgamations in Sweden proved to be more efficient than compulsory amalgamations. Even the Local Government Association of Queensland (Dollery et al., 2013, page 226) stressed the importance of the voluntary nature of any amalgamation proposal for its ultimate success.

However, due to the presence of strong differences in local identities, voluntary amalgamations are not easy to realize, even in the presence of economies of scale. In Italy, for example, where the recent federalist wave has stressed the importance of local autonomy, only a few amalgamations occurred in the last twenty years, despite the fact that national legislation provides strong incentives for voluntary amalgamations. Pirani (2012) showed that only nine municipal amalgamations have taken place in Italy since 1995, involving just 24 municipalities out of a total of more than 8,000.

The use of public resources to promote voluntary amalgamation is another questionable point. Even assuming that these incentives are effective, they represent a net loss of welfare for the population not involved in amalgamation, since all of the benefits will be enjoyed by only the residents of amalgamated municipalities.

Structural reforms of local government based on voluntary amalgamations are difficult to govern and the expected economic impact of such reforms is essentially unpredictable because it is difficult to predict which municipalities will actually merge. A number of attempts to solve this problem can be found in Sorensen (2005), who analyzed the Norwegian case, Miyazaki (2013), who considered the situation in Japan, and Dur and Staal (2007), who based their study on a theoretical model. In any case, the authors stressed the importance of the expected efficiency gains and the fact that the results may not be generalized to other countries.[7]

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[6] Since 1990, with increasing attention being paid to local autonomy, there has been a strong territorial fragmentation in the local administrations of many Central and Eastern European countries, where the number of municipalities increased between 107% and 472% within the space of a few years. See Swianiewicz (2010).

[7] Miyazaki (2013) analyzed voluntary amalgamation decisions taken by municipalities in Japan and showed, using data from local referendums on consolidation, that the expected "*efficiency gains from consolidation are one of the key impetus for deciding to merge*". He also found that voluntary amalgamations are likely to be realized between large and small municipalities, and if unconditional grants are low. Sorensen (2005) found that consolidation is more likely to occur when the efficiency gains are large. Although these gains are greater in small municipalities, these administrations are often prepared to sacrifice some efficiency gain to remain

A reform of local administrations based on voluntary amalgamations appears to be an optimal strategy if the aim is to improve local autonomy and to guarantee an increase in local social welfare. In this case, the distribution of benefits among local populations is an essential part of the amalgamation decision. However, if the main aim of the reform is to improve public financial viability, this strategy is likely to fail.

2.2 The impact of amalgamation: the need for an ex-ante assessment

Numerous quantitative analyses examine the impact of municipal amalgamations on current expenditure.[8] Focusing on Australia's considerable experience of compulsory amalgamations, Dollery et al. (2013) rejected amalgamation as a means of generating greater financial sustainability in local governments. This result can be attributed to the absence of scale and scope economies, to high transitional costs and to the presence of constraints on the revenue-raising side. Slack and Bird (2013) considered the amalgamation of municipalities in the Toronto area. Mainly due to the specific case considered, the economic effects are unsatisfactory because cost reductions were small and transitional costs were higher than expected. Reid (2013) analyzed the local government reform that has been taking place in New Zealand since 1946, and found that the amalgamation strategy was strongly driven by considerations involving efficiency and effectiveness only in recent years.

Transitional costs, either concerning municipal direct financial costs or monetary and time costs for populations, must be properly assessed during amalgamation. In some cases, such as in England and Wales, efficiency gains due to amalgamations do not seem to be high enough to outweigh the costs involved (Rhys, 2013).[9] Transitional costs and expenditure reduction cannot, however, be compared directly because the former occur only once, while the latter recurs every year. For this reason, a proper discounted cash flow method must be applied.

Moisio and Uusitalo (2013) analyzed the amalgamation process in Finland and found that the larger municipal size obtained by merging small municipalities did not reduce per capita expenditure, mainly because expenditure increased in a number of categories, such as

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independent polities. Dur and Staal (2007) demonstrated that, in the presence of spillovers, if a large and a small municipality decide to consolidate, the smaller one will continue to suffer from an underprovision of public goods. Village inhabitants have insufficient incentives to vote for consolidation, but national government can solve this problem using an appropriate transfer scheme.

[8] Some authors consider the impact on tax rates and debt. To find out what affects debt burden see, in particular, Park (2013), whose econometric analysis refers to consolidated governments in South Korea. Park concludes that municipal amalgamations should not be implemented in order to achieve financial sustainability in terms of debt management, as consolidation may be associated with an increase in the debt burden.

[9] As the author underlined, the results may depend on the specific amalgamation process carried out in England, which took the form of a vertical consolidation. In Italy, many amalgamations essentially failed to gain popular consensus because of the high perceived transitional costs.

education and health care. Reingewertz (2012) studied the economic impact of an Israeli amalgamation reform in 2003 and found that, on the contrary, this process led to an approximately 9% decrease in municipal expenditure.[10]

These results are largely case specific and cannot be generalized to other institutional contexts, meaning that ex-post analyses are of limited benefit for policy purposes, therefore the ex-ante analysis of a planned amalgamation may be a useful tool for policy makers.

An ex-ante evaluation of a compulsory amalgamation reform was conducted by Iommi (2013a, 2013b) with respect to Tuscany's municipalities. Using a simple procedure she estimated that the reform could lead to savings of € 96 million per year (-11% compared to the current level) due to the avoidance of bureaucracy costs, in addition to € 65 million per year for foregone costs of political bodies.[11]

3 A procedure for the ex-ante assessment of a general compulsory amalgamation policy

Let us assume that, in order to reduce municipalities' expenditure, policy makers decide to carry out a structural reform of the local government based on a general compulsory amalgamation policy.

The ex-ante assessment of this policy can be implemented using a procedure based on the knowledge of the followings points:

a) the existing spatial relationships between municipalities. Given the initial set of M municipalities, Λ_M, spatial relationships are defined by a square matrix $\mathbf{W}$ (of order M) in which each row and each column represents a municipality. The generic element w_{ij} of the matrix is equal to 1 if municipalities i and j are adjoining and equal to zero otherwise.

b) the socio-economic characteristics of each municipality. Exogenous data is represented by a matrix $\mathbf{X}$ of dimension $M \times K$, whose element $x_{i,k}$ indicates the value of variable k ($k = 1,...,K$) for municipality i ($i = 1,...,M$);

c) the municipalities' expenditure behavior. The actual per capita expenditure of the i-th municipality, E_i, can be written as the sum of $\hat{E}_i$, the expected per capita expenditure of the i-th municipality, and a residual, $\hat{\varepsilon}_i$, which measures the i-th municipality's peculiarities:

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[10] Reingewertz (2012) also found that the impact on total revenues was very low and not highly statistically significant, whereas the impact on debt was large (+12%), but not significant.

[11] Iommi's basic hypotheses are: a) municipalities merge until the new municipal boundaries coincide with the boundaries of higher level administrations; b) per capita expenditure of a new administration is equal to the average value of the present administration of the same size. However, the method used is of little use in designing new administrative boundaries and is limited by the assumption that a municipal's population size alone affects per capita expenditure.

$$E_i = \Gamma(x_{i,1},...x_{i,K}) + \hat{\varepsilon}_i = \hat{E}_i + \hat{\varepsilon}_i \tag{1}$$

The estimated expenditure function $\Gamma(x_1,..x_K)$ represents average municipal behavior.

d) the amalgamation policy used by policy makers. Any amalgamation policy can be seen as a way of transforming the original set of municipalities Λ_M into a new set, Λ_N, which includes a smaller number of municipalities ($N < M$). A policy consists of a set of criteria and constraints that allow policy makers to identify municipalities that could be amalgamated and those that are convenient to amalgamate.

e) the method used to compute the expected expenditure reduction. Ex post, the gain resulting from the amalgamation between municipalities i and j is, by definition, the difference between the sum of actual expenditures of municipalities i and j and the expenditure of the new municipality ij formed by the amalgamation:

$$S_{ij} = E_i POP_i + E_j POP_j - E_{ij} POP_{ij}, \tag{2}$$

where POP_i and POP_j are the populations of the original administrations, while E_{ij} and $POP_{ij} = POP_i + POP_j$ are the per capita expenditure and population of the amalgamated municipality ij, respectively. However, before proceeding with the amalgamations, the value of S_{ij} in equation (2) cannot be computed since term E_{ij} is unknown. In order to solve the problem, we must first consider the fact that, by equation (1), $E_{ij} = \hat{E}_{ij} + \hat{\varepsilon}_{ij}$. Furthermore, since the amalgamated municipality will inherit all of the characteristics of the original municipalities, the residual $\hat{\varepsilon}_{ij}$ will necessarily depend on the original municipalities' residuals. We assume that $\hat{\varepsilon}_{ij}$ is an average of those residuals, weighted by population:

$$\hat{\varepsilon}_{ij} = (\hat{\varepsilon}_i POP_i + \hat{\varepsilon}_j POP_j) / POP_{ij}. \tag{3}$$

It follows that:

$$E_{ij} = \hat{E}_{ij} + (\hat{\varepsilon}_i POP_i + \hat{\varepsilon}_j POP_j) / POP_{ij}, \tag{4}$$

and substituting into (2) we obtain:

$$S_{ij} = \hat{E}_i POP_i + \hat{E}_j POP_j - \hat{E}_{ij} POP_{ij}. \tag{5}$$

The relevant aspect of equation (5) is that the expenditure reduction can be computed ex ante on the basis of the *expected* per capita expenditures of the municipalities involved.

The value of $\hat{E}_{ij}$ in equation (5) is computed under two hypotheses:

- the behavior of municipalities does not change after amalgamation, meaning that the estimated expenditure function $\Gamma(x_{ij,1},...,x_{ij,k},..,x_{ij,n})$ is also applicable to the new municipality;
- the values of all explanatory variables of the new municipality $x_{ij,k}$ are derived directly from those of the original municipalities. In many cases, ex-post values (e.g. the number of inhabitants or the land area) are just the sum of the original values. In other cases, post-amalgamation values are averages of the original data, weighted by population. In aggregate, exogenous variables remain unchanged.

With the previous information and hypotheses, the expected financial impact of a compulsory amalgamation policy can be computed using the iterative procedure represented in Figure 1, which considers the amalgamation of a couple of municipalities in each iteration. The procedure follows the steps below:

- Step 1: identification of all potential amalgamations on the basis of data matrix **X**, spatial matrix **W** and the amalgamation policy adopted;
- Step 2: if the set of potential amalgamation is not empty, the procedure continues, otherwise it stops;
- Step 3: the best amalgamation is chosen according to the policy criteria (e.g. amalgamation *ij* between municipalities *i* and *j*);
- Step 4: data matrix **X** and spatial matrix **W** are updated, adding the new municipality *ij* and removing *i* and *j*. As a consequence, the number of municipalities decreases by one at each iteration; [12]
- Step 5: the expected per capita expenditures $\hat{E}_i$, $\hat{E}_j$ and $\hat{E}_{ij}$ are computed by means of the estimated expenditure function. The expenditure reduction S_{ij} is then computed using equation (5).

The iterative procedure stops when all potential aggregations have been exploited.[13] The main outputs of the procedure are the expected expenditure reduction generated by each amalgamation and the total amount of expenditure reduction that can be achieved from the amalgamation program, S_T.[14]

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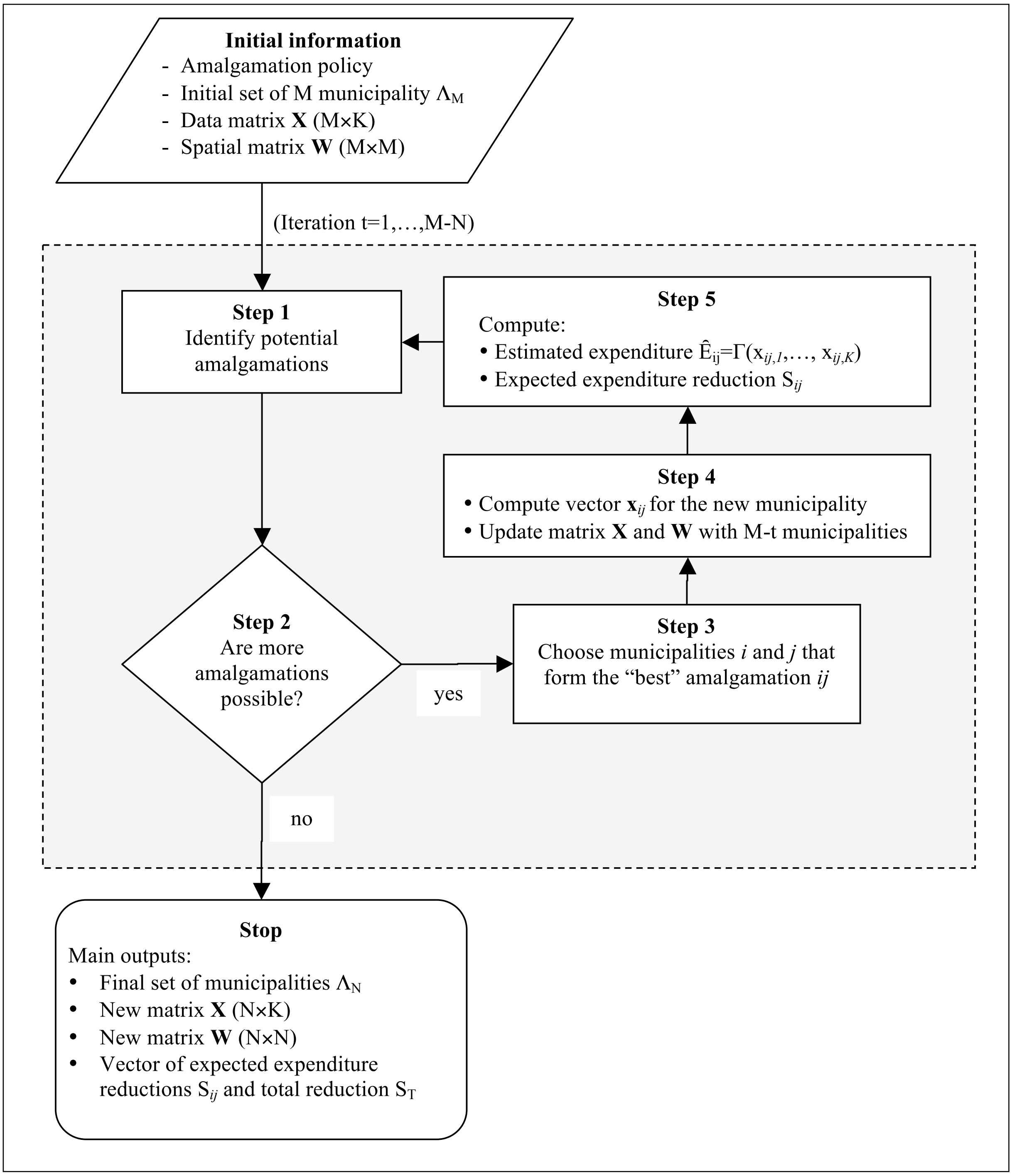
[12] A newly formed municipality can be aggregated to other municipalities in subsequent iterations.
[13] The computer code was written using the package R (R Development Core Team, 2011).
[14] Total expenditure reduction does not include transitional costs, which are not considered at this stage. It can be demonstrated that the expected expenditure reduction generated by an amalgamation involving many

Figure 1 – Iterative procedure for the ex-ante assessment of a general compulsory amalgamation program



municipalities is invariant with respect to the way and the order in which municipalities aggregate with one another, i.e. if they consolidate progressively two by two or all together simultaneously.

4 An application to Veneto Region Municipalities

4.1 The initial set of municipalities

The procedure presented in paragraph 3 was tested considering the 581 municipalities of the Veneto Region, situated in northeast Italy with the regional capital of Venice. The basic data set **X** includes all relevant variables that describe the financial, economic and social characteristics of each municipality in 2010.[15] A number of general characteristics of these municipalities are shown in Tables A.1 and A.2 of the Appendix. The average population size is 8,499 inhabitants; 6.9% of municipalities have fewer than 1,000 inhabitants, 53.9% have under 5,000 inhabitants and 97% have fewer than 30,000 inhabitants. The high fragmentation of municipalities makes the Veneto Region an interesting case study in order to assess the effects of a structural reform based on a compulsory amalgamation program.

4.2 The municipal expenditure function

In specifying the expenditure function $\Gamma(x)$, a crucial role was assigned to the institutional context. The expenditure behavior of Italian municipalities is in fact expected to present structural breaks with respect to population size. The first break is due to the Domestic Stability Pact (*DSP*), which was applied in 2010 to only municipalities with more than 5,000 inhabitants. Other breaks concern municipalities with fewer than 1,000 inhabitants, which have always been subject to specific legislation, and the seven provincial capitals due to the particular services they have to provide.[16] Figure 2 shows the relationship between per capita expenditure and population for Veneto Region municipalities.[17]

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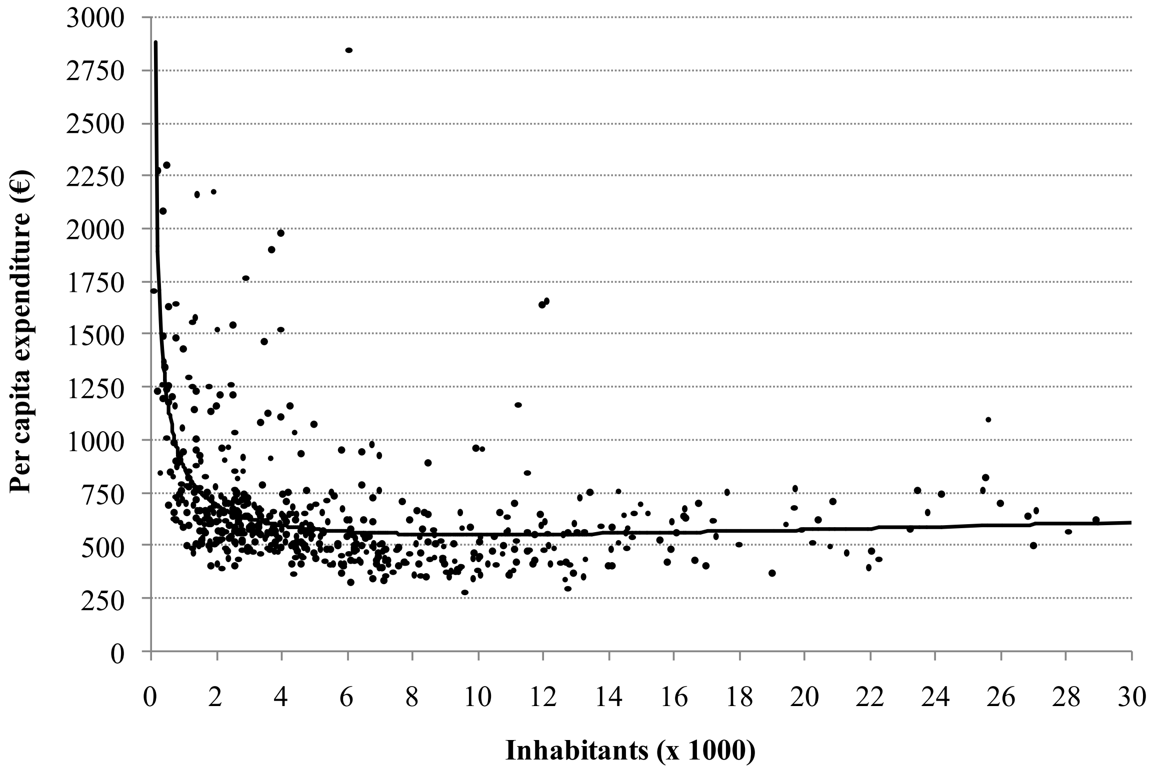
[15] The authors wish to thank the Italian National Institute of Statistics (*ISTAT*) for providing data on municipalities, particularly concerning spatial matrix **W**.

[16] It is worth noting that, in 2010, municipalities with fewer than 1,000 inhabitants were forced to supply certain public services in association with other municipalities. For this reason, we will consider the per capita expenditure of such associations as a determinant of the municipal per capita expenditure.

[17] In order to highlight the particularities of small municipalities, Figure 2 shows only municipalities with fewer than 30,000 inhabitants. A simple relationship between per capita expenditure and population size is shown by the fitted line computed using a simple quadratic function of log population (see Table A.3 in Appendix).

Figure 2 – Veneto Region municipalities: per capita expenditure and population (year 2010)



Due to the presence of structural breaks, the expenditure function was specified as follows:

$$\ln E_i = \alpha_0 + \alpha_1 d_{1i} + \alpha_2 d_{5i} + \alpha_3 prov_i + \sum_{k=1}^{K} \beta_k x_{i,k} + \sum_{k=1}^{K} \delta_k d_{1i} x_{i,k} + \sum_{k=1}^{K} \gamma_k d_{5i} x_{i,k} + \varepsilon_i, \qquad (6)$$

where the dependent variable is the natural log of per capita current expenditure. Terms d_1 and d_5 are two dummy variables that indicate, respectively, municipalities with fewer than 1,000 inhabitants (d_{1i}=1) and with between 1,000 and 5,000 inhabitants (d_{5i}=1). The term $prov_i$ is a dummy variable that indicates whether the municipality is a provincial capital. The complete set of explanatory variables is given in Table A.1 in the Appendix.

In order to evaluate the presence of economies of scale, the set includes the log of the number of inhabitants, the log of demographic density and their squared values.[18] Among the several control variables included in equation (6), two financial indexes of municipality budget were

[18] Randall and DeEdgra (2009) stressed the importance of controling for population density when estimating municipal expenditure functions. The square log of population and density are introduced in order to allow some form of non-linearity.

considered: per capita national grants and per capita personal income (*PIT*) tax base. Other explanatory variables include many social, economic and territorial characteristics of the area.
Tests confirm that municipalities' expenditure behavior differs structurally depending on whether the number of inhabitants is fewer than 1,000, between 1,000 and 5,000, or more than 5,000. Provincial capitals present a significantly different level of expenditure. [19]

Equation (6) was estimated with robust *OLS* using the stepwise technique, starting with the full set of 63 regressors and a constant.[20] The results are given in Table 1. The majority of the coefficients are significant at 1%; the remaining ones are significant at 5%. The adjusted R^2 is 0.76. All coefficients have the expected sign.

The elasticity of per capita expenditure with respect to per capita grants is equal to 0.46, which implies that, evaluated at the average values, an increase in € 1 of per capita grants determines an increase in € 1.27 of per capita expenditure. The elasticity of expenditure with respect to per capita taxable income is 0.38 for municipalities with more than 1,000 inhabitants, but its value is approximately half that for small municipalities (elasticity is equal to 0.195).

Entrepreneurial intensity, tourist capacity and the incidence of foreigners positively affect per capita expenditure in all municipalities. The only apparently contradictory result regards the effect of family size. The negative coefficient indicates that per capita expenditure decreases as long as the average number of components increases. However, this result seems reasonable considering the diffusion of single elderly families, who usually require more local services.

Demographic density is quite relevant in explaining municipal expenditure. As expected, an increase in density determines a reduction in expenditure in all classes of municipalities, but the effect is higher for those with fewer than 5,000 inhabitants. The altimetric zone determines a decrease in expenditure when passing from mountainous areas to flat areas for municipalities with more than 5,000 inhabitants. The effect is reversed, however, for small municipalities.

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[19] The validity of the specification (6) was verified using Wald tests. First, we tested the null hypothesis that all 43 coefficients $\alpha_1, \alpha_2, \alpha_3, \delta_k, \gamma_k$ are simultaneously zero. The resulting *F* statistic was *F*(43,517)=2.74, meaning that the hypothesis of equal coefficients for the entire sample can be rejected with a *p-value*<0.00001. The null hypotheses that coefficients α_1, δ_k and α_2, γ_k are simultaneously zero can be rejected, as we found *F*(21,517)=2.19 (*p-value*< 0.0018) and *F*(21,517)=2.12 (*p-value*< 0.0027), respectively. The *t* statistics for α_3 is -4.43 (*p-value*<0.00001). Although equation (6) was estimated using different values of population limits, coefficients did not yield statistically significant results.

[20] The significance level for removing a variable was set at 5%.

Migration and birth rates are relevant only for municipalities with fewer than 1,000 inhabitants. The first variable negatively affects per capita expenditure, whereas higher birth rates determine an increase in expenditure. An interesting result is that, for this class of municipalities, belonging to a municipality association determines a reduction in expenditure.

Table 1 – The estimated expenditure function

Dependent variable: Municipalities' per capita current expenditure (*ln*)			
Explanatory variables	Coefficient	t-test	
Constant	5.06985	4.08	**
ln population	-0.89530	-4.95	**
(ln population)^2	0.04967	5.17	**
ln population density	-0.00738	-4.19	**
ln per capita total grants	0.45924	8.38	**
Entrepreneurial intensity	0.04020	6.81	**
ln per capita PIT tax base	0.37898	3.90	**
Tourism intensity	0.00128	6.71	**
ln average household size	-0.86476	-5.63	**
Incidence of foreigners	0.00953	4.06	**
Altimetric zone	-0.02578	-2.39	*
d_5 (dummy for $1,000 < \text{population} \leq 5,000$)	-0.54654	-2.45	*
Dummy for provincial capital	-0.30256	-3.75	**
Interactions			
$d_1 \times$ ln population density	0.78273	3.24	**
$d_1 \times$ (ln population density)^2	-0.11792	-3.35	**
$d_1 \times$ net migration rate	-0.03302	-2.03	*
$d_1 \times$ ln per capita PIT tax base	-0.18438	-3.38	**
$d_1 \times$ ln municipalities association per capita expenditure	-0.01913	-2.33	**
$d_1 \times$ ln birth rate	0.01825	2.28	*
$d_1 \times$ altimetric zone	0.09804	3.08	**
$d_5 \times$ (ln population)^2	0.00941	3.19	**
$d_5 \times$ (ln density)^2	-0.00658	-2.38	*
$d_5 \times$ altimetric zone	0.03817	2.97	**
Number of observations	581		
Adjusted R^2	0.7631		
Standard error of the regression	0.1755		
$F(22,558)$	116.81		

Notes: Robust *OLS* results
** statistically significant at the 1% level
* statistically significant at the 5% level
For a definition of the variables, see Table A.1

4.3 Economies of scale and amalgamation effects

Focusing on economies of scale and the distortions caused by fiscal rules, consider first how a standard municipality's expected per capita expenditure varies with the number of inhabitants, whilst all other variables (including density) remain constant.[21] In Figure 3 (I), point *a* represents a municipality with 500 inhabitants that have the average characteristics of municipalities with fewer than 1,000 inhabitants.[22] The solid line shows how per capita expenditure of municipality *a* varies as population ranges from 0 to 5,000 inhabitants according to the estimated regression. When population reaches 1,000 inhabitants, there is discontinuity due to the structural break in fiscal and administrative rules. In contrast, the dotted line shows the expenditure trend if fiscal and administrative rules are kept constant. Let us consider the case in which the population of municipality *a* is tripled (from 500 to 1,500 inhabitants). The estimated per capita expenditure is *a"* if the appropriate fiscal and administrative rules are considered, whereas it is *a'* if fiscal and administrative rules are kept constant.

This example shows that small municipalities may benefit from *technical* economies of scale (as expenditure decreases in passing from *a* to *a'*), but this effect is partially offset by tighter fiscal and administrative rules, determining *institutional diseconomies* (as expenditure increases from *a'* to *a"*).

Figure 3 (II) represents the effects of amalgamating municipality *a* (with 500 inhabitants) and municipality *b* (with 2,000 inhabitants). Each municipality lies in the region of the expenditure curve corresponding to the average characteristics of its class of population. The new municipality created by the amalgamation is represented by point *c*. As the new municipality is a weighted average of *a* and *b*, point *c* cannot lie in the expenditure curves drawn in Figure 3(II), because along those lines the socio-economic characteristics of the municipalities, except population, are held constant. In this example, the role of economies of scale is ambiguous, and *b* will not benefit from the amalgamation, since its ex-post per capita expenditure is higher than its ex-ante value. No voluntary amalgamation will occur in this case, while a compulsory amalgamation would be profitable if the total expenditure of *c* was lower than the total expenditures of *a* and *b* together.

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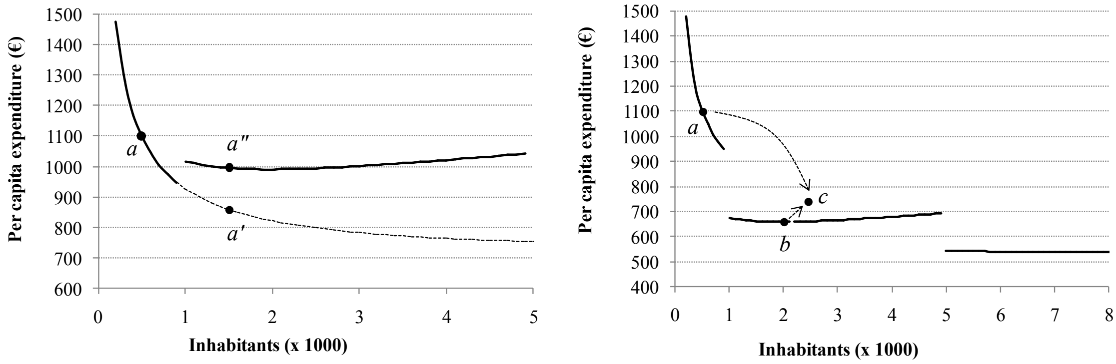
[21] This corresponds to an amalgamation of municipalities that are equal in all respects apart from population.

[22] The term "average characteristics" means that the exogenous variables are set at the average values of all municipalities of that class.

Figure 3 – Scale and amalgamation effects

(I) *scale effect* (II) *amalgamation effect*



4.4 Amalgamation policy: criteria and constraints

As shown in Figure 1, the first step of the proposed ex-ante assessment procedure is to define the amalgamation policy. Here, four possible different policies have been defined, the main characteristics of which are summarized in Table 2. Each policy is formalized by specifying three main aspects:

1. the initial set of municipalities that could amalgamate,
2. the constraints that need to be satisfied,
3. the method used to choose which municipalities to amalgamate.

The first two policies, *A1* and *A2*, reflect the traditional approach to amalgamation, which is implemented exclusively on the basis of observable structural characteristics of municipalities. These policies are based on the consideration that population size and the associated economies of scale are the main drivers of amalgamations. In policy *A1,* municipalities with fewer than 5,000 inhabitants are forced to amalgamate with the smallest neighbor. In contrast, policy *A2* considers the socio-economic characteristics of neighboring and small municipalities, which are forced to amalgamate with the most similar neighbor.[23]

Moreover, we propose a second set of policies, *B1* and *B2*, which instead look for the greatest economic efficiency. In this case, the initial set of potential amalgamations is formed by all possible pairs of neighboring municipalities. The best couple of municipalities to be amalgamated first is chosen as follows:

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[23] The similarity is defined by means of the euclidean distance between two municipalities. The distance between municipality *i* and its neighbor *j* is $d_{ij} = \sqrt{\sum_{k=1,K} \frac{1}{K}[(x_{ik} - x_{jk})/\bar{x}_{ik}]^2}$, where x_k are the following eleven variables: per capita current expenditure, population density, per capita grants, entrepreneurial intensity, per capita PIT tax base, tourism intensity, average household size, incidence of foreigners, altimetric zone, net migration rate, birth rate. The term $\bar{x}_{ik}$ is the mean value of variable *k* among all neighbors of municipality *i*.

a) Policy *B1* considers the amalgamation which maximizes the expenditure reduction, without any dimensional constraint;

b) Policy *B2* is based on the assumption that the amalgamation is more acceptable for the municipalities involved if, for both municipalities *i* and *j*, there is a reduction of ex-post per capita expenditure, i.e. if $\hat{E}_{ij} < \hat{E}_i$ and $\hat{E}_{ij} < \hat{E}_j$.[24] Among all possible pairs of neighboring municipalities that satisfy the above conditions, the criterion chooses the amalgamation with the maximum average per capita expenditure saving: $d\hat{E}_{ij} = \frac{1}{2}(\hat{E}_i - \hat{E}_{ij}) + \frac{1}{2}(\hat{E}_j - \hat{E}_{ij})$.

Table 2 – Amalgamation policies

<table>
<tr><th></th><th colspan="4">Policies</th></tr>
<tr><th></th><th>A1</th><th>A2</th><th>B1</th><th>B2</th></tr>
<tr><td>Starting point</td><td colspan="2">The smallest municipality</td><td colspan="2">All possible pairs of amalgamations (initially 1,644 pairs)</td></tr>
<tr><td>Population size constraint</td><td><5,000</td><td><5,000</td><td>-</td><td>-</td></tr>
<tr><td>Financial constraint</td><td>-</td><td>-</td><td>Positive aggregate expenditure reduction: S_{ij}</td><td>Positive expenditure reduction for both municipalities: $\hat{E}_i - \hat{E}_{ij} > 0, \hat{E}_j - \hat{E}_{ij} > 0$</td></tr>
<tr><td>Territorial constraint</td><td colspan="4">a) No amalgamation between adjoining municipalities belonging to different mountain valleys
b) No limitations if municipalities are separated by rivers or belong to different provinces</td></tr>
<tr><td rowspan="2">Method of choice</td><td colspan="2">The smallest municipality is amalgamated with:</td><td colspan="2">The amalgamation chosen is that with:</td></tr>
<tr><td>The smallest neighbor</td><td>The most similar neighbor</td><td>Maximum aggregate expenditure reduction: max S_{ij}</td><td>Maximum average expenditure saving: max $d\hat{E}_{ij}$</td></tr>
</table>

5. Results and sensitivity analysis

5.1 Basic results

The financial and administrative effects of the four amalgamation policies simulated are shown in Tables 3 and 4, respectively. Total annual expenditure reduction S_T, varies from a minimum of € 24,377 million per year if policy *A2* is adopted to a maximum of € 48,489 million if policy *B1* is used. This means a reduction in total expenditure ranging from -0.67%

[24] Note that this criterion is neither a sufficient nor a necessary condition for realizing a voluntary amalgamation, which depends on local preferences about private and public goods and on cultural and political affinity. However, it signals cases where there is a reciprocal economic gain.

in the first case to -1.33% in the second case. However, higher effects are expected for municipalities involved in amalgamations: policy *A2* generates a 2.33% reduction in total expenditure for amalgamated municipalities, whereas policy *B2* leads to amalgamated municipalities benefitting from a saving of 8.28%. Note that although policy *B2* leads to a smaller expenditure reduction in absolute terms than policies *A1* and *B1*, it is a more interesting policy for local administrations forced to amalgamate because they have the highest percentage gain (8.28%) and the highest level of per capita expenditure reduction (€ 50.0).

The lowest total expenditure reductions occur when policies *A2* and *B2* are used, because they strongly reflect local interests. The first policy explicitly takes into account local preferences (the most similar municipalities are amalgamated); the second policy requires that all amalgamated municipalities enjoy a reduction in per capita expenditure compared with the ex-ante situation. Instead, the greatest impact occurs when the explicit goal is to maximize total expenditure reduction without constraints, as in *B1*.

Quite surprisingly, when amalgamations are based on the simple rule that smallest municipalities must be consolidated first (policy *A1*), the second highest total expenditure reduction is achieved: € 40.6 million (6.11% reduction in total expenditure for amalgamated municipalities).

The reliability of the results was assessed by computing the 95% confidence intervals of expected total expenditure reduction (see Table 3).[25] The confidence intervals are sufficiently low to validate the general conclusions made in the study. Policy *A2* has the highest forecast error (±38% of the expected value); policy *B2* has a forecast error of only ±9%.

The effects of the structural reform considered here are not uniformly distributed among municipalities. The last part of Table 3 shows the distribution of new municipalities for the percentage variation of classes of expenditure. Amalgamations pursuing policies *A1* and *A2* result in 13 and 25 new municipalities with a negative expenditure reduction, respectively. In contrast, none of the new municipalities have negative reductions under policies *B1* and *B2*. Some new municipalities present a relevant percentage of expenditure reduction. When policy *B2* is applied, 38 new municipalities (50% of new municipalities) achieve a percentage expenditure reduction exceeding 10%.

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[25] We computed the standard errors of the expenditure forecast of each amalgamation and then performed a Montecarlo simulation to obtain the confidence interval of the total expenditure reduction S_T.

The financial impact of policies can also be assessed considering the total present value of the annual expenditure reduction. Considering a period of 20 years and a 3% discount rate, the resulting figures (Table 3) are almost fifteen times greater than the annual expenditure reduction. For policies with the greatest expenditure reduction, *A1* and *B1*, the present values are € 605.3 million and € 721.3 million, respectively. These amounts seem to be sufficiently high to offset any possible transitional costs, incurred only once, and confirm the viability of the amalgamation plan.

The administrative effects of the four policies differ considerably (see Table 4). The number of new municipalities ranges from a minimum of 76 with policy *B2* to a maximum of 130 with policy *A2*. Symmetrically, the number of inhabitants involved in amalgamations range from a minimum of 617,655 (12.5% of the total population) with policy *B2* to a maximum of 1,618,067 (32.8%) with policy *A2*.

The total number of municipalities decreases (-43.9% with *A2* and -19.3 with *B2*) while the average population size of municipalities increases considerably in all cases. In particular, with policy *A2* the average number of inhabitants rises to 15,146, with a 78.2% increase compared to the ex-ante situation.

These results demonstrate that a small population size is neither a sufficient nor a necessary condition for a convenient amalgamation. In particular, if policies *B1* and *B2* are implemented, 11 and 28 municipalities, respectively, with fewer than 5,000 inhabitants are not involved in amalgamations. In contrast, a number of amalgamations involve only municipalities with more than 5,000 inhabitants, demonstrating that such municipalities can benefit from amalgamation.

Figure 4 depicts the spatial effects of the four amalgamation policies in a map of municipalities of the Veneto Region. The new municipalities created by amalgamation can be identified by looking at neighboring municipalities with the same color.

It is interesting to note that, under policy *A1*, based on population size only, a large number of amalgamated municipalities are located in the upper part of the map (the northern part of the Region) where municipalities are small and located in mountainous areas. Policy *B1*, on the other hand, excludes some of these municipalities from efficient amalgamations. With policy *B2,* municipalities in mountainous areas are almost absent because it is difficult in these cases to determine any mutual benefit of amalgamating.

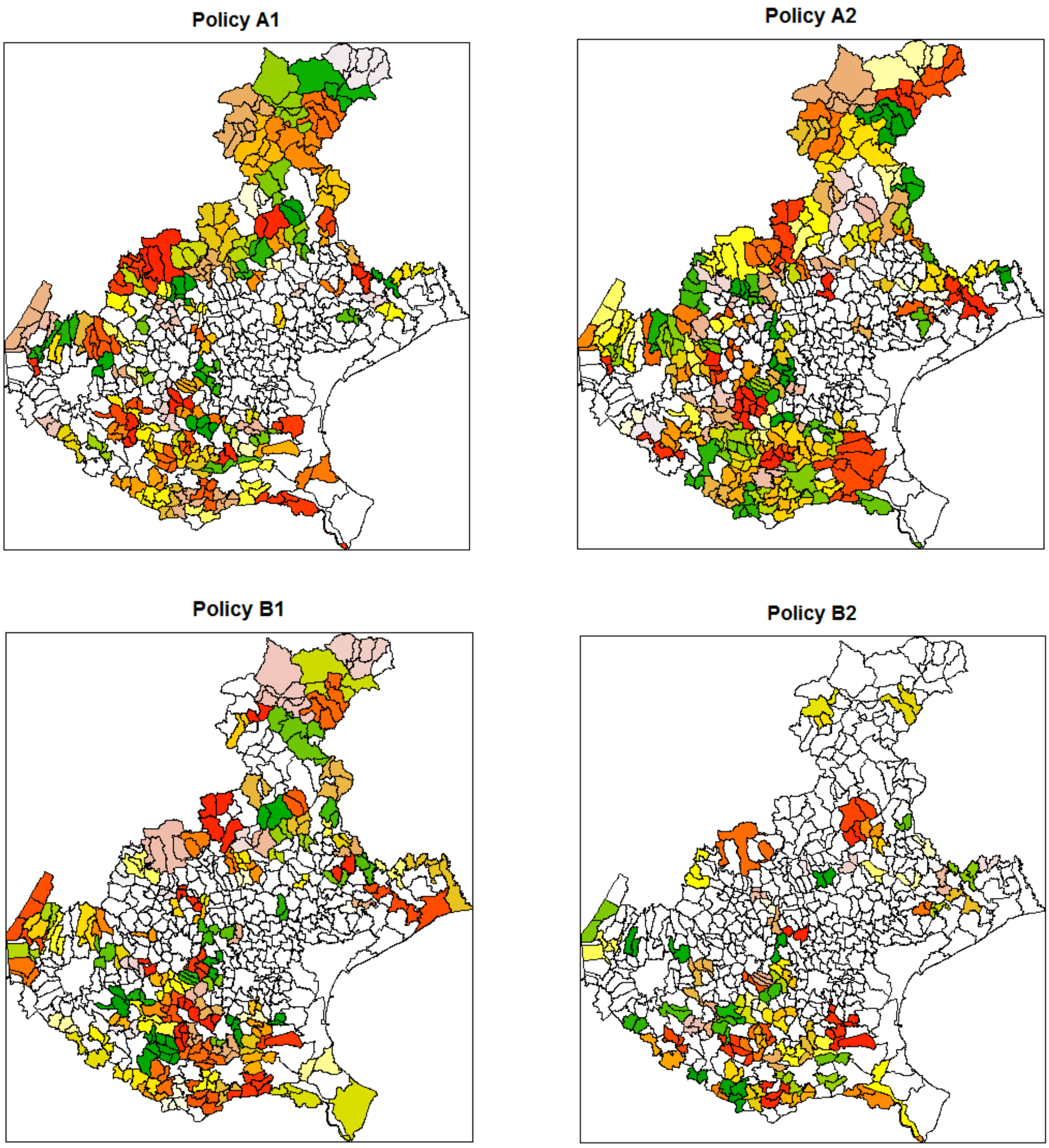
Table 3 – Veneto Region: financial effects of compulsory amalgamations

	Present situation (year 2010)	Amalgamation policies			
		A1	***A2***	***B1***	***B2***
Current expenditure (k€)	3,639,036	3,598,348	3,614,659	3,590,547	3,608,125
Expenditure reduction due to amalgamations (k€)		40,687	24,377	48,489	30,910
95% confidence interval (k€)	*Min.*	*34,723*	*15,229*	*41,279*	*28,124*
	Max.	*46,767*	*33,743*	*55,798*	*33,720*
Expenditure reduction/total expenditure (%)		1.12%	0.67%	1.33%	0.85%
Present expenditure by amalgamated municipalities (k€)		666,080	1,046,522	699,423	373,266
Expenditure reduction/expenditure of amalgamated municipalities (%)		6.11%	2.33%	6.93%	8.28%
Average annual per capita expenditure reduction (€)		41.1	15.2	47.1	50.0
Average annual expenditure reduction in new amalgamations (€)		360,063	187,512	448,969	406,711
Present value of expenditure reduction (20 years, at 3%) (k€)		605,322	362,661	721,389	459,863
Distribution of new municipalities					
Percentage expenditure reduction (*pr*)	Number of municipalities				
pr <= -2.5%		3	5	0	0
-2.5% < *pr* <= 0.0%		10	20	0	0
0.0% < *pr* <= 2.5%		19	43	25	12
2.5% < *pr* <= 5.0%		17	23	21	10
5.0% < *pr* <= 7.5%		14	12	18	8
7.5% < *pr* <= 10.0%		13	5	14	8
10.0% < *pr* <= 15.0%		34	21	26	33
15.0% < *pr* <= 20.0%		3	1	3	4
20% > *pr*		0	0	1	1
Total		113	130	108	76

Table 4 – Veneto Region: administrative effects of compulsory amalgamations

	Present situation (year 2010)	Amalgamation policies			
		A1	*A2*	*B1*	*B2*
Number of municipalities					
Total	581	352	326	377	469
Reduction of municipalities		229	255	204	112
% reduction		*39.4%*	*43.9%*	*35.1%*	*19.3%*
Involved in amalgamations		342	385	312	188
% involved		*58.9%*	*66.3%*	*53.7%*	*32.4%*
New municipalities		113	130	108	76
New municipalities as a % of ex-post total		*32.1%*	*39.9%*	*28.6%*	*16.2%*
Average number in amalgamations		3.03	2.96	2.89	2.47
Population					
Total	4,937,854				
Involved in amalgamations		989,211	1,618,067	1,029,235	617,655
Involved/total (%)		*20.0%*	*32.8%*	*20.8%*	*12.5%*
Average population in new municipalities		8,754.1	12,446.7	9,530.0	8,127.0
Average population of total municipalities	8,498.9	14,028.0	15,146.8	13,097.8	10,528.5
Increase with respect to present		*65.1%*	*78.2%*	*54.1%*	*23.9%*
Distribution of municipalities					
Inhabitants	Number of municipalities				
Fewer than 1000	40	0	0	11	28
1,000–4,999	273	0	0	46	117
5,000–9,999	137	189	153	151	175
10,000–19,999	94	126	132	130	112
20,000–49,000	30	30	34	32	30
More than 50,000	7	7	7	7	7
Total	581	352	326	377	469
Distribution of new municipalities					
Inhabitants	Number of municipalities				
Fewer than 1000		0	0	2	1
1,000–4,999		0	0	5	2
5,000–9,999		80	58	58	55
10,000–19,999		33	59	41	18
20,000–49,000		0	12	2	0
More than 50,000		0	1	0	0
Total		113	130	108	76

Figure 4 – Maps of simulated amalgamations in the Veneto Region



Note: New municipalities created by amalgamations can be identified by looking at neighboring municipalities with the same color.

5.2 Sensitivity analysis: population size constraint

The effects of policies *A1* and *A2* depend also on the population constraint that limits amalgamation to municipalities with fewer than 5,000 inhabitants. Table 5 shows a simulation analysis conducted by varying the population constraint from 1,000 to 10,000 inhabitants. In both policies *A1* and *A2,* a higher population limit leads to a smaller number of municipalities, but the maximum expenditure reduction occurs at 5,000 inhabitants. In any case there is a considerable expenditure reduction when the threshold is higher than 3,000 inhabitants with policy *A1* and lower than 6,000 with policy *A2*. It is worth noting that in some cases, especially with policy *A2*, there is a negative expenditure reduction (i.e. an increase in expenditure). This fact suggests that the population level constraint should be chosen carefully.

Table 5 – Veneto Region: expenditure reduction with different population constraints in amalgamation policies *A1* and *A2*

	Amalgamation policies			
	Policy *A1*		**Policy *A2***	
Population constraint	**Number of municipalities**	**Expenditure reduction (k€)**	**Number of municipalities**	**Expenditure reduction (k€)**
1,000	546	789	541	497
2,000	495	-568	484	1,863
3,000	443	8,656	416	12,423
4,000	398	25,569	369	20,993
5,000	352	40,687	326	24,376
6,000	328	38,780	299	19,057
7,000	298	33,344	263	-1,190
8,000	274	26,880	238	-13,316
9,000	256	20,398	221	-25,102
10,000	256	20,398	209	-34,031

5.3 Sensitivity of results with respect to the expenditure function specification

In order to evaluate how the results are affected by the model specification, a simplified version of the expenditure function was estimated. This model, based on the naive idea that municipal per capita expenditure depends on population size only, was used to compute the fitted line shown in Figure 2. The estimation results yield a low adjusted R^2 (0.32), as shown in Table A.3.

The financial impacts of the four amalgamation policies estimated using the simplified expenditure function are given in Table 6. Regardless of the amalgamation policy used, the expected expenditure reduction is almost double that in the previous case, although the ranking among policies remains the same. The minimum expected gain is realized with policy *A2* (€ 52 million); the maximum effect occurs if policy *B2* is implemented (€ 79 million).

These results are important because they highlight the fact that expenditure function specification represents a crucial step towards an ex-ante assessment of amalgamation policies. The expected expenditure reduction is highly sensitive to different specifications and estimates of the municipal expenditure function.

Table 6 – Veneto Region: the financial effects of compulsory amalgamation policies using the simplified expenditure function

	Present situation	Amalgamation policies			
		A1	***A2***	***B1***	***B2***
Current expenditure (k€)	3,639,036	3,562,961	3,586,277	3,559,814	3,561,419
Expenditure reduction from amalgamations (k€)		76,075	52,758	79,222	77,617
Expenditure reduction/total expenditures (%)		*2.09%*	*1.45%*	*2.18%*	*2.13%*
Present expenditure by amalgamated municipalities (k€)		666,080	1,046,522	797,348	780,446
Expenditure reduction/expenditure of amalgamated municipalities (%)		*11.42%*	*5.04%*	*9.94%*	*9.95%*
Average annual per capita expenditure reduction in amalgamated municipalities (€)		76.9	32.6	63.7	64.3
Average annual expenditure reduction in new amalgamations (€)		222,441	137,034	207,387	206,428
Present value of expenditure reduction (20 years, at 3%) (k€)		1,131,802	784,907	1,178,622	1,154,742

6. Conclusions

Amalgamation policies are usually based on the hypothesis that small municipalities provide local public services inefficiently, meaning that they should be encouraged or forced to merge in order to exploit economies of scale. Voluntary amalgamations would allow better results than compulsory amalgamations, but are difficult to achieve because the desire to maintain local identity often prevails.

Most of the economic literature focuses on the effects of past municipal amalgamation programs. However, the results of those studies are of little use because they are case specific. The aim of this paper was to provide a tool for policy makers to estimate *ex ante* the expected financial and administrative effect of any compulsory amalgamation policy.

An iterative procedure was developed to achieve this. It explicitly considers the spatial relationships between municipalities and the aggregation criteria adopted by policy makers, which requires the formalization of a number of constraints and objective functions.

Implementation of the proposed method requires the initial estimation of an expenditure function of the municipalities, as this allows the expected expenditure of an amalgamation to be defined.

The proposed approach also provides local administrators with quantitative information about the possible financial outcomes of a voluntary amalgamation of municipalities.

Applying the model to a case study, the municipalities of an Italian Region, the effects of a general compulsory amalgamation program was assessed on the basis of four alternative policies that differ in terms of constraints and goals. The results obtained support the idea that the highest expenditure reduction is not obtained when municipalities are aggregated solely on the basis of population size, but when expenditure reduction maximization is explicitly introduced into the amalgamation selection. The case study also reveals the presence of institutional economies and diseconomies of scale, which partially offset technical economies of scale.

The results are sensitive to different specifications and estimates of the expenditure function, which represents the crucial step for any ex-ante amalgamation program assessment.

Appendix

Table A.1 – Municipal variables used in estimation

	Variable	Description	Mean	Std. Dev.	Min	Max
1	Per capita current expenditure	€	665.05	313.18	283.09	2846.79
2	Population	Inhabitants in 2010	8498.89	19687.12	127	270,884
3	Population density	Inhabitants/land area (ha)	293.02	276.85	5.72	2306.93
4	Per capita grants	€	239.66	94.88	104.30	901.49
5	Entrepreneurial intensity	Firms/inhabitants (×100)	7.33	1.80	1.48	19.08
6	Per capita PIT tax base	€	11659.82	1565.65	5054.04	21265.63
7	Tourism intensity	Beds/inhabitants (×100)	19.37	65.85	0.00	681.42
8	Average household size		2.52	0.20	1.52	2.98
9	Incidence of foreigners	Foreigners/inhabitants (×100)	8.26	3.95	0.47	20.77
10	Altimetric zone	1 = Internal mountain 2 = Coastal mountain 3 = Internal hill 4 = Coastal hill 5 = Flat	3.78	1.60	1	5
11	Net migration rate	Net migration/inhabitants (×100)	0.27	0.75	-2.21	5.04
12	Birth rate	Births/inhabitants (×1000)	9.36	2.12	0.00	14.98
13	Municipal associations' per capita current expenditure	€	18.38	51.88	0.00	385.45
14	Per capita exogenous tax revenues	€	34.90	9.89	14.29	184.70
15	Young-age-dependency ratio	Population aged 0-14/ population aged 15-64 (×100)	21.83	2.96	11.35	29.66
16	Old-age-dependency ratio	Persons aged 65 and over/population aged 15-64 (×100)	30.72	6.80	14.97	64.41
17	Jobs per inhabitant	Total jobs/inhabitants (×100)	29.20	17.26	2.58	197.90
18	Mortality rate	Deaths/inhabitants (×1000)	9.36	3.34	3.09	35.18
19	Mountain municipal associations' per capita expenditure	€	26.10	78.31	0	485.11
20	Dummy d_1	1 if inh. $\leq$ 1,000 0 otherwise	0.069	0.253	0	1
21	Dummy d_5	1 if 1000 $<$ inh. $\leq$ 5000 0 otherwise	0.470	0.500	0	1
22	Dummy *prov*	1 if provincial capital 0 otherwise	0.012	0.109	0	1

Table A.2 – Distribution of inhabitants and current expenditure for Veneto Region municipalities (2010)

Classes (inhabitants)	Number of municipalities	%	Inhabitants	%	Current expenditure (euro x 1,000)	%
< 500	10	1.72	3,252	0.07	4,730.3	0.13
500–999	30	5.16	22,826	0.46	21,881.9	0.60
1,000–1,999	74	12.74	114,452	2.32	89,130.3	2.45
2,000–2,999	83	14.29	207,370	4.20	144,439.1	3.97
3,000–4,999	116	19.97	456,376	9.24	289,239.8	7.95
5,000–9,999	137	23.58	987,082	19.99	514,616.5	14.14
10,000–19,999	94	16.18	1,255,678	25.43	711,057.8	19.54
20,000–49,999	32	5.51	943,038	19.10	617,290.4	16.96
50,000–99,999	1	0.17	82,807	1.68	67,299.3	1.85
> 100,000	4	0.69	864,973	17.52	1,179,350.2	32.41
Total	581	100.00	4,937,854	100.00	3,639,035.5	100.00

Table A.3 – Simplified municipal expenditure function

Dependent variable: Municipal per capita current expenditure (ln)

Explanatory variables	***coefficient***	***t-test***	
Constant	13.59296	26.24	**
ln population	-1.58574	-13.37	**
(ln population)^2	0.08595	12.76	**
Number of observations	581		
Adjusted R^2	0.3198		
Standard error of the regression	0.2973		
F(2,578)	107.280		

Note: ** statistically significant at the 1% level

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