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Keywords
Italian Health Care System, Local Health Authority, Consolidation

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Consolidation is often considered as a means to lower service delivery costs and enhance accountability. This paper uses a prospective evaluation design to derive estimates of the potential cost savings that may arise from Local Healthcare Authorities (LHAs) amalgamation process, which is concerning the Italian National Health System. We focus specifically on cost savings due to scale economies with reference to a particular subset of the production costs of the LHAs, i.e. the administrative costs together with the purchasing costs of both goods as well as non-healthcare related services. Our results demonstrate the existence of economies of scale linked to the size of the LHA population. Hence, the decision to reduce the number of LHAs may result in larger local health authorities that are more cost efficient, especially when the consolidation process concerns merging a large number of LHA.

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1. Introduction

In recent years, health spending has grown faster than the gross national product in many OECD countries. Especially in the years preceding the economic crisis, health spending outpaced the rest of the economy, with an annual average growth of 3.8% (OECD Health Statistics, 2015). Even though reform efforts have slowed this trend, unless there are major changes in healthcare policy, the demands of health spending on public-sector budgets are likely to grow further in coming years: indeed, the cost of medical technology and its increasing use and the ageing of the population may contribute to the spiraling health care costs. The financial crisis, large government deficits and austerity public spending policies have imposed a tight budget constraint on the healthcare systems putting great emphasis on the necessity of considering organizational restructuring among health providers aimed at controlling or even cutting selected health expenditures.

Analogous to the general OECD trend, also in Italy health expenditure has steadily increased over time exceeding the GDP and making its containment a major political issue. In order to place stricter control over the public healthcare expenditure, deep reforms started already in the 90s, bringing Italy to experience a process of decentralization, which has seen a progressive shift of jurisdiction in the health domain from center to Regions. The Italian National Health System (NHS) has been interested by a reorganization process too characterized by the frequent merging of the Local Healthcare Authorities - hereafter LHAs - above all the smaller ones (Ferrè and Ricci, 2012). This process has continued in the recent years: the basic idea is that the consolidation of existing LHAs into a smaller number of much larger health local authorities may lead to minimize administrative overlaps delivering efficiency gains (despite the paucity of empirical evidence in support of this contention).

At an international level, studies that examine the economies of scale deriving from the local health department (LHDs) consolidations are not many. In general, they have supported the idea that consolidating LHDs may increase efficiency and improve the effectiveness of public health services. Hoornbeek et. al (2015), for instance, examined the effects of LHDs consolidations on the total and administrative expenditures in Ohio. They found that the consolidation of the LHDs might lead to a reduction in total expenditures, but not to a statistically significant change in administrative expenses. Santerre (2009) used a nationally representative sample of American LHDs to investigate the relation between population size and local public health spending. His findings suggested that the minimum efficient scale of a local public health department is approximately 100,000 people. Above that size, additional population has little impact on public

health spending per capita. Bates and Santerre (2008) contributed to the empirical literature by examining the consolidation of a set of district health departments in Connecticut. They found that a 1 percent increase in population results in a 1.6 percent decline in public health spending per capita. All these analyses are ex-post assessment on what has been the impact of the LHDs amalgamation on the health spending.

With respect to the previous literature on the consolidation of LHDs, we use an ex-ante evaluation design to derive estimates of the potential resulting cost savings that may arise from LHAs amalgamation. We focus specifically on cost savings due to scale economies with reference to a particular subset of the production cost of the LHAs, i.e. the administrative costs together with the purchasing costs of both goods as well as non-healthcare related services that, in Italy, made up 18.2% of the production costs in 2012 (Italian Ministry of Health, 2012).

We are not aware of any study about the economic effects of amalgamation in the health sectors concerning the Italian NHS. Our research intends to fill this gap in the literature taking the advantage of the regional setting of the Italian NHS, which offers a "unique field" for exploring the economic effects of the LHAs amalgamation. This type of analysis may be of particular interest to policymakers inclined to limit the large and growing cost of healthcare, especially at this stage of the radical restructuring effort, where no empirical investigations into economies of scale were formally included in the Italian policy agenda to inform the policy process.

The remainder of the paper is organized as follows: the second section presents the institutional background about the amalgamation process that has concerned Italy in the last decades. The third section describes the empirical approach. The fourth section presents the results and provides detailed evidence relating to scale efficiencies. The conclusions review the methodology and results and provide implications for policy and future research.

2. The Merger Process

The Italian NHS is a Beveridge-like health care system, funded through general taxation. It was established in 1978 to replace a Bismarckian system of health insurance funds, with the declared goal of providing uniform and comprehensive healthcare services across the country (France et al. 2005; France and Taroni, 2005; Torbica and Fattore, 2005). Since its inception, the NHS has been heavily reformed: as healthcare expenditure increased steadily over time, the central government repeatedly introduced policy reforms aimed at controlling such growth. In particular, in the last 20 years deep reforms have transformed the centralized structure of the Italian NHS through a process of decentralization, with a progressive shift in responsibilities,

management and funding from central to regional jurisdictions (Canta et al. 2006). From the 1990s reforms, which involved a process of decentralization of the NHS, the regional governments coordinate and control the LHAs and public and private accredited hospital activity. LHAs are distributed throughout the country. Each LHA organizes and plans the health care systems for a specific area to provide services in the community closer to where people live. The LHAs ensure the "essential levels of care" (Livelli Essenziali di Assistenza, LEA) established by national laws.

The healthcare reforms have also changed the structure of the NHS, entailing a drastic reduction during the 90s of the LHAs, which saw the numbers of LHAs decreasing from 659 in 1992 to 197 in 2001. Then, the territorial reorganization has continued albeit less drastically. Indeed, as can be observed in Table 1, the number of LHAs has reduced by 58 units (-29,4%) going gradually from 197 in 2001 to 139 in 2015. At the same time, their average size has increased by 51%, from 289,000 people in 2001 to approximately 437,000 people in 2015. Of the 58 LHAs that were merged between 2001 and 2015 a good 32 of them are indeed located in regions under the Recovery Plan.[1]

The merging of LHAs seems tightly linked with the central government efforts to contain costs, especially through policies aimed at increasing the efficiency of public spending. However, even the most virtuous of Regions have merged or are in the process of merging local health services. Emilia Romagna is one of these and has just recently merged four LHAs creating one of the largest LHA in Italy. Tuscany, too, is moving along these lines, where in 2015 a Bill was passed to reform the Regional Health Service by merging twelve LHAs into just three. Veneto is about to follow suit where there is a high number of LHAs with a lower average size and Lombardy, too, where a recent Regional Health Reform Bill envisages the reduction of fifteen LHAs to eight.

This amalgamation process has seen an organizational model emerge where the size of the LHAs has reached a provincial dimension and in some cases, regional. Apart from a few big metropolitan cities (Turin, Milan, Rome and Naples), whose territories are subdivided into various LHAs, over the rest of the country, the LHAs' catchment area often coincides with the

[1] In order to prevent regional health systems' financial failure in some regions, the central government has introduced a special regime, the so-called "Recovery Plan", in the attempt to place stricter control over regions' healthcare spending (see also de Belvis et al; 2012).

provincial one. There is just one notable exception, which is nevertheless about to change, and that is in the Veneto area where there are twenty-one LHAs in seven provinces.

How the LHAs are distributed in demographic terms is anything but uniform. As can be seen in the Graph 1, most of the LHAs (90 in number that is 62 % of the total) have a user base lower than 400 thousand inhabitants. There is, however, a significant number of LHAs, with a user base of 400 to 600 thousand inhabitants (30 in number that is 20.6% of the total). Against this, there are five LHAs with fewer than 100 thousand in their user base (three of them in the Veneto area) and eleven in Lombardy and Campania with more than one million users. Some statistics regarding the dimensions of the LHAs are shown in the Table A1 in the Appendix.

The aim of this paper is to estimate the potential cost savings which may derive from the amalgamation process which is concerning the Italian NHS yet. The choice of concentrating on components- i.e. the management costs - as opposed to the total production cost is due to particular features of the Italian NHS that on the one hand expects the individual LHAs to keep within their budget and on the other makes the LHAs almost totally financially dependent on their Regional Governments financial transfers.[2] This makes it impossible to estimate economies of scale at an aggregate level.[3]

3. LHAs amalgamation: the empirical approach

Savings calculations has been made along the same lines as those of Harrison (2011) as well as Rizzi and Zanette (2015).

The potential total saving (S_{ij}) which may derive from a pairwise consolidation of the LHAs *i* and *j* has been modelled as:

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[2] The Italian NHS organizational structure consists of three levels: central government: regions and autonomous provinces and local health authorities. The Central Government is responsible for the national health planning for ensuring the "essential levels of care" (Livelli Essenziali di Assistenza, LEA) to their citizens which guarantee equal health care coverage throughout the country (Torbica and Fattore, 2005). It provides annually financial transfers to the Regions (through the National Health Fund) which are set according to a procedure based on a complex formula involving population size, average age, mortality rates and other regional characteristics, among which the historical spending levels. The financial transfers are then disbursed by each Region to its LHAs (see Giannoni and Hitiris, 2002; France et al. 2005; France and Taroni, 2005; Torbica and Fattore, 2005).

[3] Preliminary estimates stressed that the local variability of the per-capita total production cost does not depend neither on the LHAs demographic dimension nor on the other socio-economic variables. It arose that the local variability of the per-capita production cost tends to be quasi-exclusively explained by the financial transfers disbursed by each Region to its LHAs. In particular, we observed that the total production costs exhibit unitary elasticity with respect to the Regional transfers because each LHA uses all the received resources. It follows that the variability of the per-capita total production cost cannot be used neither to estimate the potential differences in the population healthcare needs nor the differences in healthcare demand.

$$S_{ij} = C_i POP_i + C_j POP_j - C_{ij} POP_{ij}, \quad (1)$$

Equation (1) indicates the difference between the sum of the costs for the merging LHA *i* and LHA *j* and the cost of LHA *ij* resulting from the merger event. C_i and C_j are the per-capita costs of the pre-merging LHAs, POP_i and POP_j indicate their original population, while C_{ij} and $POP_{ij} = POP_i + POP_j$ indicate the post-merger per-capita cost and population respectively. Since the value of C_{ij} is unknown ex-ante, it is not possible to compute the potential S_{ij} that may be obtained from the amalgamation. Hence, we use expected costs rather than actual costs to evaluate cost savings:

$$\hat{S}_{ij} = \hat{C}_i POP_i + \hat{C}_j POP_j - \hat{C}_{ij} POP_{ij} \quad (2)$$

where $\hat{C}_i$, $\hat{C}_j$ e $\hat{C}_{ij}$ represents the expected per-capita costs.

For the analysis of the economies of scale, we used the log-linear regression model. In order to obtain the expected value of $\hat{C}_i$, $\hat{C}_j$ e $\hat{C}_{ij}$ included in the equation (2), which refer to the administrative costs, the purchasing costs of goods and non-healthcare related services alternatively, we estimated three different LHA expenditure functions each of which with the following model specification:

$$lnC_h = \alpha + \beta_1 lnpop_h + \beta_2 lnpop_h^{\,2} + \sum_{k=1,K} \gamma_k lnx_{hk} + \sum_{d=1,D} \delta_d z_{hd} + \varepsilon_h \quad (3)$$

The dependent variable lnC_h is the natural logarithm of the per-capita costs for the LHA *h*; $lnpop_h$ is the logarithm of the district population. Population was set as an explanatory variable for exploring whether the LHA size (in terms of number of inhabitants) may affect the healthcare per-capita costs for the examined cost type (administrative costs, purchasing costs of goods and non-healthcare related services). We used a quadratic function, which complies with the theory of economies of scale (U-shaped curve). This approach can capture a range of scale effects, such as the one in which costs per-capita fall initially, but then rise after some threshold number of inhabitants are served. x_{hk} is a vector of K explanatory variables expressed in logarithm and z_{hd} is a vector of D dummy explanatory variables which capture LHAs fixed characteristics. $\beta_1, \beta_2, \gamma_k$ and δ_d are the parameters to be estimated, ε_h reflects the error term.

Equation (3) has been estimated through an OLS model with robust standard errors and by using a step-wise backward elimination (at the 5% level of significance). Essentially, stepwise regression assesses all the possible explanatory variables in the dataset and tests which variables should be included in the model. We started with all of the predictors in the model and backward stepwise regression was used to arrive at a more parsimonious model. The variable that is least significant (i.e. the one with the largest p value) is removed and the model is refitted. Each subsequent step removes the least significant variable in the model until all remaining variables have individual p values ≤ 0.05. This follows a 'general to specific' method of model building, commonly used in econometrics (Maddala, 1992). The variance inflation factor (VIF) index was used to test collinearity. Some of the problematic (VIF index >10) predictors were removed. Goodness of fit and predictive power were measured with the adjusted R^2 index, and Akaike's information criterion (AIC). The results of the regression model are included in the Table 2, which also contains the eliminated potential predictors.[4]

3.2 Data and variables

The data relating to the costs of the LHAs have been gathered from the 2012 annual balance sheet drawn up each year by the LHAs and published within the (NSIS) New Health Information System by the Ministry of Health. A key characteristic of the NSIS is that it standardizes the type and format of health data collected across Italy's regional health systems. In order to make the sample more uniform the analysis focused on those 119 LHAs of Regions with an Ordinary Statute (ROS).[5]

Data concerning the dependent variable have been defined according to the disaggregation of the published balance sheet:

- the "administrative costs" include the cost for "administrative personnel", with either a permanent or a fixed term contract, as well as "other operational costs" including

[4] As sensitivity analysis, we re-run the model with a less stringent p-value ≤ 0.10 so as not to arbitrarily exclude variables that may be relevant with respect to the hypotheses being tested. This construction did not significantly affect the results that remained similar to those presented in the paper. For the sake of brevity, the results of the sensitivity analysis are not included but they are available on request.

[5] Italy comprises fifteen ordinary statute regions and five special statute regions, which have greater fiscal autonomy and legislative powers in all subject matters that are not expressly covered by State legislation. Special statute regions (indicated with an asterisk in Table 1) cannot be directly comparable with that of the other regions.

allowances, expenses and social security contributions for Governing Bodies and Statutory Auditors;

- "cost of goods" include both the cost of buying health goods (drugs, medical devices, dietary products, chemicals etc.) as well as non-health goods (foodstuffs, cleaning products, fuel etc);
- "Non-health services buying costs" include laundry, cleaning, canteen, heating, waste disposal, insurance premiums and consultancy fees.

The first part of Table A.2 in the Appendix includes descriptive statistics of the above mentioned costs. The 119 LHAs of the ROS, have an average annual per-capita administrative cost of 40.9 euro, goods purchasing cost of 183.2 euro and of non-health products of 91.3 euro. The high value of the variation coefficients and the noticeable difference between the minimums and the maximums do, however, highlight a significant variability between the LHAs' per-capita costs. These costs total 15.9 billion euro and represent 18.2% of the total LHAs production costs. The lower share is the administrative costs (2.4%) whilst the purchasing of goods and non-health services total 10.6% and 5.3% respectively of the full production cost.

An important aspect for our purposes is the relationship between the per-capita costs and the demographic dimension of the LHAs. Graph 2 shows that the per-capita cost for the three areas considered tends to decrease as the LHAs resident population grows. In particular, it can be seen how in the larger LHAs (those with a population of over a million) the per-capita cost turns out on average to be barely 52.8%, 38.3% and 48.3%, respectively for the administration, goods purchasing and non-health services purchasing than that of the smaller LHAs (of up to 200,000 inhabitants).

The definition of the control variables and the related descriptive statistics are included in Table A.2 in the Appendix. Since the demographic and socio-economic variables at LHAs level are not available in a specific national database, in order to capture these characteristics, it was necessary to reconstruct the data in relation to the catchment areas of each LHAs. This was made possible by a special table that links Municipalities to LHAs published by the Ministry of Health. Once the LHAs catchment area was established, the Municipalities data from the National Institute of Statistics (ISTAT) was used. It was thus possible to identify the surface area and the housing density covered by the LHAs, the number of Municipalities, the demographic structure indices such as the ageing index, the elderly dependency index, the structural dependency index and the quota of foreigners. An analogous procedure was used

to reconstruct income per-capita in each of the LHAs starting from the Municipalities data on taxable income of each municipality published by the Ministry of Home Affairs.

Among the control variables, it is the per-capita grant received from the Regional Governments, which deserves the most attention. The Central Government distributes the National Health Fund to the Region (see footnote 2). For the LHAs the grant received from the Regions represents 97.4% of the total production costs of the health service provided to resident citizens (Ministry of Health, 2012). The regional grant represents the most important exogenous variable that the LHAs managers have to contend with.

The control variable data on staff and structures that measure health activity have been taken from the National Health Service database. Integrated Homecare Patients are part of this category as well as a number of LHAs and hospital indicators (eg. medical staff, beds available and number of days in hospital). Data was also collected on all the following services: Unified Reservation Centers, the Addiction Treatment Service, Departments of Preventative Medicine, Mother-Child clinics and Mental Health, Transport to Dialysis Centers, Mobile Reanimation Units, and ambulances for the emergency transport of newly born babies. Data on district activity was gathered taking into consideration the number of doctors, pediatricians, emergency medical service stations (and of emergency medical service hours) and the number of prescriptions.

The regional differences in the organization of the Health Service and the consequential effects on the administration costs have been evaluated using binary variables. The regional dummies have been defined bearing in mind that the Regional Health Service can vary according to the organizational model adopted (integrated model, semi-integrated, semi-separate and separate).[6] Three different dummies have therefore been defined (one for each organizational model apart from the "separate" one which refers to the Lombardy Region). Finally, a binary variable was introduced that indicates whether a LHA belongs to a Region under a Recovery Plan.

Input prices have not been considered among the control variables in view of the fact that the medical staff salaries (the main production cost component) and many other input unit prices are uniformly set by law nationwide.

[6] According to Mapelli (2007), four models characterize the way different regions have organized the governance structures of their health care enterprises. The classification reported here uses one of the more significant parameters: the direct management of hospital beds (for further details see also Brenna, 2011).

4. Results

Econometric analysis highlights economies of scale linked to the size of the LHA population. Indeed, Table 2 shows that the costs per capita considered in this analysis tend to decrease as the demographic size of the LHA grows. The elasticity of the administrative cost per capita as far as the resident population is concerned is -0.2525 whilst the square of the logarithm of the population concerning the goods and non–health service buying is -0.006 and -0.0086 respectively. All things being equal, this indicated that the demographic growth of the LHA brings with it a reduction in costs, hence a satisfactory LHA merging policy brings about savings. This result is backed by the downward trend regarding the population by the three functions shown on Graph 3 displaying how, for the three activities considered, *coeteris paribus*, the costs per capita are much higher for the smaller LHA than for the larger ones (see also Santerre, 2009).

In order to evaluate the potential effects of merging, two different policies have been simulated: the first assumes that only smaller LHA are merged and in particular those that are within the first distribution quartile as far as resident population is concerned. This first simulation involved 31 LHA with fewer than 214,726 inhabitants and a further 17 bordering LHA which led to the creation of 23 new LHA with an average population size of 473.586. As a result the number of LHAs decreased by 25 units.

The second policy, which is more general than the one before, envisages a full territorial reorganization of the NHS. It assumes that the number and territorial competence of the LHA align with those of the new provinces according to the Decree Law 5 November 2012 n.188, where the system is organized into 51 provinces.[7] Under this hypothesis 105 of the 119 RSOs' LHA would have different territories from those envisaged and would be grouped into 35 new LHA with an average population of 1,157,242. In this case the number of LHAs decreased by 70 units.

Once the new LHA territories have been defined, for each of the LHA the expected cost per capita has been estimated for each of the three activities according to the expenditure functions previously estimated. The expected savings for each single aggregation and for the whole merging policy have then been calculated based on the equation (2). The simulation results for these two scenarios are given in Tables 3 and 4.

[7] The Law Decree n. 188 of 5 November 2012 was meant to reduce the Italian provinces from 89 to 51.

As far as the first policy is concerned (Table 3) the savings are expected to amount to 522 million euro, most of which coming from savings in the buying of goods (258 million euro). Such a policy would allow a 2.54% average reduction in the total LHA production cost. In some cases, however, such as those regarding the LHA merging in Tuscany, the economic advantage would be 5.42%.

On the other hand, the savings from the second merging policy would be far more substantial (Table 4). Due to the fact that in this scenario almost all LHA would be merged, the savings would amount to 2.2 billion euro. In addition, as far as total production costs are concerned the savings would be more substantial, on average 3.07%, due to the fact that the average size of the new LHA would be considerably bigger than that of the first scenario. On average, this policy would allow each LHA to save on average 63 million euro, most of which coming from savings on goods purchasing (32.1 million euro).

The results obtained also indicate that not all merging is beneficial to the same extent. The greatest savings can be found in those that envisage merging a larger number of LHA, such as the new LHAs in Veneto and Tuscany. Here the savings could exceed 4% of the total health service production cost.

5. Conclusions

Many mergers and reconfigurations of Italian LHAs have taken place in recent years with important changes in the structure of the NHS. Insofar as we have been able to ascertain, the potential presence of economies of scale due to LHAs merging process in Italy has not empirically investigated before. In our paper, we performed a cross sectional study using a prospective evaluation design to derive estimates of the potential resulting cost savings that may arise from LHAs amalgamation. Our results demonstrate the existence of economies of scale (especially with regard to management costs) linked to the size of the LHA population. Hence, the decision to reduce the number of LHAs may result in bigger local health authorities that are more cost efficient especially when the consolidation process involves a larger number of LHA. The research findings of this paper provide a practical insight into the concerns and challenges of local health authorities' amalgamations and may have important implications for the NHS organizations and for the containment of the public health care expenditure.

Even though the Italian health care sector now accounts for over 8.8% of GDP (the other advanced countries with modern health care systems spend 9 % or more) Italy has

experienced substantial health care spending growth which has exceeded economic growth in the last decades (France et al. 2005; de Belvis et al; 2012). The aging of the population and the development of potentially valuable and expensive innovations are likely to put continuing upward pressure on health spending. Italy's so-called "spending review" process confirmed that the government goal is still €10 billion (0.6 points of GDP) in savings in the Stability Law. Health care sector is expected to contribute to the public spending rationalization effort too also through the reorganization of the territorial health care system. The economies of scale that seem to derive from LHAs amalgamation may be an important driver in limiting the large and growing cost of healthcare and may be used to improve the quality of health care, for instance, in terms of making more resources available for R&D maintaining the level of service also in terms of quality and distribution (Kristensen et al.2012).

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Table 1 – The amalgamation process of the Local Healthcare Agencies

(Number of LHAs *for each Region. Underlined the year of the consolidation)*

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Piedmont	22	22	22	22	22	22	22	13	13	13	13	13	13	13	13
Valle d'Aosta*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lombardy	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
P. A. Bolzano*	4	4	4	4	4	4	1	1	1	1	1	1	1	1	1
P. A. Trento*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Veneto	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Friuli V. Giulia*	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5
Liguria	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Emilia Romagna	13	13	13	11	11	11	11	11	11	11	11	11	11	8	8
Tuscany	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Umbria	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2
Marche	13	13	13	13	13	1	1	1	1	1	1	1	1	1	1
Lazio	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Abruzzo	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4
Molise	4	4	4	4	4	1	1	1	1	1	1	1	1	1	1
Campania	13	13	13	13	13	13	13	13	7	7	7	7	7	7	7
Apuglia	12	12	12	12	12	12	6	6	6	6	6	6	6	6	6
Basilicata	5	5	5	5	5	5	5	5	2	2	2	2	2	2	2
Calabria	11	11	11	11	11	11	11	6	6	6	5	5	5	5	5
Sicily*	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Sardinia*	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Total	**197**	**197**	**197**	**195**	**195**	**180**	**171**	**157**	**148**	**146**	**145**	**145**	**143**	**140**	**139**

**: Special Statute Regions and Autonomous Provinces.*

Source: authors' elaboration on data from the Ministry of Health

Table 2 – The estimated expenditure functions

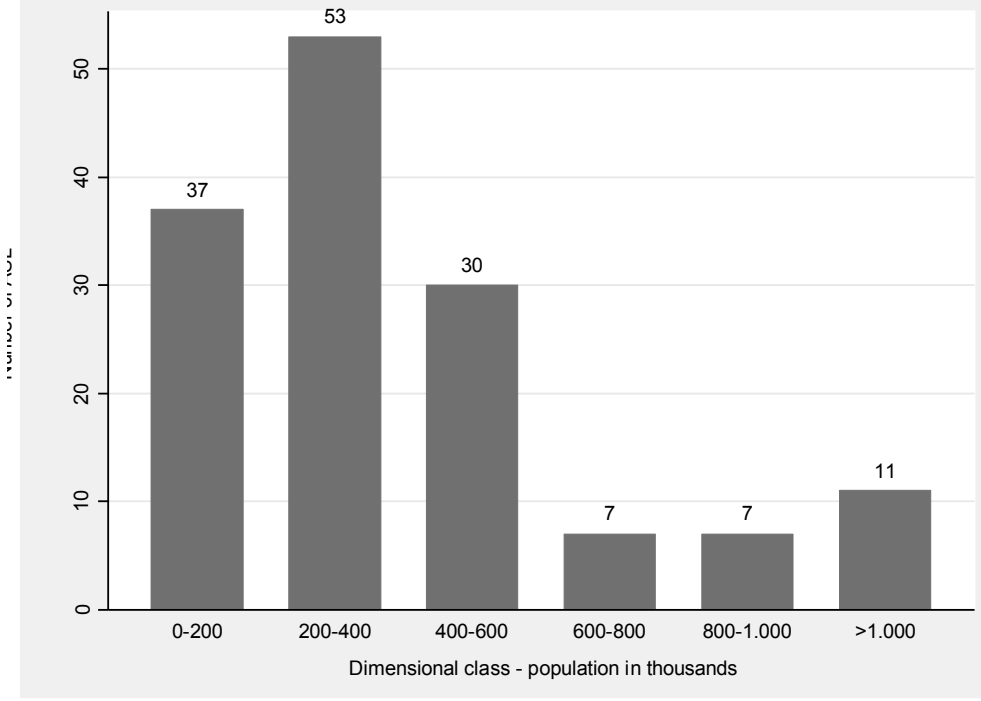
(OLS with robust standard errors and step-wise backward elimination)

	Control variables	Administrative costs			Cost of goods			Non-health service costs		
		Coeff.	t	P>|t|	Coeff.	t	P>|t|	Coeff.	t	P>|t|
	costant	2.23887	*1.38*	*0.170*	-8.99622	*-2.89*	*0.005*	-24.77602	*-7.65*	*0.000*
log	Pop	-0.25256	*-8.01*	*0.000*			#			#
log	Pop ^{2}			#	-0.00603	*-2.86*	*0.005*	-0.00869	*-3.95*	*0.000*
log	Grants	0.51765	*2.92*	*0.004*	2.09343	*4.95*	*0.000*	2.78445	*7.32*	*0.000*
log	S-healthservice	-0.41799	*-6.72*	*0.000*	-0.90131	*-7.14*	*0.000*	-0.94619	*-6.62*	*0.000*
log	S-otherservices	0.04654	*2.20*	*0.030*	0.07364	*2.47*	*0.015*	0.14692	*4.41*	*0.000*
log	Income			#			#	0.76341	*2.99*	*0.003*
dummy	d_central_h	-0.10665	*-2.88*	*0.005*			#	0.60708	*5.78*	*0.000*
log	Hospital beds	-0.04593	*-4.04*	*0.000*			#			#
log	Doctors	-0.58275	*-2.61*	*0.010*			#			#
log	Addiction services			#	-0.16335	*-2.57*	*0.011*	-0.20820	*-3.30*	*0.001*
log	Dependency			#	-1.18859	*-2.15*	*0.034*	-2.39917	*-3.24*	*0.002*
dummy	d_qintegrated			#	0.46091	*6.09*	*0.000*	0.63795	*5.36*	*0.000*
dummy	d_qseparate			#	0.31487	*2.49*	*0.014*	0.69532	*5.90*	*0.000*
dummy	d_recovery			#	0.32366	*2.78*	*0.006*			#
dummy	d_central			#	-0.29502	*-3.72*	*0.000*			#
log	Foreigners			#	0.15816	*2.27*	*0.025*			#
log	Prescriptions			#	-0.93553	*-3.27*	*0.001*			#
log	Emergency hours			#	-0.03658	*-2.48*	*0.015*			#
Numb. obs.		*119*			*119*			*119*		
F		*F(7,111)*	*75.8*		*F(13,105)*	*39.97*		*F(10,108)*	*56.87*	
Prob > F		*0.00000*			*0.00000*			*0.00000*		
R-squared		*0.77440*			*0.81550*			*0.86010*		
Root MSE		*0.18514*			*0.30659*			*0.32825*		
Akaike's information criterion (AIC)		*-55.990*			*69.436*			*83.039*		

#: Variabiles removed from regression since not significative at the 5% level.

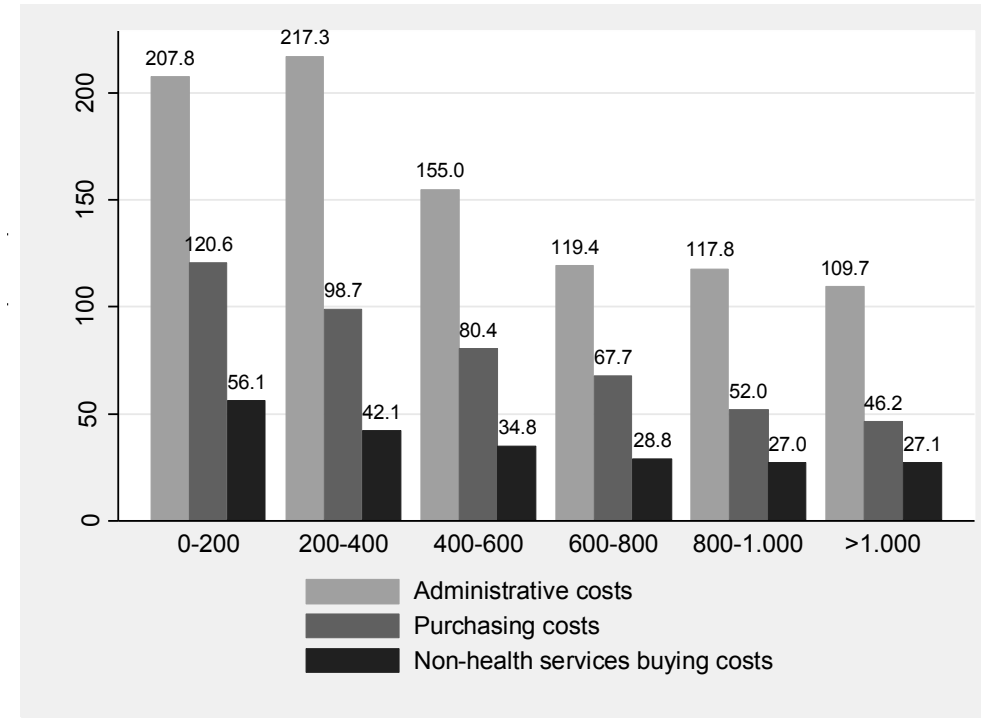
The following variabiles have also been removed from all regressions since not significative at the 5% level: density; municipalities; hotel beds; pediatricians; facilities; homecare, (all in terms of log), and d_reservation; d_maternal; d_transport; d_reanimation; d_ambulances (as dummies). See Table A.2 for descriptions.

Graph 1 - Distribution of the LHAs by dimensional class (year 2012)



Graph 2 – Per capita costs for LHA dimensional class

(Mean for each class – population expressed in thousands)



Graph 3 – Demographic dimension and per-capita costs

(The values of the others control variables are set to the mean values)

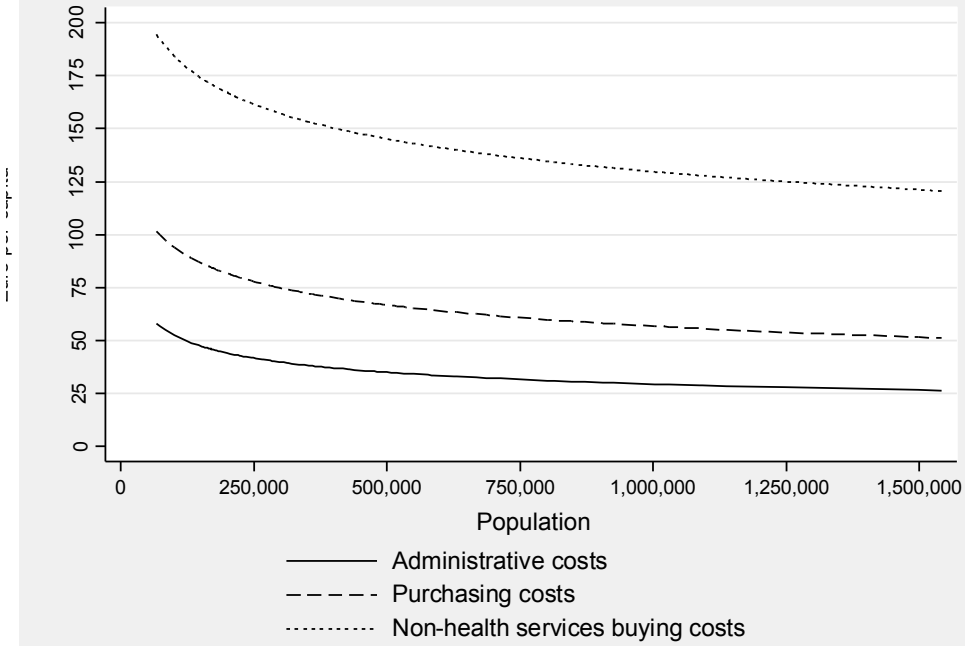


Table 3 – The effects of a minimal amalgamation program

Regions	Number of ASL		Expected savings (x1.000)				
	Before merge	*After merge*	in the administr. costs	in the cost of goods	in the non-health service costs	Total Expected savings	*as % on total production cost*
Basilicata	2	1	3,170	6,149	3,019	12,338	1.21%
Calabria	5	3	7,824	23,389	9,930	41,142	2.49%
Emilia Romagna	11	9	7,055	22,570	18,578	48,203	2.40%
Lazio	12	11	3,824	11,455	13,016	28,295	3.10%
Liguria	5	3	7,872	25,639	16,295	49,806	3.03%
Lombardy	15	14	394	4,106	2,533	7,033	1.51%
Piedmont	13	9	15,667	52,662	26,102	94,431	2.37%
Tuscany	12	10	7,045	32,686	24,131	63,862	5.42%
Umbria	4	2	6,457	26,134	25,492	58,083	3.51%
Veneto	21	13	21,086	53,335	44,366	118,787	1.97%
Total	**100**	**75**	**80,394**	**258,125**	**183,461**	**521,981**	**2.54%**
Total actual costs			519,779	2,248,915	1,134,226	3,902,920	
% of savings			15.5%	11.5%	16.2%	13.4%	

Table 4 – The effects of a general amalgamation program

Regions	Number of ASL		Expected savings (x1.000)				
	Before merge	*After merge*	**in the administr. costs**	**in the cost of goods**	**in the non-health service costs**	**Total Expected savings**	*as % on total production cost*
Abruzzo	4	2	10,002	45,550	36,867	92,420	3.47%
Basilicata	2	1	3,170	6,149	3,019	12,338	1.21%
Calabria	5	3	8,259	23,957	10,492	42,708	4.40%
Campania	7	4	20,613	59,488	44,816	124,917	2.45%
Emilia Romagna	11	5	31,804	103,005	73,984	208,794	2.60%
Lazio	12	3	62,131	203,342	166,844	432,316	3.85%
Liguria	5	3	8,977	30,831	17,388	57,195	2.45%
Lombardy	15	7	18,181	47,696	22,102	87,979	0.76%
Piedmont	13	5	45,092	176,183	79,002	300,277	3.52%
Apulia	6	4	11,439	55,172	36,888	103,498	3.03%
Tuscany	12	4	40,282	157,492	89,040	286,814	4.72%
Umbria	4	1	11,091	39,586	38,753	89,431	5.40%
Veneto	21	5	60,715	177,144	131,869	369,727	3.95%
Total	**117**	**47**	**331,756**	**1,125,595**	**751,063**	**2,208,414**	**3.07%**
Total actual costs			1,488,399	6,505,317	3,281,217	11,274,933	
% of savings			22.3%	17.3%	22.9%	19.6%	

Appendix I

Table A.1 – The dimension of Local Healthcare Agencies

(Number of LHAs per region and descriptive statistics about their population and area – year 2012)

Regions	n. LHAs	Population at 1/1/2012			Surface area (in ha.)		
		Mean	Max	Min	Mean	Max	Min
Piedmont	13	335,205	577,407	169,172	195,285	578,498	5,738
Valle d'Aosta*	1	126,620	126,620	126,620	326,090	326,090	326,090
Lombardy	15	646,725	1,497,762	101,148	159,091	346,418	22,544
P. A. Bolzano*	1	504,708	504,708	504,708	739,838	739,838	739,838
P. A. Trento*	1	524,877	524,877	524,877	620,712	620,712	620,712
Veneto	21	231,127	481,077	67,661	87,654	274,326	39,347
Friuli V. Giulia*	6	202,963	351,153	72,425	131,038	236,635	21,251
Liguria	5	313,468	711,426	145,835	108,324	154,629	66,654
Emilia Romagna	11	394,658	846,046	130,007	204,116	344,748	78,728
Tuscany	12	305,648	802,084	164,423	191,559	450,312	35,624
Umbria	4	220,804	365,754	132,840	211,608	249,615	180,805
Marche	1	1,540,688	1,540,688	1,540,688	940,138	940,138	940,138
Lazio	12	458,335	667,594	154,909	143,602	361,524	22,830
Abruzzo	4	326,604	387,761	298,087	270,796	504,755	123,033
Molise	1	313,145	313,145	313,145	446,065	446,065	446,065
Campania	7	823,489	1,092,574	284,560	195,299	495,416	13,416
Apulia	6	675,012	1,246,742	391,770	325,682	700,754	154,295
Basilicata	2	288,781	377,512	200,050	503,666	659,444	347,889
Calabria	5	391,684	713,869	163,216	304,438	670,975	115,064
Sicily*	9	555,539	1,248,660	176,717	287,027	503,450	162,389
Sardinia*	8	204,731	549,893	57,349	301,250	457,041	149,971
Total	**145**	**409,615**	**1,540,688**	**57,349**	**208,326**	**940,138**	**5,738**

**: Special Statute Regions and Autonomous Provinces.*

Table A.2 – Descriptive statistics

(Concerning the LHAs of Ordinary Statute Regions)

Name		Description	Source	Mean	Std. Dev.
		Dependent variables			
Total costs		Total production costs minus depreciations and revenues for services to non residents - Euro per-capita	**A**	1,653.32	220.40
Administrative costs		Costs for administrative personnel, with either a permanent or a fixed term contract, other operational costs, including allowances, expenses and social security contributions for Governing Bodies and Statutory Auditors Administrative costs - Euro per-capita	**A**	40.92	13.86
Cost of goods		Cost of buying health goods (drugs, medical devices, dietary products, chemicals etc.) as well as non-health goods (foodstuffs, cleaning products, fuel etc). - Euro per-capita	**A**	183.21	97.96
Non-health services costs		Total buying costs for non-health services such as laundry, cleaning, canteen, heating, waste disposal, insurance premiums and consultancy fees - Euro per-capita	**A**	91.35	47.73
		Control variables			
Pop		Resident population in the LHA on January 1°, 2012	**B**	423,382.5	295,260.8
Dependency		Structural dependency ratio of the population (pop≥65+pop≤14)/pop15-64	**B**	0.545	0.040
Foreigners		Percentage share of foreign citizens	**B**	0.075	0.032
Density		Demographic density (Pop/Surface area)	**B**	586.5	1,280.2
Grants		Grants received from Regional Governments as part of the National Health Found - Euro per-capita	**A**	1,610.3	184.7
Municipalities		Number of municipalities in the LHA (2012)	**B**	56.345	51.238
Income		Tax base of personal income tax (IRPEF), 2011 - Euro per-capita	**C**	12,476.6	2,834.8
Hotel beds		Beds in hotels (2012) /Pop	**B**	0.040	0.056
S-healthservices		Share of health services costs on total costs minus depreciations.	**A**	0.180	0.074
S-otherservices		Share of costs for consultancies, partnerships, temporary work and other labor costs in non-health area on total costs minus depreciations.	**A**	0.001	0.002
Hospital beds	*	Number of beds programmed in hospitals / Pop	**D**	615.7	440.5
Doctors		Number of doctors * 1,000 / Pop	**D**	0.764	0.077
Pediatricians		Number of pediatricians * 1,000 / Pop	**D**	0.123	0.020
Facilities		Doctor's officies and laboratories * 100,000 / Pop	**D**	13.906	7.992
Addiction services		Number of Addiction Treatment Services * 100,000/Pop	**D**	1.169	0.655
Emergency hours		Emergency medical service hours / Pop	**D**	0.327	0.238
Prescriptions		Number of prescriptions / Pop	**D**	9.907	1.392
Homecare		Integrated homecare assistance * 1,000 / Pop	**D**	11.853	8.315
d_reservation		Unified reservation center – Type 2 (Dummy)	**D**	0.269	0.445
d_maternal		Maternal and child department (Dummy)	**D**	0.866	0.343
d_transport		Transport service to dialysis center (Dummy)	**D**	0.689	0.465
d_reanimation		Mobile Reanimation Units (Dummy)	**D**	0.269	0.445
d_ambulances		Ambulances for emergency transportation of newly born babies (Dummy)	**D**	0.084	0.279
d_integrated		Dummy for LHA in regions with an integrated organizational model (n=37)	**E**	0.218	0.415
d_qintegrated		Dummy for LHA in regions with a semi-integrated organizational model (n=59)	**E**	0.496	0.502
d_qseparate		Dummy for LHA in regions with a semi-separate organizational model (n=34)	**E**	0.160	0.368
d_recovery		Dummy for LHA in regions under Recovery Plan (n=57)	**E**	0.403	0.493

d_central	Dummy for LHA in regions with Centralised Purchasing System	**E**	0.471	0.501
d_central_h	Dummy for LHA in regions with Centralised Purchasing System only for the Health Sistem	**E**	0.353	0.480

** : Only hospitals directly managed by* LHA *and assimilated.*

A : Ministry of Health (2012a).

B : Authors' elaboration on municipal data from ISTAT (2012a), ISTAT (2012b) and ISTAT (2012c).

C : Authors' elaboration on municipal data from MEF (2012).

D : Ministry of Health (2012b).

E : Authors' elaboration.