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## **Analysis of Portuguese Local Government Efficiency: An Application of Data Envelopment Analysis**

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### **Abstract**

This study intends to analyse the relative efficiency of expenditure in local government, through data envelopment analysis. As the production measure, indicators of outputs regarding expenditure per municipal function were defined, using data for Portuguese local government. This allows assessment of the possible extent of improved municipal performance in relation to the frontier of “best practice”, regarding expenditure per function. The results reveal that, for the selected functions of municipal expenditure, Portuguese local government obtained average efficiency oriented to inputs of 79% nationally. The results obtained also indicate a great variety in efficiency levels in relation to the groups of local governments and functions analysed, where medium-sized governments, those on the coast, and in the regions of the Algarve, Lisbon Metropolitan Area and the Autonomous Region of Madeira present efficiency levels above the national average. The paper contributes to the empirical-theoretical literature by supplying new evidence concerning the efficiency analysis of local government. Indeed, studies of local spending efficiency are still not abundant in the economic literature and, as far the authors know, are not available for Portugal, in particularly for municipalities’ after the global economic crisis.

**Keywords:** Local Government, Efficiency, Data Envelopment Analysis (DEA), Municipal Expenditure.

### **Introduction**

Public Administration has been subject to many changes in recent years, especially in developed countries. After the economic crisis of 2008, from which some countries have not yet recovered, many found themselves in a weak economic situation, with reduced or even shrinking economic production, increased unemployment and lower consumption. In the public sector, the impacts were felt almost immediately with a reduction in income and resource availability, as well as the natural or enforced increase in severe budget restrictions.

In Portugal, the situation was no different. As a direct consequence of the global economic crisis, due to the accumulated sovereign debt, the country had to request financial assistance from the European Union and the International Monetary Fund, which culminated, together with other demands by international

organisations, in adhering to the Economic and Financial Assistance Programme (from May 2011 to 2014), meaning severe budget restrictions. These restrictions were felt in the whole public sector, and particularly in local governments. In this context, analysis of local governments' efficiency becomes even more relevant.

Given the above, the main objective of this research is to analyse the relative efficiency of public expenditure by function in Portuguese local governments. DEA was used to calculate the entry and exit efficiency scores of the 308 Portuguese local governments.

This research aims to contribute to enriching the literature on analysis and assessment of the relative efficiency of expenditure per municipal function, as well as bringing this analysis closer to the contemporary Portuguese situation. It may even influence public strategies and policies in Portugal at the local authority level, as the results obtained can help public administrators and managers in decision-making, inasmuch as they can affect the efficiency and management of local administration.

## **Motivation and Literature**

### ***Contextualization of municipal expenditure in the Portuguese local government sector***

The glossary of terms of public finance of the Public Finance Board – CFP (2015:13) defines public expenditure or total expenditure in the following terms: “In the perspective of public accounting, ‘total expenditure’ or ‘budget expenditure’ includes all expenses of a budgetary nature. This covers all and any transaction with financial assets and liabilities (non-effective expenditure), as well as all other transactions related to acquiring goods and services, interest, subsidies, social provision, remunerations, investment (effective expenditure).”

A similar, equally relevant, definition from the same source describes ‘public expenditure or total expenditure’ as the use of resources by public bodies in acquiring goods or services to satisfy collective public needs and corresponds to the sum of current expenditure and capital expenditure (CFP, 2015:13). According to the CFP, the classification of the functions of Public Administration (COFOG, from the English, Classification of the Functions of Government) is used to identify the allocation of public expenditure according to the different functions of governance. The glossary of terms of Public Finance of the CFP (2015:6) describes the functional classification of expenditure as:

“Regulated in Decree-Law n° 171/94, of 24 June, the functional classification of expenditure specifies the purposes and activities typical of the State, facilitating the identification of the State’s priorities in satisfying collective needs. Local governments have their own functional classifier included in the Official Plan of Local Authority Accounting (POCAL) which must be used in cost accounting and in maps of the multi-year investment plan.”

In recent years, financial management of Portuguese local governments was greatly affected by a series of external factors, highlighted among them the international financial crisis of 2008 and 2009. Due to the crisis and consequent recession it caused, Portugal was forced to adopt programmes of economic austerity such as the Economic and Financial Assistance Programme – PAEF (from May 2011 to 2014), which imposed severe financial and budget restrictions, also reflected in local authority finance.

Among others, the Economic and Financial Assistance Programme (PAEF) established a set of goals with significant implications for local administrations, with a view to reorganisation and significant reduction of the number of Local Administration bodies, strengthening public service provision, increased efficiency and reduced costs. The significant increase in the attributes and competences of local governments resulting from greater decentralization of functions, expressed in the Financial Regime of

Local Governments and Inter-municipal Entities (Law n° 73/2013, of 3 September) and in the Juridical Regime of Local Governments (Law n° 75/2013, of 12 September), put additional pressure on municipal budgets, particularly in councils with greater difficulty in obtaining their own income, as a result of their economic and demographic characteristics (Veiga et al 2015).

Despite efforts to decentralize the provision of public services and the delegation and transfer of competences in relation to Portuguese local governments, the Annual Financial Report of Portuguese Local Governments of 2015 (Carvalho et al 2016) indicates that in 2010 the local public expenditure of Portuguese councils corresponded to only 15% of total public expenditure and public income to 17%, figures well below the European average of 29% and 32% respectively (Carvalho et al 2016). In parallel, regarding the weight of local capital expenditure in total capital expenditure, Portugal presents a figure (66%) above the European average (58%), clearly suggesting greater intervention by Portuguese local governments in public investment activities.

Ideally, the level of public expenditure should correspond to citizens' indirect choice of the public goods and services and social provision they desire, and they should support and finance them through a budget formed of taxes and other charges.

Analysis of public expenditure is frequently related to the question of Public Administration's efficiency in providing goods and services. In general terms, efficiency is measured based on comparison of the resources used and the quantity/quality of goods and services provided, where expenditure related to providing services of a non-commercial nature, in the absence of market prices and good physical indicators, measures outputs through the cost of the inputs used. Although complex, analysis of the efficiency of these productive processes is particularly relevant in drawing up budget programmes, since it allows identification of potential resource economies without harming the level of service provided (Cunha and Braz 2012). Its complexity arises due to the definition of the level of the productive process, especially in relation to inputs and outputs, the determination of proxies or indicators able to summarize the final results, and the absence of market prices to value the provision of products and services of a non-commercial nature, which makes it difficult to measure outputs.

Nationally, in Portugal primary expenditure increased significantly until 2010, especially in the period 1995 to 2005. As for the ratio between total expenditure and GDP, even if Portugal was situated below the average figure for the Eurozone, the country was one of the member states recording the greatest increases in public expenditure as a percentage of gross domestic product (GDP) in the period analysed by Cunha and Braz (2012). In the country, the main areas of public expenditure are service provision through a budget – defence and security, justice, education and health, among others – and making transfers to ensure income in situations such as old age, incapacity or unemployment.

At the municipal level, Veiga et al (2015:160) made a study for the Board of Local Governments (DGAL) about the evolution of income and expenditure in Portuguese councils in the period 2000 to 2014, highlighting that: "the aggregate analysis of the evolution of local authority finance reveals that Portuguese councils balanced a great reduction in their income from 2009 with a considerable reduction in their expenditure, above all in investment, generally recording positive budget balances. In addition, the local sector has achieved a considerable reduction in its debt in recent years, contributing to reducing Portugal's public debt."

Similarly, it is worth highlighting that the authors found signs that between 2008 and 2012, there was a reduction of around 3% in the weight of local public expenditure in the total expenditure of the Public Administration Sector (SPA), which indicates a greater efficiency and contribution by Local Administration than other sub-sectors of Public Administration to the process of consolidating public accounts.

### ***Review of the literature on the efficiency of municipal expenditure***

Although recent, the theoretical-empirical literature on the efficiency of municipal expenditure and local government is extensive and varied. Among the various approaches found, some are highlighted such as methodological aspects and techniques/models to assess efficiency in local government (De Borger and Kerstens, 1996), the influence of exogenous factors on municipal performance (Da Cruz and Marques, 2014), NPM and municipal performance (Christiaens, 2001; Christiaens and Van Peteghem, 2007; Ter Bogt, 2008; Rodrigues, Araújo and Tavares, 2010; Hansen, 2011; Pérez-López, Prior and Zafra-Gómez, 2015), the impact of local government efficiency on quality of life (Silva and Kuwahara, 2011) and the European literature on analysis of municipal efficiency (Seifert and Nieswand, 2014), emphasizing the Portuguese studies (Afonso and Fernandes, 2006; Afonso and Fernandes, 2008; Veiga et al, 2015).

Evolution is observed in the production of academic studies aiming to analyse local government efficiency. Although this tendency is not surprising, given the context of economic crisis and budget restrictions found globally, especially in the European Union, it also confirms a growing need in the public sector to modernize and adapt to the new world situation.

Aiming to assess the efficiency of local government expenditure, various methodologies can be used, with DEA highlighted among them. This technique consists of applying a mathematical model that observes the data and identifies the relationships between inputs and outputs, and therefore, the robustness and relevance of the results depends greatly on the correct choice of indicators, so that they are representative of the activities of the decision-making units (DMUs) to be analysed. The indicators chosen should follow consideration of how to obtain those that best represent the activities corresponding to each function analysed. To identify the common indicators in the specialized literature, an analysis was made aiming to identify consistencies and discrepancies among the studies (Table 1).

**Table 1: Indicators used to assess the efficiency of municipal expenditure**

| Author(s)                     | Indicators  |   |
|-------------------------------|---|---|
|                               | Inputs  | Outputs   |
| De Borger and Kerstens (1996) | Total municipal expenditure   | Number of beneficiaries of social allowances; number of pupils in primary school; area of public leisure facilities; number of inhabitants; and number of inhabitants over 65 years old   |
| Afonso and Fernandes (2006)   | Total municipal expenditure <i>per capita</i>   | Performance indicators representing functions (general administration; education; social services; basic sanitation; and environmental protection)  |
| Afonso and Fernandes (2008)   | Total municipal expenditure <i>per capita</i>   | Performance indicators representing functions (social services; education; cultural services; sanitation; land organisation); and number of kilometres of road infrastructure per total number of inhabitants   |
| Silva and Kuwahara (2011)     | Sum of linearly adjusted municipal expenditure  | Municipal Human Development Index (IDH-M) and multi-dimensional municipal quality of life index   |
| Da Cruz and Marques (2014)    | Number of civil servants; capital expenditure; and other operational expenditure  | Number of inhabitants; number of kilometres of road infrastructure; total urban waste collected, total effluent produced (waste water); and number of municipal infrastructures   |
| Seifert and Nieswand (2014)   | Total municipal expenditure   | Number of beneficiaries of social allowances; number of beds in health centres and old people's homes; number of kilometres of road infrastructure; and number of pupils in state education   |
| Perez-Lopez et al (2015)      | Budget and financial data   | Number of inhabitants; road network, in the case of public transport; total urban waste collected; and total effluent produced (waste water)  |
| Veiga et al (2015)            | Expenditure per function: general administration; education; housing and collective services; cultural, recreational and religious services; and transport and communications | Performance indicators representing functions (inputs), such as: total electricity consumption; number of new buildings; number of pupils enrolled in state schools; number of buildings constructed; public lighting; total urban waste collected; number of cinemas; number of live performances, number of art galleries; number of museums and fuel consumption |

The data presented in Table 1 show great consistency regarding the choice of indicators, both incoming (inputs) and outgoing (outputs), the former representing local expenditure, per capita or adjusted, and the latter representing the production of public goods or services by local government, arising from the direct or indirect application of the resources represented by the inputs, in functions of general administration, education, social services, sanitation, road infrastructure and others.

After applying DEA and identifying the frontier of efficiency and local governments' position in relation to that frontier, we have the level of efficiency of each local authority and the average of the DMUs assessed. However, just as important as identification of efficiency levels in themselves is identification of the causes, the context and the circumstances that allow efficiency or its absence. It is with this objective that the literature seeks to make other analyses, regressions, and find correlations between efficiency and other variables.

Table 2 presents a list of empirical evidence found in the literature referred to, related to exogenous and non-discrete variables.

**Table 2: Exogenous variables and their impact on the efficiency of municipal expenditure (DEA)**

| Author(s)                     | Empirical evidence   |  |
|-------------------------------|--|--|
|                               | Positive impact on efficiency  | Negative impact on efficiency  |
| De Borger and Kerstens (1996) | More local taxes and lower illiteracy rates  | More social allowances <i>per capita</i> and greater average income <i>per capita</i>  |
| Afonso and Fernandes (2006)   | Lower levels of expenditure <i>per capita</i> and larger metropolitan area   | Higher levels of expenditure <i>per capita</i> and larger non-metropolitan or suburban area  |
| Afonso and Fernandes (2008)   | Higher levels of secondary and higher education; higher average income <i>per capita</i> ; and greater geographical distance from the district capital | -  |
| Da Cruz and Marques (2014)    | Greater municipal financial independence; greater number of parishes; characteristics of insularity; and lower rates of illiteracy                     | Greater population concentration; higher level of municipal debt; higher average income <i>per capita</i> ; greater geographical area; greater tourist activity; greater participation in elections; and higher aging population index |
| Seifert and Nieswand (2014)   | -  | Greater distance between the local authority and the capital of the country; higher average income <i>per capita</i> ; greater percentage of old people (over 65)  |
| Pérez-López et al (2015)      | Greater number of public business entities; less use of financial resources; and greater tourist activity  | Greater externalization and inter-municipal cooperation; greater departmental division; higher rate of financial transfers; political majority; and higher unemployment rates  |
| Veiga et al (2015)            | Greater area; greater population concentration; characteristics of insularity; and greater number of inhabitants                                       | Greater percentage of old people (over 64); more wide-ranging in terms of altitude and area; and higher unemployment rates   |

Although relatively scarce, when compared with academic studies made in other areas of management, the literature focusing on analysis of local government efficiency, as observed, has grown in the last decade, demonstrating its relevance and importance. Study of this literature allows identification of common points and tendencies, besides giving direction and inspiration for carrying out additional research, which can corroborate or refute previous empirical evidence, or even fill gaps left in existing work.

## Empirical Evidence: Research Methodology And Results

### Research Methodology

The main aim of this study is to analyse the efficiency of expenditure per function in Portuguese local government, using the methodology of DEA. This research focused on the 308 Portuguese local governments.

Concerning expenditure per function, the sub-objective is to identify differences in average efficiency levels between groups of local governments (by region, degree of isolation and size).

Data-collection for the research was through a documentary search of secondary data coming from external sources, based on methodologies used in the work by Afonso and Fernandes (2008) and Veiga et al (2015).

The data gathered are divided in two groups, inputs and outputs. The inputs are the functions of municipal expenditure and the outputs can be seen in Table 3.

**Table 3: Outputs**

| <i>Outputs</i>   | <i>Source</i>   |
|--|---|
| Total licences granted (year: 2014)<br>Nº of new buildings (Year: 2015)<br>Nº of buildings constructed (Year: 2015)                  | INE – National Statistics Institute – Statistics on Construction and Housing ( <a href="http://www.ine.pt/">www.ine.pt/</a> )         |
| Total electricity consumption (Year: 2014)   | DGEG – Energy and Geology Board ( <a href="http://www.dgeg.pt/">www.dgeg.pt/</a> )  |
| Nº of pre-school pupils (Year: 2015)<br>Nº of pupils at primary school (Year: 2014)<br>Nº of pupils at secondary school (Year: 2015) | INE – National Statistics Institute – Annual Statistical Report of Portugal ( <a href="https://www.ine.pt/">https://www.ine.pt/</a> ) |
| Total effluent produced (Year: 2015)   | ERSAR – Regulating Body of Water and Waste Services ( <a href="http://www.ersar.pt/">www.ersar.pt/</a> )                              |
| Total urban waste collected  | INE – National Statistics Institute – Statistics on Urban Waste ( <a href="http://www.ine.pt/">www.ine.pt/</a> )                      |
| Nº of cinemas (Year: 2015)<br>Nº of live performances (Year: 2015)   | ICA – Cinema and Audiovisual Institute ( <a href="http://www.ica-ip.pt/">www.ica-ip.pt/</a> )   |
| Nº of art galleries (Year: 2015)   | INE – Survey of Art Galleries and other Places for Temporary Exhibitions ( <a href="http://www.ine.pt/">www.ine.pt/</a> )             |
| Nº of museums (Year: 2015)   | INE – Survey of Museums ( <a href="http://www.ine.pt/">www.ine.pt/</a> )  |
| Vehicles (Year: 2015)  | IMTT – Institute of Mobility and Transport ( <a href="http://www.imtt.pt/">www.imtt.pt/</a> )   |

In analysing efficiency, above all through application of the DEA technique, the greatest challenge lies in the selection of outputs, due to both the greater difficulty in having satisfactory measures and these often being incomplete. In the case of analysing municipal efficiency, what is intended is that those outputs represent municipal activity, arising from their attributes and competences defined by law (Law nº 75/2013, of 12 September), and in which resources (expenditure) are used.

The data used refer to the years 2014 and 2015, with the efficiency analysis concentrating on the five most relevant functions for the activity carried out by Portuguese local governments, whose weights are above 10% of municipal expenditure (Table 4). It is noted that the criterion adopted in this research was based on the study by Veiga et al (2015).

**Table 4: Functions of municipal expenditure**

| Function   | Weight |
|--|--------|
| (1.1.0.) General services of public administration                 | 18,45% |
| (1.2.0.) Public law and order                                      | 1,96%  |
| (2.1.0.) Education   | 13,23% |
| (2.2.0.) Health  | 0,53%  |
| (2.3.0.) Social security and action                                | 2,13%  |
| (2.4.0.) Housing and collective services                           | 21,32% |
| (2.5.0.) Cultural, recreational and religious services             | 11,49% |
| (3.1.0.) Agriculture, stock-raising, forestry, hunting and fishing | 0,50%  |
| (3.2.0.) Industry and energy                                       | 4,25%  |
| (3.3.0.) Transport and communications                              | 13,55% |
| (3.4.0.) Commerce and tourism                                      | 4,79%  |
| (3.5.0.) Other economic functions                                  | 0,85%  |
| (4.1.0., 4.2.0. e 4.3.0.) Other functions                          | 6,97%  |

Considering the literature review, this approach is most commonly adopted in studies analysing efficiency in the public sector, and is therefore indicated for the analysis intended here. Concerning the approach inherent to the treatment of returns to scale, in the same way as choosing the methodology, the most commonly used in this type of work was adopted, i.e., variable returns to scale. Adoption of this methodology allows decision-making units to be compared with units characterised by a similar structure of inputs and outputs (Seifered and Nieswand, 2014; Veiga et al, 2015, p.118).

**Table 5: Indicators of inputs and outputs for analysis of efficiency**

| Inputs: Expenditure per function   | Outputs   |
|--|---|
| (1.1.0.) General services of public administration<br>(General administration)   | Total licences granted<br>Total electricity consumption<br>N.º of new constructions   |
| (2.1.0.) Education<br>(Non-higher education; Auxiliary education services)   | Nº of pre-primary pupils<br>Nº of primary pupils<br>Nº of secondary pupils            |
| (2.4.0.) Housing and collective services<br>(Housing; Sanitation; Water supply; Solid waste; Environmental protection and nature conservation) | Nº of buildings constructed<br>Total effluent produced<br>Total urban waste collected |
| (2.5.0.) Cultural, recreational and religious services<br>(Culture; Sport, recreation and leisure; other civic and religious activities)       | Nº of cinemas<br>Nº of live performances<br>Nº of art galleries<br>Nº of museums      |
| (3.3.0.) Transport and communications<br>(Road transport)  | Vehicles  |

Source: Own elaboration.

## Results

### *Efficiency of expenditure per municipal function*

#### *'(1.1.0) General services of Public Administration'*

Table 6 presents the Pearson correlation coefficients, or product-moment correlation coefficient, between the inputs and the measures of output, observing values that can be classified, according to Samuel and Okey (2015), as moderate, in the case of 'Total energy consumption' (0,445), and weak, in the case of 'Total licences granted' (0,189) and 'N° of new constructions' (0,045).

**Table 6: Correlation between inputs and outputs of function '(1.1.0) General services of public administration'**

| Input   | Outputs                |                               |                         |
|---|------------------------|-------------------------------|-------------------------|
|   | Total licences granted | Total electricity consumption | N° of new constructions |
| Expenditure in the function '(1.1.0) General services of public administration' | 0,189                  | 0,445                         | 0,045                   |

Table 7 presents the summary of the results of the efficiency analysis regarding the expenditure included in this function.

**Table 7: Summary table of the results of the efficiency analysis of function '(1.1.0.) General services of public administration'**

| Local government group  | Obs.      | % off efficient LGs | Average efficiency | Standard deviation | Min.        | Max.     |
|-------------------------|-----------|---------------------|--------------------|--------------------|-------------|----------|
| Small                   | 13        | 8%                  | 0,25               | 0,29               | 0,01        | 1        |
| Medium-sized            | 10        | 14%                 | 0,40               | 0,32               | 0,03        | 1        |
| Large                   | 1         | 25%                 | 0,34               | 0,39               | 0,02        | 1        |
| Lisbon and Porto        | -         | -                   | -                  | -                  | -           | -        |
| Inland                  | 9         | 7%                  | 0,25               | 0,28               | 0,01        | 1        |
| Transition              | 3         | 8%                  | 0,34               | 0,30               | 0,03        | 1        |
| Coast                   | 8         | 16%                 | 0,37               | 0,33               | 0,01        | 1        |
| Islands                 | 4         | 15%                 | 0,33               | 0,34               | 0,05        | 1        |
| Azores                  | 1         | 6%                  | 0,23               | 0,23               | 0,02        | 1        |
| Alentejo                | 1         | 2%                  | 0,22               | 0,23               | 0,01        | 1        |
| Algarve                 | 1         | 8%                  | 0,37               | 0,30               | 0,02        | 1        |
| LMA                     | 0         | 0%                  | 0,12               | 0,14               | 0,01        | 0,41     |
| Centre                  | 10        | 13%                 | 0,33               | 0,32               | 0,01        | 1        |
| Madeira                 | 3         | 30%                 | 0,49               | 0,41               | 0,02        | 1        |
| North                   | 8         | 13%                 | 0,30               | 0,31               | 0,01        | 1        |
| <b>National average</b> | <b>24</b> | <b>10%</b>          | <b>0,30</b>        | <b>0,30</b>        | <b>0,01</b> | <b>1</b> |

In Portugal, for expenditure in function ‘(1.1.0) General services of public administration’, the highest values of average efficiency are found in medium-sized local governments, in local governments on the coast and in the Autonomous Region of Madeira, with efficiency levels above 30% in the national scope.

Some facts should be highlighted, such as the absence of results for the Lisbon and Porto group, and the absence of efficient local governments for Lisbon Metropolitan Area (LMA), and the fact of the percentages of efficient local governments not reflecting the proportion in relation to all councils in that group, but rather in relation to all the councils observed during the final analyses of the DEA technique.

### **‘(2.1.0) Education’**

Table 8 presents the Pearson correlation coefficients, or product-moment correlation coefficient, between inputs and measures of output for function ‘(2.1.0.) Education’. The values found can be classified as moderate in the case of all indicators, which although relatively high, even more so when compared with the correlation coefficients of other functions such as ‘(1.1.0.) General services of public administration’ and ‘(2.4.0.) Housing and collective services’, they present significantly lower values. The same occurs when comparing with the results obtained by Veiga et al (2015).

**Table 8: Correlation between inputs and outputs of function ‘(2.1.0.) Education’**

| Input  | Outputs                  |                      |                        |
|--|--------------------------|----------------------|------------------------|
|  | N° of pre-primary pupils | N° of primary pupils | N° of secondary pupils |
| Expenditure in function ‘(2.1.0.) Education’ | 0,584                    | 0,545                | 0,575                  |

The results of the efficiency analysis of expenditure in function ‘(2.1.0.) Education’ (Table 9) show lower average values than other functions, with an average efficiency of only 18% nationally, only higher than the average efficiency of function ‘(3.3.0.) Transport and communications’. The average efficiency values are found to be even lower than those obtained by Veiga et al (2015), where the average national efficiency found for function ‘(2.1.0.) Education’ was 40,40%. For this function, the most efficient results were observed in medium-sized councils, those on the coast and LMA. The negative emphasis is on Madeira, for which no council was found on the frontier of efficiency regarding function ‘(2.1.0.) Education’, and for the minimum values observed, zero for almost all the council groups studied, except for LMA.

**Table 9: Table summarizing the results of the efficiency analysis of function '(2.1.0.) Education'**

| Local government group | Obs. | % of Efficient LGs | Average efficiency | Standard deviation | Min. | Max. |
|------------------------|------|--------------------|--------------------|--------------------|------|------|
| Small                  | 6    | 4%                 | 0,11               | 0,24               | 0,00 | 1    |
| Medium-sized           | 15   | 23%                | 0,27               | 0,38               | 0,00 | 1    |
| Large                  | -    | -                  | -                  | -                  | -    | -    |
| Lisbon and Porto       | -    | -                  | -                  | -                  | -    | -    |
| Inland                 | 10   | 8%                 | 0,16               | 0,31               | 0,00 | 1    |
| Transition             | 3    | 8%                 | 0,14               | 0,26               | 0,00 | 1    |
| Coast                  | 7    | 16%                | 0,27               | 0,36               | 0,00 | 1    |
| Islands                | 1    | 6%                 | 0,18               | 0,29               | 0,00 | 1    |
| Azores                 | 1    | 10%                | 0,17               | 0,28               | 0,00 | 1    |
| Alentejo               | 2    | 4%                 | 0,14               | 0,29               | 0,00 | 1    |
| Algarve                | 1    | 9%                 | 0,19               | 0,31               | 0,00 | 1    |
| LMA                    | 1    | 50%                | 0,50               | 0,49               | 0,2  | 1    |
| Centre                 | 9    | 10%                | 0,16               | 0,29               | 0,00 | 1    |
| Madeira                | 0    | 0%                 | 0,20               | 0,29               | 0,00 | 0,89 |
| North                  | 7    | 12%                | 0,23               | 0,35               | 0,00 | 1    |
| National average       | 21   | 9%                 | 0,18               | 0,31               | 0,00 | 1    |

#### ***'(2.4.0) Housing and collective services'***

The linear correlation coefficients (Table 10), or product-moment correlation coefficient, between inputs and measures of output for function '(2.4.0.) Housing and collective services', are surprising. Of all the functions analysed, it is the only one with a negative, albeit weak, correlation between inputs and measures of output representing the 'N° of buildings constructed' (-0,089), which means in this case a reduction of 8,9% in the number of buildings constructed in relation to increased expenditure on '(2.4.0.) Housing and collective services'. For the other outputs, weak correlations, below 0,3, are also observed, except for 'Total effluent produced' (0,335), which presents a moderate correlation, although with positive values all significantly lower than those obtained by Veiga et al (2015).

**Table 10: Correlation between inputs and outputs of function '(2.4.0.) Housing and collective services'**

| Input  | Outputs                  |                         |                             |
|--|--------------------------|-------------------------|-----------------------------|
|  | N° buildings constructed | Total effluent produced | Total urban waste collected |
| Expenditure on function '(2.4.0.) Housing and collective services' | -0,089                   | 0,335                   | 0,207                       |

The results, presents in table 11 are mixed, with an average efficiency of 28% nationally, compared to 38,1% observed in the report by Veiga et al (2015), although with three groups, in this case directly related, that do not represent efficient local governments, these being the islands. In line with the patterns identified in the previous functions, for '(2.4.0.) Housing and collective services', higher average levels

of efficiency are found in medium-sized local governments, those with coastal characteristics, and those located in the LMA.

**Table 11: Table summarizing the efficiency results of function ‘(2.4.0.) Housing and collective services’**

| Local government group  | Obs.      | % of Efficient LGs | Average efficiency | Standard deviation | Min.        | Max.     |
|-------------------------|-----------|--------------------|--------------------|--------------------|-------------|----------|
| Small                   | 13        | 8%                 | 0,23               | 0,29               | 0,01        | 1        |
| Medium-sized            | 13        | 16%                | 0,37               | 0,35               | 0,03        | 1        |
| Large                   | -         | -                  | -                  | -                  | -           | -        |
| Lisbon and Porto        | -         | -                  | -                  | -                  | -           | -        |
| Inland                  | 7         | 6%                 | 0,21               | 0,25               | 0,01        | 1        |
| Transition              | 6         | 15%                | 0,33               | 0,36               | 0,02        | 1        |
| Coast                   | 13        | 23%                | 0,40               | 0,39               | 0,02        | 1        |
| Islands                 | 0         | 0%                 | 0,25               | 0,24               | 0,02        | 0,85     |
| Azores                  | 0         | 0%                 | 0,23               | 0,20               | 0,02        | 0,85     |
| Alentejo                | 5         | 10%                | 0,29               | 0,32               | 0,01        | 1        |
| Algarve                 | 2         | 17%                | 0,36               | 0,37               | 0,02        | 1        |
| LMA                     | 1         | 33%                | 0,47               | 0,39               | 0,09        | 1        |
| Centre                  | 11        | 13%                | 0,29               | 0,33               | 0,01        | 1        |
| Madeira                 | 0         | 0%                 | 0,29               | 0,29               | 0,02        | 0,81     |
| North                   | 7         | 10%                | 0,25               | 0,30               | 0,01        | 1        |
| <b>National average</b> | <b>26</b> | <b>11%</b>         | <b>0,28</b>        | <b>0,32</b>        | <b>0,01</b> | <b>1</b> |

**‘(2.5.0) Cultural, recreational and religious services’**

Table 12 indicates the levels of correlation observed between inputs and indicators of outputs representing the function analysed. It is of note that of all five functions selected for the efficiency analysis in this study, ‘(2.5.0.) Cultural, recreational and religious services’ is the one presenting the highest average correlation values, with values representing strong correlations, above 0,7, for three of the four output measures, the exception being ‘Nº of cinemas’ (0,535), which presents a moderate correlation.

**Table 12: Correlation between inputs and outputs of function ‘(2.5.0.) Cultural, recreational and religious services’**

| Input  | Outputs       |                         |                     |               |
|--|---------------|-------------------------|---------------------|---------------|
|  | Nº of cinemas | Nº of live performances | Nº of art galleries | Nº of museums |
| Expenditure on function ‘(2.5.0.) Cultural, recreational and religious services’ | 0,535         | 0,807                   | 0,798               | 0,755         |

Table 13 shows quite divergent results compared to the other functions, with the frontier of efficiency of function ‘(2.5.0.) Cultural, recreational and religious services’ being formed of large local governments,

those located in the Autonomous Region of Madeira, and transitional and coastal local governments. Another difference in relation to the other functions analysed previously is the greater number of observations of efficient councils, and the return of large councils in the analysis, not considered as outliers as a whole, and having 40% of the councils in the group observed in the analysis, forming the frontier of efficiency. With an average efficiency of 68%, far above the 28% nationally, large local governments present the best result for function '(2.5.0.) Cultural, recreational and religious services'.

**Table 13: Table summarizing the results of the efficiency analysis of function '(2.5.0.) Cultural, recreational and religious services'**

| Local government group | Obs. | % of Efficient LGs | Average efficiency | Standard deviation | Min. | Max. |
|------------------------|------|--------------------|--------------------|--------------------|------|------|
| Small                  | 15   | 9%                 | 0,23               | 0,31               | 0,00 | 1    |
| Medium-sized           | 13   | 15%                | 0,35               | 0,36               | 0,01 | 1    |
| Large                  | 2    | 40%                | 0,68               | 0,31               | 0,17 | 1    |
| Lisbon and Porto       | -    | -                  | -                  | -                  | -    | -    |
| Inland                 | 13   | 10%                | 0,22               | 0,21               | 0,00 | 1    |
| Transition             | 6    | 15%                | 0,33               | 0,36               | 0,00 | 1    |
| Coast                  | 9    | 13%                | 0,37               | 0,35               | 0,01 | 1    |
| Islands                | 2    | 9%                 | 0,31               | 0,35               | 0,01 | 1    |
| Azores                 | 0    | 0%                 | 0,18               | 0,22               | 0,01 | 0,87 |
| Alentejo               | 9    | 17%                | 0,34               | 0,36               | 0,00 | 1    |
| Algarve                | 1    | 8%                 | 0,24               | 0,28               | 0,00 | 1    |
| LMA                    | 1    | 11%                | 0,37               | 0,29               | 0,07 | 1    |
| Centre                 | 10   | 11%                | 0,29               | 0,34               | 0,01 | 1    |
| Madeira                | 2    | 29%                | 0,59               | 0,41               | 0,02 | 1    |
| North                  | 7    | 9%                 | 0,21               | 0,31               | 0,00 | 1    |
| National average       | 30   | 11%                | <b>0,28</b>        | 0,34               | 0,00 | 1    |

### ***'(3.3.0) Transport and communications***

Table 14 presents the correlation between inputs and the output measure of 'Vehicles' (0,485) used in carrying out this study, the correlation being moderate.

**Table 14: Correlation between inputs and outputs of function '(3.3.0) Transport and communications'**

| Input   | Outputs  |
|---|----------|
|   | Vehicles |
| Expenditure on function '(3.3.0.) Transport and communications' | 0,485    |

The results in Table 15 reveal the lowest efficiency levels of the five functions studied. Surprisingly, the highest values of relative efficiency refer to medium-sized local governments, those located on the coast

and in the LMA and the Algarve. It also stands out that the average efficiency observed, 11%, is much lower than the values observed in the other functions, only coming close to function '(2.1.0.) Education', with 18%. Of note are the maximum values observed for large local governments and those located in the Autonomous Region of the Azores, of 1% and 17% respectively.

**Table 15: Table summarizing the results of the efficiency analysis of function '(3.3.0.) Transport and communications'**

| Local government group  | Obs.     | % of Efficient LGs | Average efficiency | Standard deviation | Min.        | Max.     |
|-------------------------|----------|--------------------|--------------------|--------------------|-------------|----------|
| Small                   | 5        | 3%                 | 0,07               | 0,20               | 0,00        | 1        |
| Medium-sized            | 3        | 4%                 | 0,21               | 0,26               | 0,00        | 1        |
| Large                   | 0        | 0%                 | 0,01               | 0,00               | 0,00        | 0,01     |
| Lisbon and Porto        | -        | -                  | -                  | -                  | -           | -        |
| Inland                  | 3        | 2%                 | 0,08               | 0,19               | 0,00        | 1        |
| Transition              | 0        | 0%                 | 0,10               | 0,20               | 0,00        | 0,89     |
| Coast                   | 4        | 7%                 | 0,21               | 0,30               | 0,00        | 1        |
| Islands                 | 1        | 4%                 | 0,07               | 0,20               | 0,00        | 1        |
| Azores                  | 0        | 0%                 | 0,03               | 0,04               | 0,00        | 0,17     |
| Alentejo                | 3        | 6%                 | 0,11               | 0,24               | 0,00        | 1        |
| Algarve                 | 1        | 9%                 | 0,24               | 0,34               | 0,00        | 1        |
| LMA                     | 1        | 25%                | 0,26               | 0,43               | 0,01        | 1        |
| Centre                  | 1        | 1%                 | 0,11               | 0,20               | 0,00        | 1        |
| Madeira                 | 1        | 13%                | 0,15               | 0,32               | 0,00        | 1        |
| North                   | 1        | 2%                 | 0,10               | 0,20               | 0,00        | 1        |
| <b>National average</b> | <b>8</b> | <b>3%</b>          | <b>0,11</b>        | <b>0,23</b>        | <b>0,00</b> | <b>1</b> |

### *Efficiency of the set of functions*

Table 16 presents the average efficiency levels of each group of all six frontiers of efficiency calculated, with one frontier for each of the five municipal functions and one for the set of functions, which allows the results presented in the previous sections to be combined. Functions '(1.1.0.) General services of public administration', '(2.4.0.) Housing and collective services' and '(2.5.0.) Cultural, recreational and religious services' present the highest national average efficiency, between 28% and 30%, but still far below the average efficiency of the set of functions. Those results partially corroborate the conclusions of the study by Veiga et al (2015), which although not presenting the same levels of efficiency, also functions '(2.4.0.) Housing and collective services' and '(2.5.0.) Cultural, recreational and religious services' are the ones revealing the best national averages. On the contrary, function '(3.3.0.) Transport and Communications' presents the lowest level of national efficiency, of 11%.

**Table 16: Efficiency of the set of local governments by function and type of local government**

| Local governments group | (1.1.0.)    | (2.1.0.)    | (2.4.0.)    | (2.5.0.)    | (3.3.0.)    | Set of functions |
|-------------------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Small                   | <b>0,25</b> | <b>0,11</b> | <b>0,23</b> | <b>0,23</b> | <b>0,07</b> | <b>0,75</b>      |
| Medium-sized            | 0,40        | 0,27        | 0,37        | 0,35        | 0,21        | 0,83             |
| Large                   | 0,34        | -           | -           | 0,68        | <b>0,01</b> | 1                |
| Lisbon and Porto        | -           | -           | -           | -           | -           | -                |
| Inland                  | <b>0,25</b> | <b>0,16</b> | <b>0,21</b> | <b>0,22</b> | <b>0,08</b> | <b>0,76</b>      |
| Transition              | 0,34        | <b>0,14</b> | 0,33        | 0,33        | <b>0,10</b> | 0,81             |
| Coast                   | 0,37        | 0,27        | 0,40        | 0,37        | 0,21        | 0,84             |
| Islands                 | 0,33        | 0,18        | <b>0,25</b> | 0,31        | <b>0,07</b> | <b>0,74</b>      |
| Azores                  | <b>0,23</b> | <b>0,17</b> | <b>0,23</b> | <b>0,18</b> | <b>0,03</b> | <b>0,74</b>      |
| Alentejo                | <b>0,22</b> | <b>0,14</b> | 0,29        | 0,34        | 0,11        | 0,80             |
| Algarve                 | 0,37        | 0,19        | 0,36        | <b>0,24</b> | 0,24        | 0,91             |
| LMA                     | <b>0,12</b> | 0,50        | 0,47        | 0,37        | 0,26        | 0,85             |
| Centre                  | 0,33        | <b>0,16</b> | 0,29        | 0,29        | 0,11        | <b>0,77</b>      |
| Madeira                 | 0,49        | 0,20        | 0,29        | 0,59        | 0,15        | <b>0,75</b>      |
| North                   | 0,30        | 0,23        | <b>0,25</b> | <b>0,21</b> | <b>0,10</b> | 0,79             |
| <b>National average</b> | <b>0,30</b> | 0,18        | <b>0,28</b> | <b>0,28</b> | <b>0,11</b> | 0,79             |

Note: Values in bold correspond to values (average by type of council) below the national average.

Comparison of the averages of each group of councils with national averages highlights the following conclusions. Firstly, regarding the division of local governments by size, while medium-sized councils present the best results, above the national averages in all functions of expenditure, small councils are in the opposite position, presenting the worst results, below the national averages for all frontiers calculated. Secondly, regarding groups according to the isolation index, as well as medium-sized councils, coastal ones are found to be most efficient, with averages above national ones in all functions, whereas inland councils are seen to be less efficient, with averages below national ones also in all functions. Finally, regarding the division of local governments according to NUTS II regions, those of the Autonomous Region of the Azores stand out negatively, as together with small councils and inland ones, they lie below the national average in terms of efficiency. Similarly, while no region was found to be completely above the average of national efficiency, three regions revealed only one value or average of inefficiency, these being the Algarve, the LMA and the Autonomous Region of Madeira.

## Conclusions and Discussion

This paper aim was to assess the efficiency of municipal expenditure in the Portuguese local government.

The results confirm that for the five functions of municipal expenditure selected, Portuguese local government obtained an average input-oriented efficiency of 79% nationally, i.e., theoretically it would be possible to reduce inputs by an average of 21% without altering the amount of outputs. Concerning the division of local governments according to different criteria such as size, isolation and geographical location, the local authority groups presenting the best results are those of medium-size and located on the

coast, with efficiency levels above national averages in all functions, while councils in the Algarve, LMA and the Autonomous Region of Madeira also presented higher levels of efficiency, but in five of the six averages calculated. Standing out negatively are the groups of small, inland councils and those located in the Autonomous Region of the Azores, with these groups presenting efficiency below the national averages for all the functions analysed.

As for the results obtained to respond to the study's aim, it is inferred that:

- Regarding size: although it is possible to infer a relationship between local authority size and their efficiency from the results of the small and medium-sized council groups, as the results point towards negative and positive influences on efficiency, respectively, the attempt to achieve homogeneity through excluding outliers seems to have had a disproportionately negative effect on large councils, compared to the others, which can raise doubts as to the credibility of the results obtained.
- Concerning the isolation index: some coastal local governments are associated with higher levels of efficiency, with inland ones presenting lower levels, below national averages. However, it is important to point out that this situation only applies to mainland councils and not those on the islands. For the island regions, although the literature indicates higher levels of efficiency, justified by their political-administrative specificity, due to the existence of Regional Governments, those results are not confirmed in this research, with the islands presenting mixed results and making it difficult to reach a conclusion about the island factor on efficiency.
- As for geographical location: dividing the country according to the NUTS II regions, the results do not allow such clear inferences and associations as in the divisions by size and isolation. Although councils in the Autonomous Region of the Azores present average efficiency below the national average for all functions, the origin of this inefficiency or its association with the islands is not clear, as the same is not found for the Autonomous Region of Madeira. In relation to geographical location by region and a positive relationship with efficiency, this seems to be the case of councils located in the Algarve and the LMA, but this association is not as robust as in the case of medium-sized councils and those located on the coast.

In generally, the findings of the study show that on average local government authorities in Portugal are relatively efficient, however need to improve in the use of in resource management, allocation and decision marking in order to increase their relative efficiencies.

Concerning future research, further analysis could be done using different inputs and outputs in order to increase the robustness of the results.

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