

SIZE AND EFFICIENCY: Evidence from Portugal

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ABSTRACT

With Europe's financial crisis, it is known that the Eurozone, in particular, Portugal, Italy, Spain, and Greece, is among the regions that are the most affected. In Portugal, the financial crisis caused huge concern with the efficiency of public expenses, not just within the government, but from society as a whole. As such, the understanding of efficiency in public management is indispensable. It is known that various elements can, when combined, determine the efficiency of entities, including public ones. This article seeks to examine the relationship that exists between the size of municipalities and the efficiency of public management in Portugal. A size indicator was created for this, and then the values determined by this indicator were related to efficiency as measured by DEA methodology (Data Envelopment Analysis). This research is justified given the importance of understanding ways to stimulate public policies that improve efficiency in the public sector. The results indicate a strong positive relationship between size and efficiency, thus larger sub-regions would be more efficient.

Keywords: *Public finances, Efficiency in Public Management, Data Envelopment Analysis, DEA*

1 INTRODUCTION

In Portugal, the crisis of the Welfare State during the 1970s caused increasing demand for improvement in the application of public resources during that period. As a result of these demands, different forms of public management were applied, which raised Portugal to the management level already in place in the rest of the countries in Europe (MILES e SNOW, 1984).

Nolasco (2004) divides the transformations of the Portuguese public system in three distinct periods. The first phase was between 1974 and 1985, focusing on public functions, decentralization, and the deconcentration of responsibilities. One example is the Law of Bases of Administrative Reform, which sought to objectively simplify processes and reduce bureaucracy (WARRINGTON, 1997).

The second phase took place between 1985 and 1995, which stands out for its adoption of the principles from *New Public Management*. In agreement with the OECD (1996), these reforms took place by changing structures and work methods. Portugal was among the European countries with the best directioning of resources in public management, however the level of services performed did not match the applied volume (ARAUJO NETO *et al.*, 2013).

The third period, which took place between 1995 and 2004, was marked by principles tied to *eGovernment*, characterized by a large demand for information. An example was the creation of the Integrated System for the Evaluation of Public Administration Performance by means of Law No. 10/2004, from March 22, 2004 (PORTUGAL, 2004). From that date on, Portuguese management gained new terrain, focusing on the offering of services that could respond to the demands of the citizens.

In regards to the efficiency of the productive units, it is rather interesting to perform analyses on the results obtained, not only for strategic purposes, but also for the planning of actions in the short and long term. The relationship between *inputs* (human, technical, material, or financial resources) and *outputs* (goods and/or services) is considered to be the most interesting way to study efficiency (SILVESTRE, 2010). Data Envelopment Analysis (DEA) emerges from the search for these measures. The use of DEA to obtain technical and allocatory efficiency has been successfully used in various fields of public administration (GOMES, MANGABEIRAS, and MELLO, 2005).

In the midst of the international financial crisis which started in 2007, it is known that the Euro Zone was one of the most affected regions. Within the Euro Zone, Portugal stands out as one of the most affected countries (ARAUJO NETO *et al.*, 2013). The financial crisis in Portugal forced governmental entities to undertake successive budget cuts in such a way that the study of efficiency determinants has become fundamental.

This article seeks to examine the relationship between size and allocative efficiency in the Portuguese economy, in 2009, by means of the Data Envelopment Analysis method. The research is justified given the necessity of the formulation of public policies, which should consider territorial dimensions.

The present article is structured in five sections, in addition to the introduction. The literature review is done in the second section, where efficiency and size in Portuguese public management are correlated. In the third phase, the methodological procedures used in the research are presented and finally, in the sixth section, conclusions and suggestions for future studies are presented.

2 PUBLIC MANAGEMENT, EFFICIENCY AND TERRITORY SIZE

Public management is governed by diverse goals, different from private administration, which clearly focuses on the maximization of profits. Governments, as providers of services and redistributors of wealth, need better evaluations.

In regards to the OCDE countries, Rodrigues and Araujo (2005) affirmed that the public management reforms took place in different ways among them. Some countries followed the continental model, while some opted for the Anglo-Saxon model. The Anglo-Saxon model is marked by a strong tendency for the adoption of privatization measures and the use of quasi-markets, while in the continental model the reform agenda is linked to deregulation and decentralization (RODRIGUES and ARAUJO, 2005). CCT (*Compulsory Competitive Tendering*) stands out as an example. CCT was a program which proposed replacing direct management, which functioned by means of a formal hierarchy, for an indirect management model, governed by contracts. In Portugal, the evolution of public management has been marked by a strong Continental influence which has led Portugal to more efficient management (RODRIGUES and ARAUJO, 2005).

At the economic level, efficiency can be divided into technical and allocative efficiency. Technical efficiency is represented by the capacity of the unit of production in maximizing its product, using available factors. Allocative efficiency measures the administrative units' management capacity of financial resources. In firms, allocative efficiency is represented by the minimization of production costs (FARRELL, 1957). A firm or production unit is efficient if there isn't another way to elevate the level of production given a certain quantity of factors, including

in the public sector (FARRELL, 1957; VARIAN, 2006). In regards to ways to estimate efficiency, generally this is done through econometric (based on the stochastic frontier functions) or mathematical (Data Envelopment Analysis) models (ARAUJO NETO et al, 2013). Data Envelopment Analysis (DEA) is a methodology which has gained enormous success in the study of efficiency in the public sector throughout the world (PEÑA, 2008). It is a deterministic methodology which analyzes DMU (*decision making units*) in a comparative manner as to their results.

Sampaio de Sousa and Stosic (2005) used DEA to evaluate the efficiency of municipal public expenditures. Faria, Januzzi, and Silva (2008) measured, through DEA, the efficiency of expenditures on education and public health in the municipalities of the state of Rio de Janeiro. The results of the research suggest that the relationship between efficiency and efficacy is nonlinear. Delgado and Machado (2007) analyzed efficiency in public schools in Minas Gerais. The study concluded that in schools located in regions of the state where there was a larger offering of educational resources, there was a greater tendency towards efficiency (ARAUJO NETO et al, 2013).

Hauner and Kyobe (2010) used DEA to measure the efficiency of governmental management in 114 countries, of note Canada, the USA, the United Kingdom, Portugal, Brazil, and Nigeria. For this study, at the methodological level, the efficiency proxy was used to calculate efficiencies in health and education (ARAUJO NETO et al, 2013). Afonso, Schuknecht, and Tanzi (2005), Gupta and Verhoeven (2001), and Tanzi Schuknecht (1997) also sought to measure and study the efficiencies of governments. Their studies measure the level of efficiency in the public sector, related to government expenses and socio-economic indicators. The results suggested that the level of efficiency in countries is linked not only to its income level, but also to various other factors such as education, territorial size, and level of social cohesion.

Afonso, Schuknecht, and Tanzi (2006) examined the efficiency of the public sector in the member states of the European Union, concluding that the security of property rights, income level, competency of the civil service, and the educational level of the population affect efficiency. Hauner (2008) examined the determinants of efficiency in public spending in various regions of Russia. In his study, efficiency shows a strong correlation, in particular, to higher *per capita* income, a smaller share of federal transfers in subnational governments' revenues, better governance, better democratic control, and lower expenditures.

During the tremendous effort to find the efficiency determinants, it became obvious that there are numerous influencing factors, and one of them is the size of the production units. Roh, Moon, and Jung (2013) analyzed community hospitals in the USA, and the results suggest that there should be public policies to stimulate hospitals to move towards medium-size. Small hospitals should grow, and large ones should downsize, as a very significant factor for obtaining optimum efficiency. In Portugal, Araujo Neto et al (2013) measure the efficiency of public spending in regions known as NUTS III (French *nomenclature des unités territoriales statistiques*, nomenclature of territorial units for statistical purposes.) While analyzing calculated efficiencies with managerial reports, it was found that for the most part the NUTS III were formed primarily by small municipalities which presented lower efficiencies.

3 METHODOLOGY

The division of the Portuguese territory carried out in 1986 divides each one of the member states into a whole number of units, known as NUTS (French *nomenclature des unités territoriales statistiques*, nomenclature of territorial units for statistical purposes.) The NUTS are divided into three levels and do not have administrative value. Level I is formed by three large regions, being: Continental Portugal, and each one of the Archipelagos, Açores and Madeira. Level II is divided into five commissions of regional coordination and the two autonomous regions. The NUTS II are regions formed by the 308 Portuguese municipalities. At present, in Portugal there are three NUTS I, subdivided in seven NUTS II, which are subdivided into thirty NUTS III (CARVALLO et al., 2013).

The objective of the study is to verify the existence of a relationship between territorial size and efficiency, and for this the NUTS III were considered, which are composed of all the Portuguese municipalities. The values related to efficiency were extracted from the work of Araujo Neto et al. (2013). These values can be seen in Table1.

Table 1 – NUTS III Subregions

Ranking	Region	Efficiency	Ranking	Region	Efficiency
1 nd	Cávado	1	14 th	Cova da Beira	0.6092
1 nd	Entre Douro e Vouga	1	15 th	Lezíria do Tejo	0.6040
1 nd	Pinhal Litoral	1	16 th	Serra da Estrela	0.5724
2 nd	Ave	0.9346	17 th	Península de Setúbal	0.5656
3 rd	Baixo Vouga	0.8549	18 th	Beira Interior Sul	0.5263
4 th	Grande Porto	0.8268	19 th	Douro	0.4937
5 th	Grande Lisboa	0.8052	20 th	Alto Trás-os-Montes	0.4591
6 th	Baixo Mondego	0,7369	21 st	Pinhal Interior Norte	0,4574
7 th	Tâmega	0,7278	22 nd	Beira Interior Norte	0,4227
8 th	Oeste	0,7034	23 rd	Alentejo Litoral	0,3983
9 th	Minho-Lima	0,6645	24 th	Alentejo Central	0,3877
10 th	Região Autónoma dos Açores	0,6448	25 th	Baixo Alentejo	0,3863
11 th	Dão-Lafões	0,6325	26 th	Alto Alentejo	0,3406
12 th	Médio Tejo	0,6195	27 th	Algarve	0,3392
13 th	Região Autónoma da Madeira	0,6170	28 th	Pinhal Interior Sul	0,2839

Source: Araujo Neto et al (2013)

The calculation of efficiency was performed using DEA, through which an efficient barrier is created by comparing a productive unit with the efficient units. The set of optimal points, represented by PTF in Equation 1, is the result of the division of the weighted sum of the produced m outputs (y_r) by the weighted sum of the used n inputs (x_i) (ARAUJO NETO *et al.*, 2013). Smith and Mayston (1987), Valdmanis (1992), and Kooreman (1994) believe that DEA is among the best ways to measure the efficiency of the functioning of the public machine.

$$PTF = \frac{\sum u_r y_r}{\sum v_i x_i} \quad \text{Where; } u_r \in \mathfrak{R}^m \text{ e } v_i \in \mathfrak{R}^n \quad (1)$$

As an input, Araujo Neto *et al.* (2013) use operational costs, which are represented by costs of consumed materials, supplies and external services, personnel costs, transfers and subsidies conceded, amortizations, provisions, other operational costs, financial costs, and extraordinary costs (CARVALHO *et al.*, 2011). For the model's products, the synthetic index of regional development (competitiveness), the synthetic index of regional development (Cohesion), and the synthetic index of regional development (environmental quality) were used (ARAUJO NETO *et al.*, 2013).

In terms of the methodology of the analysis, Carvalho *et al.* (2011) classifies the 308 Portuguese municipalities as to size, using the number of inhabitants as a proxy. This classification organized the municipalities into three categories differentiated by number of inhabitants as follows:

- Small Municipalities: those municipalities with a population smaller than or equal to 20,000 inhabitants;
- Medium-sized: those municipalities with a population greater than 20,000 inhabitants and smaller than or equal to 100,000 inhabitants;
- Large: those municipalities with a population of greater than 100,000 inhabitants.

To measure size an index was created, which we will call the Size Index. From the classification in Carvalho *et al.* (2011), a score of 3 was attributed to large municipalities, 2 for medium-sized ones, and 1 for small ones, which can be seen in Table 2. As already seen, NUTS III are units composed of numerous municipalities. As such, a weighted average of the scores of the municipalities that compose each of the NUTS III was calculated. With this the Size Index was obtained for each of the NUTS III, represented by a score that varies from 1 to 3.

Size	Score
Large	3
Medium	2
Small	1

Source: Created by the Authors

$$IDI = \frac{Qgl * 3 + Qml * 2 + Qpl * 1}{Qgl + Qml + Qpl} \quad (2)$$

In which Qg_i represents the number of large municipalities, Qm_i the number of medium-sized municipalities, and Qp_i the number of small municipalities. In this manner, the size indicator can vary from 1 to 3. Finally, the relationship between them was measured with the efficiency and the Size Index of each one of the NUTS III. For this measurement, the Pearson correlation was used.

4 ANALYSIS OF THE RESULTS

From Table 3, it is possible to visualize the efficiencies calculated by Araujo Neto et al (2013) and the Size Indicator calculated for each of the NUTS III. As can be inferred, only three NUTS obtained the highest result, of 1 in degree of efficiency, indicating the maximum result, these are: Cávado, Entre Douro and Vouga, and Pinhal Litoral. These same NUTS obtained size indexes of 2.39, 2.27, and 2.20 respectively. To the contrary, Alto Alentejo, Algarve, and Pinhal Interior Sul have the worst efficiency indicators with values of 0.3406, 0.3392, and 0.2839 respectively, and also size values of 1.24, 1.72, and 1. These values point to a possible relationship between efficiency in public spending and size.

Table 3 – Size Scores

Region	Size	Efficiency	Region	Size	Efficiency
Cávado	2.3846	1	Cova da Beira	1.80	0.6092
Entre Douro e Vouga	2.2727	1	Lezíria do Tejo	1.7778	0.6040
Pinhal Litoral	2.20	1	Serra da Estrela	1.50	0.5724
Ave	2.20	0.9346	Península de Setúbal	2.40	0.5656
Baixo Vouga	1.90	0.8549	Beira Interior Sul	1.40	0.5263
Grande Porto	2.5556	0.8268	Douro	1.1905	0.4937
Grande Lisboa	2.9231	0.8052	Alto Trás-os-Montes	1.3333	0.4591
Baixo Mondego	1.9412	0.7369	Pinhal Interior Norte	1.25	0.4574
Tâmega	1.80	0.7278	Beira Interior Norte	1.20	0.4227
Oeste	1.6667	0.7034	Alentejo Litoral	1.5714	0.3983
Minho-Lima	1.4615	0.6645	Alentejo Central	1.1333	0.3877
Região Autónoma dos Açores	1.3478	0.6448	Baixo Alentejo	1.1429	0.3863
Dão-Lafões	1.3529	0.6325	Alto Alentejo	1.2353	0.3406
Médio Tejo	1.6250	0.6195	Algarve	1.72	0.3392
Região Autónoma da Madeira	1.5333	0.6170	Pinhal Interior Sul	1	0.2839

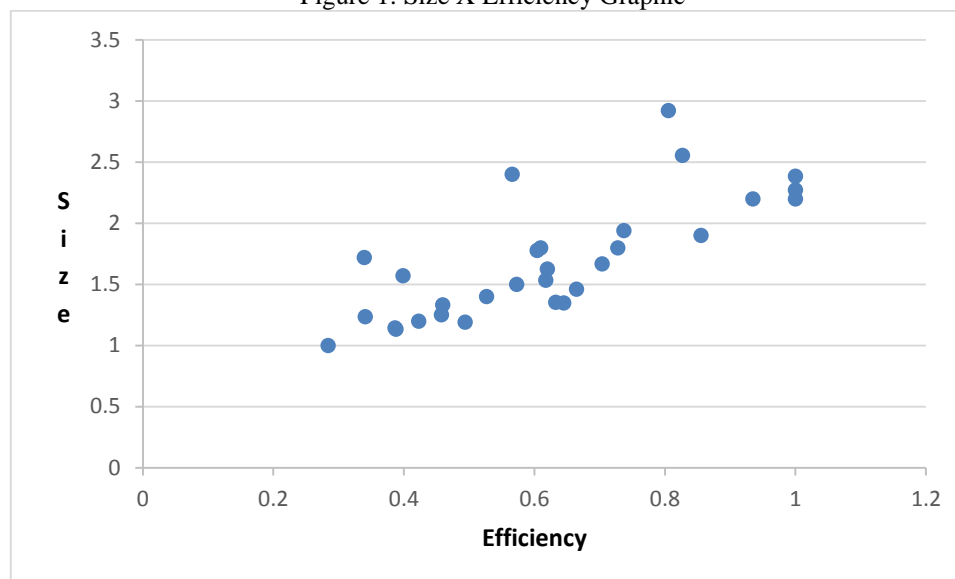
Source: Prepared by the Authors

According to the report on the Land Development Program (2009), the municipalities that make up the sub-region of Cávado implemented modernization policies in Public Management during the period from 2005 to 2009. These measures, according to Araujo Neto *et al.* (2013) were fundamental to the improvement of local efficiency. However, Araujo Neto *et al.* (2013) justifies that said measures, such as the one implemented in Cávado, were only economically viable given the size of the municipalities it is made up of. In the case of the sub-region of Entre Douro and Vouga, the 5 municipalities adopted modernization measures in the public entities. These measures took place from 2007 to 2013. As an example, we can cite the implementation of Quality Management Systems, which resulted in the receipt of an ISO 9001 international certification (ARAÚJO NETO *et al.*, 2013). In regards to the sub-region of Pinhal Litoral, it is made up of 5 municipalities and stands out for its strategic guidelines aiming to reduce costs and bureaucracy.

As to the composition of these NUTS, they are made up of 56.25% of medium-sized municipalities, 25% of large sized municipalities, and only 18.75% of small-sized municipalities. These findings serve as significant proof of the relationship between size and efficiency in the management of public resources.

A Pearson's correlation was used in order to measure the relationship between size and efficiency, which can be visualized in the scatter plot in Figure 1.

Figure 1: Size X Efficiency Graphic



Source: Prepared by the Authors

From the calculation of the linear Pearson correlation between the efficiency and size indicators, a value of 0.7653 was found. This value indicates a strong relationship between size and efficiency, which supports the studies of Araujo Neto *et al* (2013). According to Araujo Neto *et al* (2013), the implementation cost of reforms in public management is very high, and, as such, in the NUTS primarily made up of small sized municipalities, these reforms would not be possible.

6 CONCLUSION

DEA allows for the comparison of production units with regard to their efficiency, whether it be technical or allocative. The State and its management units can then also be considered to be units of production, and furthermore, through the calculated efficiencies, investigate what determines efficiency in Public Management. For the study, the relationship between efficiency and municipal size was analyzed. For this, first a size index was constructed and then correlated with the efficiencies already calculated in Araujo Neto *et al* (2013).

Discussion regarding the impact of size on efficiency is innovative in the literature, not only in Portugal, but also at the international level. Already used in studies of corporate finance, its application in public finance is another innovative factor. Such a study allows comparisons to be carried out between different time periods, in future studies, allowing us to determine whether the size of municipalities has contributed to a better allocation of public resources.

The results suggest that size is strongly related to efficiency in public spending and also suggest that the benefit of size can be decreasing, such as in the case of Porto. However, through this research, it is possible to conclude that medium and large sized municipalities have a higher degree of efficiency.

One limitation of this study was the lack of other indicators to test the influence of other elements on efficiency. The model is developed from data from 2009. This prevented a panel analysis from being carried out, as an analysis of the evolution of the influence of size on efficiency in NUTS III was not possible. For future studies, we suggest that new indicators be created and that panel data methods be used.

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