



# Smoothed bootstrap Malmquist index based on DEA model to compute productivity of tax offices



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## ABSTRACT

This paper analyses the productivity growth of the SUMA tax offices located in Spain evolved between 2004 and 2006 by using Malmquist Index based on Data Envelopment Analysis (DEA) models. It goes a step forward by smoothed bootstrap procedure which improves the quality of the results by generalising the samples, so that the conclusions obtained from them can be applied in order to increase productivity levels. Additionally, the productivity effect is divided into two different components, efficiency and technological change, with the objective of helping to clarify the role played by either the managers or the level of technology in the final performance figures.

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## 1. Introduction

The widespread use of the neo-classical doctrines as practically the only paradigm for providing an economic framework within which to carry out the production activity of a country or region has inevitably generated an increased interest in analysing efficiency and productivity in recent years.

Public services have attracted particular attention in this respect based on the opinion that their scope is limited due to their hypothetical x-inefficiency compared to the private sector, leading to logical attempts to improve management models in a way that does not compromise the fulfilment the objectives established by the state (González-Páramo & Onrubia, 2003).

This is the environment within which the SUMA offices develop their activity in the province of Alicante (Spain). They were established in 1990 and are fundamentally engaged in providing the most efficient tax management service as possible based on the available resources which are becoming increasingly scarce.

In addition to the effect of globalisation, another factor to be considered when evaluating these tax offices is the type of activity that they develop. As service providers they offer a product with intrinsic characteristics (intangibility and heterogeneity) that complicate the evaluation of the efficiency and productivity of their production process (McLaughlin & Coffey, 1990; Parsons, 1997).

The aim of this paper is analyses the productivity growth of the 30 SUMA tax offices located in Alicante (Spain) evolved between 2004 and 2006 by using Data Envelopment Analysis (DEA) models and Malmquist index. Additionally, a smoothed bootstrap technique is used to provide confidence intervals, and a Mann Whitney U test is used to study the possible effect that certain variables (in particular, population and the number of municipalities within the area of influence of each office) could have on the productivity of the offices.

This study is organised as follows: Section 2 presents a literature review of previous studies will be conducted in order to reflect the current state of research in the field and to support the subsequent selection of the analysis model and variables. Section 3 presents the statistical model will be justified and described. The data used in the study will be presented and the results obtained will be expounded and discussed in Section 4, and finally in Section 5, the conclusions will suggest the main ideas that could be implemented in order to improve the efficiency and productivity of the SUMA tax offices.

## 2. Literature review

The main aim of this section is to obtain the necessary information to determine the way in which the analysis will be undertaken. Firstly, a review of the studies carried out to date evaluating the efficiency of tax offices will be performed. After, conclusions will be drawn from the analysis model studied and the variables used which will be useful in selecting the most appropriate variables for the specific case of this study.

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The earliest of those studies was the article written by [González and Miles \(2000\)](#), who analysed the technical efficiency of 15 Regional Inspection Units of the Spanish Central Tax Authority in 1995 using an input-oriented BCC DEA and bootstrap technique continuing the work of [Simar and Wilson \(1998\)](#) and [Löthgren and Tambour \(1999\)](#). The function of this Authority is the management of the Spanish central tax system and customs services which is fundamental in ensuring the collection of the funds calculated in the Spanish Government's budget. In this context, the objective of the Regional Inspection Units of the Authority is to prevent tax evasion and fraud by large taxpayers. In order to conduct their study, the authors used the percentage of inspectors over the total personnel of each unit (work factor) as an input. They did not consider other resources such as investments or current expenditure due to the intensive nature of the work of the units. With respect to outputs, the authors used the number of inspections per taxpayer in the area (proxy of the volume of relative effort) and the volume of recovered fraudulent debt per open proceeding in relation to the GDP of the area of jurisdiction (proxy of the result obtained corrected by the level of wealth of the area). The principal results obtained based on DEA only identified four centres with an efficiency level higher than 75%. However, in an analysis carried out using a bootstrap technique the average levels of efficiency of all the units revealed levels between 80% and 90% with no significant differences in efficiency between them.

Two years later, [Moesen and Persoons \(2002\)](#) conducted an analysis of the productive efficiency of 289 regional tax offices belonging to the Finance Ministry in Belgium during 1991. This time, the study was performed using two alternative parametric methods: DEA (under variable and constant returns to scale) and FDH (Free Disposal Hull) whose results were subjected to a sensitivity analysis to the outliers ([Belsley, Kth, & Welsch, 1980](#)). The inputs employed in the study were the number of full-time equivalent employees and the outputs were the number of audited returns of category A (wage-earners) and B (independent professionals) and the number of audited returns of category A and B that lead to an increase in the tax base.

In addition to the efficiency analysis, [Moesen and Persoons \(2002\)](#) also performed a Tobit censored regression to try to explain the differences between the results of the different offices. These disparities were explained by circumstances such as the presence of a central tax office that automatically handles aspects related to tax files, the position of a highly qualified manager, the daily zeal of the office and finally, its scale.

In the same line of research, [Barros \(2005\)](#) analysed the efficiency levels of 41 tax offices in Lisbon (Portugal) from 1999 to 2002 by using a Cobb–Douglas cost frontier model. Here the author chose a parametric model for the study instead of a non-parametric model. He used the price of work (average wage earned per assimilated full-time workers), total personal taxes divided by the population in the office area and the ratio of rents of the offices in the area as inputs. The outputs used were the total tax collected at the constant 1999 price and the total clear-up rate of actions (mainly legal and administrative disputes and executive actions). The main findings reveal that in each year the average efficiency level was approximately 80% (diminishing slightly towards the end of the period) and that the proximity of the office to an urban area had a positive impact on its efficiency level. Furthermore, the author identifies factors drawn from the literature as possible causes of inefficiency that may be applicable to the units analysed, such as the rigidity of the labour market when job tenure is not linked to performance, the difficulty of controlling managers that act on behalf of the government, the existence of asymmetric information among different offices and, finally, the x-inefficiency typical of public sectors; due to a lack of professional incentives, scarce competitive pressure and a tendency to prioritise the

personal satisfaction of workers over that of the company ([Albi, 1992](#); [Leibenstein, 1966](#)).

After Spain, Belgium and Portugal it was Norway's turn to have the efficiency of its tax offices analysed. [Forsund, Kittelsen, Lindseth, and Edvarsen \(2006\)](#) studied the performance of 98 local tax offices in Norway from 2002 to 2004 by applying an output-oriented BCC DEA, Malmquist index and smoothed bootstrap. The input variables considered were: the cost of resources (such as manpower, offices and current expenses) adjusted for compensating special circumstances (for example, rent and travel costs) in order to control non-discretionary variables such as population, price levels, area or population density. The outputs used were: people relocated each year, false registrations, employees and pensioners' tax returns, complaints regarding tax assessments, returns from non-incorporated business and corporate taxes. Based on their findings the authors recommend that the small offices could improve their productivity by increasing their size and the government should be concerned with at least one third of the units. However, they do not provide details regarding the way to achieve this objective, leaving it open for further research.

Barely two years after completing his first study on the efficiency of the Portuguese offices, [Barros \(2007\)](#) complemented his original work by conducting an analysis of the technical and allocative efficiency of the same units through non-parametric models. More precisely, he used input-oriented CCR and BBC DEA models and, in the second stage, a Tobit regression to identify the possible explanatory variables involved. As inputs of the DEA models he used the number of employees, rents paid by the premises and the population, average salary, rents on premises divided by the area of those premises and personal taxes per capita (with all the monetary variables at the constant 2000 price). As outputs the author used the total amount of income tax collected, VAT, value of inheritance, donations and other taxes and the clear-up rate of contested cases.

In terms of efficiency levels, the offices produced good results given that in the worst of cases the average efficiency level was 81.6%. The author found that the factors that could help to improve those levels that were statistically and positively significant were the urban location of the offices, the municipal expenditure and the level of GDP of their area. On the other hand, the factor that had a negative effect was the level of salaries as a ratio of total costs.

Subsequently, the field of study returned to Spain although this time the units analysed were different to the previous one. [Fuentes \(2008\)](#) studied the behaviour of the efficiency and productivity of 32 SUMA tax offices in Alicante (Spain) between 2004 and 2006 using output-oriented BCC and CCR DEA, Malmquist Productivity and modified quasi-Malmquist indices. The inputs used in the analysis were the area of each unit and its number of employees. The outputs were the number of tax returns and number of taxpayers dealt with. The most significant conclusions drawn from the results focused on the idea that efficiency could be improved by adopting measures to generate team spirit and encourage responsibility and professionalism. Likewise, improving employees' skills, increasing their interest in taking part in business improvement and involving better technology could also be effective.

Two years later, [Katharaki and Tsakas \(2010\)](#) evaluated the efficiency of 27 tax offices in Greece during the period 2001–2006 by using output-oriented CCR and BBC DEA, DEA window analysis and also Tobit regression in order to explain non-discretionary factors. As inputs the authors considered the number of employees and computers, and the number of people and legal entities paying taxes. The outputs used were the taxation funds related to the number of people and legal entities. The authors' main findings revealed a good level of scale of the majority of the units. However, human resources, the technical infrastructure and the increase in

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