The efficiency of basic economic branches in Greek regions: Evidence from Data Envelopment Analysis.

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Abstract

An input-oriented BCC model used to estimate the efficiency of basic economic branches in Greek regions at NUTS 2 level. The basic agriculture-forestry and fishery such as basic wholesale and retail trade, public administration and education were completely efficient in the most regions in 2017. On the other hand, the basic energy, transportation-storage and financial services displayed as completely efficient in the lowest number of regions.

Keywords: economic base theory**,** basic economic branches, data envelopment analysis, Greek regions

1. Introduction

The purpose of the paper is to estimate the efficiency of basic economic branches in Greek regions with the technique of Data Envelopment Analysis (DEA). First of all, an important theory of regional economic development is economic base theory (Alexander 1954; Tiebout 1962), which assumes that local regional economies are composed of two parts: (a) a non-basic component which exists to serve the needs of the local resident population; (b) a basic component which produces goods and services for consumption outside the local region (Stimson et al., 2006). The method for estimating the impact of that basic component upon the local economy is the economic base multiplier (Dinc, 2002; Campbell, 2003; Mulligan et al. 2013; Guimarães et al. 2014; Gkouzos and Christofakis, 2018).

Some of the recent research approaches with the DEA technique at regional and sectoral level are presented below.

Halkos and Tzeremes (2010) measured the economic growth policies of the Greek prefectures. The results indicated significant regional policies inefficiencies among the Greek regions. Especially, the results supported the previous studies about the Greek regional and economic development policies over the last decade which in turn suggested that even though the dominant economic and regional development policy in Greece has been changed dramatically over the last decade, the development and economic inefficiencies have been derived from administrative ineffectiveness.

Aristovnik (2014) applied the technique to a wide range of EU-27 regions to evaluate the technical efficiency of harnessing information society riches also for educational and training purposes. The research findings confirmed the idea that regions with a mature information society generally enjoyed better educational outputs and results compared to regions still developing their information society pattern. In contrast, a wide range of NUTS 2 regions from Eastern and Southern Europe was characterised by an extremely low rate of information society development and efficiency in terms of educational outputs/results, indicating the significant potential to develop the information society and improve educational results in many EU regions, particularly those from catching-up EU member states.

Charoenrat and Harvie (2017) estimated the technical efficiency of Thai manufacturing SMEs, which classified into two aspects: by size of manufacturing SMEs and by export intensity. The results denoted that the average technical efficiency of all categories of Thai manufacturing SMEs were relatively low and no technical efficiency improvement existed in the last period. Lastly, the firm-specific factors found to have a positive and significant relationship with the technical efficiency of Thai manufacturing SMEs were: the firm size, the firm age, the skilled labour, the location of specific areas, the type of manufacturing ownership, the cooperative, foreign investment and exports.

Melecký (2018) focused on territorial effects of relevant EU Funds in programming period 2007–2013 in infrastructure. More specifically the paper tested the factors of two inputs and five outputs, trying to elucidate the differences obtained by the Member States in effective use of the European Regional Development Fund and the Cohesion Fund in the transport sector. Preliminary results revealed that most countries with a lower amount of funding achieved higher efficiency, especially countries in the group of so called “old EU Member States”.

Karakitsiou et al. (2020) analysed the efficiency of hotel and restaurant sector across the Greek regions. The most efficient regions were Attiki, Voreio Aigaio and Notio Aigaio, while the regions of Anatoliki Makedonia and Thraki, Thessalia and Sterea Ellada presented the lowest efficiency.

Pougkakioti and Tsamadias (2020) investigated the relative efficiency and productivity change of municipalities of Greece in regions of Thessalia and Sterea Ellada during the period 2013–2016. Some results could be drawn from the analysis: Over the time period considered, there was a gradual improvement of the average efficiency and productivity of the municipalities, while only 9 of the 50 municipalities showed best performance and the relatively large municipalities with population criteria pictured comparatively better performances on average than relatively small ones.

Radonjic (2020) noted the differences in efficiency between Serbian regions. So, infrastructure, investment in new fixed assets and employment levels used into the analysis. According the results about one-third of the analysed regions in Serbia were efficient. With the city of Belgrade excluded, the regions of Northern Serbia were the most developed, while the most inefficient regional parts were those in Eastern and Southern Serbia.

The next part describes the methodology to succeed the purpose of the paper.

2. Research Methodology

Firstly, the location quotient (LQ) method is probably the most popular and widely used economic base analysis technique (Wang and vom Hofe, 2007). It can be expressed as (Isserman, 1977):

$$LQ_i = \frac{E_{ir}}{E_r} / \frac{E_{in}}{E_n} \quad (1)$$

Where:

E: employment variable,

i: economic branch,

r: region,

n: nation

If the $LQ_i > 1$ then can estimate the basic employment of an economic branch as (Isserman, 1977):

$$X_{ir} = \left[1 - \left({}^{1}/_{LQ_i}\right)\right] E_{ir} \tag{2}$$

More specifically, that technique led to estimate the basic economic branches. Of course the results are not pictured in the paper; however they are taken into account to evaluate the efficiency through the data envelopment analysis.

The Banker, Charnes and Cooper model (1984) is used here for the efficiency of basic economic branches; which is input-oriented for each Greek region too:

$$\begin{gathered} min_{\theta,\lambda}\theta, \\ -y_i + Y\lambda \geq 0, \\ \theta_{\chi i} - X\lambda \geq 0, \\ N1'\lambda = 1, \\ \lambda \geq 0 \end{gathered} \tag{3}$$

The value of model ranges between 0.000 and 1.000 or 0% and 100%.

When the value of model is 0.000 (0%), it means that a quantity of outputs could be produced with 100% quantities of inputs.

When the value of model is 1 (100%), it means that a quantity of outputs could be produced with 0.000 (0%) quantities of inputs.

Finally, employment for each Greek region and economic branch for the years 2000 and 2017 used in the paper, according to the official data of Hellenic Statistical Authority (2020).

3. Empirical Analysis

The following table indicates the efficiency scores of each basic economic branch in each Greek region for 2000 and 2017.

Table 1: Efficiency of basic economic branches.

Economic Branches	A		B		C		D		E		F	
Regions/Years	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000
An. Makedonia-Thraki	0.967	0.835	0.248	0.285	0.173	0.153	0.479	0.249	0.349	0.325	0.386	0.278
K. Makedonia	0.172	0.095	0.076	0.101	0.952	1.000	0.144	0.109	1.000	1.000	0.120	0.094
D. Makedonia	1.000	0.902	1.000	1.000	0.610	0.469	0.929	0.443	1.000	0.771	1.000	0.729
Ipeiros	0.645	0.845	0.635	0.444	0.367	0.368	0.672	0.437	0.833	0.590	0.611	0.635
Thessalia	0.683	0.744	0.186	0.355	0.201	0.172	0.289	0.243	0.308	0.253	0.258	0.208
Ionia Nisia	0.914	0.695	1.000	0.622	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Dytiki Ellada	1.000	0.601	0.471	0.352	0.187	0.197	0.695	0.326	0.328	0.260	0.314	0.274
Sterea Ellada	0.816	0.724	0.267	0.272	1.000	1.000	0.420	0.382	0.380	0.340	0.335	0.271
Attiki	0.436	0.483	0.058	0.048	1.000	0.396	0.057	0.045	1.000	1.000	0.063	0.050
Peloponnisos	1.000	1.000	0.201	0.241	0.274	0.263	1.000	0.300	0.370	0.326	0.307	0.330
V. Aigaio	0.986	0.820	0.761	1.000	0.885	0.804	1.000	0.636	0.989	1.000	0.911	1.000
N. Aigaio	1.000	1.000	0.344	0.863	0.532	0.492	0.952	1.000	0.566	0.916	1.000	1.000
Kriti	0.422	0.588	0.227	0.319	0.219	0.267	0.515	0.402	0.304	0.252	0.330	1.000
Average	0.772	0.718	0.421	0.454	0.569	0.506	0.627	0.429	0.648	0.618	0.510	0.528

Economic Branches: **A**. Agriculture-Forestry and Fishery, **B**. Energy, **C**. Manufacturing, **D**. Construction, **E**. Wholesale and Retail Trade, **F**. Hotels and Restaurants, **G**. Transportation and Storage, **H**. Financial Services, **I**. Public Administration, **J**. Education, **K**. Health Services, **L**. Entertainment.

Continued Table 1: Efficiency of basic economic branches.

Economic Branches	G		H		I		J		K		L	
Regions/Years	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000	**2017**	2000
An. Makedonia-Thraki	0.411	0.535	0.357	0.346	1.000	1.000	0.301	0.287	0.260	0.398	0.334	0.512
K. Makedonia	0.071	0.106	0.078	0.070	0.076	0.081	1.000	1.000	0.150	0.619	0.081	0.185
D. Makedonia	0.918	1.000	0.919	0.870	0.510	0.417	0.626	0.586	0.739	0.800	1.000	0.768
Ipeiros	0.740	0.679	0.589	0.546	0.403	0.280	1.000	0.375	1.000	0.688	0.500	0.673
Thessalia	0.398	0.344	0.337	0.249	0.178	0.155	1.000	1.000	0.246	0.289	0.243	0.249
Ionia Nisia	0.770	0.867	0.710	0.591	1.000	0.627	0.998	0.780	1.000	0.790	0.814	0.737
Dytiki Ellada	0.277	0.314	0.306	0.290	0.197	0.199	0.257	0.605	0.251	0.253	0.333	0.267
Sterea Ellada	0.382	0.330	0.434	0.519	0.299	0.241	0.282	0.354	0.329	0.500	0.342	0.582
Attiki	1.000	1.000	1.000	1.000	1.000	1.000	0.053	0.035	1.000	1.000	1.000	1.000
Peloponnisos	0.336	0.297	0.388	0.330	0.221	0.223	0.288	0.295	0.286	0.383	1.000	1.000
V. Aigaio	1.000	0.781	1.000	1.000	1.000	1.000	1.000	1.000	0.884	1.000	0.868	1.000
N. Aigaio	0.377	0.446	0.483	0.616	0.404	0.479	0.458	0.702	0.596	0.664	0.442	0.586
Kriti	0.272	0.339	0.230	0.264	0.210	0.195	0.299	0.274	0.239	0.295	0.239	0.293
Average	0.535	0.541	0.525	0.515	0.500	0.454	0.582	0.561	0.537	0.591	0.554	0.604

Economic Branches: **A**. Agriculture-Forestry and Fishery, **B**. Energy, **C**. Manufacturing, **D**. Construction, **E**. Wholesale and Retail Trade, **F**. Hotels and Restaurants, **G**. Transportation and Storage, **H**. Financial Services, **I**. Public Administration, **J**. Education, **K**. Health Services, **L**. Entertainment.

According the above table, the basic agriculture-forestry and fishery indicated the highest average efficiency scores (0.722 in 2017 and 0.718 in 2000) in comparison with the rest basic sectors. Also, it noted the largest number of regions above the average efficiency score for both examined years. Especially, the regions of Dytiki Ellada (1.000), Dytiki Makedonia (1.000), Peloponnisos (1.000), Notio Aigaio (1.000), Voreio Aigaio (0.986), Anatoliki Makedonia-Thraki (0.967), Ionia Nisia (0.914) and Sterea Ellada (0.816) showed efficiency scores above the average score in 2017.

The basic wholesale and retail trade as the basic construction had quite significant average efficiency scores, 0.648 and 0.627 respectively in 2017. Here, Kentriki Makedonia (1.000), Dytiki Makedonia (1.000), Ionia Nisia (1.000), Attiki (1.000), Voreio Aigaio (0.989), Ipeiros (0.833) showed efficiency scores above the average in the basic trade such as Ionia Nisia (1.000), Peloponnisos (1.000), Voreio Aigaio (1.000), Notio Aigaio (0.952), Dytiki Makedonia (0.929), Dytiki Ellada (0.695) and Ipeiros (0.672) in the basic construction.

For the next economic branches could be observed the following results for the last examined year:

The regions of Dytiki Makedonia (1.000), Ionia Nisia (1.000), Voreio Aigaio (0.761), Ipeiros (0.635) and Dytiki Ellada (0.471) showed efficiency scores above the average in basic energy (average efficient score: 0.421).

The regions of Ionia Nisia (1.000), Sterea Ellada (1.000), Attiki (1.000), Kentriki Makedonia (0.952), Voreio Aigaio (0.885), Dytiki Makedonia (0.610) showed efficiency scores above the average in basic manufacturing (average efficient score: 0.569).

The regions of Dytiki Makedonia (1.000), Ionia Nisia (1.000), Notio Aigaio (1.000), Voreio Aigaio (0.911) and Ipeiros (0.611) showed efficiency scores above the average in basic hotels and restaurants (average efficient score: 0.510).

The regions of Attiki (1.000), Voreio Aigaio (1.000), Dytiki Makedonia (0.918), Ionia Nisia (0.770) and Ipeiros (0.740) showed efficiency scores above the average in basic transportation and storage (average efficient score: 0.535).

The regions of Attiki (1.000), Voreio Aigaio (1.000), Dytiki Makedonia (0.919), Ionia Nisia (0.710) and Ipeiros (0.589) showed efficiency scores above the average in basic financial services (average efficient score: 0.525).

The regions of Anatoliki Makedonia-Thraki (1.000), Ionia Nisia (1.000), Attiki (1.000), Voreio Aigaio (1.000) and Dytiki Makedonia (0.510) showed efficiency scores above the average in basic public administration (average efficient score: 0.500).

The regions of Kentriki Makedonia (1.000), Ipeiros (1.000), Thessalia (1.000), Voreio Aigaio (1.000), Ionia Nisia (0.998), Dytiki Makedonia (0.626) showed efficiency scores above the average in basic education (average efficient score: 0.582).

The regions of Ipeiros (1.000), Ionia Nisia (1.000), Attiki (1.000), Voreio Aigaio (0.884), Dytiki Makedonia (0.739), Notio Aigaio (0.596) showed efficiency scores above the average in basic health services (average efficient score: 0.537).

The regions of Dytiki Makedonia (1.000), Attiki (1.000), Peloponnisos (1.000), Voreio Aigaio (0.868) and Ionia Nisia (0.814) showed efficiency scores above the average in basic entertainment (average efficient score: 0.554).

4.Conclusions

To sum up, an input-oriented BCC model according data envelopment analysis used to estimate the efficiency of basic economic branches in Greek regions. The basic agriculture-forestry and fishery noticed the highest average efficiency score into analysis. Also, it indicated the largest number of regions above the average efficiency score. Moreover, the specific basic economic branch such as trade, public administration and education were completely efficient (1.000) in the most regions in 2017. The wholesale-retail trade and construction showed quite considerable average efficiency scores with a number of regions above the specific scores too. On the other hand, the lowest average efficiency score was pictured by basic energy. Finally, the basic energy, transportation-storage and financial services displayed as completely efficient in the lowest number of regions.

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