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The Efficiency of Oecd Countries' Judicial Systems By Data Envelopment Analysis. Why of Differences?

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I. INTRODUCTION

Justice is a public good and, as a consequence, its administration, which is organized by the state, must be efficient. There are two reasons why its efficiency is required. On the one hand, this service is paid by everybody's taxes and, as a result, every citizen has the right to receive it. On the other, it is also needed because of the economic implications of an unstable and slow judicial system(Hayo & Voigt, 2014). Furthermore, it is not debatable that, due to the current globalisation, countries are continually competing in order to persuade possible potential investors. These are always seeking well-planned and structured public policies which use the available resources as efficiently as possible.(Barroso, Sáez, De, Rey, & Carlos, 2011)

The purpose of this study is to analyse the working efficiency of fifteen OECD members' Judicial Administration, which is a preliminary step for a further evaluation of these countries' wellness. Each Judicial Administration is regarded as an independent production unit (DMU) which uses inputs to produce outputs according to a production function. For the assessment of improvements in a DMU, factors such as productivity and efficiency must be taken into account. The former can be measured by the ratio between the outputs and inputs considered along the process. The latter is either the state of production where the maximum number of outputs is obtained with the available inputs, or the state of production where the same amount of outputs is achieved by using the minimum number of inputs.

Traditionally, the efficient frontier methods have been the ones used in order to determine efficiency. These are classified into two types: parametric and non-parametric methods. The Data Envelopment Analysis (DEA) methodology, which is the approach used in this study, belongs to the latter group. Here, it is not necessary to know the production function in advance. Instead, it consists in finding the values that are part of the efficient frontier and, taking them as a reference, setting the remaining inefficiencies.

Regarding public policies, this methodology has been widely used in the analysis of public sectors'efficiency, very early (Ganley& Cubbin, 1992), and still used in sectors such as education´s (El-mahgary, Rönnholm, Hyyppä, Haggrén, & Koponen, 2014), health´s (Volkan & Serdal, 2016), environment's (Yu, Liu, & Xu, 2012) or financials (Haq, Skully, & Pathan, 2010) and there are also studies about the judicial systems of specific countries(Nissi & Rapposelli, 2010; Finocchiaro Castro & Guccio, 2014) . However, to the best of our knowledge, there are no comparative studies applied to Justice between the countries here exposed. Hence, a brief description of the method here used is included in the next section. Section III is devoted to the efficiency analysis of OECD member countries' Judicial Systems, with a further interpretation of the results in Section IV. Finally, and basing on such results, aspects for improvement are suggested in Section V. This is followed by one last section which includes concluding remarks.

II. METHODOLOGY

In its most simple and intuitive version, a production unit is efficient when it is capable of producing the maximum amount of outputs by using the minimum number of inputs possible, all subjected to the appropriate operating environment restrictions(Ray, 2004). From this definition, it can be abstracted that the concept of efficiency is relative and, consequently, it is imperative to compare the production unit under analysis with homogeneous ones. In the case of a single output, or inputs where the quantities in use can be related to those used by other DMU, the problem is easy to solve. However, it becomes more complicated as the productive units to compare, and the number of inputs and outputs considered, increase.

To solve the problem, Charnes, Cooper and Rhodes (1978), basing on the Farrell's (1957) work, proposed the Data Envelopment Analysis (DEA) methodology. It immediately reached high levels of popularity, being applied in the efficiency analysis in sectors such as industry, banking, hospitals, education... The developed method is applied to production units that are similar in terms of their outputs and inputs, giving a score of relative efficiency. That is, it points to those units that, in comparative terms, are the most efficient ones. Nonetheless, this does not imply that such units are efficient (meaning that they reach their maximum

theoretical output), but that, among all the productive units analysed, these obtain the highest outputs with the available inputs, always under constant returns to scale assumptions. The model adopts its authors' initials and so, it is renamed as CCR.

In 1984, Banker, Cooper and Charnes, understanding that there could be other factors preventing the production units from operating in an optimal scale, extended the previous model to the case of variable returns to scale. The model was renamed as BCC adopting, anew, the authors' initials.

In addition, both models accept output-orientated versions (which maximize the quantities produced with the available inputs) and input-orientated versions (which minimize the amount of inputs used to achieve certain levels of outputs).

Schematically, the CCR output-orientated model can be mathematically formulated as follows:

Assuming n productive units which use m inputs (x) to produce s outputs (y) so that the unit j uses the amount of inputs $x_{ij} > 0$, i = 1,2, ... m, to produce the amount of outputs $y_{ij} > 0$, i = 1,2, ..., s, the aim will be

$$\max h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

$$\text{subject to } \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \; j=1,2,\ldots,n \text{ with } u_r, v_i > 0 \;\; i=1,2,\ldots,m;\; r=1,2,\ldots,s \quad (1)$$

The subscript 0 refers to the unit to be evaluated. The restriction ensures that the optimal $h_0^* = \max h_0$, will be between 0 and 1.

III. DEA APPLIED TO THE EFFICIENCY ANALYSIS OF EUROPEAN OECD MEMBER COUNTRIES' ADMINISTRATION OF JUSTICE SYSTEMS.

3.1. Countries selection and dataset.

This study considers only OECD countries. The unavailability of the data required for this study constrains the selection to fifteen European countries, as well as to the year 2012. This is, to date, the latest year in which there is information published by the "European Commission for the Efficiency of Justice (CEPEJ)". This institution was created in 2002 within the European Council. Its mission is to collect data related to the member countries' judicial systems, for the sake of improving their functioning. This is done in pursuance of "presenting a picture of the European States' judicial systems, as accurate as possible, in order to enable a comparison between them". These countries are sufficiently homogeneous in terms of their judicial objectives as to fulfil the key hypotheses ensuring that the application of the DEA methodology produces reliable results. Table 1 lists some relevant characteristics of these countries and their statistics.

Table 1: Countries considered for the study and some of their relevant features.

Country	GDP (€)	Population Number	Public Expenditure (€)	Percentage of the Public Expend in the Judicial System (%)
Austria	1.713.551.797,60	8.451.860	157.799.650.000	0.49
Czech Republic	152.983.676,302	10.509.286	68.087.191.726	0.70
Denmark	245.047.743,464	5.602.628	69.900.000.000	0.60
Finland	193.032.220,854	5.426.674	52.353.408.000	0.73
Germany	2.611.587.405,00	80.233.100	878.654.000.000	1.04
Hungary	97.106.220,400	9.908.798	51.573.528.468	0.88
Italy	1.535.641.205,48	59.685.227	535.003.616.032	0.86
Norway	400.215.985,000	5.051.000	138.210.000.000	0.38
Poland	390.185.158,000	38.533.000	77.785.333.399	2.35
Portugal	163675.119,423	10.487.289	80.869.200.000	0.75
Turkey	621.732.723,864	75.627.384	231.786.944.783	0.60
Spain	1.025.943.032,20	46.006.414	480.111.000.000	0.76
Sweden	419.188358,231	9.555.893	209.462.351.800	0.49
Switzerland	491.990.472,000	8.039.060	156.432.260.920	1.02
England-Wales	1.713.551.797,60	56.567.800	596.083.582.900	0.92
Descriptive Statistics				
MEAN	2,611,587,405.00	80,233,100.00	878,654,000,000.0	2.350

STANDARD DEVIATION	762,199,917.851	27,831,351.91	251,145,481,655.4	0.461
MAX	2,611,587,405.00	80,233,100.00	878,654,000,000.0	2.350
MIN	97,106,220.400	5,051,000.000	51,573,528,468.00	0.380
COEFFICIENT OF VARIATION	29.185%	34.688%	28.583%	19.629%

It is important to highlight the coefficients of variation's low levels in the characteristics considered. Therefore, regarding this characteristics, they can be considered as homogeneous countries.

3.2. Inputs and Outputs.

On the one hand, we will consider the Justice Administrations as producers of "Cases disposed". That will be the output. On the other hand, the "Cases filed and Pending cases", the "Justice Spending", and the "Staff" -represented by judges and prosecutors[1]- will be used as inputs. In table 2 their definitions are given.

Table 2: Output and inputs.

Output	Number of Cases disposed	Disposed or resolved cases are those which have been finished in the recorded year. In this investigation, though, the only ones that we are computing are those that have been resolved in the first instance, as the data offered for those cases resolved in the second or further instances are much incomplete. The procedure is understood as completed if it has either definitively concluded (final judgement or discontinuance of proceedings), provisionally concluded (provisional filing of the proceedings), or it is being passed on to a second instance, subject to appeal.
Inputs	Number of Cases filed + Number of Pending cases	Only the cases of a criminal, contentious civil and commercial, and administrative nature filed in the judicial system –in the first instance– in 2012 have been taken into account. The ones which have been excluded are of a non-contentious civil and commercial nature; cases regarding execution, property registers, and trade; and those falling into the category of "others", since very few countries offer such data. Cases pending or in process (also from the first instance and of a criminal, contentious civil and commercial, and administrative nature) are the cases that were filed that year, or in previous years, and which had not yet been resolved –and, thus, were still pending- by January 1st, 2012.
	Public spending(€)	State Budget for the Administration of Justice
	Staff: Number of Judges + Number of Prosecutors	Judge: The authority responsible for making, or participating in, a judicial decision for opposing parties (either individuals or legal entities) in the course of proceedings. Prosecutor/ Public Ministry[2]: The authority responsible, on behalf of the society and the public interest, for ensuring implementation of the law when an action is subject to penalty. For that matter, they need to take into account the rights of individuals, on the one hand, and, on the other, the necessary effectiveness of the penal justice system.

Source: CEPEJ

Table 3 presents descriptive statistics for the main variables under study.

Table 3: Summary Statistics of output and inputs variables

	Mean	Coefficient of variation	Median
Number of Cases disposed (Output)	1.462.549,33	103,243%	767.085
Number Cases filed + Number of Pending cases (Input)	2.387.169,93	112,975%	957.235
Public spending (€) (Input)	2.156.097.709	117,197%	1.018.131.920
Staff (Input)	6.424,66667	105,566%	4.297

Here the high dispersion of data was observed. It was measured by applying the coefficients of variation to both the output and the inputs considered. These are correlated, as can be seen in table 4.

[1]The countries that have been considered are those for which there is available data about the selected inputs and outputs.

Table 4: Correlation coefficients between output and inputs.

	Number of Cases disposed	Number of Cases filed + Number of Pending cases	Public spending	Staff
Number of Cases disposed	100%	96,329%	69,043%	74,032%
Number of Cases filed + Number of Pending cases		100%	67,466%	64,446%
Public expenditure			100%	73,010%
Staff				100%

Overall, a low correlation between the number of cases disposed and the public spending was observed.

3.3. Results.

Table 5 contains the relative efficiencies, obtained from the output-orientated[2] CCR model for each[3] country

Table 5: Relative Efficiencies

	Efficiency
Austria	87,84%
Czech Republic	100,00%
Denmark	100,00%
Finland	80,11%
Germany	77,92%
Hungary	99,45%
Italy	92,74%
Norway	93,23%
Poland	89,80%
Portugal	65,81%
Turkey	100,00%
Spain	100,00%
Sweden	86,10%
Switzerland	86,42%
England-Wales	100,00%

[2] The output-orientated CCR model was considered because we wish to obtain the maximal output with the available inputs.

[3] DEAP Software

Table 6: Efficiency crossed

angl-gall	suis	suède	espag	turquie	portuga	pologne	norvège	italie	hongrie	allemagne	finlande	danemark	rép. chèque	autriche	Efficiency Crossed (%)
17,61	87,84	87,84	-4,35	36,78	62,86	61,647	87,84	-8,42	33,16	87,84	87,84	62,86	63,00	87,84	autriche
36,57	95,08	95,08	66,96	92,46	100,00	94,66	95,08	29,36	100,00	95,08	95,08	100,00	100,00	95,08	rép. chèque
45,51	100,00	100,00	15,43	67,59	100,00	78,31	100,00	-5,63	61,29	100,00	100,00	100,00	98,04	100,00	danemark
14,43	80,10	80,10	-37,15	8,54	57,67	36,11	80,10	-22,69	36,95	80,10	80,10	57,66	46,74	80,10	finlande
28,19	77,91	77,91	65,43	81,71	73,71	82,38	77,91	30,20	47,08	77,91	77,91	73,71	83,06	77,91	allemagne
34,62	91,82	91,82	64,16	88,91	96,43	91,49	91,82	27,90	99,45	91,82	91,82	96,43	96,08	91,82	hongrie
86,49	50,10	50,10	72,88	67,74	65,76	52,98	50,10	92,74	51,05	50,10	50,10	65,76	68,85	50,10	italie
7,96	93,22	93,22	-86,43	-45,13	38,14	-24,05	93,22	-37,14	16,07	93,22	93,22	38,14	18,55	93,22	norvège
25,69	85,94	85,94	62,43	83,55	83,19	89,80	85,94	26,14	82,90	85,94	85,94	83,19	85,94	85,94	pologne
27,42	60,91	60,91	38,06	57,0	65,81	57,73	60,91	16,30	58,84	60,91	60,91	65,81	65,09	60,91	portugal
68,00	79,39	79,39	97,31	100,000	100,00	84,17	79,39	73,75	100,00	79,39	79,39	100,00	101,36	79,39	turquie
92,45	73,85	73,85	100,00	97,008	93,375	78,07	73,85	99,03	70,72	73,85	73,85	93,37	98,61	73,85	espagne
25,34	86,10	86,10	22,67	58,97	72,11	72,74	86,10	3,68	38,28	86,10	86,10	72,11	77,25	86,10	suède
30,21	86,41	86,41	32,59	66,86	71,32	75,99	86,41	8,94	31,03	86,41	86,41	71,32	83,30	86,41	suisse
100,00	78,81	78,81	104,21	102,36	92,03	82,62	78,81	103,30	50,50	78,81	78,81	92,03	104,93	78,81	angle-gall

Only 5 of them have proved to be efficient. Denmark is the one which appears more often (9 times) in the reference group of inefficient countries.
The use of cross-efficiency[4] (Table 6)and the obtained mean (Table 7)

Table 7: Mean of cross-efficiencies.

Country	Mean of crossed efficiencies (%)
Austria	56,814
Czech Rep.	86,034
Denmark	77,370
Finland	45,261
Germany	68,868
Hungary	83,097
Italy	61,660
Norway	32,365
Poland	75,901
Portugal	54,507
Turkey	86,731
Spain	84,386
Sweden	63,986
Switzerland	66,006
England-Wales	86,991

According to Boussofiane, et al. (1991), England-Wales appears as genuinely efficient, presenting an average close to 1. Per contrary, Denmark is the one whose assessment is based on the most disparate criteria, as compared to those used by the other units.
So as to detect scale inefficiencies, we repeated the analysis with the BCC model[5],

Table 8: Scale efficiency

Country	Efficiency (BCC)	Scale
Austria	88.07%	irs
Czech Rep.	100.00%	-
Denmark	100.00%	-
Finland	100.00%	irs
Germany	96.97%	drs
Hungary	100.00%	irs
Italy	98.79%	drs
Norway	100.00%	irs
Poland	100.00%	drs
Portugal	66.27%	drs
Turkey	100.00%	-
Spain	100.00%	-
Sweden	87.98%	drs
Switzerland	88.90%	drs
England-Wales	100.00%	-

It is detected that inefficiencies are caused because they are not operating at an optimal scale: four of them (Austria, Finland, Hungary and Norway) are operating with increasing returns to scale, and six of them (Germany, Italy, Poland, Portugal, Sweden and Switzerland) with decreasing returns to scale. Under these conditions, it is possible to boost their technical efficiency by using different amounts of inputs to achieve better results in the output.
Table 9 shows the percentages of change that the countries' inputs should experience to operate efficiently

[4] It is developed by calculating the efficiency indexes that each Administration of Justice would obtain if they were applied the weightings employed for the other Administrations of Justice.
[5] It adds to the model proposed in (1) a convexity restriction

Table 9: Change in the inputs.

Country/Percentages of change in the inputs	**Number of Cases filed + Number of Pending cases**	**Justice spending**	**Staff**
Austria	0.00%	-43.37%	-48.75%
Czech Rep.	0.00%	0.00%	0.00%
Denmark	0.00%	0.00%	0.00%
Finland	0.00%	0.00%	0.00%
Germany	0.00%	-83.56%	-46.15%
Hungary	0.00%	0.00%	0.00%
Italy	-32.07%	-26.39%	0.00%
Norway	0.00%	0.00%	0.00%
Poland	0.00%	0.00%	0.00%
Portugal	0.00%	0.00%	0.00%
Turkey	0.00%	0.00%	0.00%
Spain	0.00%	0.00%	0.00%
Sweden	0.00%	-57.67%	-30.19%
Switzerland	0.00%	-72.72%	-15.19%
England-Wales	0.00%	0.00%	0.00%

Thus, the spending on justice, with an average percentage decrease of 18.91%, reaching values close to 84%, is the worst used resource. This is followed by the staff which, on average, could be reduced by a 9.35 % (almost a 49% in Austria)

IV. CONCLUSIONS.

The Administration of Justice is a public good and, as such, it must be efficient. That is, it must use the available resources optimally. A country's judicial system, when functioning properly, encourages investment and provides security to its citizens. As a consequence, it avoids, not only the uncertainties that entail costs, such as the lawyers and experts' honorariums; but also other indirect or implicit costs not displayed, such as an increase on the risk premium, a decrease in employment, a reduction in demand... Therefore, States compete between each other to have a good reputation in aspects that might initially seem to be unrelated to the economy as, for example, a country's legal system. Decisions on locating companies' production centres in one State over another are not only adopted basing on labour costs considerations, but also on the various countries' institutions and judicial systems. A large social and professional sector in the Administration of Justice considers that the lack of resources is the cause of its amiss functioning and, therefore, demands a higher investment. Nonetheless, through this study we found that, out of the 15 judicial systems analysed, in 6 out of the 9 countries that proved to be inefficient the situation is caused by not operating at an optimum level. Thus, the findings of this study may provide the policy makers with some insight as to develop appropriate policies which would be focused on using the available monetary resources correctly, instead of only considering a higher investment.

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