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RANKING OF PERFORMANCE THROUGH A NON PARAMETRIC MODEL
CASE OF JUSTICE IN ARGENTINA

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1. INTRODUCTION

The objective of the study is to deepen the analysis of the performance of the administration of justicie in the provinces of the Argentina[7]. In this opportunity we propose to do an analysis of technical efficiency by the comparison of the used inputs, the outputs obtained and ideal of each of these values. In this way, comparisons are made between the inputs used in the process of transforming inputs variables in output variables and the minimum necessary quantities; or, between the outputs obtained and the maximum achievable.

Among the techniques most widely used for measuring technical efficiency are models DEA that calculate an empirical border from the observed data using non-parametric techniques.

The consulted bibliography recounts abundantly the use of these methods in the efficiency evaluation in the courts of Justice in countries like United States, Canada and European countries

7 The authors presented a preliminary study in which addressed with a MCDA method analysis of the Judicial System in Argentina. Fourth Workshop on Knowledge Discovery, Knowledge Management and Decision Making (Eureka 2013). Mazatlan, Mexico. November 6-8 of 2013.

(Francisco García J. et al, 2007); however, it is not so common in Latin American countries. In the consulted works you can see that the technique usually employed, in cases similar to the one that concerns us, is DEA, even when they have also been found using parametric models (Pedraja, f. et to the. 1996). Also, it has been observed that, independently of the technique used, (inputs) inputs and outputs (outputs) defined do not differ mostly in the reviewed work. The work is organized as follows, in paragraph 2 discusses the characteristics of the system of administration of Justice in Argentina. In point 3 the DEA models used are described. Next is the implementation, results and conclusions of the study.

The authors expressly stated that the basis of this chapter text gave rise to a paper presented at the Eureka Virtual Physical Meeting 2014, Culiacan, Mexico. The paper was evaluated and approved by the scientific committee of the event.

2. CHARACTERIZATION OF THE JUSTICE SYSTEM IN ARGENTINA

The administration of justice in Argentina is organized in two jurisdictions: the ordinary justice and the federal justice.

The ordinary justice is administered and organized by each province according to the autonomy that the Constitution confers on article 5º. For this reason, the judicial organization is different in each province of the Republic in accordance with established by the respective provincial constitutions. Most of the provinces are organized through Magistrates Courts, Courts of First Instance, Cameras of Appeal and a High Provincial Court. The Argentine Republic recognizes 24 provincial jurisdictions on which the analysis is performed in this work.

The federal justice is the exception and deals with the cases specially established in the Constitution. The territory of the Republic is divided in 17 federal jurisdictions.

The present study is carried out on the provincial jurisdictions without dabble in different topics serving the service of Justice, this is: criminal, civil, commercial and labor. Neither organs distinction is done nor of instances. Its intention is to give an integral vision of the use of the resources allocated by each province in terms of its efficiency.

3. DEA MODELS

From this methodology it is possible to identify the technological frontier based on units that, by its good results, are considered as those that perform the best production practices in relation to the other units. In this way, establishing a frontier of reference through which it is possible to define efficiency measures. These measures are calculated as the ratio between the weighted sum of outputs and the weighted sum of inputs. These weights are determined for each DMU through the results of an optimization model and ensure the highest possible efficiency.

It is essential for the application of DEA to analyze units (DMUs - decision making units), in this case the units of administration of justice in the Republic of Argentina, are relatively homogeneous (Charnes et al. 1978), this means that perform similar tasks in similar market conditions and looking for similar objectives.

Suppose n DMUs to evaluate where each DMU_j *(j = 1,.., n)* produces *s* outputs y_{rj} *(r=1,..,s)* using *m* inputs x_{ij} *(i=1,..,m).*

DEA uses the following measure of efficiency for the DMU_j:

$$h_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \qquad (1)$$

Where v_i *(i=1, …,m)* and u_r *(r=1, ... ,s)* are the weights or weights of the inputs and outputs, respectively. These weights for the j^{th} DMU can be calculated using the following problem of mathematical programming:

$$h_o^* = \max h_o$$

sujeto a

$$\begin{aligned} h_j &\leq 1, \quad j = 1,..., n \\ v_i, u_r &\geq 0 \\ i &= 1,.., m \\ r &= 1..., s \end{aligned} \qquad (2)$$

The expression (3) represents the ratio of the weighted sum of outputs and the weighted sum of inputs for the evaluated DMU (DMU*o*). Calculating this model for each unit, to obtain the *n* DEA efficiency rates, h_j^* associated with each DMU, where each of them will be associated with (*m*+*s*) optimal weights, corresponding to each input and each output weights.

$$h_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \qquad (3)$$

While large is h_j^*, the better will be the performance of the DMUj with respect to its efficiency. However, the greatest possible value is 1, because of the restrictions imposed in the mathematics program. If $h_j^* = 1$ then DMUj is relatively efficient.

The first DEA model was proposed by Charnes, Cooper, and Rhodes in 1978, called CRS Model assumes constant returns to scale. The second model, called the VRS assumes variable returns to scale (Banker, Charnes and Cooper, 1984). Several formulations of DEA models were subsequently developed.

The CRS and VRS models generally get more of a DMU with rates equal to one, that is, several units sharing first place preventing obtain a total order strict. To prevent this from happening, Andersen and Petersen (1993) introduce a modification to the model (2) excluding the restriction $h_0 \leq 1$ for DMU*o*, of the form:

$$\begin{aligned} & h_o^* = \max h_{\ o} \\ & \textit{sujeto a} \\ & \qquad h_j \leq 1, \quad j = 1,..., n \quad \text{y } j \neq o \\ & \qquad v_i, u_r \geq 0 \end{aligned} \qquad (4)$$

This allows to evaluate efficient DMUs with efficiency ratios bigger than one, breaking with the draws that frequently occur in the applications of DEA, which make it difficult to perform a strict ordering. This model is known by the name of Superefficient Model.

4. APPLICATION

To analyze the performance of the ordinary justice in each province we propose to use the Superefficient model with constant returns.

The following input variables are defined:

- ✓ Magistrates (M): this variable represents the number of judges, appellate judges, members and ministers appointed by province.
- ✓ Staff (S): The number of judicial officials.
- ✓ Employees (E): The number of judicial employees.

Output variables considered are:

- ✓ Resolution rate (RR) = defined as the ratio between the number of resolved cases and the number of entered cases. The numerator includes the cases that were resolved during the year under review, including endings for definitive judgments and other modes that put an end to the process (mediation, conciliation, transactions, expiration dates). The denominator on the other hand, indicates the number of cases entered for the first time in the judicial system in the year reported.
- ✓ Population (P): The number of habitants by province.

DMUs are defined as the administration of justicie of each province and the Autonomous City of Buenos Aires (C.A.B.A) [8]

Thus defined, the conceptual model has 3 inputs and 2 output and 19 DMUs, fulfilling recommended by Cooper, Seiford and Tone rule (2004), which indicates that:

$n \quad \{ \quad \}$

The data is for the year 2010 (shown in Appendix 1) and were obtained from published statistics judicial of the Argentine Provinces and CABA Board prepared by the Federal Courts and Superior Courts of the Argentine Provinces and City Autónoma de Buenos Aires.

To resolve the Super-efficient DEA model we used Banxia 4 Frontier Analyst software.

8 There was excluded from the study the judiciary of the provinces of Río Negro, San Luis, Saint John, Jujuy and Santa Cruz because is not information available for any of the analyzed variables.

The efficiency indices obtained for each province are shown in annex 2.

Annex 3 lists the following additional information:

- ✓ Number of times that each efficient province was referring.
- ✓ The references and the percentage of reduction of inputs and increased outputs are identified for the provinces that were inefficient.

These values of potential improvement provide very useful information to the inefficient units in the sense that you indicate the changes in inputs and outputs that you would be projected to the efficient frontier.

5. ANALYSIS OF THE RESULTS

The results obtained, we can emphasize the following aspects:

Regarding Efficient Units:

- ✓ Results shows that five provinces are efficient. They are: Tierra del Fuego, C.A.B.A, Formosa, Entre Ríos and Santa Fe.
- ✓ C.A.B.A was 14 times benchmark, then between rivers (12 times), Formosa and Tierra del Fuego in 10 opportunities, while Santa Fe only four times.

Regarding the Inefficient Units:

- ✓ Fourteen provinces were inefficient, with index values between 85% and 44%. The average efficiency in units inefficient group is 63.25%.
- ✓ Inefficient provinces: Buenos Aires, Santiago del Estero, Salta, la Pampa, La Rioja, Misiones and Tucumán obtained better performance than the average of their group.
- ✓ Seven inefficient provinces are below the average efficiency of its group (Córdoba, Corrientes, Chaco, Chubut, Neuquén, Catamarca and Mendoza).

Regarding the input and output variables:

- ✓ Global potential improvements (Annex 4) shows a strong influence of the output variable resolution rate (RR) in the potential of the system with respect to the remaining variables improvement.
- ✓ There are provinces whose potential to become efficient depends mainly on the increase in this variable (RR), such as large provinces such as Buenos Aires, Cordoba and Mendoza.
- ✓ Small provinces have mostly proportional potential improvements in outputs (zero values associated with the slack variables).

6. CONCLUSIONS

We believe that the study is useful for administrators of justice in the provinces of Argentina. Considering that the DEA models obtain efficiency values of a unit from the comparison with the performance of their peers, the results allow them aware of the situation of each province in comparison with the rest.

The case of inefficient provinces the results suggest the modifications that they should try to incorporate to increase its performance. It is considered important that the intervention measures put special emphasis of increasing the rate of resolution (RR), as this is a variable directly controllable by decision makers.

The work leaves open some lines of research that the authors addressed in future work. One is related to the greater disaggregation of the data, so for example, it would be desirable to deepen the analysis inherent in the different jurisdictions that serves the administration of justice (criminal, civil, labor and commercial).

We also expected to develop a hybrid model for integrating DEA with MCDA models as a way to use analysis and allow a greater degree of participation decision makers; increasing in this way, the possibilities of achieving the implementation of the recommendations arising from the results of the model.

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ANNEX 1

Data input and output variables

Province	Magistrates	Staffs	Employees	Population	Resolution Rate
Buenos Aires	1206	7820	10567	15625084	0.77
Catamarca	75	256	795	367828	0.72
Chaco	193	797	1381	1055259	0.72
Chubut	95	473	929	509108	0.74
C.A.B.A	65	969	1652	2890151	0.81
Córdoba	541	1304	3775	3308876	0.39
Corrientes	121	525	1408	992595	0.62
Entre Ríos	214	189	1028	1236300	0.65
Formosa	62	69	677	530162	0.57
La Pampa	121	154	485	318951	0.71
La Rioja	70	199	0	333642	0.65
Mendoza	239	1127	2620	1738929	0.35
Misiones	142	381	1072	1101593	0.33
Neuquén	71	495	941	551266	0.68
Salta	124	409	1164	1214441	0.58
Santa Fe	326	998	1829	3194537	0.73
Santiago del	70	274	969	874006	0.29
Tierra del Fuego	33	122	248	127205	0.88
Tucumán	117	769	1299	1448188	0.76

ANNEX 2

Efficiency Ranking

Province	Score
Tierra del Fuego	421.45
C.A.B.A	356.12
Formosa	170.70
Entre Rios	125.14
Santa Fe	103.11
Buenos Aires	84.52
Sgo. del Estero	78.84
Salta	77.16
La Pampa	75.24
La Rioja	72.39

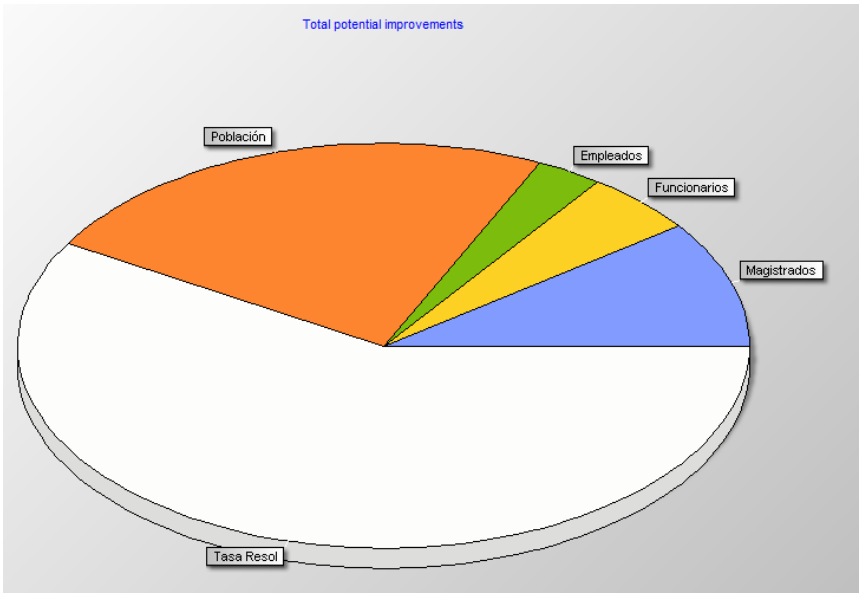
Province	Score
Misiones	71.97
Tucuman	69.38
Cordoba	61.58
Corrientes	54.41
Catamarca	53.97
Chaco	50.05
Neuquen	46.18
Chubut	45.77
Mendoza	43.98

ANNEX 3

Potential improvements. Benchmark units

Province	Score	Decrease Magistrates (%)	Decrease Staff (%)	Decrease Employee (%)	Increase Populatios (%)	Increase RR (%)	Times Benchmark
Buenos Aires	84.52	-65.52	-20.74	0.00	18.32	572.88	0
C.A.B.A	356.12	0.00	-73.74	-45.53	-71.92	-66.75	14
Catamarca	53.97	0.00	0.00	-1.74	85.28	85.28	0
Chaco	50.05	-59.76	-1.32	0.00	99.78	99.78	0
Chubut	45.77	0.00	0.00	0.00	118.49	118.49	0
Cordoba	61.58	0.00	0.00	0.00	62.38	454.47	0
Corrientes	54.41	0.00	0.00	0.00	83.80	83.80	0
Entre Rios	125.14	-48.32	0.00	0.00	-20.09	20.23	12
Formosa	170.70	-9.57	0.00	-57.45	-41.42	-41.42	10
La Pampa	75.24	-32.29	0.00	0.00	32.90	32.90	0
La Rioja	72.39	0.00	0.00	0.00	38.13	38.13	0
Mendoza	43.98	0.00	0.00	0.00	127.38	320.59	0
Misiones	71.97	0.00	0.00	0.00	38.95	87.23	0
Neuquen	46.18	0.00	0.00	0.00	116.57	116.57	0
Salta	77.16	0.00	0.00	0.00	29.60	29.60	0
Santa Fe	103.11	-68.30	0.00	0.00	-3.02	26.46	4
S. del Estero	78.84	0.00	0.00	0.00	26.84	137.42	0
T. del Fuego	421.45	-31.18	-79.28	0.00	52.67	-76.27	10
Tucuman	69.38	-44.31	-2.76	0.00	44.13	44.13	0

ANNEX 4
Global potential improvements



Magistrados	-10,08 %
Funcionarios	-4,99 %
Empleados	-2,94 %
Población	23,53 %
Tasa Resol	58,46 %