# Socio Economic Factors and Justice. Colombia 2010-2015

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## Abstract

This article to establish the link between economic and social factors and the provision of the formal justice service based on the official record of judicial process, entries and exits delivered by the Colombia Judicial Branch. To do it: first, provision justice service performance estimators was calculated focused on the efficiency and effectiveness in the operation of the system using DEA, Data Envelopment Analysis, techniques to obtain estimate data set that allow comparing the performance of the judicial system in Colombia as a measure of access to justice. Afterwards, the socio-economic data was obtained as a way to dispose measurements about factors that could or could not impact the provision justice service performance estimators, those was done for 32 subnational divisions, departments, since 2010 to 2015 annual reports. Subsequently, the correlation matrices between the efficiency aspects and the socioeconomic factors were identified as the way to estimate the relationship between factor variables of the social environment and provision justice service performance estimators, each subnational division has particular behavior each year, and will be used as scenario evolution in order to propose strategies to get away the service performance estimators to the efficient frontier.

## Keywords
Justice Engineering Service, Little's Law, Data Envelopment Analysis, Public Police; Colombia

## 1. Introduction

The analysis of the provision of justice services has a long tradition (Monzingo 1977) in different international contexts including Latin America, and it is pertinent to evaluate the efficiency of the provision of justice services (Cohen, 2004). The evaluation may vary according to the available methods (Riley et al. 2015, Pérezy 2018, Christin et al. 2015, Ridgeway, 2018) among the techniques used to compare the relative efficiency of the performance of the justice service we find the Data Envelopment Analysis (Ferrandino 2013; Ridgeway 2014; Ferro et al. 2018).The provision of the justice service depends on access to judicial offices and their geographical location, as well as their efficiency (Teixeira et al. 2019) on the overflow and adaptation of the justice system to new circumstances such as transitional justice systems for special situations, little common or transitory such as the internal conflict in Colombia (Chenou et al. 2019). The literary review shows the importance of judges in Poland (Bełdowski et al. 2020) for the use of the stochastic borders method, the allocation of cases, resources and processes according to conditions and that today they can potentially be delegated to the machines (Simmons. 2018).

From the Institutionalist perspective it is presumed that it is the institutions that build society and from the Structuralist perspective, it is the institutions and the dynamics that are the result of the social structure. Therefore, the identification of the sources of efficiency and inefficiency depend on the perspective assumed about the study of a justice system, thus the identification of the efficiency of justice in the construction of an economic system is relevant from the perspective institutionalist (Lorizioy 2014) or it could be approached from the empirical approach, without a previous epistemological reference in the exploration of the sources of efficiency and inefficiency for judicial systems as is done for Italy (Finocchiaro 2014) This ideological effect on the selection, processing approach and treatment of judicial processes affects the performance and delivery of judgments within the courts (Yates et al. 2013), For its

part (Idrovo 2007), it indicates that not only political, administrative or environmental aspects determine and impact the performance of judicial offices in the socio-political systems adopted by a country; however, studies on the construction of the efficiency of judicial offices focus their attention on the internal factors of their operation and the judicial system.

It should be noted that the provision of justice services is directly affected by the request for the service and this request is affected by the social conditions in which the service is provided (Ouimet et al 2018). The aforementioned investigation seeks in 145 countries and through the criteria of experts the bases to build a system of structural equations to identify the effect of social factors in the formation of crime. Therefore, it indirectly looks for the social factors that affect the provision of the justice service, according to the authors given the absence of studies that directly link social factors with judicial performance.

### 1.1 Objectives

The general objective are "Evaluate the operation of the justice service in Colombia through the estimation of procedural times using data analysis techniques to weight the incidence of economic and social factors at the departmental level and by years in the period 2010 to 2015", and the research has three specific objectives:

- Estimate performance measures of the provision of the justice service focused on the efficiency and effectiveness in the operation of the system from the application of data analysis techniques to have metrics that allow comparing the performance of the judicial system in Colombia as a measure of access to justice.
- Establish how economic and social factors affect the provision of justice service and their influence on the performance measures identified to analyze scenarios and propose strategies that take the service to the efficient border.
- Propose a scheme that links the estimation of access to justice with the economic and social factors that affect the provision of the service in Colombia to identify the constituent characteristics of access to justice.

## 2. Literature Review

The right of Access to Justice allows access to other rights, which is recognized and enshrined in the International Covenant on Civil and Political Rights; likewise, it is in accordance with articles 8 and 10 of the Universal Declaration of Human Rights. The World Justice Project –WJP– captures comparable data on legal needs and access to justice on a global scale, the results of the 2019 report are derived from the access to justice module, administered in 101 countries in 2017 and 2018 using a probability sample of 1,000 respondents in each country. This data is used to calculate scores and rankings for the "Annual Rule of Law Index" produced by the WJP. Here the access to justice module comprises 128 of the 340 questions in the survey instrument that inquires about the experience in dealing with everyday legal problems.

According to this report, "justice problems are ubiquitous" and indicate that approximately half –49% - of the people surveyed experienced a legal problem in the last two years, with different prevalence and severity depending on the country or administrative territory. Likewise, the most common problems are related to the consumer, housing, money and debt. Here, of the estimated 36% of people in the world who have experienced a non-trivial legal problem in the last two years, 51% of these are unable to meet their civil justice needs (World Justice Project 2019). On the other hand, the United Nations indicates that "one of the main obstacles to access to justice is the cost of representation and legal advice", allowing to implicitly identify that the socioeconomic condition of the individual and the region , are a possible obstacle to access, provision and adjustment in law to the service of justice.

From the point of view of law, lawyers carry out a recognizable process but have not developed a clear stopping rule for the processes they carry out as engineering does. He assures that lawyers have in common with engineers your basic tasks, both require doing something useful that works for your clientele (p. 67). Clients turn to lawyers, as they come to engineers, with problems that they cannot solve on their own, and the service that both engineers and lawyers provide is the resolution of those problems (Almiron 2010).

For the Portuguese judicial system they estimated the efficiency of the Portuguese judicial system based on empirical records; They then study the decision to close small courts on the grounds of efficiency, testing the hypothesis that there is a relationship between the size of the courts and their efficiency. To achieve the two objectives, they used DEA techniques.

In Italy they studied the inefficiency and the optimal structure of the justice sector, finding that technical inefficiency follows the traditional Italian economic dualism, the size of the inefficiency component is homogeneously distributed. This homogeneous distribution is probably due to the presence of an administrative rule that establishes the presence of a fixed number of courts per district 5, which does not allow economies of scale to be properly exploited, for example, large cities have only one court and it should have many more. The authors conduct a literature review on the application of DEA in the evaluation of justice services and propose a new methodology using the directional distance function –DDF for its acronym in English– to measure inefficiency in the courts.

In they identify that several studies focus on analyzing the time required to make a decision, that is, the "delays" of the judicial system, without taking into ac-count the point of view of the citizens; For the authors, a joint analysis of the behavior of the judges, on the one hand, and the organization of the courts, on the other hand, is crucial to get the whole picture. In a first phase of the research and from the data available for the years 2009 to 2011, they analyzed 103 cuts subdivided into 25 regions using DEA, the second phase includes an analysis using the Malmquist index and at the same time they consider that it is the first time that this index is used to analyze a judicial system.

The mergers carried out for the Swedish district courts from 2001 to 2009 can be rationalized based on economic production arguments and in their study, [26] they investigate whether political decisions should have been evaluated before taking such a merger decision; In this study they did not examine the cost of the merger in the judicial sector; For example, questions related to social utility and the higher cost of acquiring justice services produce a new judicial map, which may generate less demand for justice services. Therefore, the quantitative and qualitative aspects of the merger must consider economic and social aspects that may affect the provision of the service.

The DNP [27] rated the technical efficiency of the processes registered by the Judicial Branch in search of the efficient border, for the criminal and civil specialty in promiscuous courts, representing 72% of the total effective income to the Judicial Branch in the year 2016. Using Data Envelopment Analysis –DEA– they estimated "if each of the judicial offices of the country uses optimally, or not, the resources used in its activity, comparing each court with the most efficient unit evaluated. Within your circuit, district, or department".

With the DEA BBCO models [28] they estimated the performance measures of the justice service, using information from the judicial processes for 32 political-administrative divisions of Colombia between 2007 and 2015 and proposed a procedure to support the strategic planning process in the justice service based on DEA models.

## 3. Methods

The investigative approach is of a mixed descriptive type, due to the review of the public information sources of the procedural movement in Colombia and sociodemographic data. For this, the average procedural times are determined, then the performance of the system is estimated, and the technique called Data Envelopment Analysis is used. For the interpretation of the information, statistical methods such as Pearson's correlation are used to identify the relationships between pairs of variables and Grounded Theory is used.

Under the understanding that "Delaying a process represents the denial of justice", the time in which a process is within the system without being attended, can become a measure of access to justice. For the system, an inactive process represents dead load - queued process. Therefore, the system is represented from the movement of processes in the judicial system and the aspect to observe is the number of processes that are in the node at an instant t. At any instant of time t, X (t) takes the values of 1,2, ... and t can be any value of the set (0, α), from the instant in which the observation begins to the infinite future. If the processes arrive one by one –inputs– and the total number of processes that are in the system –inventory– is observed, then the value of X (t) increases by one and when a process leaves –exit - decreases by one. The inventory refers to the number of current judicial processes existing within the judicial system. Within the system you can have the following: Effective procedural income, Procedural Egress, Effective Procedural Expenses, Ending Inventory, Average Inventory.

Procedural time is understood as the time between the beginning and the end of a procedural stage, and its behavior can be described as a queuing system. There is the number of processes that enter the system –L– by state between the years 2010 to 2015 and are shown in table 1. Likewise, there is the initial inventory within the system year by year

by department in table 2, that is -L-. From the equation L = $\lambda$W, we solve for W and cross the data to obtain the average time in the system.

$$L/\lambda = W \quad (1)$$

The Data Envelopment Analysis –DEA– technique proposes a mathematical programming for the construction of an efficient frontier and to compare the technical efficiency of units. A unit is efficient when for a certain level of resource consumption, it manages to maximize the way in which it evaluates and weights the values, or when, for a certain level of production, the unit manages to minimize the resources consumed. The unit with the highest productivity index is used as a benchmark for the performance of the other units.

In the seminal model presented by Charnes, Cooper and Rhodes (1978) the efficiency measure related the weighted sum of inputs –inputs– with the outputs –outputs– of each decision unit –Decision Making Unit - DMU– using models. of linear optimization that included as a restriction that this index must be positive and less than unity Through procedures of linearization and application of Primal-Dual properties, Charnes et al., 1978– obtain the DEA CCR model, and Banker et al. –1984– develop the DEA BCC linear programming model, which are the most widely used. According to this, are defined as input variables population, birth and death, as output variables income and procedural expenses; the equation is defined as

$$Max_{u,v} \quad h_0 = \frac{\sum_{r=1}^{s=2} U_r * Y_{ro}}{\sum_{i=1}^{m=3} V_i * X_{io}}$$

$$subject\ to: \frac{\sum_{r=1}^{s=2} U_r * Y_{rj}}{\sum_{i=1}^{m=3} V_i * X_{ij}} \leq 1; \ \forall j: 1..32; \ U_r, V_r \geq 0 \quad (2)$$

Where:
ho: Objective function and efficiency measure.
xij: Quantity of the i-th (i = 1,…, m) input that enters the j-th (j = 1,…, n) department.
Yrj: Quantity of the r-th (r = 1,…, t) output that comes out of the j-th (j = 1,…, n) department.

The Xij and Yrj are known parameters.
Vij: Weight of the i-th (i = 1,…, m) input that enters the j-th (j = 1,…, n) department.
Urj: Weight of the r-th (r = 1,…, t) output that comes out of the j-th (j = 1,…, n) department.
Ex: Efficiency of the j-th department (j = 1,…, n)

## 4. Data Collection

The collection of information will be done through the different information systems of each of the entities attached to the Ministry of Justice and Law –National Police, Judicial branch, attorney general of the nation, National Penitentiary and Prison Institute–. For this study, data from 2010 to 2015 are taken according to what is available in each system, and it is obtained by department.

## 5. Results and Discussion

Entry of judicial processes and initial inventory by year and department, table 1 contains the average times in the system obtained for equation (1), this data is relevant because in justice "delay is deny", the longer a process is in the system, it could indicate that justice is not being administered effectively.

Table 1. Average times in the judicial process system by year and region

| Region | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | |
|---|---|---|---|---|---|---|---|
| Caribbean | 1,44 | 0,97 | 0,98 | 0,95 | 0,77 | 0,67 | |
| Middle East | 1,41 | 1,11 | 0,97 | 0,86 | 0,68 | 0,59 | |
| South Central | 1,06 | 0,97 | 0,87 | 0,67 | 0,57 | 0,44 | |
| Coffee Region | 0,83 | 0,64 | 0,43 | 0,46 | 0,41 | 0,38 | |
| Plains | 0,94 | 0,78 | 0,63 | 0,49 | 0,54 | 0,43 | |
| Pacific | 1,30 | 0,86 | 0,93 | 0,82 | 0,59 | 0,57 | |

The data in Table 1 shown a decrease in the average times the Coffee region and the Caribbean region with the longest times. Once the mathematical technique DEA has been applied, the scores are obtained per year by department, the results are shown in Table 2 by regions. Colombia is a country that is divided into regions, which are territorial divisions made from heterogeneous characteristics in terms of relief, climate, vegetation, and soil classes of the country.

When talking about incidence, it is necessary to establish whether the variables are related to each other, so it begins with a conceptualization around how to determine relationships between variables from the Thaler formula, through Granger causality and finally correlation. To establish the relationship or not between variables, a matrix is constructed with the data entered and obtained with the application of the DEA, for its part, variables of an economic and social nature are included. In total, there are 42 variables and data for the 32 departments for the six years.

The study of causality is the basis of the study of incidence, the values define the factual possibilities that have already happened within the conditions described. The causal study requires at least two components: the identification of the theory and the empirical support of this theory. However, it should be noted that the theoretical formulation is associated with specific approaches that are more subject to human power relations and dogmatic traditions in the psycho-socio-biological-neuronal context in which the person proposing the theory is. On the other hand, the numerical techniques available for causal identification have been available for more than 70 years, at least summarizing five techniques to identify causality from exploratory causal analysis with time series data. For his part, Rodríguez indicates that the probabilistic concept of causality is based on the idea that in time the cause always precedes the effects: If one-time series causes another, the knowledge of the first process would help to predict the future values of the another after the influences of other variables have been taken into account.

Among the techniques described is Granger causality, according to Gujarati “the Granger causality test assumes that the relevant information for the prediction of the respective variables is contained only in the time series information on these variables” (Camerano 1997)

Table 2. Score by region and department for each year

| Region | Departament | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| Caribbean | Bolívar | 0,38 | 0,56 | 0,65 | 0,68 | 0,63 | 0,49 |
| | La Guajira | 0,39 | 0,43 | 0,40 | 0,44 | 0,35 | 0,31 |
| | Magdalena | 0,44 | 0,33 | 0,35 | 0,39 | 0,34 | 0,36 |
| | Cesar | 0,51 | 0,54 | 0,83 | 0,77 | 0,53 | 0,56 |
| | Córdoba | 0,59 | 0,56 | 0,53 | 0,68 | 0,59 | 0,58 |
| | Sucre | 0,60 | 0,61 | 0,57 | 0,50 | 0,50 | 0,40 |
| | Atlántico | 0,68 | 0,68 | 0,67 | 0,58 | 0,54 | 0,41 |
| | San Andrés | 0,76 | 0,79 | 0,97 | 0,89 | 0,93 | 0,85 |
| Middle East | Cundinamarca | 0,26 | 0,30 | 0,44 | 0,35 | 0,29 | 0,28 |
| | Norte De Santander | 0,43 | 0,64 | 0,57 | 0,54 | 0,70 | 0,56 |
| | Boyacá | 0,53 | 0,70 | 0,67 | 0,54 | 0,48 | 0,52 |
| | Santander | 0,60 | 0,65 | 0,65 | 0,77 | 0,81 | 0,72 |
| | Bogotá | 0,72 | 0,92 | 0,82 | 1,00 | 0,83 | 1,00 |

| Region | Departament | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| South Central | Caquetá | 0,51 | 0,71 | 0,67 | 0,81 | 0,73 | 0,91 |
| | Huila | 0,52 | 0,69 | 0,76 | 0,67 | 0,60 | 0,54 |
| | Tolima | 0,53 | 0,59 | 0,72 | 0,78 | 0,68 | 0,62 |
| | Putumayo | 0,59 | 0,58 | 0,60 | 0,65 | 0,97 | 0,97 |
| | Amazonas | 0,59 | 0,63 | 0,51 | 0,56 | 0,47 | 0,42 |
| Coffee Region | Risaralda | 0,46 | 0,59 | 0,73 | 0,76 | 0,62 | 0,64 |
| | Quindío | 0,50 | 0,60 | 1,00 | 0,68 | 0,52 | 0,46 |
| | Caldas | 0,59 | 0,67 | 0,63 | 0,56 | 0,59 | 0,64 |
| | Antioquia | 0,70 | 0,79 | 0,81 | 0,84 | 1,00 | 0,98 |
| Plains | Vaupés | 0,20 | 0,17 | 0,27 | 0,23 | 1,00 | 0,22 |
| | Vichada | 0,40 | 1,00 | 0,44 | 0,35 | 0,32 | 0,26 |
| | Guaviare | 0,43 | 0,52 | 0,43 | 0,40 | 0,36 | 0,28 |
| | Meta | 0,45 | 0,57 | 0,70 | 0,86 | 0,55 | 0,55 |
| | Casanare | 0,55 | 0,66 | 0,85 | 0,74 | 0,65 | 0,57 |
| | Guainía | 1,00 | 1,00 | 1,00 | 0,46 | 0,79 | 0,42 |
| Pacific Coast | Nariño | 0,39 | 0,50 | 0,46 | 0,50 | 0,48 | 0,46 |
| | Cauca | 0,42 | 0,45 | 0,45 | 0,47 | 0,47 | 0,42 |
| | Choco | 0,54 | 0,60 | 0,65 | 0,73 | 0,74 | 0,45 |
| | Valle Del Cauca | 0,64 | 0,73 | 0,70 | 0,69 | 0,69 | 0,67 |

It is considered as a small sample N = 150 for the Granger test to be valid, therefore, given the availability of information for only six years, it is not possible to apply this technique and it is chosen to constitute the correlational structure between the variables based on the database used and proceed to its interpretation based on the results obtained. Therefore, it is established if the variables are correlated using Pearson's correlation, which expresses the degree to which the subjects have the same order in two variables; The value of the correlation coefficient ranges from 0 to ± 1, a correlation equal to 0 means no relationship. It is worth clarifying that correlation is not proof of causality. Given the above, the correlational approach is used on two data sets: the DEA data and efficiency measures –19– and the socioeconomic variables –23–. The variables of the optimized linear program DEA capture the performance, the operating conditions and the effective results of the justice service provision, as well as their specific weighting.

It should be noted that therefore there is a space of 19 * 23 * 2 = 874 possible correlations considering the positive or negative sense of the relationship between each pair of variables. Therefore, the presentation of results is carried out by means of three sets of tables to simplify the reading. This selection identifies that if this sub-table was not taken among the correlations of all the variables, there would be 42 * 42 * 2 = 3528 correlation hypotheses.

Likewise, the 95% level of significance was selected and a diagram was drawn up that summarizes the results of the correlations that identify the relationship between each pair of hypothesized variables - Another exercise could include the 99% level of significance for these 874 hypotheses of job (table 3)-.

Table 3. Summary table of correlations

| Type of correlation | Negative and significant | Positive and significant | **Max** | **Average** | **Mín** |
|---|---|---|---|---|---|
| Score | 0 | 1 | 0,33 | 0,08 | -0,17 |
| SM Population | 0 | 0 | 0,17 | -0,03 | -0,26 |
| Projection Population | 0 | 8 | 0,90 | 0,23 | -0,20 |
| SM Births | 1 | 0 | 0,22 | -0,03 | -0,37 |
| Projection Births | 0 | 7 | 0,93 | 0,22 | -0,19 |
| SM Kills | 4 | 0 | 0,13 | -0,08 | -0,45 |
| Projection Deaths | 0 | 8 | 0,90 | 0,23 | -0,22 |
| PM Procedural entry | 1 | 7 | 0,50 | 0,14 | -0,31 |
| SM Procedural income | 0 | 2 | 0,48 | 0,05 | -0,24 |
| Projection Procedural Income | 0 | 8 | 0,89 | 0,23 | -0,25 |
| PM Procedural discharge | 0 | 7 | 0,46 | 0,13 | -0,29 |

| | | | | | |
|---|---|---|---|---|---|
| SM Procedural discharge | 0 | 4 | 0,49 | 0,06 | -0,10 |
| Projection Procedural exit | 0 | 8 | 0,90 | 0,23 | -0,25 |
| DP Population | 2 | 1 | 0,93 | 0,08 | -0,53 |
| DP Births | 0 | 2 | 1,00 | 0,08 | -0,29 |
| DP Deaths | 2 | 2 | 0,70 | 0,12 | -0,47 |
| DP Procedural Income | 3 | 1 | 0,69 | -0,11 | -0,45 |
| DP Procedural Discharge | 2 | 1 | 0,61 | -0,08 | -0,90 |
| v* | 3 | 1 | 0,51 | -0,13 | -0,84 |

Table 4 summarizes the number of times –analysis in the horizontal direction– that negative correlations with and without significance appear, as well as the number of positive relationships with and without significance, it also includes the maximum, average and minimum for each variable. There are 18 negative correlations with significance and 178 without significance, among the positive correlations 173 are not significant and 68 are significant. It can therefore be identified that the measurement of efficiency is affected by socioeconomic conditions in various negative and positive ways. additionally, get the summary in a vertical sense, there are 18 negative correlations with significance and 178 without significance, among the positive correlations 173 are not significant and 68 are significant.

Next, within the correlations with high significance, the correlations with 95% reliability are identified, finding values above 0.3, which are shown in Table 4.

The inclusion of quadratic variables is done with the purpose of identifying the effect of variables of exponent two with the performance measurement, as happened for population, births and others.

From the correlations found, the correlation diagram of figure 1 is constructed. Lines in black denote positive correlations and those in red, negative correlations. 6 groups of variables were identified with which the relationship between these groups of variables is obtained, this would provide a space of 3*3*2 = 18 potential types of relationships of which not all the combinations are present in figure 1. The projection variables –Population, Births, Deaths, Income and Procedural Exit– are shown enclosed in square brackets because six variables have a positive correlation, so the line towards this group of variables means that the variable in question is related to all the variables projection, this way of representing it was done in order to simplify the diagram so that it is more understandable.

At the same time, the colored bubbles group the types of variables, in dark gray are the socioeconomic variables, in gray the variables associated with the justice system, the remaining are data and efficiency measures of data envelopment analysis.

A different graph can be obtained with the relationship of the same type of variables with a significance of 99%, in which relationships with greater statistical significance are identified that affect the score, efficiency, gaps, weights, and the original data. systematically regardless of time, geographic location and the size of the service provision associated with a single department .

Table 4. Summary of correlations with 95% reliability

| Spearman Correlation Coefficient | Score | SM Births | SM Deaths | MProc. Income | PM Proc. Discharge | DP Population | DP Births | DP Deaths | P Proc. Income | Proc. Discharge | v* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DP PBL*PBL | | | | | | 0,93 | | | -0,31 | | -0,40 |
| DP NAC*NAC | | | | | | | 1,00 | 0,59 | | -0,90 | -0,84 |
| DP MUE*MUE | | | | | 0,31 | | 0,48 | 0,70 | -0,45 | -0,50 | -0,58 |
| DPIP*IP | | | | | | -0,32 | | -0,47 | 0,69 | | |
| DPEP*EP | | | | | | -0,53 | | -0,41 | | 0,61 | 0,51 |
| Victimizing fact statement | | | -0,30 | | 0,39 | | | | | | |
| Number of displaced people | | | | | 0,38 | | | | | | |
| Number of displaced persons expelled by department | | | -0,45 | | 0,46 | | | | | | |
| Number of displaced people received by department | | | | | 0,45 | | | | | | |

| Spearman Correlation Coefficient | Score | SM Births | SM Deaths | MProc. Income | PM Proc. Discharge | DP Population | DP Births | DP Deaths | P Proc. Income | Proc. Discharge | v* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial inventory of judicial processes | 0,33 | | -0,39 | 0,35 | 0,38 | | | | | | |
| Average time of judicial processes | | 0,37 | | 0,48 | | | | | -0,32 | | |
| Total GDP (Billions of current pesos) | | | -0,33 | | 0,32 | | | | | | |

The line between inventory of judicial processes and score suggests that an in-crease in the inventory will generate an increase in the score of the department, this in relation to the concept of access to justice allows to indicate the existing need in which the number of processes is greater than enter the system, since the various studies indicate that there is a low level of access to justice in Colombia. Likewise, and as indicated by the legal needs studies in Colombia and the world, the IGI reports among others, social inequality and impunity reinforce the cycle of violence and therefore structural measures to improve social and economic conditions of the population will make it possible to improve the system as a whole, that is, beyond studying the justice service, a society must ensure the application of the rights of its citizens.

Scenarios are therefore of a statistical nature by identifying in a homogeneous way the most direct relationships from the correlations. On the other hand, this causal model allows us to identify the complex structure interwoven and related in the identification of relationships between variables beyond the specific provision of the jus-tice service. From here, a scheme of structural relationships could be presented from the multivariate statistic in which each of the performances of the departments are a particular case in use of the provision of the service. Thus, the correlational model captures the different scenarios of variable relationships in the provision of the justice service (figure 1).

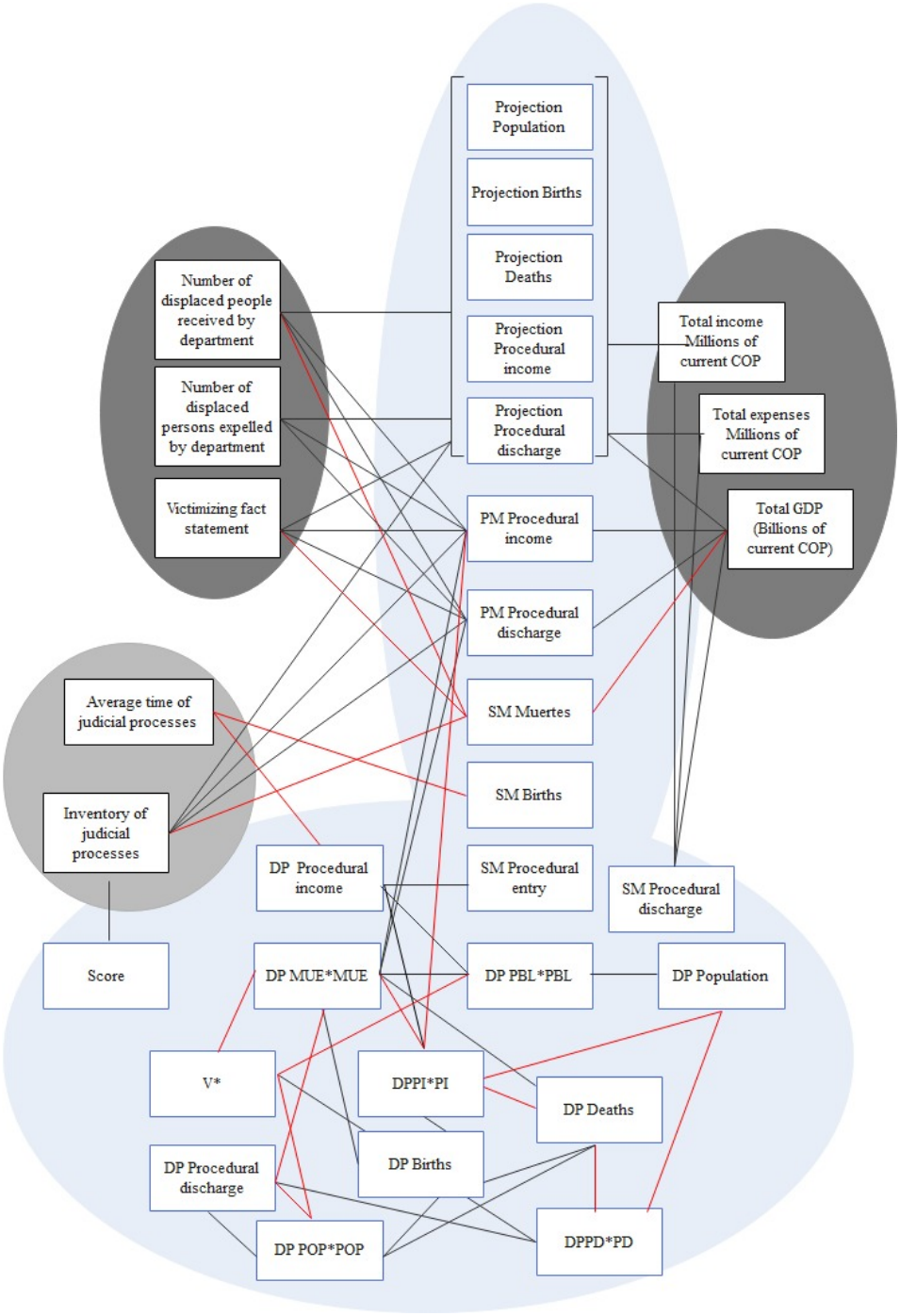


Figure 1. Correlational diagram grouped variables between DEA performance estimators and socioeconomic factors

## 6. Conclusion

It was possible to estimate the performance measures of the provision of the jus-tice service focused on the efficiency and effectiveness in the operation of the sys-tem. Efficiency was analyzed using Little's Law, which allows studying the performance in operations of various systems through the flow of inventories, finding that the average times of judicial processes in general have decreased in the time horizon studied. The application of Litlle's Law and its variants allow establishing that the highest percentage value is evidenced in dead or queued cargo, which means that the service demanded by citizens is not being provided, only 4% are cases attended.

On the other hand, to find the effectiveness of the different decision-making units –departments of Colombia– the non-parametric technique was used Involvement Analysis of Data –DEA for its acronym in English– finding that they are located on the border. efficient in the departments of Antioquia, Bogotá, Quindío, Guainía, Vaupés and Vichada in some of the years this according to Farrel's efficiency, how-ever, accepting the Pareto-Koopmans concept, no DMU is really efficient in the peri-od of time studied . Therefore, based on the efficiency and effectiveness measures found, it can be ensured that Colombia is a country with a low level of access to jus-tice.

Different techniques are recognized that allow determining relationships between variables such as Thaler's formula, Granger causality or correlation, but given the availability of data, Pearson's correlation is used, through which 874 possible correlations are found.

The Pearson correlation is established from two data sets: the DEA data and efficiency measures –19– and the socioeconomic variables –23–. Then the correlations with a significance level of 95% are identified and a diagram was prepared that summarizes the results of the correlations that identify the relationship between each pair of variables. The scenarios are therefore of a statistical nature by homogeneously identifying the most direct relationships from the correlations.

From there, two major scenarios are established: first, the need for citizens to come to request the justice service, given a crime, since the various studies indicate that a high percentage do not attend due to ignorance or consider that they will not be at-tended to. Second, an improvement in social and economic conditions will allow citizens to enjoy their fundamental rights, thus reducing the burden within the system.

## References

Almiron, «Acceder a la Justicia. El estado actual de la problemática en la provincia de Tucumán,» 2010.

Bełdowski, Ł. Dąbroś y W. Wojciechowski, «Judges and court performance: a case study of district commercial courts in Poland,» European Journal of Law and Economics, vol. 50, nº 1, pp. 171-201, 2020.

Chenou, L. Chaparro y M. Rubio, «Broadening conceptualizations of transitional justice through using technology: ICTs in the context of Justicia y Paz in Colombia,» International Journal of Transitional Justice, vol. 13, nº 1, 2019.

Christin, A. Rosenblat y D. Boyd, «Courts and Predictive Algorithms. Data & Civil Rights: A New Era of Policing and Justice,» 2015Cohen, E. S. «Hector Fix-Fierro, Courts, Justice & Efficiency: A Socio-Legal Study of Economic Rationality in Adjudication,» Canadian Journal of Law and Society, vol. 19, nº 2, p. 268, 2004.

Ferrandino, «The Efficiency of Frisks in the NYPD, 2004-2010,» Criminal Justice Review, vol. 38, nº 2, 2013.

Ferro, C. Romero y E. Romero-Gómez, «Efficient courts? A frontier performance assessment,» Benchmarking, vol. 25, nº 9, p. 3443–3458, 2018.

Finocchiaro y C. Guccio, «Searching for the source of technical inefficiency in Italian judicial districts: an empirical investigation,» European Journal of Law and Economics, vol. 38, nº 3, p. 369–391, 2014.

Figueroa, C. J. L. P. «Tracking the New Demand for Justice in the Big Data Ecosystem,» European Journal of Economics and Business Studies, vol. 10, nº 1, pp. 90-98, 2018.

Lorizio y A. Gurrieri, «Efficiency of Justice and Economic Systems,» Procedia Economics and Finance, vol. 17, pp. 104-112, 2014.

Monzingo, «Economic Analysis of the Criminal Justice System,» Crime & Delinquency, vol. 23, 1977.

Riley, M. D. Harelson, M. Monte , M. Chong, M. O'Hern, M. Smith y K. P. White, «Criminal justice system data analysis and visualization,» 2015.

Ouimet, A. Langlade y C. Chabot, «The dynamic theory of homicide: Adverse social conditions and formal social control as factors explaining the variations of the homicide rate in 145 countries,» Canadian Journal of Criminology and Criminal, 2018 Ridgeway, «Policing in the era of big data,» Annual Review of Criminology, vol. 1, 2018.

Ridgeway y J. M. MacDonald, «A Method for Internal Benchmarking of Criminal Justice System Performance,» Crime and Delinquency, vol. 60, nº 1, 2014.

Simmons, «Big Data, Machine Judges, and the Legitimacy of the Criminal Justice System,» SSRN Electronic Journal, 2018.

Teixeira, J. Bigotte y H. Repolho, «Location of courts of justice: The making of the new judiciary map of Portugal,» European Journal of Operational Research, vol. 272, nº 2, pp. 608-620, 2019.

World Justice Project, «World Justice Project,» 2019. [En línea]. Available: http://data.worldjusticeproject.org/accesstojustice/#/country/COL. [Último acceso: 05 01 2020].

Yates, D. Cann y B. Boyea, «Judicial Ideology and the Selection of Disputes for U.S. Supreme Court Adjudication,» Journal of Empirical Legal Studies, vol. 10, nº 4, p. 847–865, 2013.

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