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THE EFFICIENCY OF THE ITALIAN JUDICIAL SYSTEM: A TWO STAGE DATA ENVELOPMENT ANALYSIS APPROACH

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THE EFFICIENCY OF THE ITALIAN JUDICIAL SYSTEM: A TWO STAGE DATA ENVELOPMENT ANALYSIS APPROACH

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1. Introduction

In this paper, an efficiency analysis is carried out in a traditional area of the public sector, the Judicial System. It is important, therefore, to analyze the present situation in order to better understand the actual condition of Italian judicial system. Even the Council of Europe has urged our country for the adoption of legislative measures necessary to shorten the trials duration, both civil and criminal. The Judiciary Committee has decided to conduct a survey on the rationality and efficiency of the configuration of districts. Our goal is to verify whether the system dysfunctions, represented by the extent of backlog, the length of trials and the level of costs, can be traced back to a non-optimal courts size and a wrong inputs combination.
The methodology used to implement the above is the technique called Data Envelopment Analysis (DEA), as proposed by Simar and Wilson (2007) in the two-stage version. Consistently with what was suggested by the authors, in a first phase a score of efficiency is determined for each Decision Making Unit (DMU), while in the second one the possible determinants of the possible inefficiency are analyzed, with particular attention to the size of the district.
The paper is organised as follows. Section 2 reviews the theoretical background, Section 3 present the methods, Section 4 presents the data used and discusses the results obtained, Section 5 contains the main implications for future research.

2. Effectiveness of the Italian judicial system

Although there are numerous data provided by ISTAT, this is a little topic discussed in our country. Among the productions in this regard we remember Marselli and Vannini (2004) present a study on Court districts of appeal and analyse inefficiency through socio-economic context variables of the territory of competence, while Castro and Guccio (2012) explain the inefficiency in terms of demand for justice and advocacy. Peyrache and Zago (2012) instead propose an analysis of the surrounding area, focusing on the duration of a cause and the one that could be the optimal size of the courts; Ippoliti (2014) studies the impact of the competitiveness of the forensic market on the technical efficiency of judicial circles. Other studies relate to litigation, focusing mainly on civil justice. Felli et al. (2007) study the litigation and demand for civil justice in Italy, proposing and testing a decision-making model of the parties involved. There is also the contribution of Marchesi (2003) on the congestion of the Italian judicial system and the length of the times of resolution of the civil causes which, according to the author, depend more on problems on the side of the demand for justice than from the shortcomings of the offer. The Bank of Italy has proposed several works on Italian justice (Bripi et al., 2011; Carmignani, 2004; Carmignani and Giacomelli, 2009; Carmignani and Giacomelli, 2010). Carmignani and Giacomelli (2009) present a prevalently descriptive study of the profound operating differences between the different areas of the country, emphasizing how the proceedings duration results in significantly higher media in southern regions compared to those in the north-center. Using a prevalently descriptive approach in this work, the authors document these differences and investigate possible explanations by examining the characteristics (number of proceedings initiated in the courts) and the allocation of human and financial resources of the courts. Carmignani (2004) instead proposed a study to ascertain whether and to what extent the efficiency of the enforcement impact on the financial structure of undertakings, in particular about the degree of use of commercial debt in relation to other sources of indebtedness. Bripi et al. (2011) provide a review of studies carried out in the last years, especially in the Bank of Italy, aimed at evaluating the quality and efficiency of public services in Italy. The main themes addressed by the authors are education and justice (public administration at the central level), health (public administration at regional level) and all many local public services, such as public transport, waste, etc.

From the analysis of justice, compared both at the international level and at the level of macro Italian areas, emerge wide territorial gaps and considerable delays, as already underlined in previous studies. Finally, Carmignani and Giacomelli (2010) investigate the relationship between the number of lawyers and civil litigation, taking into consideration the Italian provinces between 2000 and 2005. The authors suggest the presence of positive relationship between the number of lawyers and litigation, testing whether the causal effect between the two variables. They also indicate in the presence of the faculties of Jurisprudence one of the determinants of the number of lawyers. From the analysis of justice, compared both at the international level and at the level of macro Italian areas, emerge wide territorial gaps and considerable delays, as already underlined in previous studies.

Considering the international bibliography, judicial efficiency was discussed, and several studies have been proposed by the scientific community. Cauthen and Latzer (2008), Binford et al. (2007) study the determinants of the delay in expressing judgement. Ramseyer (2012) analyse the relationship between the productivity of judges and their academic training. Dimitrova-Grajzl et al. (2012) studies the relationship between arrears and decisions of the courts, while Cooter (1983) and Posner (1993) analyse the productivity of the courts in terms of the magistrates' incentives. Considering the empirical work, the literature is even more differentiated. Despite several comparative works between judicial national systems (Deyneli, 2012), scientific research has been addressed to individual national systems. Pedraja-Chaparro and Salinas-Jimenez (1996) analyse the Spanish courts while Beenstock and Haitovsky (2004) consider the Israeli courts. The choice to focus on individual national systems is clearly conditioned by the opportunity to compare systems homogeneous DMUs, as suggested by St. Aubyn (2002) and, in this way, avoid problems of comparability due to different rules systems (Civil Law and Common Law) or due to data non-homogeneous (different sources and extraction criteria).

3. Methods

3.1 Data Envelopment Analysis (DEA)

Introduced in 1978 by Charnes, Cooper and Rhodes, DEA is a deterministic and non-parametric methodology which allows to evaluate the efficiency of a DMU relative to a given set of production units chosen for comparison. Till the 1978 the measurements of production efficiency were very accurate, precise and punctual, but too restrictive, and ignored the possibility of combining multiple inputs and outputs to achieve a measure of total efficiency. The DEA became, over the years, a new branch of productive efficiency study, alternating with the econometric method.

It works by formulating hypotheses about the structure and production technology. If the available data are only of a quantitative nature, it is possible to calculate the efficiency only in its "technical" component, while in the presence of data on the prices of the production factors it is possible to calculate the economic efficiency (in terms of cost and profit) in all its components: "technique" and "allocative". Given the success of this new technique, it was used, among other things, to assess the efficiency of banks, hospitals and transport systems, in fact it was particularly effective in the insurance context, mainly because is based on the idea of a production process that is consistent with the ability of DMUs to transform a certain level of input into a certain level of output and because it allows to determine the efficiency of each sample company by comparing its technology with all the possible technologies resulting from the linear combination of the observed productions for other sample companies.

It is possible to describe any productive process with a pair of **x** and **y** vectors, respectively composed of m and s elements. Each **x** element indicates the amount of each of the m inputs used in the process and each **y** element indicates the amount produced for each of the s output. The two vectors can be assembled in a single **z** vector.

For a simpler formulation of **z**, it is possible to apply some hypotheses of the DEA approach.

- Hypothesis 1: The observed production processes belong to **z** (what is realized is realized is feasible)
- Hypothesis 2: Free disposal hypothesis for outputs (leaving unchanged input quantities can always reduce output). Based on this hypothesis if a productive process belongs to **z** also all the production processes having the same inputs and the output vector no longer belong to **z**.
- Hypothesis 3: Free disposal hypothesis for outputs (leaving production unchanged by increasing the amount of production factors). Based on this hypothesis if a productive process belongs to **z** also all the production processes having the same output vectors and the less input vector belong to **z**.

The three assumptions outlined above lead to a production set called Full Disposal Hull, that is, of the free output format in input.

- Hypothesis 4: Convexity if the production processes belong to **z** then belongs to **z** even each hybrid production process. Given the start vectors, together with all their possible convex combinations, is the so-called convex envelope of the vectors themselves. The assumption of convexity in the economy presupposes the perfect divisibility of the observed production processes and the subsequent compaction of fractions obtained in a single hybrid process. For this hypothesis, each factor must be perfectly divisible: it is an acceptable assumption. Starting from the previously defined FDH production set, adding the convex hypothesis, you get the Free Container Hull Disposal.
- Hypothesis 5: possibility of inaction assumes that inputs and outputs can be reset at the same time or that it is possible to stop production without cost.

- Hypothesis 6: Possibility to increase the scale, each process is replicable on a larger scale if z_1 belongs to $\mathbf{z}$ then also cz_1 belongs to $\mathbf{z}$ with $c \geq 1$. It is a strong hypothesis, as it implies that there are no degressive scale returns.

While the first three hypotheses can be considered universally acceptable, the others have to be evaluated on the basis of an in-depth knowledge of the technology adopted in the specific manufacturing sector.

Differently from the "statistical" approach that compares production units with some imaginary average production units, DEA compares each DMU with the most efficient DMUs and evaluates its relative efficiency. Production units work by using certain inputs and producing specific outputs. These decision-making units are therefore the entities to be evaluated for the DEA, and each of them can be described as a "black box" that absorbs inputs and converts them by producing the outputs. The DEA's productive process is therefore the ability of DMUs to transform a given input level into a desirable output level, so the productivity of a decision unit derives from the relationship between output and input of the production process.

The calculation of this ratio, as it is conceivable, does not create any particular problems in case the decision unit operates with a single input and a single output, but becomes more complicated when the input and output numbers increase for the making the decision units adopt a different weighting system (multiplier values) than the unit. In the DEA approach, the weights to be attributed to inputs and outputs are not predefined, but for each decision unit we use the weights that are more favorable to it, maximizing its efficiency measure; these weights are obtained by solving linear programming problems of the type: input-oriented if deal problems related to minimization of proportional input, without alteration of the output level; output-oriented, maximizing output volume from a certain amount of input.

In essence, the DEA attributes an efficiency score to each unit in respect of a scale that has as much as 0% and 100%, and then compares each score with all scores referring to units belonging to the so-called "peer group. From this study comes the efficient convex boundary that by tracing, based on the relationship between input and output, the geometric location of all points Pareto-optimal on the production border (the so-called Production Option Set), allows to understand and therefore highlight the best performers of the sampler used as a benchmark and draw a kind of barrier indicating the maximum amount of output that can be generated from a given input level and the minimum required input level to get a certain output.

The DEA approach also aims to specify production boundaries only in terms of desirable properties such as convexity and monotony without imposing any other structural parameter by means of it (Cooper, Seiford and Zhu, 2011). It is emphasized that in the hypothesis of empirical analysis, the

efficiency of each production unit is measured in relation to an empirical production frontier, since the only available data, when real-world analysis is carried out, are directly observable. All units lying on the border are intuitively identified as efficient, all others being ineffective. For each inefficient unit, the DMUs that dominate (peer), which are therefore better than it and that they are setting their benchmark as a parameter used to improve their performance.
The efficient DMUs lie on the Production Possibility Set, so there is no combination of other companies in the sample that can produce the respective output vector of each of them using a lower input volume and that they act as peer groups against the DMUs inefficient. For each decision unit it is possible to evaluate the relative efficiency that measures what is the associated capacity of the specific unit to use resources to produce output, in comparative terms compared to all the other DMUs in the sample. At the theoretical level, assuming that there are m inputs $\mathbf{x}=(x_1,\ldots,x_m)'$, s outputs $\mathbf{y}=(y_1,\ldots,y_s)'$, then it can be stated that a T (reference set) technology contains all possible production functions (activities): given a T technology, every efficient DMU can be equally efficient according to input-oriented projection as per output-oriented projection, but not the opposite (Kleine, 2004). In essence, the peers for the DMU differ according to the way chosen to move towards the efficient frontier. While some DMUs would come up to compose the peer group if it was decided to move the DMU to the efficient frontier by minimizing inputs at the same output, other DMUs would do so if the goal was to drive output maximization at the same input. In fact, every ineffective decision-making unit must meet its objectives, namely targets in terms of reducing resources consumed by the same results, or increasing results with the same amount of absorbed resources in order to be as efficient as the efficient DMUs forming the reference peer group. It is precisely for this reason that it is possible to state that the DEA does not merely provide the efficiency scores associated with the inefficient DMU but it also performs the function of identifying the projections of the same for the achievement of the efficient frontier, giving indications of how they work could become effective (Chen, Cook, Kao C. and Zhu, 2013). To be more precise, we will say that DEA's application can also be used to meet the objective of identifying sources of inefficiency, classifying DMUs, managing appraisals, evaluating the goodness of the strategies and plans in place, creation of quantitative bases in order to reallocate resources, and so on (Liu, Lu, Lu and Lin, 2013).
The DEA is part of the deterministic analysis, ie non-stochastic, and especially non-parametric, in the sense that it should not require a priori specified the production function but allows that reaches the determination of efficiency corresponding to DMU means linear programming techniques. The main advantage of the methodology on which this work focuses all its attention is that it is able to readily incorporate multiple input variables and multiple output variables in order to measure the

relative efficiency of each DMU make any restriction on them. In any case, like any empirical evaluation technique, DEA is also based on a set of simplification assumptions that must be known before it can proceed with the interpretation of the results obtainable once this methodology is applied.

Consisting in a more deterministic and statistical technique, DEA produces results that are particularly sensitive to measurement errors. Furthermore, since the DEA measures the relative efficiency of the decision units contained within the same well-defined sample being examined, it ends up not being a reliable and meaningful technique in terms of comparing the efficiency scores inherent in different studies. In other words, it makes sense to comment on the efficiency scores only by contextualizing the reflections in the conducted analysis, without comparing the results obtained with those possibly referring to a different analysis. Secondly, DEA scores are sensitive and closely related to the input and output specification of the model and the size of the sample being studied.

Another consideration to be made, but which also applies to other no-parametric techniques other than the DEA, is the one that managers have to consider the fact that DEA certainly provides quantitative guidance that serves as a guide to applying improved adjustments and can highlight the benefits that monetary terms could be obtained on the basis of the mathematical analysis derived from the model, but it is also worth pointing out that the reality of the facts is that generally about 20-40% of the proposed improvements from the model can be carried relatively easy, another 20-40% requires specific and highly specialized work, while everything else is inapplicable (Wu, Yang, Yang, Vela and Liang, 2007). What we could define as the parent of DEA models is the Constant-Returns-to-Scale (CRS) model often referred to by the CCR acronym due to the names of scholars (Charnes, Cooper and Rhodes) who introduced it in 1978. The objective of this model is to support the resolution of a fractional linear programming problem aimed at maximizing the efficiency value of a generic decision-making unit belonging to all of the n reference firms, all of which yields the optimum weights to associate input and output. The constraints imposed by the maximization problem ensure that the weights of the DMU under consideration take on strictly positive values and that the ratio between the weighted output sum and the weighted input sum is less than or equal to 1 for all DMUs, determined that the unit is a parameter accessible only by the units lying on the efficient frontier. The problem just exposed is a fractional linear programming problem that needs to be converted to a simpler linear programming problem by normalizing the denominator to be solved. However, after identifying the optimal solution, it is possible to identify the so-called "excess inputs" and "excess outputs": if the input and output excesses are null then it

means that the decision unit, they refer to, lies on the efficient frontier and does not require any modification in terms of input and output quantities in the production process.
Consider a set of n DMUs, each consuming different amounts of m inputs to produce s outputs, and let x_{ij} denote the amount of input i (i=1,…,m) and y_{rj} the amount of output level r (r=1,…,s) for DMU j (j=1,…,n). The objective is to measure the efficiency of one of the set of n DMUs, unit j_0, relative to the best observed practice in the sample. It is possible to obtain a measure of relative efficiency of unit j_0 that is defined by the ratio of a weighted sum of its outputs to a weighted sum of its inputs. To this end, weights are not defined a-priori, but they are chosen in order to maximise the efficiency ratio of the unit j_0 analysed so that they are shown in the best possible light. Thus, the relative efficiency of DMU j_0 is obtained by treating weights as variables and by maximising the efficiency ratio of the unit subject to the efficiencies of all the units being constrained to be less than an arbitrary limit such as 1:

$$e_0 = \max \frac{\sum_{r=1}^{s} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \tag{1}$$

$$s.t. \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \qquad j = 1,\ldots,n \tag{2}$$

$$u_r, v_i \geq 0 \qquad \forall\ r, i \tag{3}$$

where u_r and v_i are the weights for the *r*-th output and the *i*-th input, respectively. The efficiency score is bounded between zero and one. DMU j_0 is said to be efficient (has a score of unity) if no other unit or combination of units can produce more than DMU j_0 on at least one output without producing less in some other output or requiring more of at least one input.
Note that the CCR model is built on the assumption of constant returns to scale of activities (CRS): that is, if an activity (x, y) is feasible, then, for every positive scalar t, the activity (tx, ty) is also feasible. However, it must be remembered this assumption is only appropriate when all units are operating at an optimal scale. The use of CRS specification when not all units are operating at the optimal scale, will result in measures of technical efficiency which are confounded by scale efficiencies. Banker et al. (1984), in fact, show that the efficiency score generated by the CCR model is a composite total efficiency score that can be decomposed into two components, one due to scale efficiency and one due to pure technical efficiency, devoid of these scale efficiencies effects.
Designed by Banker, Charnes and Cooper in 1984, the BCC model represents a further extension of the CCR model. The difference with respect to the latter mainly concerns scale returns, which are

no longer considered constant with a consequent production boundary represented by a half-line passing through the source: the BCC model is characterized by a border represented by a convex function, expression of variable returns to scale of activities (VRS). For the analysis, it is necessary to know beforehand the production scale with which the sample units operate, or to know the input/output size at which inefficiency becomes a direct consequence of scale returns.

The model is obtained by adding the convexity constraint in the previous formulation:

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{4}$$

The CCR model yields an evaluation of overall technical efficiency. The BCC model, on the other hand, can distinguish between technical and scale inefficiencies by estimating pure technical efficiency at the given scale of operation for each unit. Hence, the divergence between the CRS and VRS efficiency score captures the impact of scale size on the performance of the unit concerned but not the nature of scale inefficiency.

Furthermore, the additive model was developed by Charnes, Cooper, Golany, Seiford and Stutz in 1985. The basic characteristic as well as its strength is the unavoidable a priori definition of input or output orientation as both aspects are considered simultaneously. The additive model bases efficiency assessment on slack maximization rather than analyzing them only in a second phase. It is characterized by Variable Returns to Scale (VRS) and is why the efficient frontier, always defined by the most efficient DMUs, assumes the same shape as the BCC border.

Finally, the multiplicative model, developed in 1983 by Charnes, Cooper, Seiford and Stutz, unlike the previous models, which through the estimation of a production function created a linear, efficient line at a fraction, develops an efficient frontier that is no longer linear and but a log-linear border at times or Cobb-Douglas at times.

According to Koopmans (1951), technical efficiency is a situation such that it is impossible to increase even just one output without either decreasing at least another output or increasing at least one input; or, vice versa, it is impossible to decrease even just one input without either increasing another input or decreasing at least one output. In other words, it is the maximum obtainable output given a set of inputs, or the minimum level of inputs required to produce a given level of output. Farrell (1957), largely inspired by Koopmans (1951), introduced the concept of “best practice frontier”.

DEA began as a tool to measure efficiency of public sector organizations: indeed it has several advantages over other methodologies for performance evaluation with regard to the study of the productive behaviour of public or not-for-profit organizations (Ganley and Cubbin, 1992). Since Charnes, Cooper and Rhodes’ seminal paper, numerous DEA models have appeared in the literature. Although all DEA models provide useful outcomes for evaluating the efficiency of homogeneous DMUs under analysis, their orientation and their attention is focused on different issues and different assumptions. First of all, they assume different returns to scale (returns to scale of a point on the production frontier are defined as the amount that all the outputs will increase by for a proportionate increase in all inputs): they allow for constant (CCR model), increasing or decreasing (BCC model) returns to scale. Moreover, DEA models require one to choose between an input-orientation and an output-orientation, according to which quantities managers have most control over.

3.1 Tobit model

To shed some light on how exogenous factors affect judicial court, a regression analyses is performed. To measure the impact of the exogenous variables on the BCC scores, the coefficients of the following tobit model are estimated. The standard Tobit (Tobin's probit) model can be defined as follows for observation (Court) *i:*

$$y^{*}=\boldsymbol{\beta}'\mathbf{x}+e \qquad (5)$$

where y^* is a latent variable and y is the DEA score (Amemiya 1984), with $y_i=y_i^*$ if $y_i^*<0$, $y=0$ otherwise, error terms $e \sim N(0,\sigma^2)$, $\mathbf{x}$ are explanatory variables and $\boldsymbol{\beta}$ unknown parameters estimated by applying the maximum likelihood estimation method. As the BCC scores vary between 0 and 1, a Tobit regression model with lower and upper limits of the outcome variable has been estimated.

4. Data and results

In this paragraph are described the results of a two stage DEA Analysis carried out on data obtained from the Italian Ministry of Justice. The Italian territory is divided into 140 Ordinary Courts, each with a geographical basis.

In the first stage, we apply two different DEA models, CCR and BCC, in order to evaluate the performance of the Italian Judicial system for the year 2015, the most recent for which all required data are available. The data required have been obtained from the Italian Ministry of Justice. The Italian territory is divided into 140 Ordinary Courts, each with a geographical basis.

As mentioned in the introduction, the selected variables accurately reflect the production activity of the analysed DMUs. Our DEA analysis is therefore performed with the following input variables: the number of judges employed, the number of administrative staff, the number of new cases filed during the year, which represents the justice demand, and the number of pending cases, which indicates the inefficiency degree of justice in relation to social expectations. The sum of the two latter variables represents the caseload. It is important to control for the caseload because judges cannot provide their services unless lawsuits are filed. Therefore, omitting the caseload would imply that productivity is underestimated for those years in which a court is charged with a small caseload (Schneider, 2005). The output of a court in terms of dispute resolution is captured by the number of cases finished during the year, so our model includes as output the total number of dispositions. Efficiency results are computed for each courts using input-orientation, so their objective is to minimise inputs while producing at least the given output levels.

In Tab. 1 it should be noted that seven ordinary courts –Aosta, Foggia, Mantova, Padova, Roma, Tivoli and Vercelli are identified, with a score of one, as being fully CCR-efficient. In addition, the remaining units are sub-efficient but they show quite high ratings and the mean CCR-efficiency score is 0.8637 (Tab. 2 presents a summary of the efficiency ratings). With regard to the results provided by the BCC model, we observe that nineteen courts – Aosta, Bari, Foggia, Isernia, Lanciano, Lanusei, Mantova, Milano, Napoli, Padova, Roma, Rovereto, Sulmona, Tivoli, Torino, Urbino, Vasto, Vercelli, Verona form the best practice frontier. Besides, most units register high efficiency scores, in fact the average efficiency is 0.8872.

The results obtained indicate that most units are operating on efficient scales, with a high correlation between the different efficiency scores of the Courts using both types of frontier, CRS and VRS.

Table 1: DEA efficiency scores

Court	CCR	BCC	Scale
Agrigento	0.7001	0.7033	0.9954
Alessandria	0.9237	0.9380	0.9848
Ancona	0.8811	0.8816	0.9995
Aosta	1.0000	1.0000	1.0000
Arezzo	0.9616	0.9650	0.9964
Ascoli Piceno	0.9571	0.9674	0.9894
Asti	0.9310	0.9313	0.9996
Avellino	0.8397	0.8433	0.9958
Avezzano	0.9526	0.9774	0.9746
Barcellona Pozzo Di Gotto	0.6935	0.7855	0.8828
Bari	0.8793	1.0000	0.8793
Belluno	0.9057	0.9431	0.9603
Benevento	0.8198	0.8207	0.9989
Bergamo	0.9415	0.9490	0.9921
Biella	0.8212	0.8507	0.9653
Bologna	0.9290	0.9495	0.9784

Bolzano	0.8966	0.9278	0.9664
Brescia	0.9182	0.9344	0.9827
Brindisi	0.7115	0.7127	0.9983
Busto Arsizio	0.9360	0.9518	0.9834
Cagliari	0.7699	0.7700	0.9999
Caltagirone	0.6826	0.7555	0.9036
Caltanissetta	0.7292	0.7384	0.9875
Campobasso	0.8468	0.8719	0.9713
Cassino	0.7710	0.7747	0.9952
Castrovillari	0.6584	0.6814	0.9662
Catania	0.7633	0.7759	0.9838
Catanzaro	0.6366	0.6398	0.9951
Chieti	0.9602	0.9703	0.9896
Civitavecchia	0.7499	0.7726	0.9706
Como	0.9726	0.9836	0.9889
Cosenza	0.8406	0.8410	0.9994
Cremona	0.9918	0.9974	0.9944
Crotone	0.8076	0.8271	0.9764
Cuneo	0.8064	0.8097	0.9959
Enna	0.7968	0.8150	0.9776
Fermo	0.9052	0.9171	0.9871
Ferrara	0.9531	0.9597	0.9930
Firenze	0.8605	0.8796	0.9783
Foggia	1.0000	1.0000	1.0000
Forlì	0.8708	0.8740	0.9963
Frosinone	0.8852	0.8882	0.9966
Gela	0.5778	0.6477	0.8920
Genova	0.8896	0.9427	0.9437
Gorizia	0.9373	0.9603	0.9760
Grosseto	0.9178	0.9258	0.9914
Imperia	0.8537	0.8589	0.9939
Isernia	0.9611	1.0000	0.9611
Ivrea	0.8731	0.8787	0.9936
La Spezia	0.9324	0.9344	0.9979
Lagonegro	0.6466	0.6742	0.9591
Lamezia Terme	0.9088	0.9885	0.9193
Lanciano	0.9245	1.0000	0.9245
Lanusei	0.7002	1.0000	0.7002
L'aquila	0.8763	0.9072	0.9660
Larino	0.8211	0.9020	0.9104
Latina	0.8259	0.8264	0.9994
Lecce	0.7694	0.8363	0.9201
Lecco	0.9423	0.9612	0.9803
Livorno	0.9621	0.9624	0.9997
Locri	0.8796	0.8905	0.9878
Lodi	0.9478	0.9480	0.9998
Lucca	0.9540	0.9547	0.9993

Macerata	0.9016	0.9043	0.9970
Mantova	1.0000	1.0000	1.0000
Marsala	0.8361	0.8361	1.0000
Massa	0.9550	0.9633	0.9913
Matera	0.9100	0.9304	0.9781
Messina	0.7002	0.7018	0.9977
Milano	0.9708	1.0000	0.9708
Modena	0.9619	0.9640	0.9978
Monza	0.9299	0.9398	0.9895
Napoli	0.9150	1.0000	0.9150
Napoli Nord	0.5300	0.5324	0.9955
Nocera Inferiore	0.7042	0.7309	0.9635
Nola	0.9051	0.9099	0.9947
Novara	0.9047	0.9085	0.9958
Nuoro	0.8995	0.9293	0.9680
Oristano	0.8939	0.9112	0.9810
Padova	1.0000	1.0000	1.0000
Palermo	0.8405	0.8739	0.9619
Palmi	0.7090	0.7241	0.9793
Paola	0.6747	0.7505	0.8990
Parma	0.9280	0.9299	0.9979
Patti	0.5827	0.6662	0.8746
Pavia	0.9871	0.9958	0.9913
Perugia	0.8440	0.8453	0.9984
Pesaro	0.9428	0.9552	0.9870
Pescara	0.9472	0.9491	0.9980
Piacenza	0.9210	0.9268	0.9937
Pisa	0.8636	0.8657	0.9976
Pistoia	0.8749	0.8782	0.9962
Pordenone	0.9263	0.9264	0.9999
Potenza	0.7608	0.7664	0.9927
Prato	0.9439	0.9478	0.9960
Ragusa	0.7494	0.7521	0.9965
Ravenna	0.9701	0.9701	1.0000
Reggio Calabria	0.7278	0.7304	0.9964
Reggio Emilia	0.9414	0.9425	0.9988
Rieti	0.8797	0.9001	0.9774
Rimini	0.9940	0.9963	0.9976
Roma	1.0000	1.0000	1.0000
Rovereto	0.9289	1.0000	0.9289
Rovigo	0.9078	0.9099	0.9976
Salerno	0.8249	0.8285	0.9956
Santa Maria Capua Vetere	0.8438	0.8496	0.9932
Sassari	0.8866	0.8866	0.9999
Savona	0.9022	0.9031	0.9990
Sciacca	0.7523	0.8058	0.9336
Siena	0.9433	0.9484	0.9946

Siracusa	0.7662	0.7671	0.9988
Sondrio	0.8907	0.9504	0.9372
Spoleto	0.7951	0.8365	0.9505
Sulmona	0.8032	1.0000	0.8032
Taranto	0.9396	0.9458	0.9935
Tempio Pausania	0.7810	0.8310	0.9398
Teramo	0.9079	0.9112	0.9963
Termini Imerese	0.7006	0.7039	0.9953
Terni	0.8945	0.8997	0.9943
Tivoli	1.0000	1.0000	1.0000
Torino	0.9142	1.0000	0.9142
Torre Annunziata	0.8236	0.8270	0.9959
Trani	0.8282	0.8291	0.9989
Trapani	0.9342	0.9359	0.9982
Trento	0.9605	0.9605	1.0000
Treviso	0.9354	0.9606	0.9738
Trieste	0.8969	0.9042	0.9920
Udine	0.9248	0.9551	0.9683
Urbino	0.8628	1.0000	0.8628
Vallo Della Lucania	0.5241	0.6741	0.7774
Varese	0.9352	0.9376	0.9974
Vasto	0.9404	1.0000	0.9404
Velletri	0.9233	0.9258	0.9973
Venezia	0.9082	0.9296	0.9770
Verbania	0.8606	0.8857	0.9716
Vercelli	1.0000	1.0000	1.0000
Verona	0.9901	1.0000	0.9901
Vibo Valentia	0.6283	0.6988	0.8991
Vicenza	0.8881	0.8890	0.9990
Viterbo	0.8900	0.8942	0.9953

Table 2: Summary statistics for DEA efficiency scores

	CCR efficiency	BCC efficiency	Scale efficiency
Mean	0.8637	0.8872	0.9732
Minimum	0.5241	0.5324	0.7002
Maximum	1.0000	1.0000	1.0000
Standard deviation	0.1048	0.0988	0.0444

It is possible to note that by applying the VRS model, courts with values equal to the unit have increased considerably, from a maximum of seven with a high degree of efficiency, in the CRS model, to 19 with an efficiency result equal to 1 and also between north, center and south there is greater fair distribution.

Finally, it can be noted that the relationship between overall efficiency and scale efficiency proves to be the pure technical efficiency. The CCR model, with constant yields, has made it possible to measure the overall efficiency of each DMU while the pure technical efficiency is measured through the model with variable yields. The relationship between overall efficiency and pure technical measure the scale efficiency. When the ratio is equal to one (100%) it means that the unit examined operates at an optimal size (MPSS, most productive scale size); if it is less than the unit, it means that a variation in the production size can allow the unit to gain efficiency.

With respect to each inefficient unit DEA also identifies its reference set of efficient DMUs (peer units). Focusing on efficient units, the number of citations in peer groups can be interpreted as a measure of the "robustness" of best practice units. Table 3 displays the frequency with which efficient courts appear in the peer group of the inefficient ones. Firenze is the most robustly CCR efficient unit (115 times, respectively). Rieti is the most robust efficient unit in the BCC model.

Table 3: Frequency in reference set

Peer set – CCR model	Frequency to other DMUs	Peer set – BCC model	Frequency to other DMUs
Firenze	115	Rieti	101
Mantova	66	Vercelli	80
Padova	69	Aosta	60
Tivoli	7	Mantova	54
Rimini	5	Padova	57
		Foggia	33
		Rovereto	8

The econometric analyses aimed at assessing the influence of contextual factors on the measures of performance obtained by means of the DEA models were carried out using STATA15. At this stage, the purpose of the regression was explorative. For this reason the discussion of the results obtained is focused only on the algebraic sign of the coefficients and not on their magnitude. External variables, like those used in the regressions, account only for small differences attributable to environmental factors not controlled by the subject that organizes the service, in this case the judicial court itself. Knowing the influence they can have on the DMU's dimensional inefficiency can thus provide helpful information. It is not easy to formulate expectations concerning the influence of the variables considered.

The external variables considered are:

1) Duration of judicial procedure
2) Litigiousness ratio
3) Population (Log_POP)
4) Dimension of judicial courts (coded into small, medium and large)
5) Geographical location (coded into northern, southern and centers)

The results of the estimated model are shown in table 4.

Table 4: Estimated Tobit models

Variables	Model 1	Model 2	Model 3
Duration	-4.59e-05	-5.73e-05	-5.73e-05
	(4.29e-05)	(4.24e-05)	(4.24e-05)
Litigiousness ratio	3.92e-05***	4.04e-05***	4.04e-05***
	(8.32e-06)	(8.26e-06)	(8.26e-06)
Log_pop	0.194***	0.196***	0.196***
	(0.00815)	(0.00807)	(0.00807)
North	0.0425*	0.0414*	0.0414*
	(0.0235)	(0.0237)	(0.0237)
South	-0.0594**	-0.0594**	-0.0594**
	(0.0246)	(0.0241)	(0.0241)
Medium		-0.0368*	-0.0368*
		(0.0199)	(0.0199)
Large		0.0161	0.0161
		(0.0201)	(0.0201)
Observations	140	140	140

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Concluding remarks

Among the main European countries, Italy has the highest number of lawyers per capita, the activity of the magistrate is basically supported by two categories of human resources: the staff with administrative functions and the honorary judiciary. The functions carried out in the courts by the honorary judges of the court and in the proxies of the deputy prosecutors are of various nature and go from mere support to the judge replacement only in some sessions, up to the real taking up of procedures for some selected subjects. In any case, the activity of the honorary magistrates is not adequately reported and therefore calculate the actual workload taking into account also this category of staff, which as we have seen as well, is almost impossible. If the national judicial statistics are passed to the territorial ones it is discovered that Italy is characterized by a wide variability of the performances that show a certain connotation and geographical coherence: the north shows on average the best levels of service, followed by the areas of central Italy, while the regions of the south and the islands are in distress. The data show the wide variability of performance between the different areas of the country .

Another indicator of the performance on the "qualitative" level of the great Italian courts that seems to confirm the considerations just made It is the one relating to the "holding" of decisions in appeal with respect to the first degree. There have been analysed the existence of the judgments of second degree, in matters of civil litigation and work from the great Italian courts and the incidence of those representing a confirmation of the judgment of first instance was calculated. Unfortunately, the analysis is affected by the objective limit of a partial accuracy in the classifications operated by the clerks of the courts of appeal that too often abuse the voice of outcome "other", not classifiable either between the confirmations or between the reforms. Such abuse It is particularly incisive in the Court of Appeal of Rome. Also in this case, the large tribunals of the North show a percentage of results of "holding" of decisions of first degree above the average of the observed sample. Turin with 59%, Bologna with 58% and Milan with 55% are highlighted.

The message that can be deduced from the analysis of this section of the document dedicated to the great Italian courts is that foreign companies that wish to invest in Italy, would find in the north of the country a judicial context substantially aligned with the best and most developed European squares. Another set of factors that could help explain the performance of the Italian system in comparison with other countries concerns the costs and resources that flow the system. The total cost of Italian justice is almost 8 billion Euros, equal to about 1.3% of public expenditure. Italy spends relatively more in wages and salaries; the figure is also explained by the average remuneration of Italian magistrates who are among the highest in Europe.

Furthermore, this method has helped us to identify benchmarking courts so that the best practices can be implemented to become efficient. Hence, the present study represents an additional source of useful information to policy makers for future policy actions.

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