

Civil justice: a method for assessing efficiency

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JUDICIAL EFFICIENCY

What is exactly?

- 1) Ability, given the available resources, to solve civil disputes in appropriate (short) times;
- 2) Quality of decisions, in terms of accuracy and certainty;
- 3) Judgment independence

Judicial offices can be considered efficient when...

- *The proceedings **duration** is reasonable;*
- *The number of **ancient pending proceedings** (backlog) is negligible;*
- *The **clearance rate (resolved/incoming cases)** is equal or higher than 1;*
- *Etc..*

JUDICIAL EFFICIENCY

- *The Superior Council of Judiciary has been focusing its attention on the reduction of civil judicial pending proceedings in the Courts, especially the ones entered since long time for which the probability to incur in economic sanctions due to long duration is higher.*
- Each year since the 2011 (D.L. 98/2011 art.37) the Csm makes a work of programming, support and analysis of the data from “*Programmi di Gestione*” (Management Programs), a survey which has to be yearly filled by *Courts of first and second instance*.

PURPOSE OF THE STUDY

- Create a *statistical efficiency measure* for the Italian Courts by considering input and output variables, in order to make geographical and dimensional comparisons.
 - *Data Envelopment Analysis (DEA)*:
Non parametrical linear programming *output oriented* models which locate the most efficient judicial offices (*benchmark*) and attribute to the others a score varying in $[0,1]$ (minimum efficiency-maximum efficiency).
- Analyze the potential influence of the Council activity over the performance of the judicial offices, measured in terms of organization variables.

DATA ENVELOPMENT ANALYSIS

The Data Envelopment Analysis (DEA) is a non parametric technique (no hypothesis on the production function) useful to measure the **productivity** of a productive unit (decision making unit - DMU) according to multiple *input* and *output* and to evaluate its **efficiency** wrt a given set of productive units.

- The **Productivity** is the ratio between a produced output and a used input.
- The **Efficiency** is a comparison of the obtained productivities, for different levels of productive activity and for different input combinations, among different Productive Units (DMUs).
 - **Input oriented**: Fixing a given output, how much the input quantities can be reduced?
 - **Output oriented**: Fixing a given input, how much the output quantities can be increased?

Technical efficiency

Obtaining the maximum output given a certain input

DATA ENVELOPMENT ANALYSIS

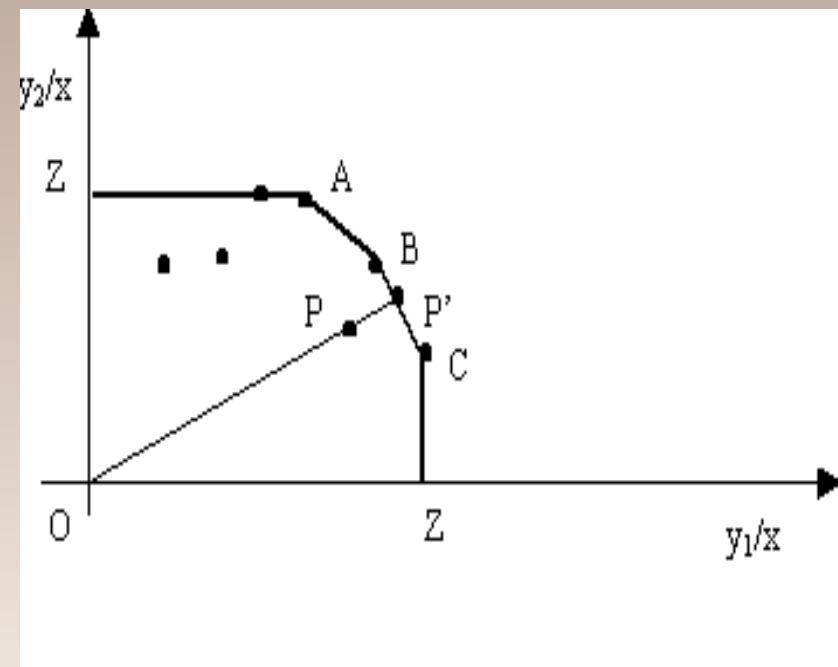
Input vs. output oriented DEA

Input oriented VRS DEA model	Output oriented VRS DEA model
$\min \theta$ s.t. $-y_i + Y\lambda \geq 0$ $\theta x_i - X\lambda \geq 0$ $1^T \lambda = 1$ $\theta \text{ free}, \lambda \geq 0$	$\max \phi$ → $1/\phi = \text{TE score}$ s.t. $-\phi y_i + Y\lambda \geq 0$ $x_i - X\lambda \geq 0$ $1^T \lambda = 1$ $\phi \text{ free}, \lambda \geq 0$

A productive unit is *dominated* if there is a virtual combination of the other DMUs producing an higher output with the same input (*output-oriented*).

The efficiency of P: $OP/OP' = x$
(P produces at the x% of its possibilities)

To assess all the DMU efficiency, the linear program is needed to be solved many times as much as the number of the DMU, each time changing the DMU of reference.



DATA ENVELOPMENT ANALYSIS

- The AC segment is the *efficient frontier*: the points of the segment represent virtual units obtainable as a convex combination of A and C.
- The unit represented by P' (point where the straight line going through the origin and P meets the segment AC) is, among the possible virtual units dominating P, the one producing an output proportional to the one produced by P.
- The efficiency measure of P is computed as OP/OP' ; hence if P was efficient, its output vector should be multiplied by OP'/OP .

DATA ENVELOPMENT ANALYSIS

Input variables

- Judicial personnel coverage rate, year 2018 (Judicial present personnel/ judge staff working in courts)
- Number of incoming cases over the judge staff working in courts in the civil sector (standardized variable).

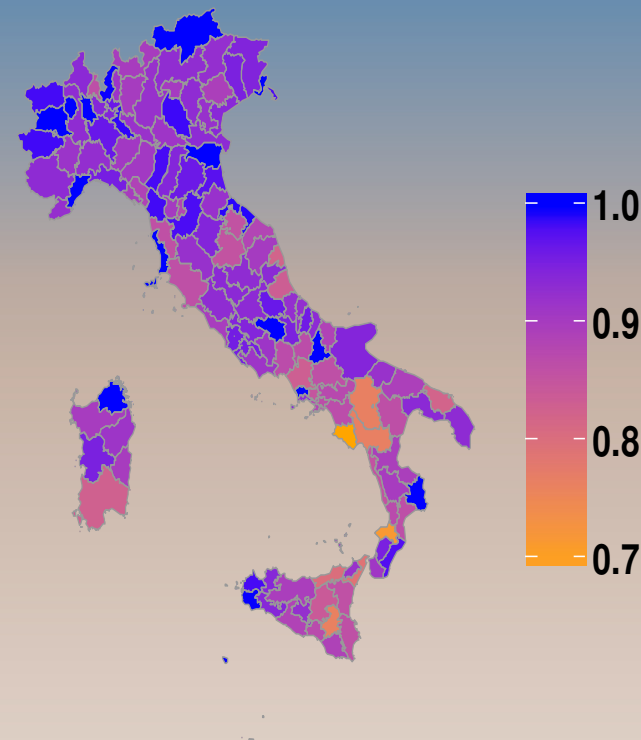
Output variables

- Percentage of 2018 intra-triennial pending cases (*%Intra*)
- Ratio between ultra-triennial pending cases 2017 and ultra-triennial pending cases 2018 (*UT17/UT18*)
- # of resolved judicial proceedings over the judge staff working in courts in the civil sector (*Def/Civil staff*)
- Clearance Rate (*Cl_Rate*)

DATA ENVELOPMENT ANALYSIS

Judicial Offices resulted *efficient* according to the DEA Model

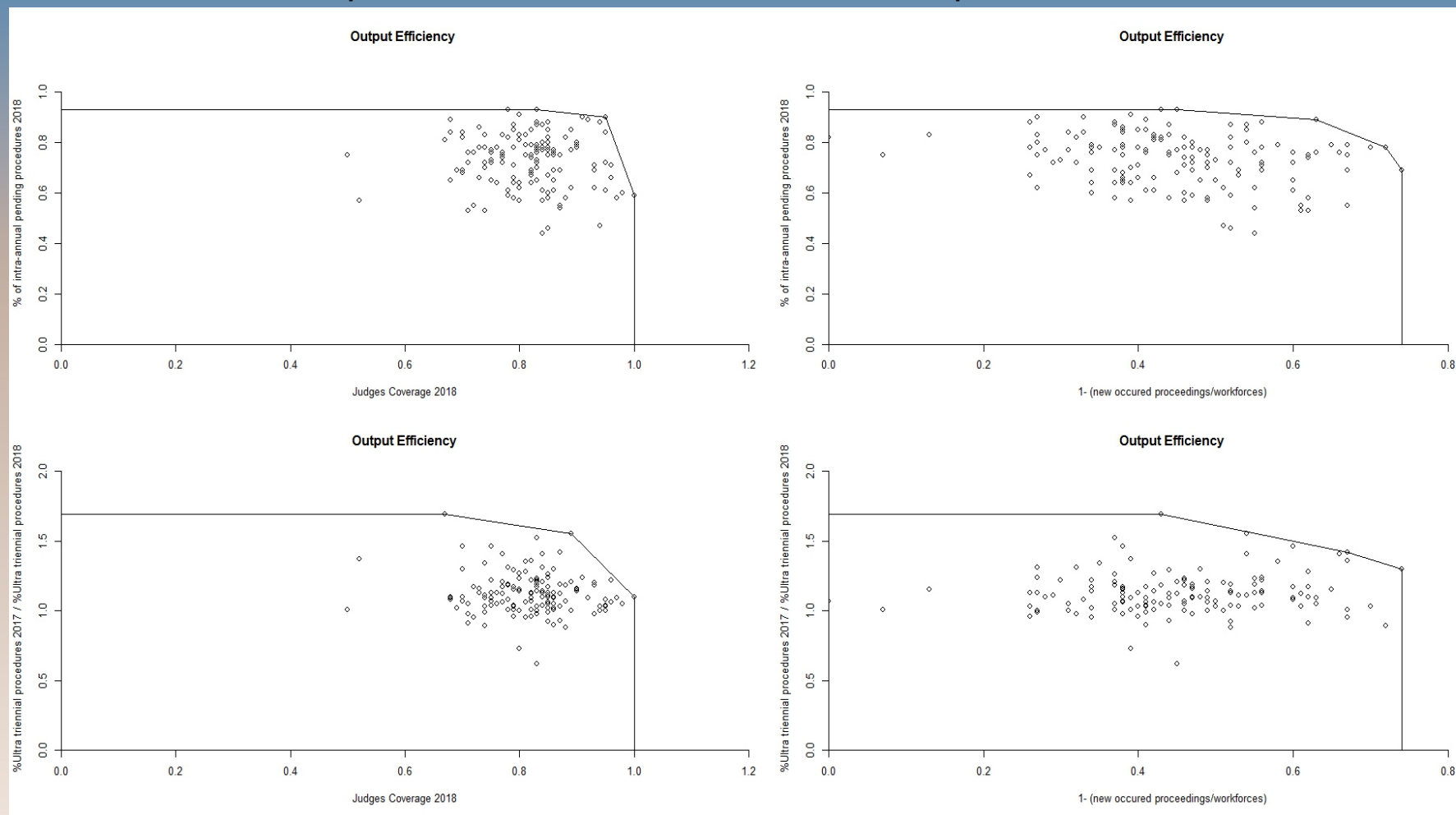
Courts	Dimension	Geographical distribution	%Intra - triennial pending cases	Clearance rate
Avezzano	Small	South	0.84	1.11
Biella	Small	North	0.75	1.05
Bolzano	Medium small	North	0.89	1.04
Campobasso	Small	South	0.82	1.05
Crotone	Medium small	South	0.72	1.28
Ferrara	Medium small	North	0.93	1.07
Gorizia	Small	North	0.88	1.08
Ivrea	Medium small	North	0.9	1.07
Livorno	Medium small	Center	0.81	1.12
Napoli Nord	Medium big	South	0.93	0.84
Novara	Small	North	0.78	1.15
Savona	Medium small	North	0.87	1.13
Tempio Pausania	Small	South	0.57	0.99



Judicial offices with efficiency lower than 80%: Caltagirone, Lagonegro, Messina, Potenza, Vallo della Lucania, Vibo Valentia

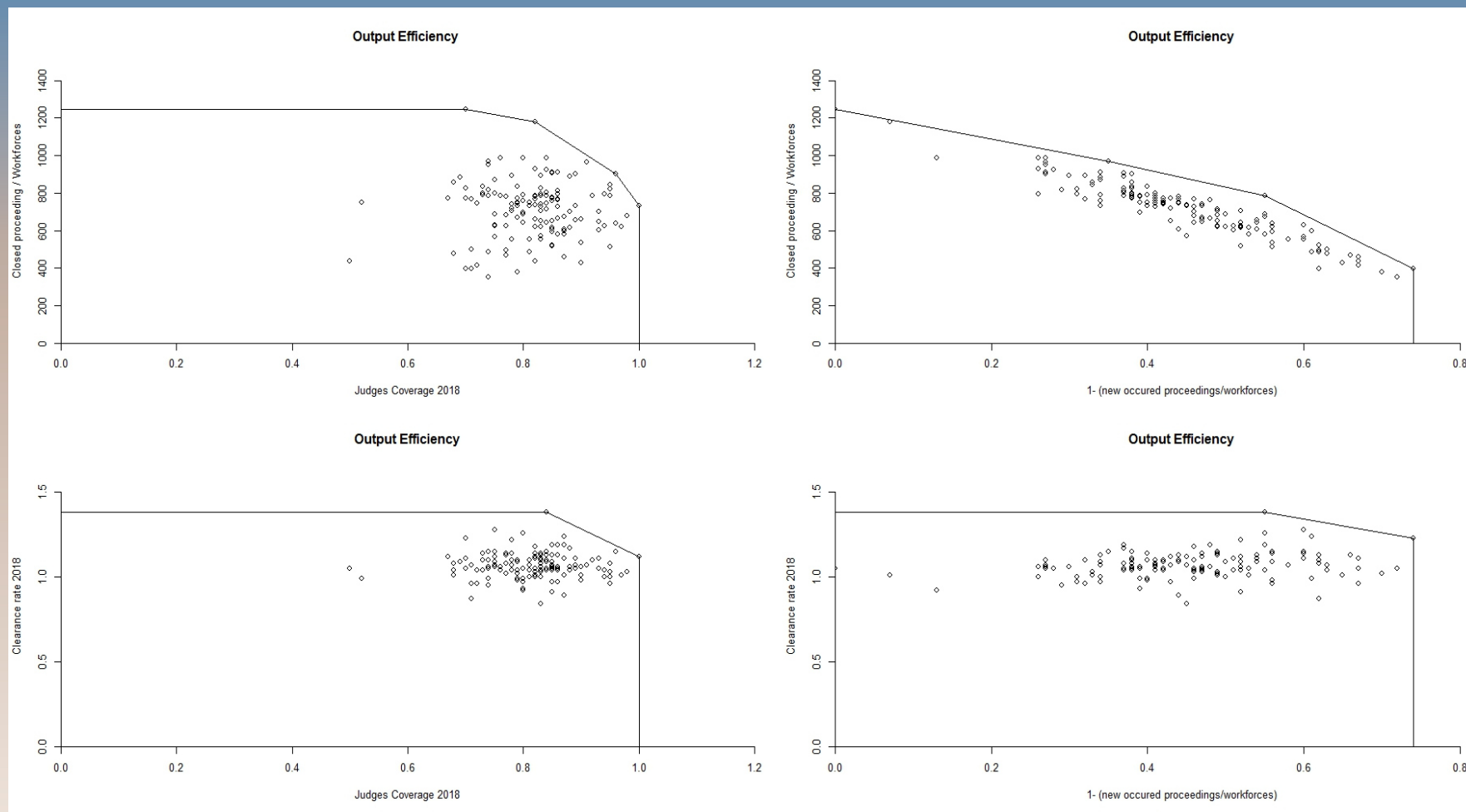
DATA ENVELOPMENT ANALYSIS

Efficient frontier over the first two output: % intra-annual judicial proceedings & %Ultra triennial procedures 2017 / %Ultra triennial procedures 2018



DATA ENVELOPMENT ANALYSIS

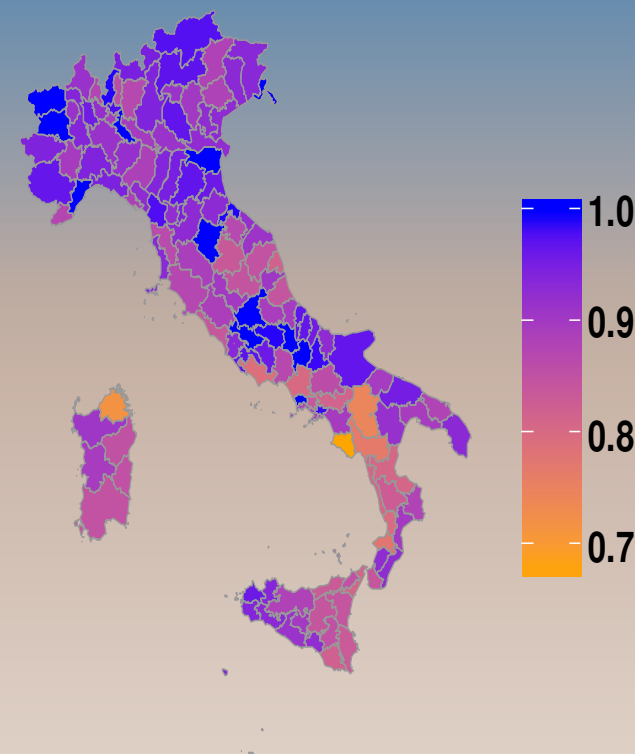
Efficient frontier over the second two output: Resolved proceeding / Workforces & Clearance rate 2018



DATA ENVELOPMENT ANALYSIS

Judicial Offices resulted *efficient* according to the DEA Model – SICID (civil litigations)

Courts	Dimension	Geographical distribution	%Intra - annual proceedings	Clearance rate
Aosta	Small	North	0.95	1
Arezzo	Medium small	Center	0.86	1
Ferrara	Medium small	North	0.96	1
Gorizia	Small	North	0.91	1
Isernia	Small	South	0.62	1.1
Ivrea	Medium small	North	0.95	1.1
Lodi	Small	North	0.9	1
Napoli Nord	Medium big	South	0.95	0.9
Rieti	Small	Center	0.8	1.1
Savona	Medium small	North	0.96	1.1
Sulmona	Small	South	0.98	1
Tivoli	Medium small	Center	0.83	0.9
Trieste	Medium small	North	0.94	0.9

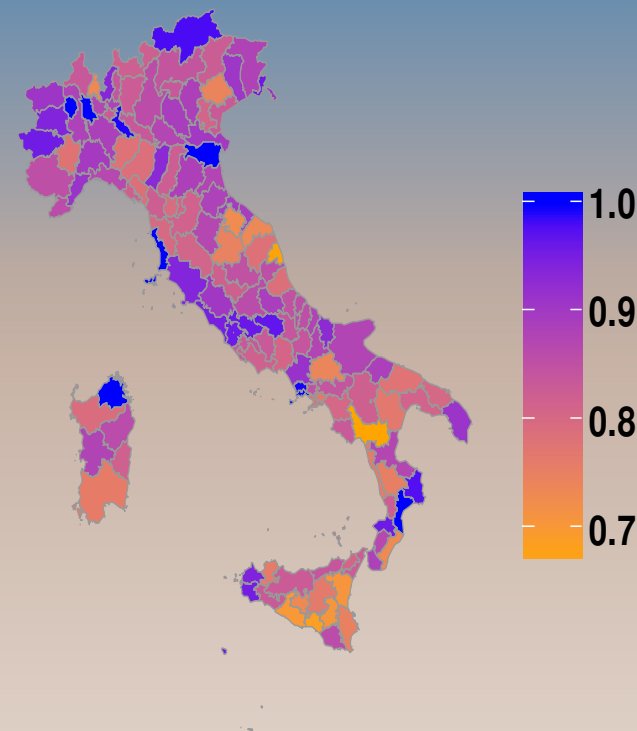


Judicial offices with efficiency lower than 80%.: Lagonegro, Lamezia Terme, Latina, Potenza, Tempio Pausania, Vallo della Lucania, Vibo Valentia.

DATA ENVELOPMENT ANALYSIS

Judicial Offices resulted *efficient* according to the DEA Model – SIECIC (insolvency procedures)

Courts	Dimension	Geographical distribution	% Intra – triennial pending cases	Clearance rate
Biella	Small	North	0.56	1.27
Catanzaro	Medium Small	South	0.88	0.87
Ferrara	Medium Small	North	0.89	1.21
Livorno	Medium Small	Center	0.62	1.33
Napoli	Metropolitan	South	0.79	1.14
Novara	Small	North	0.68	1.43
Tempio Pausania	Small	South	0.45	1.10



Judicial offices with efficiency lower than 70%: Fermo, Gela and Lagonegro

EFFICIENCY AND ORGANIZATION OF THE JUDICIAL OFFICES

Beta Regression (Cribari-Neto 2004)

- The r.v. Beta:
 - assumes values in the standard unit interval (0,1);
 - useful to describe rates and proportions;
- The model build on the base on this distribution is similar to a generalized linear model
 - the link function $g(\cdot)$, defined by $(0,1) \in \mathcal{R}$, is strictly monotone and twice derivable;
 - different possible choices for the link functions: *logit*, probit, log-log.

$$g(\mu_i) = \sum_{j=1}^k x_{ij} \beta_j = \eta_i$$

- $y_1, \dots, y_n$ independent realizations of the r.v. $Y_i \sim \text{Beta}(\mu_i, \phi)$, μ_i and precision parameter ϕ unknown;
- $x_{1j}, \dots, x_{1k}$ k fixed and known costant variables ($k < n$);
- $\beta = (\beta_1, \dots, \beta_k)$ vector of unknown parameters $\beta^k \in \mathcal{R}$

EFFICIENCY AND ORGANIZATION OF THE JUDICIAL OFFICES

Variables considered in the Beta Regression

- **Efficiency measures obtained through the DEA model**
- **Proceedings duration (net of geographical distribution and turn over effects)**
- **Geographical distribution**
- **Turn over**
- Judicial offices dimension
- Number of best practices
- Management positions

Source: Ministero della Giustizia, Programmi di gestione 2016.

EFFICIENCY AND ORGANIZATION OF THE JUDICIAL OFFICES

- **Planning capacity (Disposal/Goal)**
 - **Disposal:** measured as difference between the ultra-triennial pending cases 2018 and the ultra-triennial pending cases 2017.
 - **Goal:** % of ultra-triennial pending cases the office wanted to dispose of, as indicated in the management programs 2017
 - ✓ **Good capacity** (0.5-1.5)
 - ✓ **Low capacity or Prudent** (>1.5)
 - ✓ **No capacity** (<0.5)
- Number of specialized sections
- Number of active enterprises per court
- Population 2011
- Staffing plan variation

Source: Ministero della Giustizia, Programmi di gestione 2016.

REGRESSION MODELS (EFFICIENCY)

Two step Regression

Linear Model Results (y = Proceedings duration)

Parameter	Estimate	Std. Error	t value	Pr(> t)
Intercept	376.38	35.59	10.57	< 2e-16 ***
North	-103.69	32.06	-3.23	0.001 **
South	130.03	30.72	4.23	4.22e-05 ***
Turn over	1.73	0.53	3.24	0.001 **

$$R^2 = 0.46$$

Beta Regression Results (y = efficiency measures obtained by DEA)

Parameter	Estimate	Std. Error	z value	Pr(> z)
Intercept	2.366	0.196	12.098	< 2e-16 ***
Duration (net)	-0.002	0.0004	-5.183	2.19e-07 ***
North	0.487	0.167	2.914	0.003 **
South	-0.079	0.153	-0.514	0.607
Turn over	-4.079e-05	0.003	-0.014	0.989
No plan. capacity last year	-0.247	0.129	-1.901	0.057 .
Low plan. capacity last year	0.336	0.269	1.248	0.212
Phi coefficient (precision model with log link)				
Intercept	2.9751	0.1377	21.609	<2e-16 ***
district courts 1	0.6086	0.2961	2.055	0.039 *

REGRESSION MODELS

Logit Model over the Y= increasing or not of efficiency in two years

Parameter	Estimate	Std. Error	z value	Pr(> z)
Intercept	0.223	0.202	1.103	0.269
Low plan. capacity	2.079	1.068	1.947	0.051 .
No plan. capacity	0.624	0.447	1.397	0.162

Multinomial logit Model over the Planning capacity

Parameter	ODDS Ratio		
	(Intercept)	Working staff variation+ (Ref= No variation)	Working staff variation - (Ref= No variation)
Good plan. capacity (Ref= No cap)	2.125***	2.267 **	1.882
Low plan. capacity (Ref= No cap)	0.187***	2.909	3.555

REGRESSION MODELS (SICID - EFFICIENCY)

Two step Regression

Linear Model Results (y = Proceedings duration)

Parameter	Estimate	Std. Error	t value	Pr(> t)
Intercept	320.97	39.99	8.03	4.21e-13 ***
North	-106.36	36.02	-2.95	0.00371 **
South	145.19	34.52	4.21	4.68e-05 ***
Turn over	1.63	0.60	2.72	0.00742 **

$$R^2 = 0.43$$

Beta Regression Results (y = efficiency measures obtained by DEA)

Parameter	Estimate	Std. Error	z value	Pr(> z)
Intercept	2.167	0.185	11.695	< 2e-16 ***
Duration	-0.002	0.0004	-5.784	7.3e-09 ***
North	0.572	0.159	3.592	0.000329 ***
South	0.010	0.146	0.069	0.945
Turn over	-0.0003	0.003	-0.116	0.907
No plan. capacity last year	0.0416	0.130	0.320	0.749
Low plan. capacity last year	0.438	0.208	2.112	0.035 ***
Working staff variation +	0.023	0.128	0.184	0.854
Working staff variation -	-0.395	0.173	-2.278	0.023 * **
Phi coefficient (precision model with log link)				
Intercept	3.107	0.137	22.691	<2e-16 ***
district courts 1	0.496	0.295	1.681	0.0928 .

CONCLUSIONS

- ✓ To create an efficiency measure based on a set of output variables (performance indicators) and of available input variables (resources availability) without specifying a production function (DEA).
- ✓ Statistical relations between efficiency measures and proxy variables of the organization capacity of the judicial offices in order to identify the major or minor effort of the Council in the activities aimed at the improvement of the offices performances.
- ✓ The most efficient courts, looking at both the whole civil sector and the subsector of the civil litigations (SICID), are located mostly in the North and in the Center, while the distribution of the estimated efficiency outcomes in the insolvency procedures setting (SIECIC) is less geographically concentrated.
- ✓ The proceedings duration is lower in the North Courts and the greater is the duration of resolving time of proceedings the lower is the judicial offices efficiency.
- ✓ The increasing of the turn over corresponds to the increasing of the proceedings duration.

CONCLUSIONS

- ✓ The judicial offices with lower proceeding duration are more efficient and the probability of being more efficient is greater for the offices of the North Italy wrt the ones from the Center or the South.
- ✓ Similar settings can be found also in the two civil subsectors even if in the insolvency procedures setting (SIECIC) they are not statistically significant.
- ✓ The probability of being efficient is lower for the offices with no planning capacity in the last year wrt the offices with good planning capacity and the fact of being a district court significantly affects the dispersion parameter.
- ✓ Offices with a low planning capacity this year have become more efficient wrt the last year (logistic model).
- ✓ The probability of having a good planning capacity (ref= no capacity) is greater of about 2.3 times in the offices which had a working staff increase wrt the offices without any working staff variation (multinomial logit model).
- ✓ In the civil litigation sector (SICID) the beta regression shows similar results as far as the duration and the geographical distribution is concerned; furthermore offices with a low planning capacity (prudent offices) in the last year, have a greater probability of being efficient, wrt offices with a good planning capacity, together with offices with a working staff decrease wrt offices with no variation.