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Determinants of Judicial Efficiency in Morocco

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Abstract

In this paper, we aim to measure Moroccan judicial efficiency and identify its determinants during the implementation of judicial reform. For this, we use a two-stage approach. First, we use data envelopment analysis (DEA) under output orientation to measure the efficiency of the 109 Moroccan courts. In the second stage, we explore determinants of efficiency using the Ordinary Least Squares regression model. The results show a low level of courts efficiency of 56.2% in 2018, despite an improvement during the reform implementation period. At the same time, the results show that efficiency increases in populated cities with high demands on justice, and in courts with high proportions of cases in process, and employing senior judges. Therefore, this paper presents some managerial implications for court managers and provides further research directions for assessing judicial efficiency.

Keywords

Data Envelopment Analysis, Efficiency Measurement, Judicial Efficiency, Efficiency Determinants, Moroccan Courts, Judicial Reform

1. Introduction

The judicial system is one of the foundations of a modern state. It is the guarantor of the application of laws and a factor of good governance and development impetus. Therefore, Morocco has become aware of the importance of promoting its judicial system to support the country's structural reforms. In fact, a reform committee was formed in 2012 to make a diagnosis and propose a reform plan. According to this diagnosis, the Moroccan judicial system is plagued by dysfunctions and weaknesses, as well as slowness and deep complexity, and even some perverse practices that have caused citizens to lose faith in the justice system. Following this diagnosis, the government adopted a national charter for judicial reform, comprising six strategic axes, and began the implementation in 2013.

The state has committed significant human and financial resources to implement this reform. This includes increasing the number of judges and clerks, improving training quality, and improving infrastructure and justice services. This effort increased the share of the justice budget in the state budget to 1.6%, which raised questions about the effectiveness and efficiency of the actions implemented.

Thus, our study aims to identify the efficiency determinants of Moroccan courts during the implementation of the judicial reform charter. For this, we used a two-stage analysis, which consists of measuring the court's efficiency in the first stage. Indeed, the findings of this preliminary analysis were incorporated into our larger study (Achenchabe & Akaaboune, 2021), which examined the productivity change in Moroccan courts between 2013 and 2018. The second stage analysis is using an OLS ordinary least squares regression to identify the variables that influence the efficiency of the courts.

As with most previous studies, the number of judges, clerks, and staff costs was used as inputs for variable selection, while the number of cases resolved was used as output. Our primary source was data from the Department of Justice. To analyze the efficiency determinants, we identified the exogenous variables mentioned in the literature. Then, we collected the data available in the reports of the Ministry of Justice and other state organizations such as the High Commission for Planning.

As a result, this study contributes to a better understanding of the impact of judicial reform on court efficiency and the factors that influence it. This can assist decision-makers in making managerial decisions. Furthermore, to the best of our knowledge, our research is the first to examine judicial efficiency in Morocco and among developing countries.

The paper is organized as follows: Section 2 presents a literature background of the study; Section 3 presents the methods and data; Section 4 presents and discusses the results obtained; Section 5 contains the main findings of the study and implications for future research.

2. Literature Review

According to the literature review, the DEA method has been widely used in studies aimed at measuring efficiency and productivity (Johnes, 2006a). This is enabled by the non-parametric method's ability to include multiple inputs and outputs in the measurement, which is useful for non-profit organizations. According to Voigt (2016), few studies have addressed the technical efficiency of justice systems, resulting in a lack of interest among researchers in cost-related studies in this sector. Moreover, according to Rosales-Lopez (2008), there are fewer DEA studies than those focusing on the quality of judicial decisions. This is more apparent in African countries where we have identified a single study (Elbialy & Garcia-Rubio, 2011) which deals with judicial efficiency.

Researchers frequently mention the court size variable in studies that have

addressed efficiency determinants. Indeed, Yeung and Azevedo (2011) indicated that the size of a court, represented by the number of judges and clerks, has a positive influence on the efficiency of Brazilian state courts. The same sense of relationship has been proven by Schwengber and Sousa (2005) concerning the Rio courts in Brazil and by Santos and Amado (2014) concerning the Portuguese courts. Beldowski et al. (2020) also indicated that an increase in the number of judges can significantly enhance the number of resolved cases. Moreover, they found that court efficiency is significantly associated with some auxiliary court staff members and variables capturing the economic development of court jurisdiction. Similarly, Finocchiaro Castro and Guccio (2014) demonstrate that citizens' high demand for justice and the presence of large courts are positively correlated with the presence of efficient courts.

On the other hand, Finocchiaro Castro and Guccio (2014) pointed out that the number of pending cases is associated with low efficiency for Italian courts. The same result was reported by Ferro et al. (2018), Lewin et al. (1982), and Castro and Guccio (2016) also mentioning the negative effect of workload.

In the same framework, Fauvrelle and Tony C Almeida (2018) studied the efficiency change determinants of Brazilian State Courts between 2009 and 2014 and tested the influence of exogenous variables such as the proportion of criminal cases. The results indicated the non-existence of a significant relationship between the proportion of criminal cases and the court's efficiency. However, Elbialy & Garcia-Rubio (2011) asserted in their work that the complexity of civil cases negatively impacts the efficiency of Egyptian first instance courts.

Regarding the influence of court human resources, Santos and Amado (2014) indicated that courts with a higher proportion of administrative staff are more efficient than those with a higher proportion of judges. On the other hand, some studies (Dimitrova-Grajzl et al., 2012; Schneider, 2005) highlight the academic level of judges and indicate that the higher a judge's level of education (for example, a doctorate), the more efficient the court. Other studies emphasize the significance of the court's management performance, which is directly related to the court president's profile. In this regard, Yeung and Azevedo (2011) confirmed, using management performance evaluation indicators, that efficiency is positively correlated with management performance.

From another perspective, several studies have indicated the relationship between court efficiency and the age or seniority of judges. Thus, Ferro et al. (2018) showed through the study of first instance courts in Argentina during the period 2006-2010 that the age of judges negatively affects efficiency. Indeed, the court is inefficient as the average age of judges increases. Bhattacharya and Smyth (2001) reached the same conclusion when they studied the supreme courts in Australia and found that judges perform poorly as they get older.

Furthermore, Ferro et al. (2018) and Dimitrova-Grajzl et al. (2012) found no significant relationship between a judge's service length or gender and court productivity. Elbialy and Garcia-Rubio (2011), on the other hand, confirmed

that only high-ranking judges increase productivity and efficiency in Egyptian courts.

Similar to judges, previous studies have attempted to investigate the possible link between the profile of a court's clerk and its efficiency. Thus, Ferro et al. (2018) indicated that the seniority of clerks positively affects efficiency, while there is no proven relationship between the gender of staff and efficiency. Dimitrova-Grajzl et al. (2012) underlined that there is no relationship between the experience of clerks and the productivity of a court. They believe that the experience of judges and their specialization is more important than the seniority or experience of court clerks.

In terms of economic activity, Fauvrelle and Tony C Almeida (2018) indicated that there is no correlation between GDP per capita and court productivity. Indeed, socioeconomic factors do not always have an impact on the efficiency of the court. According to Yeung and Azevedo (2011), the most efficient courts are those located in economically active regions, where cases are typically more complex.

Another critical factor emphasized by Falavigna et al. (2015) is the court's geographic location. Indeed, according to this study, the efficiency of Italian courts increases from south to northwest.

The characteristics of the population were also treated as exogenous variables that could influence court efficiency. In this context, Gorman and Ruggiero (2009) assessed the efficiency of prosecutor offices in 26 US states, concluding that those in low-income counties with a minority population are less efficient. Furthermore, a 10% increase in the average income of the population results in a 3% increase in efficiency, whereas there is no significant relationship between the percentage of the population with a bachelor's degree and the efficiency of prosecutor offices.

In general, the literature review reveals that many studies have examined the determinants of efficiency from various perspectives. However, the literature does not show similar results because the determinants vary across countries and judicial systems. Moreover, few studies have dealt with measuring the court's efficiency in Africa, and no study has treated the efficiency of the Moroccan judicial system. Furthermore, the majority of studies have been limited to one type of court, i.e. the Appeal Courts or the First Instance Courts. Thus, our study will contribute to filling this gap by attempting to assess the efficiency of various types of courts as well as identify the determinants of efficiency in the context of the Moroccan judicial system, which has undergone major reform.

3. Methods

3.1. Date Envelopment Analysis

Charnes et al. (1978) introduced the Data Envelopment Analysis (DEA) as a non-parametric method using linear programming to measure the efficiency of a set of units called Decision-making units (DMU) by constructing a border en-

veloping all the possible combinations of inputs and outputs for each DMU. Two basic models have been proposed as part of the DEA method. The first is the CCR model (Charnes et al., 1978), which assumes that the units operate under constant returns to scale (CRS). The second is the BCC model (Banker et al., 1984) which assumes variable returns to scale (VRS).

The basic DEA CCR model is appropriate when the units operate at the optimal size and in a perfect competition environment. It is focused on an input orientation, which means the minimization of inputs for a given level of outputs, and on the assumption of constant returns to scale (CRS).

This model is unable to provide information on the extent to which the identified inefficiency may be due to technical or scale inefficiency. This is why Banker et al. (1984) proposed the BCC model to extend the initial CCR model by adopting the hypothesis of variable returns to scale (VRS). Thus, this allows the efficiency to be decomposed in a technical part due to the scale.

The study considers a set of n DMUs that consume m input to produce s outputs. Based on the rating proposed by Johnes (2004), the technical efficiency of a DMU k, as defined by Charnes et al. (1978), is measured by the ratio between the weighted sum of the outputs and that of the inputs:

$$TE_k = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{1}$$

where:

TE_k : Technical efficiency of a DMU k using m input to produce s output

y_{rk} : Quantity of output r produced by the DMU k

x_{ik} : Quantity of input i consumed by the DMU k

u_r : Weight of the output r

v_i : Weight of the input i

s: Number of outputs

m: Number of inputs

The technical efficiency of each DMU is maximized under certain conditions (Johnes, 2004). Firstly, the weights of the outputs and inputs of the DMU k cannot generate an efficiency score greater than 1 (Equation (3)). Secondly, the weights applied to outputs and inputs are strictly positive (Equation (4)). For each DMU, the following linear programming problem has to be solved by maximizing the ratio TE_k such as:

$$\max \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{2}$$

Under constraints:

$$\frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \le 1, \quad j = 1, \cdots, n \tag{3}$$

$$u_r, v_i > 0, \quad \forall r = 1, \cdots, s; i = 1, \cdots, m \tag{4}$$

where:

k: DMU for which efficiency is measured;

j: The DMUs studied.

Two approaches are possible to solve this linear programming problem. The input-oriented model, where the weighted sum of the inputs is minimized by keeping the outputs constant, and the output-oriented model, which will be the focus of this study, where the weighted sum of the outputs is maximized while maintaining constant the inputs.

Thus, the primal equation for the output-oriented VRS model to be used in this research is presented below. It represents the multiplier form of the problem to be solved.

$$\min \sum_{i=1}^{m} v_i x_{ik} - c_k \tag{5}$$

Under constraints:

$$\sum_{i=1}^{m} v_i x_{ik} - \sum_{r=1}^{s} u_r y_{rj} - c_k \geq 0 \tag{6}$$

$$\sum_{r=1}^{s} u_r y_{rk} = 1 \tag{7}$$

$$u_r, v_i > 0, \ \forall r = 1, \cdots, s; i = 1, \cdots, m \tag{8}$$

where v_i : The weighting coefficient of each input.

The duality rule in linear programming can be used to rewrite an equivalent form called "wrapped form". This is generally preferred since it contains only $s + m$ constraints instead of $n + 1$ of the multiplier form. Thus, the dual formula of the output-oriented VRS model is written:

$$\max \varnothing_k \tag{9}$$

Under constraints:

$$\varnothing_k y_{rk} - \sum_{j=1}^{n} \lambda_j y_{rj} \leq 0, \ r = 1, \cdots, s \tag{10}$$

$$x_{ik} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0, \ i = 1, \cdots, m \tag{11}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{12}$$

$$\lambda_j \geq 0, \ \forall j = 1, \cdots, n \tag{13}$$

where

$\frac{1}{\varnothing_k}$: The technical efficiency score;

λ_j : The weighting coefficients which measure the capacity of each DMU (*j*) to constitute the benchmark.

The VRS model also helps to identify the nature of returns to scale (increasing or decreasing returns to scale) and the number of outputs that can be produced by each DMU using the same level of inputs.

Thus, based on the DEA model just described, we used the DEA method in

the first stage to assess the efficiency of 109 Moroccan courts during the period of implementation of the judicial reform charter between 2013 and 2018. The choice of this method is justified by its many advantages, including the fact that it is appropriate for public organizations and does not require price information, as well as the relaxed assumptions on input-output data distribution and the non-specification of the technological frontier (Cooper et al., 2001).

Our research covers nearly all Moroccan courts, including 21 appeal courts, 68 first instance courts, 9 administrative courts, and 11 commercial courts. We excluded the Supreme Court because it is a law court that cannot be compared to other courts, as well as one first instance court whose input and output values are extreme and cannot be compared to other courts.

We used the DEA under output orientation method during the first stage analysis because Moroccan courts are plagued by issues related to a large stock of pending cases and slow processing. The DEA BCC model was used with the VRS assumption. This model is more appropriate for the courts' case because it is a monopoly system that is difficult to operate on an optimal scale.

3.2. Two Stage Regression Model

The literature refers to second-phase or "two-step" studies that link efficiency scores to explanatory variables. These variables are generally considered as exogenous to the entity's production technology and are not directly related to the inputs and outputs used to calculate efficiency.

Therefore, in the second stage of analysis, we identified a set of exogenous variables based on previous research findings, then classified these variables into three categories: those related to judicial activity, those related to judge's clerk's profiles, and finally variables related to socioeconomic and demographic factors.

There is no agreement in the literature on the best regression model to use in this case. Indeed, McCarty and Yaisawarng (1993) argue that a Tobit model is more appropriate because the efficiency scores are capped at 1, whereas Hoff (2007) believes that an OLS regression is sufficient. McDonald (2009) considers that the Tobit regression may be inappropriate and that the OLS regression gives more consistent results. More recently, Banker and Natarajan (2008) proposed a model with a less restrictive form-based mainly on the use of the ordinary least squares (OLS) method.

Thus, we performed the statistical tests for residuals normality and heteroskedasticity, then we opted for ordinary least squares regression to identify the variables that influence the court's efficiency. Three models are used, one with the technical efficiency CRS as the dependent variable, another with the efficiency under the VRS assumption, and the last with the scale efficiency variable, while all 20 explanatory variables are used in all three models. This decision is motivated by our intention to find disparities in the influence of the explanatory variables on each of the efficiency types examined.

3.3. Data

All data about the judicial system came from the Moroccan Ministry of Justice-for the period 2013 to 2018, while data about exogenous variables came from official governmental reports and documents for 2018.

There is no consensus in the literature regarding an ideal model for selecting the input and output variables used in the DEA model (Johnes, 2006b; Avkiran, 2001). Therefore, we used inputs and outputs that are frequently used in literature and that appear to us to be the most representative of the Moroccan court production process.

– The inputs:

- Nb_judge: Number of judges;
- Nb_clerk: Number of clerks;
- F_cost: Court operating expenses.

– The outputs:

- Cases resolved: Number of cases resolved or number of judgments rendered.

For the selection of exogenous variables, we consider the literature and the availability of data to integrate 20 independent variables into our model as follows:

– Dependent variables:

- EFF_CRS: Efficiency under CRS assumption;
- EFF_VRS: Efficiency under VRS assumption;
- EFF_S: Scale efficiency.

– Independent variables:

▪ Variables related to judicial activity:

- SIZE_CASES: Size of the court in terms of current cases;
- SIZE_STAFF: Size of the court in terms of human resources (judges and clerks);
- PEND_CASE: Pending cases i.e. the number of unresolved cases at the end of the year;
- PRP_JUDGE Proportion of judges in court;
- PRP_CRIM Type of cases handled, more precisely the proportion of criminal cases;
- SPECIA Specialization of the court (takes the value 1 if it is a commercial or administrative court and the value 0 if it is a general court);
- TYPE Type of court (takes the value 1 if it is an appeal court and the value 0 if it is a first instance court).

▪ Variables linked to the profiles of judicial personnel

- EXP_JUDGE: proportion of senior judges (over 15 years of experience) compared to all judges;
- FEM_JUDGE proportion of female judges;
- DEG_CLERK proportion of clerks at scale 11 (grade in the public sector achieved with a bac+5 diploma);
- EXP_CLERK average length of service of clerks;

- FEM_CLERK proportion of female clerks;
- Variables linked to socio-economic and demographic factors:
- LOGPOP Log of the number of inhabitants in the perimeter of the court;
- GDP_H GDP per capita in the city where the court is located;
- D_SDR The kilometer distance between the court and the regional administrative entity in charge of managing the administrative, logistical, and human resources of the courts;
- North, South, Center, or East: location of the court in the country;
- DIP_POP proportion of the population with a higher education level;
- INC_POP Income of the region's population.

Table 1 shows the descriptive statistics for the input and output variables, the efficiency scores obtained in the first stage of analysis, and the statistics for the exogenous variables, which are the independent variables in our model.

Table 1. Descriptive statistics of the variables for the year 2018.

		Mean	Std dev	Min	Max
1er stage Variables Inputs and outputs of the DEA model (observations = 109)	Judges number	35	27	9	169
	Clerks number	109	74	21	351
	Court operating expenses	29,971,095	21,257,040	6,730,760	112,875,647
	Resolved cases	26,973	30,976	1379	175,058
2e stage Exogenious variables (observations = 109)	SIZE_CASES	32,005	35,440	1675	188,936
	SIZE_STAFF	144	99	30	467
	PEND_CASE	5244	6026	139	35,972
	PRP_JUDGE	0.24	0.05	0.09	0.37
	PRP_CRIM	0.40	0.20	-	1.00
	SPECIA	0.21	0.41	-	1.00
	TYPE	0.24	0.43	-	1.00
	EXP_JUDGE	0.31	0.25	-	0.97
	FEM_JUDGE	0.20	0.16	-	0.64
	DEG_CLERK	0.39	0.10	0.20	0.66
	EXP_CLERK	18.37	2.39	10.84	23.82
	FEM_CLERK	0.47	0.11	0.25	0.74
	lOGPOP	5.91	0.55	4.82	7.39
	GDP_H	29,807.52	11,448.53	16,201.00	84,949.00
	D_SDR	74.76	114.90	0.10	532.50
	North	0.25	0.43	-	1.00
	South	0.07	0.26	-	1.00
	Center	0.50	0.50	-	1.00
	East	0.14	0.35	-	1.00
	DIP_POP	0.09	0.10	0.02	0.69
	INC_POP	8 359	3154	4985	13,131

The period of implementation of the judicial reform charter has seen an upward trend in the means and productivity of the courts. Thus, in 2018, the data shows an average of 35 judges and 109 clerks per court. On the other hand, operating expenses vary significantly, with a minimum of 6.7 million dirhams and a maximum amount of 112.8 million dirhams.

On the other hand, the statistics of exogenous variables, show a wide range of court sizes, whether in terms of cases (from 1675 to 188,936) or staff (30 to 467). The same observation applies to pending cases. The average is around 5245 cases, with a maximum of 35,972 pending cases. Our model also includes seven dummy variables with mean values that are frequently less than 0.5.

4. Results and Discussion

The use of a two-stage approach allowed in a first stage to measure the court's efficiency between 2013 and 2018 in order to assess the impact generated by the implementation of the judicial reform on productivity. Secondly, the use of the OLS regression allowed to test the influence of exogenous variables on the court's efficiency in 2018, and thus to identify the determinants that allow courts to become more efficient in the context of reform.

We present in Table 2 the summary statistics of the efficiency results under the assumption of constant and variable returns to scale. The results by the court groups are presented in **Appendix 1**.

The results have shown that the average efficiency level is relatively low in 2018, with 56.2% under the CRS assumption and 72.4% under the VRS assumption. Thus, the Moroccan courts have a wide margin to improve their efficiency. Regarding the results by court type, first instance courts are the least technically efficient, and the Appeal courts are the most efficient. Our results also show that 19 courts had CRS efficiency scores between 9.9% and 50%, compared to only six fully efficient courts.

The same results allow us to assess the nature of returns to scale. Thus, most courts operate under increasing scales, which means that they can further increase their productivity by taking advantage of economies of scale. Administrative courts are the exception, with a majority under decreasing returns to scale, implying the need to divide these courts into several entities.

For the second stage, we present the estimation results of the analysis models in Table 3 and the detailed results in **Appendix 2**. The results show that the value of the statistic R2 for the three models relating to the CRS efficiency, the

Table 2. Summary statistics for DEA efficiency scores.

	Mean	Std dev	Min	Max
EFF_CRS (CCR Model)	0.562	0.225	0.099	1.000
EFF_VRS (BCC model)	0.724	0.223	0.206	1.000
EFF_S Scale	0.790	0.217	0.192	1.000

Table 3. Results of the regression models.

VARIABLES	Eff_CRS	Eff_VRS	Eff_S
SIZE_CASES	5.68e−06***	5.08e−06***	1.39e−06*
SIZE_STAFF	−0.000992***	−0.00121***	−8.61e−05
PEND_CASE	−1.10e−05**	−6.79e−06	−6.13e−06
PRP_JUDGE	0.601	0.722	0.0590
PRP_CRIM	0.141	0.157	0.0883
SPECIA	−0.433***	−0.0643	−0.488***
TYPE	−0.0675	0.198**	−0.314***
EXP_JUDGE	0.323***	0.208	0.154
FEM_JUDGE	−0.120	−0.159	0.0966
DEG_CLERK	−0.0655	0.179	−0.224
EXP_CLERK	0.000163	−0.000926	0.00673
FEM_CLERK	0.337	−0.128	0.480**
lOGPOP	0.323***	0.117	0.345***
GDP_H	1.04e−07	−2.52e−06	1.35e−06
D_SDR	0.000383	0.000344	3.25e−05
North	0.0659	−0.110	0.163
South	−0.0145	−0.0352	−0.0295
Center	0.0590	−0.0863	0.121
East	0.0502	−0.138	0.136
DIP_POP	0.0230	−0.140	0.117
INC_POP	3.65e−06	1.18e−06	4.63e−06
Constant	−1.755***	−0.0755	−1.666***
Observations	109	109	109
R-squared	0.640	0.434	0.650

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

VRS efficiency, and the scale efficiency is 0.6402, 0.4337, and 0.6501, respectively, indicating a good quality of the econometric model since these values tend towards unity, except for the value of the model relating to the VRS efficiency, which is relatively low. Nonetheless, we can confirm that there is at least one independent variable that contributes to the variation in Moroccan court efficiency.

According to the study's findings, CRS efficiency is higher in courts that serve densely populated areas, as well as in courts with the greatest number of experienced judges and pending cases. The least efficient courts, on the other hand, are distinguished by a large number of pending cases and an overabundance of judicial personnel. On the other hand, the VRS technical efficiency of courts increases for Appeal courts and when the number of cases pending is large and

decreases when the number of judicial staff is excessive. Finally, the scale efficiency associated with the evolution of the court in an adequate production scale increases with the number of cases in process and the population covered by the court's perimeter and decreases for Appeal courts and specialized ones.

These findings have several managerial implications for Moroccan court administrators. First, the fact that an increase in the number of cases in progress improves court efficiency demonstrates that the increased workload induced by the cases allows the court to benefit from economies of scale to resolve more cases with fewer resources. This implies that the courts must maintain a high level of activity and not be divided or replaced by new courts. However, it should be noted that we must continue to monitor returns to scale. Indeed, once a court is subject to decreasing returns to scale, we can no longer improve its efficiency by increasing the number of cases handled.

Furthermore, the positive effect induced by the presence of a high proportion of experienced judges demonstrates a long-standing mistake made by Moroccan court managers, who tend to cover the needs of overdue courts with recruits. Indeed, it has been observed that the more experienced a judge becomes, the more he gains stability by only practicing in courts of the same judicial district. As a result, whenever a court experiences problems related to overwork or an increase in judgment delays, it becomes a priority when assigning new judges recruited. As a result of our findings, there is a need to change the type of decisions made by assigning more experienced judges to overdue courts, either as part of a temporary delegation of 3 or 6 months or by allowing judges to transfer from other courts.

The negative effect on efficiency caused by the number of judges and clerks, on the other hand, implies that all courts must consider the practices of their benchmark within the framework of the reference groups identified during the first stage analysis. Although the staff is not always interchangeable, using the same number of judges and clerks as the reference group's best practice court will almost certainly allow for an increase in the number of cases resolved.

In the same context, the result regarding the negative impact of pending cases on court efficiency, which is consistent with previous studies (Marselli & Vannini, 2004; Ferro et al., 2018; Lewin et al., 1982; Schneider, 2005; Castro & Guccio, 2016), demonstrates the need for Moroccan courts to act on these cases by gradually reducing them, rather than using this as an argument for an excessive increase in the resources mobilized.

Finally, it was found that court specialization (administrative or commercial) is a determinant of inefficiency. Even though this result contradicts some previous study findings (Gorman & Ruggiero, 2009), it illustrates that in the Moroccan context, specialization leads to the use of more means to resolve fewer cases than general courts. This implies that the Kingdom should stop establishing new commercial or administrative courts. The appropriate managerial solution would thus be to create specialized administrative structures at the level of

the already existing appeal courts and first instance courts, rather than to build new buildings, which would incur additional costs.

Our findings on efficiency determinants provide us with guidelines to follow in order to improve court efficiency. This primarily entails considering our recommendations when developing the judicial map, determining the courts' human and logistical resources, and allocating these resources.

5. Conclusion

This study aimed to identify the efficiency determinants of Moroccan courts during the implementation of the judicial reform charter. Thus, we applied the analysis approach in two stages. First, we assessed the court's efficiency. Second, we investigated the impact of exogenous variables on the obtained efficiency scores.

This study filled a gap identified in our literature review since very few studies have attempted to evaluate judicial efficiency and identify its determinants in African countries. So the results provide managerial implications for court managers and can provide recommendations for decision-making. Furthermore, we noticed a lack of similar studies in African countries, particularly Morocco. Moreover, the majority of studies have been limited to one type of court, i.e. the Appeal Courts or the First Instance Courts.

In this context, the results showed that the average efficiency of Moroccan courts is relatively low despite an improvement during the period of implementation of the reform. In addition, the majority of courts can use economies of scale to resolve a larger number of cases, reducing the stock of pending cases and adjudication delays. On the other hand, the results of the second stage analysis clearly show that the efficiency of Moroccan courts is positively influenced by the size of the court in terms of cases, by the presence of experienced judges and it increases in courts located in the most populous cities. On the other hand, efficiency decreases when the number of pending cases is excessive, as well as when the number of judicial staff is excessive.

These findings are important for understanding judicial efficiency in Morocco and assisting managers in making decisions. However, we believe that our research has some limitations that require further research. Among these limitations are the difficulty of selecting all of the courts' inputs and outputs in measuring efficiency, as well as the non-integration of a set of exogenous variables due to the lack of certain data. As a result, we believe that it would be interesting to include other outputs in future research, such as prejudicial cases resolved in court using alternative methods.

We also recommend experimenting with different methods of measuring efficiency, as well as different regression models, such as Tobit's truncated regression. It is also possible to include other exogenous variables in the regression model, such as remuneration, employee motivation, or the rate of court computerization.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix 1

Summary statistics for DEA efficiency scores

		2013			2018		
		CRS scores	VRS scores	Scale EFF	CRS scores	VRS scores	Scale EFF
	Mean	0.738	0.920	0.801	0.728	0.891	0.814
Appeal	Std dev	0.224	0.135	0.214	0.207	0.116	0.194
Courts	Min	0.228	0.408	0.326	0.331	0.620	0.331
	Max	1.000	1.000	1.000	1.000	1.000	1.000
	Mean	0.478	0.622	0.778	0.533	0.654	0.816
First Instance	Std dev	0.199	0.210	0.208	0.201	0.194	0.193
Courts	Min	0.108	0.243	0.171	0.099	0.270	0.246
	Max	1.000	1.000	1.000	1.000	1.000	1.000
	Mean	0.426	0.661	0.668	0.404	0.862	0.518
Commercial	Std dev	0.240	0.313	0.195	0.227	0.268	0.277
Courts	Min	0.140	0.164	0.365	0.181	0.206	0.192
	Max	1.000	1.000	1.000	1.000	1.000	1.000
	Mean	0.629	0.855	0.734	0.586	0.692	0.871
Administrative	Std dev	0.217	0.219	0.142	0.243	0.298	0.127
Courts	Min	0.385	0.528	0.541	0.243	0.255	0.604
	Max	1.000	1.000	1.000	1.000	1.000	1.000
	Mean	0.535	0.702	0.768	0.562	0.724	0.790
All	Std dev	0.234	0.242	0.204	0.225	0.223	0.217
courts	Min	0.108	0.164	0.171	0.099	0.206	0.192
	Max	1.000	1.000	1.000	1.000	1.000	1.000

Appendix 2

Results of regression models

VARIABLES	Eff_CRS	Eff_VRS	Eff_S
SIZE_CASES	5.68e−06***	5.08e−06***	1.39e−06*
	(9.62e−07)	(1.16e−06)	(8.33e−07)
SIZE_STAFF	−0.000992***	−0.00121***	−8.61e−05
	(0.000346)	(0.000432)	(0.000269)
PEND_CASE	−1.10e−05**	−6.79e−06	−6.13e−06
	(5.15e−06)	(4.43e−06)	(3.85e−06)
PRP_JUDGE	0.601	0.722	0.0590
	(0.398)	(0.511)	(0.418)
PRP_CRIM	0.141	0.157	0.0883

Continued

	(0.151)	(0.173)	(0.0942)
SPECIA	−0.433***	−0.0643	−0.488***
	(0.110)	(0.142)	(0.0970)
TYPE	−0.0675	0.198**	−0.314***
	(0.0830)	(0.0916)	(0.0753)
EXP_JUDGE	0.323***	0.208	0.154
	(0.117)	(0.140)	(0.116)
FEM_JUDGE	−0.120	−0.159	0.0966
	(0.146)	(0.183)	(0.163)
DEG_CLERK	−0.0655	0.179	−0.224
	(0.202)	(0.266)	(0.235)
EXP_CLERK	0.000163	−0.000926	0.00673
	(0.00661)	(0.0101)	(0.00756)
FEM_CLERK	0.337	−0.128	0.480**
	(0.206)	(0.225)	(0.186)
lOGPOP	0.323***	0.117	0.345***
	(0.0719)	(0.0909)	(0.0711)
GDP_H	1.04e−07	−2.52e−06	1.35e−06
	(1.86e−06)	(2.18e−06)	(1.79e−06)
D_SDR	0.000383	0.000344	3.25e−05
	(0.000241)	(0.000234)	(0.000231)
North	0.0659	−0.110	0.163
	(0.0499)	(0.122)	(0.102)
South	−0.0145	−0.0352	−0.0295
	(0.0907)	(0.173)	(0.134)
Center	0.0590	−0.0863	0.121
	(0.0419)	(0.117)	(0.101)
East	0.0502	−0.138	0.136
	(0.0652)	(0.129)	(0.110)
DIP_POP	0.0230	−0.140	0.117
	(0.144)	(0.172)	(0.0833)
INC_POP	3.65e−06	1.18e−06	4.63e−06
	(5.72e−06)	(7.03e−06)	(6.26e−06)
Constant	−1.755***	−0.0755	−1.666***
	(0.437)	(0.559)	(0.409)
Observations	109	109	109
R-squared	0.640	0.434	0.650

Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.