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Courts Performance: The case of Portugal

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Courts Performance: The case of Portugal

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Resumo

A importância dos tribunais e o sistema judicial dos países tem sido intrinsicamente ligada ao desenvolvimento das nações. A presente análise contém dados de 2015 a 2021 sobre todos os juízos nos tribunais portugueses de primeira instância, totalizando um número de 3,365 observações com 10 variáveis diferentes. Para analisar a eficiência dos juízos foi usada Data Envelopment Analysis. Os resultados mostraram que a eficiência é bastante balanceada em todo o país e ao longo dos anos. Dada a clara diferença entre juízos especializados e não especializados, uma análise de economias de gama foi realizada para perceber se os juízos genéricos (não especializados) seriam mais eficientes que os juízos especializados. Os resultados mostraram deseconomias de gama para quase todos os níveis de trabalhadores e número total de casos. É da opinião do autor, que este estudo fornece ferramentas suficientes para que quem toma decisões considere um reestruturação /redefinição dos juízos genéricos, principalmente no que diz respeito à flexibilidade de utilização dos trabalhadores.

Palavras-chave: Data envelopment analysis, Benchmarking, Courts Efficiency, Economies of Scope.

Abstract

For some time now, courts and countries' judicial system have been intrinsically connected to the development of the nations. The present analysis uses data from 2015 to 2021 on every bench in the Portuguese first instance courts, consisting on 3,365 observations and 10 different variables. To analyse the efficiency of benches, Data Envelopment Analysis was used. The results proved to be very balanced throughout the country and over the years. Given the clear difference between specialized and non-specialized types of benches, we assessed benches within group and between groups and computed the group frontier gap, that can be used as an indication of economies of scope of specialised vs generic benches. The results uncovered diseconomies of scope for nearly every level of staff and total case number. This study provides therefore, information and tools that allow Portuguese decision makers to consider a redesign of generic benches, mainly in what concerns staff flexibility.

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1 Introduction

Courts and countries' judicial systems have been intrinsically connected to the economic development of the nations (Ramello and Voigt, 2012). Whether by assuring judicial independence, increasing public confidence (Feld and Voigt, 2003; Voigt et al., 2015), or boosting countries' economical interests, the awareness regarding judicial efficiency keeps increasing, and major institutions are already issuing reports and recommendations worldwide on the status of several countries' judicial systems (Dakolias, 1999; WorldBank, 2018; Commission, 2022). Given their pivotal function in society, judicial systems are being accounted in several different ways regarding their efficiency. Therefore, an ever-increasing amount of research and studies are being developed with information regarding techniques/tools to measure courts optimal organization (scale), judicial systems' performance, and staff (judges and others) deficits/surplus in terms of number and incentives.

Santos and Amado (2014) already did some research on the matter, in Portuguese Courts, resourcing to Data Envelopment Analysis (DEA), confirming there were some reasoning behind public perception of Portuguese judicial system inefficiency and that part of that inefficiency was related to scale factor (size of courts). Their study went further by specifying some courts as peers for good practices, providing policy makers with tools to design some reforms. Following this study, along with other recommendations, Portugal implemented a reform in 2014, leading to a more "*focused and autonomous management of each of the 23 district courts, according to model of objective-based management to achieve greater efficacy and quality*". Further on, Silva (2018) analyzed generic competence benches, using different linkage approaches between inputs and outputs, since some of the outputs used, were produced by specific inputs while there were also inputs that could be jointly used to the production of all outputs. As far it is possible to understand, literature using DEA technique for Portuguese courts is limited to the articles mentioned above. While Santos and Amado (2014) focuses on first instance courts, Silva (2018) focuses on more disaggregated data: generic competence benches. Note that in Portugal a court of law is composed by several benches.

This paper will attempt to continue their investigations by expanding the range of analysis to benches (instead of courts or just one type of bench), using also DEA. We believe that the analysis reported in this paper contributes to the literature on the judiciary efficiency and in particular for the Portuguese case, where an analysis at the bench level mixing its various types has been considered. Alongside, this study will attempt to draw conclusions regarding the existence of economies of scope in the Portuguese courts, namely if specialized benches perform better or not than non-specialized (generic) and if there would be some efficiency improvements behind converting specialized benches into generic ones and vice-versa. To the

author knowledge, only one study focused on economies of scope applied to courts, namely Mattsson and Tidanå (2019). The authors found that merging Swedish courts would produce gains in efficiency for a relevant number of courts, due to economies of scope gains. In the present analysis, merging courts is not necessarily the goal, but instead the transformation of a court that previously handled all types of cases (generic) into a specialized (just one or two types of cases) or vice-versa[1].

A group of questions were already raised in previous literature. Although the goal of this study is not to answer those questions, some comparisons will be done during the results and discussion sections, with the data achieved throughout the analysis, as a review of the Portuguese scenario when compared to other countries situation.

The present study is organized as follows: Section 2 will describe the literature available regarding efficiency analysis, and how it was applied in the judiciary analysis as well as economies of scope, outputs and inputs, and the main implications found in the literature. Section 3 focuses on the DEA and economies of scope techniques and how they are to be applied. Section 4 describes Portuguese Judicial system structure and the data to be analysed. Section 5 analyses the results, while Section 6 discuss those same results, and finishes with a conclusion.

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[1]This study does not pretend to provide decision makers with solutions, just information that they can work upon. Therefore, whether the solution comes from merges or not should be assessed by the decision makers alone.

2   Previous Literature

To achieve competitive advantage, businesses must constantly improve their performance. One way to understand how to improve performance or productivity is through efficiency measurement, more specifically through frontier estimation based on Linear Programming and econometrics (Coelli, 1995). There is already an extensive literature about efficiency measurement, but over the past years special attention has been devoted to a specific method, namely the DEA. It was first introduced by Charnes et al. (1978) and it allows the accounting of several indicators at the same time, contextualizing the outputs produced by the inputs consumed. In Liu et al. (2013)'s systematic survey of DEA applications (from 1978 to 2010), over 3100 papers were found, ranging from Mining to Health Care sectors, with banking heading the list of top application sector. This number has grown since, but there is not, to the knowledge of the author, another systematic survey with an updated number.

Within the DEA literature, various alternative methods were developed and studied, such as Free Disposal Hull (FDH), introduced by Deprins et al. (1984). Just like DEA, FDH is a nonparametric deterministic method, that require both the values of the inputs and outputs to be known. On the other hand, FDH exploits the input-output disposability, relaxing the convexity assumption of DEA, (Shiraz et al., 2016) meaning that if a given pair of inputs and outputs are producible, then any pair with more input and less output of that given pair are also producible (Lim et al., 2016). FDH may also consider mixed integer programming problems (vs. DEA linear programming problem) as shown by Tulkens (1993).

Chambers et al. (1996) introduced Directional Distance Function (DDF). The major difference between DDF and traditional DEA measures is that the former is a non-radial and non-oriented measure of efficiency. In fact, DDF advantage lies in being able to move the inputs and outputs in a non-radial way to the frontier, allowing the treatment of undesirable outputs (their reduction). DDF is especially desirable when looking at real case scenarios, as explored in Pathomsiri et al. (2008), whereas increasing the efficiency (good outputs) of an airport can lead to the production of undesirable byproducts ("bad outputs") such as delays and mishandled baggage, which must be taken into account by managers when it comes to the decision of implementing any policy aimed at improving efficiency.

As mentioned, econometrics have also been used to measure efficiency, namely stochastic frontier analysis (SFA), introduced by Aigner et al. (1977) and Meeusen and van Den Broeck (1977). Contrary to DEA, SFA is a parametric method although some non-parametric and semi-parametric approaches have been already proposed[2]. SFA allows the analysis of technical inefficiencies in the framework of production function, as well as decomposing the growth into

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[2]For further reading, check Kumbhakar et al. (2007); Park et al. (2015)

changes in input usage, technology, and efficiency (Mastromarco, 2008).

Concerning the measurement of courts' efficiency there is already some literature focusing on the productivity (using quantitative measures) (Blank et al., 2004), but given the characteristics of the judicial system and how it changes dramatically from country to country, it becomes troublesome to assess which are the determinants of justice productivity. As Falavigna et al. (2015) state, there are two major dimensions, quantitative and qualitative. While the former is the typical maximization of outputs for given inputs, the latter tries to explain how those outputs are produced and their "negative subproducts" (if any) that contribute for the public perception and reliability of the judicial system, such as time to reach a dispute settlement.

2.1 Measurements of Efficiency in the Judiciary

One important measure of performance of courts is judges' productivity. There are already several studies focusing on judges' productivity (Choi et al., 2010; Ramseyer, 2012; Schneider, 2005) namely how significantly their educational background affects the time needed to reach a decision as well as their incentives (promotions and monetary) and reversals from courts of appeal (Schneider, 2005). Beenstock and Haitovsky (2004) demonstrate that there is a correlation between caseload and number judges. Since caseload increases when judges also increase, it is possible to infer that increasing number of judges *per se*, might not be enough to clear backlog (as judges have to deal with the increasing number of incoming cases) nor increasing the percentage of cases completed per cases initiated/pending. In the same line of thinking, when using judges' number and caseload to analyze judicial productivity, Dimitrova-Grajzl et al. (2012) showed that in first instance courts in Slovenia, number of judges is insignificant while caseload is not[3]. Complementary data from Dakolias (1999) suggests that judges' productivity is boosted when caseload increases. Despite that, it does not mean that judges are able to cope with backlog, on the contrary, they finish more cases, but the caseload increases in a bigger proportion. Kim and Min (2017) go further by arguing a negative correlation between caseload and quality, which indirectly could mean that a non-supported (by some specific analysis) increase in judges' number, could lead to a quality reduction.

Besides the analysis of individual performance measures, such as judges' productivity or clearance rate (see European (2022)), some authors have adopted the frontier methodologies described above, to cope with multiple performance measures and/or variables. While traditional DEA models (see Charnes et al. (1978); Banker et al. (1984)) are the most widely used models to measure courts' efficiency, the other models have also been applied to the context of courts, such as DDF in Falavigna et al. (2015) which accounted for the minimization delays in

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[3]Falavigna et al. (2018) complement this idea with Baumol's cost disease. For further reading, consult "The Cost Disease: Why Computers Get Cheaper and Health Care Doesn't" by William Baumol

courts decisions (bad output), and FDH (Tulkens, 1993; De Sousa et al., 2005). Besides DEA, DDF, and FDH, some authors also performed regression analysis (Beenstock and Haitovsky, 2004; Dimitrova-Grajzl et al., 2012; Bhattacharya and Smyth, 2001) and Malmquist indexes, (Mattsson et al., 2018), or even both of them (Falavigna et al., 2018) in what is called a 2-stage DEA. Malmquist Index is a non-parametric method introduced by Caves et al. (1982) that allows the analysis of efficiency changes over-time, while regression tries to understand the impact of other variables on the output (cases resolved), usually not directly related (therefore not used in the initial DEA model) to the productivity of a court[4][5].

Regardless of the method used, measuring efficiency in courts faces some challenges, namely the cases' different complexities. It is perceptible why this is a challenge, as it is not possible to try and measure the efficiency of a court without considering cases as input/output, as it is the "product" of a court (Schneider, 2005). Santos and Amado (2014), who used DEA to analyse Portuguese courts, argued that it is very hard to disaggregate the proceedings included in each type of procedural area (case type). To understand the complexity of each case, the authors used the time needed to solve each case type as a proxy for case complexity. This way, they found that civil cases took, on average, 29 months to solve, while criminal, labour, labour-criminal and tutelary took 9, 13, 7, and 13 months, respectively. They concluded that civil cases were much more complex than the remaining. While other authors decided to have different levels of aggregations, such as only cases resolved as an output (Hagstedt and Proos, 2008), or considering their categories (such as criminal, civil) (Kittelsen, 1992), Santos and Amado (2014) found that within civil category there were proceedings taking 2 months while others took nearly 100 months to solve. Therefore, the authors were the only ones in the literature, to the author knowledge, to use a high level of disaggregation of cases to tackle the complexity issue.

2.2 Economies of scope - measurement and applications

Cummins et al. (2010) analysed the US insurance industry trying to understand if companies providing both Life-health and Property-liability were more efficient (or not) than the ones providing only one of these, discovering that a conglomeration strategy (offering both services) was worse than specializing in one of them. Growitsch and Wetzel (2009) analyzed 54 railways companies from 27 European countries over five years (2000-2004) finding that there are economies of scope in integrated firms, in countries where there is competitive pressure. In countries with lower market pressure, there seems to be some diseconomies of scope. Besides the market competitiveness it was also noted that even in countries with lower market pressure, factors such as privatization and/or proportion of passenger and freight transport within the

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[4]Deyneli (2011) considered computerization and judges' salaries (e.g.)

[5]For a more comprehensive list of authors measuring courts efficiency, check Voigt (2014) and Ferro et al. (2020)

total transport operations lead to economies of scope (e.g., Estonia case could be explained by privatization). Railways have some specificities that are harder to determine in the judicial system such as transaction costs, investment planning (much larger and clearer in railways), among many others. Therefore, this industry involves a large differentiation between vertical integration and horizontal integration of activities.

Economies of scope were first described by Panzar and Willig (1981), as an intuitive production property based on cost savings resultant from the scope (instead of the scale) of a company. One can say there are economies of scope when producing two or more products in one firm is less costly than producing them separately. If the multi-product is more costly to produce in one firm rather than in separate firms, then there are diseconomies of scope. If there is no difference, then there are no economies of scope of any sort. The concept "*per se*" was not new, as many companies already applied it (and still do), but the authors managed to produce a more precise theoretical terminology. In the article, the authors described various examples of inputs able to be shared by the multi-products, such as electric power generators, indivisible equipment (e.g., factories) able to be used for more than one manufacturing process or human capital applicable to the production of more than one output. The latter is the most interesting for the study at hand. Although there are no proper cost functions, as the information for the cost of personnel is not available, it is still possible to perceive whether the same number of human personnel is able to solve more cases if they are distributed in a specific way, namely on generic courts which handle all types of cases or if they are more efficient being spread across the specialized courts. This idea will be further explored below. Despite the non-existence of an intrinsic link between DEA and Economies of Scope, it is clear, by the explanation provided above, that they can be complementary by nature, in the sense that DEA provides efficiency level of firms, and economies of scope try to provide some insights on how that efficiency might be increased. Morita (2003) demonstrated this idea in his article, where he first did a DEA analysis (with an artificial numerical example) and further proceeded to confirm the existence of economies of scope, validating the complementary idea of both methodologies.

Concerning economies of scope related with courts, there is only one article, to the author knowledge (Mattsson and Tidanå, 2019) that address the issue. In this article, the authors analysed the potential efficiency effects of Swedish courts mergers. To do so, they decomposed the results into three estimates namely, learning effect, harmony effect and scale effect. For the present analysis, harmony effect is the only relevant one. Authors state that economies of scope, more specifically the harmony effect, are "achieved by either a more productive mix of inputs, or a more easily produced output mix". The authors look for how much more average outputs can be produced with a certain average of inputs. The usage of averages is necessary to nullify

the effect of size. Though, as the authors note, that is only relevant when units are closely the same size. When they are too different in size, it might be difficult to distinguish between harmony and size effect. They concluded that efficiency gains from economies of scope ranged between 0%-20%, with 17,2% of the courts being placed in between the efficiency improvement of 10,1%-19%.

2.3   Outputs and Inputs

As stated before, the judicial organization and law varies widely across countries. This is most true when considering the qualitative characteristics of each judiciary system as each country has its own constitution. Nevertheless, it became commonly accepted that when dealing with the quantitative aspect of courts, the desired output of an efficiency measurement is "cases resolved" or finished. While some authors aggregated the cases resolved as a single output (Hagstedt and Proos, 2008; Elbialy and García-Rubio, 2011), others specified the cases resolved taking into consideration their category (e.g., criminal, civil, labour) (De Sousa et al., 2005; Kittelsen, 1992; Silva, 2018), and some went further by subdividing the outputs considering some type of weight that accounted for the complexity/heterogeneity of each case category (Santos and Amado, 2014). To the author knowledge only one DEA[6] study considered other outputs than cases settled, namely Lewin et al. (1982) that used cases pending for less than 90 days (along number of dispositions).

Regarding inputs, the literature is less converging. Several authors, Deyneli (2011); Kittelsen (1992); Tulkens (1993); Finocchiaro Castro and Guccio (2014), opted to use solely courts staff as input (judges or/and others). Although staff is commonly used by authors, as data is fairly easy to obtain, many authors enlarge the range of inputs to obtain more complete results. Schneider (2005) pointed the importance of having a measure of workload as it is the measure of demand of a court's services, meaning that if workload was to be considered null, then there would not be any outputs. Therefore, several studies included pending and/or incoming cases as measure of workload (Schneider, 2005; De Sousa et al., 2005; Peyrache and Zago, 2016; Silva, 2018; Nissi et al., 2019). Even so, this theory raised some concerns about the non-flexibility of inputs, as it is not possible to control the demand of courts (e.g., incoming cases). Some other authors also included different input variables such as geographic distribution of courts, time required to perform certain steps in the workflow, Falavigna et al. (2015, 2018). Fixed capital inputs are often not considered, exception made to Elbialy and García-Rubio (2011), that used number of computers as a proxy for capital[7] and Kerstens et al. (2022); Agrell et al. (2020); Mattsson and Tidanå (2019) that considered office space for the same purpose.

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[6]Falavigna et al. (2015) considered a "bad output" using DDF, namely "Time needed to solve a tax controversy"
[7]Deyneli (2011) also used level of computerization but in a Tobit Model (2nd stage)

2.4 Main policy implications from the literature

On previous studies many questions were raised on the implications of DEA and econometric analysis in the judiciary. Of those, six were considered especially important, namely "***Does size matters?***", "***Are reforms effective?***", "***Are specialized courts better than non-specialized***", "***How homogeneous is the efficiency within the same country?***", "***What are the country factors that affect efficiency (just for inter-country comparisons)?***", and "***How can judiciary efficiency be improved?***".

For the first question on whether the size is an important matter, the results are polarized into "Large is better" and "Small is better". For the former, Kittelsen (1992) found scale inefficiencies mainly associated with small courts; De Sousa et al. (2005) say that small courts tend to be more inefficient than its larger counterparts; Santos and Amado (2014) agrees with the previous, finding that smaller courts are less efficient than larger courts. Kerstens et al. (2022) approach is different, but found that in mergers in Swedish courts some evidence of efficiency improvement is found. Besides, they also found that horizontal mergers improve plant capacity utilisation. For the latter, Peyrache and Zago (2016) state that 35% of total inefficiency of the judiciary is due to size and together with reallocation of inputs, splitting large courts leads to higher efficiency scores. Tulkens (1993) says that most inefficient units are middle size courts as measured by clerical staff.

Regarding the second question, Hagstedt and Proos (2008) concluded that in Sweden, the reform program (reducing the number of existing courts) has improved the relative efficiency of most district courts.

The third question is answered mostly by Elbialy and García-Rubio (2011); Pereira and Wemans (2017). The first found that criminal district courts are more efficient (mean efficiency 68%) than their corresponding civil district courts (mean efficiency 64%) belonging to the same FICs even after the reform program, and that higher shares of criminal case load tend to reduce court inefficiency, while more civil and tutelary caseloads do not influence court inefficiency. The latter authors underline the positive effect on judges' productivity when cases are judged in courts where the vast majority of cases are in the civil area. Mattsson and Tidanå (2019) although not discriminating specifically the specialized vs non-specialized courts, argue that quality may be enhanced with a higher degree of specialization, and concluded that an efficiency improvement between 10,1%-19% may be achieved for 17,2% of the Swedish courts if those courts are merged based on economies of scope.

The fourth question found its conclusions mostly in Italy, with Falavigna et al. (2015) suggesting that Italy North-West is the most efficient geographical macro-area, followed by Peyrache and Zago (2016) stating that North Italy is more efficient than south and complemented by

Nissi et al. (2019), that show a more detailed decline in average level of services as you move from the North to the South and islands.

Regarding the fifth question, the work of Melcarne and Ramello (2015) reveals that a greater judicial independence positively affects the aggregate performance of the judiciary. On a similar note, Feld and Voigt (2003) further revisited in Voigt et al. (2015), highlight that *de facto* judicial independence increases the economic growth of a country, underlining the importance of the judicial in the economy, as stated in the beginning of this work.

The last question regards how judiciary efficiency might get improved. There is a considerable number of possible answers to this question. Reducing backlog may be a way of improving efficiency. Tulkens (1993) state that 70% of the backlog cannot be reduced with current inputs thus personnel increases seem to be justified; García-Rubio and Rosales (2010) found that efficiency improvements of Andalusian Civil First Instance Courts may help reduce the pending cases at most 10% (9.38%), which means that efficiency improvements will not entirely fix the problem of backlogs for Andalusian Civil Jurisdictions. Espasa and Esteller-More (2015) argue that efficiency tends to increase over time, but that high efficiency is not necessarily good if courts' congestion is not controlled (relative efficiencies); Efficiency is also negatively affected the higher the percentage of work days of temporary workers. Bielen et al. (2018) say that reducing backlogs may negatively impact litigation rates in highly litigious independent judiciaries (hence hiring more judges might not suffice), whereas in regions with lower litigation rates, increasing judges' number (to reduce backlog) may be a good approach.

Another way of improving courts performance may be an increase in *support staff*. Indeed, Santos and Amado (2014) show that courts with a higher proportion of support staff perform better than courts with a higher proportion of judges. Pereira and Wemans (2017) results provided a positive effect on productivity with the increase of the number of employees per judge and Mattsson et al. (2018) suggest that flexibility, especially of smaller courts, might be achieved with the development of a back-up labour force, allowing adjustments to demand fluctuations.

Another measure for improving efficiency may be the reduction of *opportunistic behaviour*. This suggestion is brought by Finocchiaro Castro and Guccio (2014), showing that opportunistic behaviour from both claimants and lawyers negatively affects technical efficiency in Italian judicial districts. In the case of higher numbers of lawyers in a court of justice, the length of civil proceedings and case resolution may be negatively affected.

Increasing judges' salaries and quality is considered by Deyneli (2011) (the salaries increase) as significant for the efficiency of courts, but certainly not the sole solution for justice services efficiency. Although having PhD does not guarantee *per se*, that a judge is better than the other,

Schneider (2005) concludes that the more PhD holders judges, the better the efficiency of those particular courts.

Legal system simplification is a criteria explored by Di Vita (2010) who state that reduction in legal complexity, (e.g., 10% decrease in existing laws) is expected to drop the average duration of civil proceedings in a potentially greater deal than increasing expenditures in social security, judges' productivity and/or reduction of the pending suits stock. This idea was also underlined in Elbialy and García-Rubio (2011) conclusions, where they say that civil cases are less efficient than criminal ones due to the generally requirement of higher qualifications and experience from judges to finish the cases (subsequently meaning that civil cases are more complex than criminal). The authors go further by saying that governments tend to give special attention to penal cases as "they show the degree of judicial stability of the country" resulting in a beautified picture of the country for the international community.

Finally, another possible form of improving courts' performance is through *peer comparisons (managerial and organizational)*. Although it is not easy to determine the specific features that make a court better than the other, Mattsson et al. (2018); Mattsson and Tidaná (2019) insist on the need for inefficient courts to learn from the efficient ones in terms of organization and managerial capabilities. These terms are not reflected in the raw data, as it is very hard to grasp this as a quantitative data, but the gaps presented in the various analysis can be tackled by information sharing[8].

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[8]For courts with roughly the same inputs but different outputs, this learning might be done as simply as through "processes watching". This disregards though, aspects such as staff quality (it assumes every staff member produces the same).

3 Methodology

3.1 *Data Envelopment Analysis*

First introduced by Charnes et al. (1978), DEA allows the computation of technical efficiency of Decision Making Units (DMUs). It has been used in many contexts and industries, as already explored in a survey from Liu et al. (2013). It allows the construction of a deterministic, non-parametric production frontier, which is used to compare the technical efficiency of the DMUs, based on the radial distance of each of those DMUs to the frontier. Although DEA is generally used in an input-oriented approach, as it is usually easier to control inputs over outputs, in the judicial scenario, changing the inputs is frequently not possible, as most of the time, those inputs consist on demand of the judicial services from the general public, and the staff members (judges and other staff (other staff will be represented as OS when in tables)) of the courts. Therefore, and as proposed by Farrell (1957) an output-oriented approach will be adopted here. DEA, as conceived by Charnes et al. (1978) adopts a constant return to scale (CRS) which assumes that an increase in inputs will generate a proportional increase in the outputs. In this study, two of the inputs will consist on judges and other staff. When labour is used as an input, it is not correct to assume beforehand that two workers will produce twice as much as one worker, especially in the judicial, where cases have different levels of complexities. Therefore, and as proposed by Banker et al. (1984), the model to use in this paper will be a DEA output-oriented with variable returns to scale (VRS), similar to Santos and Amado (2014):

$$
\begin{aligned}
\max \quad & \theta \\
s.t. \quad & \sum_{j=1}^{n} x_{ij}\lambda_j \leq x_{i0} \qquad (i,\ldots,m) \\
& \sum_{j=1}^{n} y_{rj}\lambda_j \geq \theta y_{r0} \qquad (r,\ldots,s) \\
& \sum_{j=1}^{n} \lambda_j = 1 \\
& \lambda_j \geq 0 \qquad (j,\ldots,n)
\end{aligned}
\tag{1}
$$

where the convexity restriction ensuring the VRS is $\sum_{j=1}^{n} \lambda_j = 1$. In (1), m is the number of inputs; s relates to the outputs; the number of DMUs is given by n and y_{r0} and x_{i0} are respectively the amount of output r generated by unit 0 and amount of input i used by unit 0, under assessment. λ_j is the intensity variable of DMU j that returns the weight being attached to each DMU j to form the efficient benchmark for the DMU 0 under analysis. θ is the score obtained from the solution of the model, where DMU 0 reached its maximum expansion rate of outputs without decreasing inputs. $1/\theta = 1$ if DMU is efficient while if this result is smaller than 1, it means that DMU is inefficient when compared with other DMUs.

Model (1) can be solved in relation to a pooled or meta-technology when $j = 1, \ldots, n$ represent all units observed over time. If units are somehow grouped by specific criteria (e.g. in our

empirical application we have different types of benches that may be desirable to also compare amongst themselves) we may consider a subsample of j, i.e. just those units belonging to a specific group. In the first case we obtain a meta-efficiency score (θ^M), while in the second case we obtain a group specific efficiency score (θ^G). Clearly the ratio between the two scores ($\frac{\theta^M}{\theta^G}$) yields a gap between the two frontiers and can be named frontier gap.

3.2 *Economies of Scope*

As mentioned before, Panzar and Willig (1981) developed the theoretical concept behind economies of scope, namely the cost efficiency behind a same firm producing two or more products with the same inputs (shareable inputs). In sum, as Morita (2003) described, the existence of economies of scope is expressed as $C(u_1, 0) + C(0, u_2) > C(u_1, u_2)$ where $C(u_1, u_2)$ represents the cost of producing u_1 and u_2 units of product A and B, respectively. What the author shows in his article, is that economies of scope do not rely solely on the information regarding input costs, but can also be applied to an efficiency perspective (related to DEA). Therefore, one may understand if there are improvements or not in the efficiency instead of cost savings. The main idea is to compare the frontiers of joint productions and separate production both given by DEA analysis. If a joint production increases the efficiency over an initial separate production, there are economies of scope. If the value remains the same then there are no economies of scope and if the efficiency decreases we are facing diseconomies of scope.

Both articles above-mentioned, take into account that economies of scope, although correct in theory, fail to provide the full scenario of firms, with concepts such as the existence of market pressure, monopolies, and other constraints. Although results are, in theory, correct, one must also take into account the environment in which the firms are inserted before taking a managerial decision regarding the results of an economies of scope analysis. In the present study, the joint production is represented by the generic benches, which deal with all types of cases, whereas the separate production are the courts that deal with only two or less than the 4 types of cases that are a part of generic. For example, some criminal benches also deal with civil cases (beside criminal ones), just as generic benches. Nevertheless they fail to deal with either labour or tutelary cases. The same happens with some of the remaining courts. Although criminal benches that solve both civil and criminal are already a joint production, since they do not have the maximum number of possible "products", namely labour and tutelary, they will still be considered as if they were a separate production against the generic benches. In the case of courts, the search for economies of scope is based on the potential cost saving and time savings within an integrated organization: The staff (judges and other staff)

is not specifically specialized which means that they could solve their own attributed share of cases or help clean the backlog of a specific type of case that is getting behind in efficiency. Besides, all the bureaucracy that goes hand-in-hand with judicial system could potentially be handled easier with investment in a central system that would streamline this process instead of relying on several different systems across different courts, especially when it comes to system interventions due to errors and other malfunctions. Cases are solved by judges, but they always have a support staff team behind. That team does not have a specific number, and depending on the case type, understanding if there are economies of scope could help not only assigning more correctly and in a more flexible way those human resource work forces, but also redesigning the courts' structure. In this specific study, only first instance courts are analyzed, but it is known the strong hierarchical structure of courts. Economies of scope could help reducing the transaction costs (essentially time) namely, the constant need to send a case appeal to an higher court, and back to the first instance in this endless "ping-pong" game as it is perceived by the general public, and often a root of dissatisfaction. Although courts are defined by some vertical and horizontal hierarchy of activities, the present study aims to understand mostly the horizontal situation. Since the data used is only relative to first instance benches, a correct vertical analysis would not be possible.

For this study, neither Morita (2003) nor Mattsson and Tidanå (2019) approaches to economies of scale are possible. The linear programming functions that assess all units in relation to the diversified group frontier to work properly, are undefined for many cases when some inputs and outputs are zero. Zero values happen because some benches do not deal with some type of cases. This will result in an overwhelming number of undefined efficiencies, that lead to no conclusions. To tackle that situation, economies of scope will be considered with the concept of frontier gap. This means that, when this ratio is closer to 1, the within-group frontier is closer to the meta-frontier. This approach will allow an analysis that could potentially reveal the true efficiency of a group by comparing its within-group frontier (not affected by others) with the meta-frontier (composed by every bench and affected by every bench as well), and a differentiation between generic (non-specialized) and the remaining bench types (specialized).

4 The Portuguese System and Data

4.1 Portuguese judicial system structure

Portuguese Judiciary system is administrated by the Ministry of Justice (government department) but unlike other countries, the head of that department does not exercise any authority over the Public Ministry nor heads the public prosecutions[9]. Courts themselves may be divided into 4(5) different larger categories (orders), Constitutional, Judicial, Administrative, and Auditing (the fifth, Military, was extinguished in 2003, but may be re-established in times of war[10]) and 3 minor jurisdictions, Peace Courts, Courts of Arbitration and Ecclesiastical Court. This paper handles only the Judicial courts which are hierarchically divided into, The Supreme Court of Justice (as its decisions are final in terms of Law, it is only possible to appeal to the Constitutional Court), Courts of Appeal (which handle the appeals from Courts of First Instance), and Courts of First Instance. The latter will be the sole focus of this analysis. As stated before, Santos and Amado (2014) uncovered some issues regarding the scale of courts which were considered in the reform of 2014 where some courts (below 250 cases yearly) were extinguished resulting in 23 general jurisdiction constituencies (*comarcas*) that deal with generic or specific competence cases[11]. Those constituencies are yet divided into Municipalities which subdivide into benches (*Juizos*). The latter comprise the division between specialized competence, generic competence, and proximity. Specialized competence benches deal with cases according to their proximity, namely central civil and criminal, local civil and criminal, local minor crimes. The remaining benches are criminal prosecution, labour, tutelary, commerce, and enforcement. In 2016, some of those changes were undone with Decree-Law 86/2016, more precisely the reactivation of the extinguished courts, based on the assumption that some population access to justice was compromised. According to Commission (2022)[12], Portugal has been improving in the past few years, nevertheless, concerns about the adequate number of human resources and transparency remain.

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[9]Public prosecution is assured by a government-independent body of magistrates headed by the Attorney General's Office.

[10]Their military judges were incorporated in Judicial Courts and together with civil judges, they handle military crimes within "Collective Courts".

[11]As a rule of thumb, bigger constituencies handle specific competence cases while smaller ones deal with generic.

[12]Portuguese specific chapter

4.2 Data

As previously mentioned, the data used for this study consists of all Portuguese first instance benches from 2015-2021. It was opted to leave military benches out, as they are only used in some special occasions and it is believed that a comparison of those with the remaining would not benefit the analysis. For the sole purpose of simplification, first instance benches of the labour-penal category, were considered as criminal benches (closer category in terms of case type). After the data was cleaned of some errors such as absolute zeros in judges / staff and cases, 3,365 observations remained (*R* software was used for both this purpose and data manipulation). The data were provided by the Portuguese Directorate-General for Justice Policy' statistics[13]. For the study at hand no benches were considered as outliers, therefore, there are benches with less than 100 cases incoming or solved whereas bigger benches have over 200,000 cases. In previous studies, such as Santos and Amado (2014), outliers were removed, but as discussed above, Portuguese justice reform of 2014 in which courts with less than 250 cases were first removed, was overturned in 2016 and those courts were reinstated. Therefore, a small number of cases alone should not be a justification to remove benches. As Schneider (2005) mentioned, justice efficiency depends mostly on its ability to answer demand, which in this case is the incoming number of cases or the ones pending from previous periods, independently of the amount.

Benches analysed can be of several types, regarding their specialisation. The Portuguese system considers 11 types of benches: generic, central civil, central civil and criminal, central criminal, civil, commerce, criminal, enforcement, tutelary, minor crimes, criminal instruction, and labour. The 11 types of benches were aggregated, for purposes of this study, into a smaller number of groups, based on the type of case they handled: Agg_Civil (which contemplates central civil and civil), Agg_Criminal (which contemplate all criminal types of benches), generic, labour, enforcement, commerce, and tutelary. This results in 7 different groups of benches, that deal with different mixes of the 4 types of cases (civil, criminal, labour and tutelary). Although enforcement and commerce (e.g.) deal with civil cases, just like the benches in Agg_Civil, it is clear that the procedures are different in each situation, therefore this separation is kept.

It is commonly accepted to assess courts efficiency using Clearance Rate (CR) (Cases finished / cases entered) and Disposition time (DT) ((pending cases / finished cases) * 365) but those measures consider no weights whatsoever, like the ones measured through, for example, DEA. Therefore they are usually seen as descriptive information about the judiciary. Table 1, was retrieved from same place as the remaining data, Portuguese Directorate-General for Justice Policy's statistics, and contains the CR and DT for the different case types for the years 2015-2021.

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[13]https://estatisticas.justica.gov.pt/sites/siej/pt-pt

	Civil		Criminal		Labour		Tutelary	
	CR	DT	CR	DT	CR	DT	CR	DT
2015	127%	824	98,39%	226	118,50%	234	121,52%	220
2016	146,44%	709	113,91%	171	104,75%	214	116,86%	184
2017	141,00%	669	114,99%	153	105,14%	181	112,46%	160
2018	137,69%	622	103,88%	171	105,52%	169	105,89%	167
2019	121,06%	421	103,40%	154	99,79%	179	100,50%	163
2020	124,17%	650	93,88%	234	89,59%	314	100,18%	200
2021	122,56%	597	101,10%	188	104,80%	206	103,31%	178
Average	131,49%	642	104,22%	185	104,01%	214	108,67%	182

Table 1: Descriptive summary of Clearance Rate and Disposition Time from year 2015 to 2021

When considering DT, the lower the value, the better, as it considers how long a bench takes to finish a case. Looking at Table 1, it is possible to see that on average, civil cases take longer to solve than all the remaining case types together. Tutelary and criminal cases have the lowest values. If one disconsiders year 2020 (COVID-19 pandemic), it is possible to see that DT was decreasing over the years for most of the case types, and it is believed that year 2021, although having lower values than 2020, is still a repercussion of what happened in the previous year. As for CR, it is the ability of courts to deal with the incoming cases and therefore its values should aim to be higher than 100%. Values over 100% mean that courts are dealing with backlog of cases, which is one of the main goals. Although the DT apparently shows an increasingly better efficiency of Portuguese courts (as they are dealing with cases faster), CR says the opposite. Looking at 2015 and 2016, the values became better for both civil and criminal cases and worse for labour and tutelary, which might indicate that courts decided to pinpoint their attention to the former two types of cases over the latter ones. But through the years of 2016-2021, CR values kept decreasing tendency, which indicates that although courts are dealing with cases faster, they are finishing less cases. Nevertheless, while the values remain above 100%, this decrease should be seen as critical.

The inputs considered for the study at hand, consist of incoming plus pending cases of the 4 different types (civil, criminal, labour, and tutelary). To this, staff was added as judges and Other Staff. As outputs, cases resolved of civil, criminal, labour and tutelary types were considered.

A descriptive summary of the variables used may be found in Table 2[14].

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[14]As this analysis is being done at the most disaggregated level, the zeros found in medians are expected as there is a majority of benches that do not deal with some type of cases

		Average per bench	Median	Standard Deviation	Min	Max	Average per year
				Years 2015 - 2021			
Inputs	Judges	2.6	2	2.62	1	33	1249
	Other Staff	8.59	6	7.45	1	80	4131
	Civil Incoming&pending	2,376.13	479	9,743.92	0	184,937	1,142,241
	Criminal Incoming&pending	248.06	43	585.62	0	8,473	119,247
	Labour Incoming&pending	160.83	0	620.98	0	6,929	77,315
	Tutelary Incoming&pending	178.33	0	634.62	0	7,911	85,728
Outputs	Civil Finished	931.95	266	2,776.42	0	46,383	448,001
	Criminal Finished	170.27	32	377.68	0	4,461	84,851
	Labour Finished	104.59	0	418.28	0	5,016	50,278
	Tutelary Finished	125.99	0	435.64	0	4,462	60,566

Table 2: Descriptive summary of variables (Inputs/Outputs) from year 2015 until 2021

Looking at Tables 3 and 4 it is possible to see that in Portugal, on average, the majority of incoming&pending cases are civil (1,142,241) followed by criminal (119,246), tutelary (85,728) and finally labour (77,315). The same happens with finished cases where the values are 448,001; 81,851; 60,566 and 50,278, respectively. It is not surprising then to say that in what concerns finished cases (outputs), civil cases represent 70% of the total cases. Nevertheless, if one divides the finished cases by the incoming cases, the ratio of cases finished per cases incoming&pending shows that civil occupies the worst place with only 39% of the incoming&pending cases finished, whereas tutelary jumps to first place with 71% of the incoming/pending cases finished.

Considering a more focused analysis year-to-year, also described in Tables 3 and 4 we found an average of 1,423,530 cases incoming plus pending (inputs), but one can see a clear decrease over the years being the max value found in 2015 (1,916,236) and minimum value found in 2021 (1,006,550). This decrease is also true for the number of judges and other staff, where the averages are 1,249 and 4,131, respectively (this might be one of the reasons why Clearance rate discussed above is also decreasing). Regarding cases finished (outputs) the numbers differ. The average of cases finished is 640,698, but although year 2015 is still the year with most cases finished (746,013) the year with the least number is year 2020 (467,248). Relevant to say as well that cases finished dropped from 2015 to 2018, but in 2019 increases nearly to numbers of 2015. Year 2020 could be seen as an outlier due to the COVID-19 pandemic. Nevertheless, it was opted to keep this year's information in the overall analysis, as the pandemic affected everyone and not just some industries, benches, courts, regions, or countries. Of course, it is possible to say that some dealt with it better, but that could be a possible pertinent analysis to be done in the future, as in who had the right tools to deal with crisis periods and how others could learn from them.

Year	Inc&pen Civil	Inc&pen Criminal	Inc&pen Labour	Inc&Pen Tutelary	Total Inc&Pen cases	Judges	Other Staff
2015	1,575,861	152,220	77,622	110,533	1,916,236	1,308	4,237
2016	1,358,492	144,726	8,1792	98,025	1,683,035	1,269	4,143
2017	1,201,190	124,184	85,435	87,575	1,498,384	1,265	4,189
2018	1,065,439	119,630	77,528	79,038	1,341,635	1,231	4,202
2019	1,113,381	117,217	77,639	81,985	1,390,222	1,219	4,151
2020	893,000	103,163	67,791	71,691	1,135,645	1,222	4,040
2021	788,324	73,585	73,395	71,246	1,006,550	1,226	3,954
Average	1,142,241	119,246	77,315	85,728	1,424,530	1,249	4,131

Table 3: Year-to-year descriptive summary of inputs

Years	Fin Civil	Fin Criminal	Fin Labour	Fin Tutelary	Total Fin Cases
2015	517,521	98,610	52,303	77,579	746,013
2016	517,167	96,291	53,112	72,149	738,719
2017	472,560	89,711	57,136	65,992	685,399
2018	435,681	79,278	54,981	56,422	626,362
2019	546,646	77,860	52,075	56,972	733,553
2020	327,977	58,771	34,243	46,257	467,248
2021	318,458	72,439	48,099	48,593	48,7589
Average	448,001	81,851	50,278	60,566	640,698

Table 4: Year-to-year descriptive summary of outputs

The distribution of benches, seen in Table 5, as expected, not balanced with 57,41% of benches in the Coast zone, whereas 36,26% are related to Countryside and around 6,33% in the Islands. When it comes to regions, the distribution is of 34% benches in the North region, 28% in the Center, with 16% in the AML, 10% in Alentejo, followed by 6% in the Islands, and 5% in the Algarve region. A visual distribution of these values (absolute values) is also found in Figure 2.

Primary Location	Coast zone	Countryside	Islands	% of Total
North	20%	15%	0%	34%
Center	15%	13%	0%	28%
Área Metropolitana de Lisboa	16%	0%	0%	16%
Alentejo	1%	9%	0%	10%
Islands	0%	0%	6%	6%
Algarve	5%	0%	0%	5%
Grand Total	57,41%	36,26%	6,33%	100,00%

Table 5: Bench distribution based on locations

In terms of benches distribution according to their specialization, Figures 1 and 2 clearly show that Countryside holds the highest number of generic benches, while North zone has the highest number in every bench specialization except for generic, which are more concentrated in the Center region.
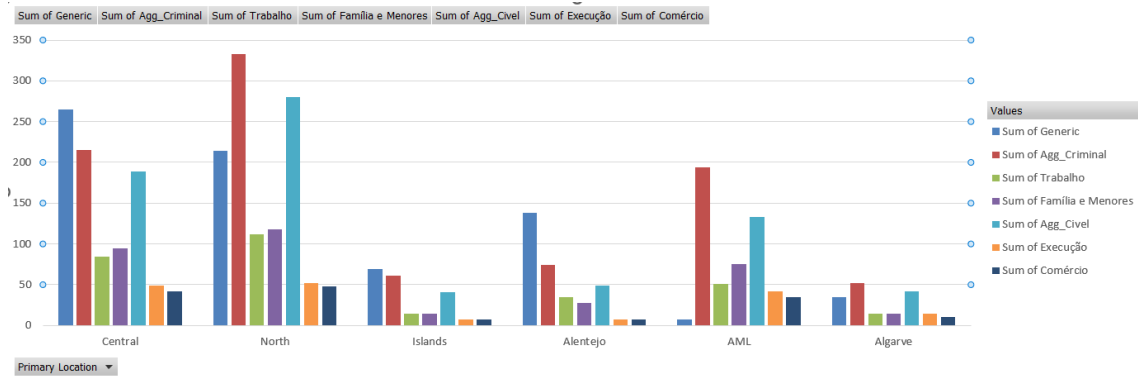
Figure 1: Distribution of benches according to location (North, Center, AML, Alentejo, Algarve, Islands)
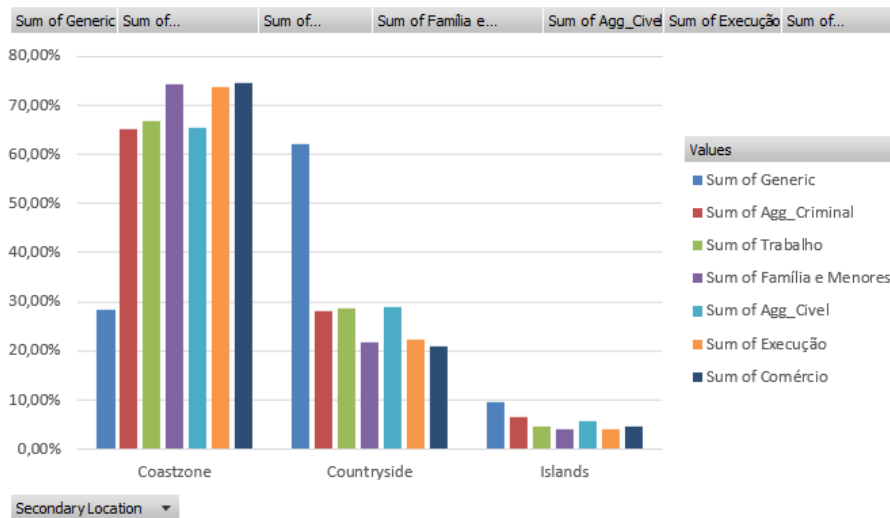

Figure 2: Distribution of benches according to location (Coast zone, Countryside, Islands)

5 Results

Even considering that the data analysed is in the most disaggregated level (benches), several types of results were drawn with different level of aggregations. The DEA analysis performed with all data pooled together, demonstrated that over the years the efficiency of courts did not suffer great changes, as seen in Table 6. We will call the efficiency scores computed in relation to the pooled frontier the 'Meta-efficiency' scores. It is possible to see that year 2020 has the lowest value, but since that year is the year where COVID-19 pandemic reached its peak, it is expected for a reduction of efficiency, just as in 2021 is expected that an extra effort was made by the professionals to deal with cases pending from the previous year. In this particular analysis, year 2021 is not removed, just because if it was indeed an effort made by professionals, then it means that those results are possible in other years as well, with the "right motivation". Therefore, one can see that (without considering year 2020) the efficiency varies in a range of around 5%, from 67,39% (year 2018) to 72,35% (year 2021)

Years	Count of benches	Average of Efficiency
2015	466	71.57%
2016	467	71,19%
2017	472	70,74%
2018	474	67,39%
2019	494	69,86%
2020	495	59,94%
2021	497	72,35%

Table 6: Efficiency over years

The same analysis focused on the different aggregated specializations instead of the years may be seen in Table 7. It is possible to see that enforcement benches have the worst efficiency, while labour and tutelary have higher values of efficiency. One of the main reasons for this is the sense of urge in finishing cases regarding labour and tutelary. The former regards with the economic safety of the population as well as the economic health of the country itself. The latter deals with divorces (e.g.), which often involve children, therefore it is of utter importance to deal with these cases as fast as possible. Enforcement very often deal with companies and these processes tend to be stretched out through time by both lawyers and stakeholders to avoid potential fines, increase gains, among other interests.

	Specialization	N. observations	N. Efficient	Avg Judges	Avg OS	Avg OS per judge	Avg Meta Efficiency
Central	Agg_Civil	168	0	4,90	9,44	1,93	45,84%
	Agg_Criminal	217	2	5,78	12,15	2,10	52,46%
Non Central	Enforcement	171	9	3,06	12,04	3,9	57,85%
	Agg_Civil	566	10	2,58	7,00	2,71	63,14%
	Commerce	149	5	3,53	15,25	4,3	69,21%
	Generic	728	20	1,30	5,14	4,0	69,48%
	Agg_Criminal	712	74	2,42	9,37	3,87	76,63%
	Tutelary	344	23	2,45	11,28	4,6	77,83%
	Labour	310	43	2,07	6,82	3,3	81,08%

Table 7: Efficiency by Specializations

Table 7 also allows to infer that Central courts have lower efficiency than the remaining. These Central courts only exist in major cities, district capitals and a few others. Besides, the cases dealt in these courts are only civil and criminal. This leads to two conclusions, firstly, civil and criminal cases tend to lower the efficiency of courts, and secondly when civil and criminal cases are dealt in central courts of bigger cities, their efficiency is even lower. This may be explained as, usually, bigger cases in terms of complexity are redirected to these courts given their allegedly higher capacity in terms of resources. Given the results, one can not say for sure that the results would be different if the cases were not redirected this way, but one can say for sure that that is lowering efficiency of courts (looking at Central Agg_Civil, one can see there is no efficient benches in the 168 observed). Besides the specialization and centrality of benches, it is also possible to notice that the ratio of Other staff per judge is the lowest in central benches, which also parallels with the lowest efficiencies. That is also noticeable between Central Agg_Civil and Agg_Criminal, where the latest has a higher ratio and higher efficiency. Non Central benches, have a higher ratio of Other staff per judge, but while their efficiency is higher than Central benches, both enforcement and labour benches values for this ratio, do not allow the same inference.

The benches were then divided into 3 categories given their efficiency, namely P1 if they had efficiency below 33%, P2 if the efficiency was between 33% and 66%, and P3 if their efficiency was higher than 66%. The average data regarding inputs and outputs was normalized using means and the results may be seen in Figure 3.

Once again it is possible to see that most inefficient benches (P1) are the ones that have the highest number of incoming&pending civil cases as well as the ones that resolve more civil cases. P1 courts also have the larger amount of judges but are, by far, receiving and solving much more civil cases. It is also possible to see that courts in P2, although not the most efficient, tend to be very balanced in all aspects. P3 courts have the lead in Other staff, seen in Figure 4, but generally differences in staff are not very relevant between efficiency bands. The main
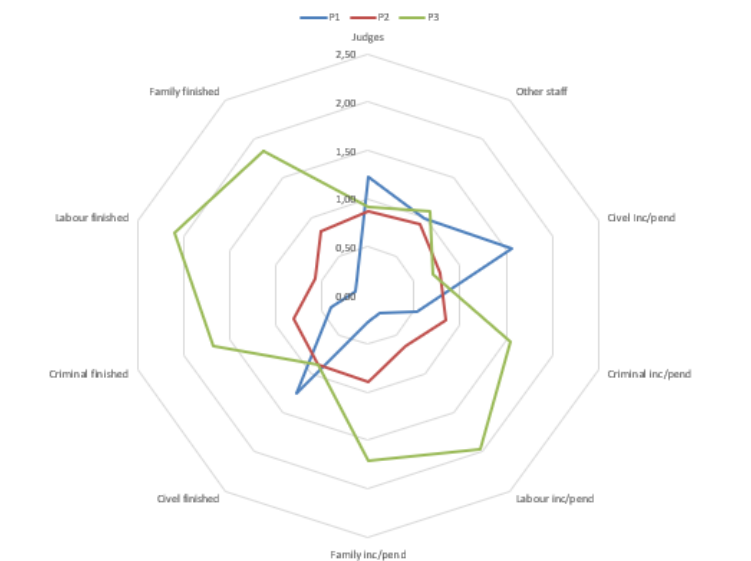
Figure 3: Distribution of inputs/outputs per Category

difference between bands regards the mix of cases, as indeed P3 benches do receive/finish, on average, more cases than the remaining courts in tutelary, labour and criminal classifications, while receiving the least number of civil cases.

An analysis was also conducted considering location of benches. Two types of locations were considered, namely a first level of aggregation divided by North, Central, Área Metropolitana de Lisboa (AML), Alentejo, Algarve, and Islands, and a second level considering Countryside and Coast zone. The division of benches across these locations was done using NUTS II[15].

The results are shown in Tables 8 and 9, as a percentage of cases distribution per region and regions' efficiency. North shows slight advantage in efficiency when compared to other regions in the mainland, just like in Falavigna et al. (2018), but contrary to what was found in Italy, Islands have the highest efficiency. Besides, Italy biggest cities (population density) are concentrated in the North region, which does not hold truth for the Portuguese scenario. The efficiency of Countryside and Coast zone within these 4 categories is very balanced, not leading to any specific conclusion. Regarding the distribution of cases, also shown in Table 8, while having only 537 benches, AML is the region with most incoming&pending cases in every category except for labour cases. In Table 9, it is noticeable that, North with 1,157 benches, gets the lead in all finished cases except for criminal, where AML is slightly above. Although concentrating 939 benches, Center region only gathers between 16,62% and 19,32% of both incoming&pending and finished cases, which demonstrates the effect of demography (population density) in cases distribution.

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[15]More information may be found here https://www.pordata.pt/O+que+sao+NUTS
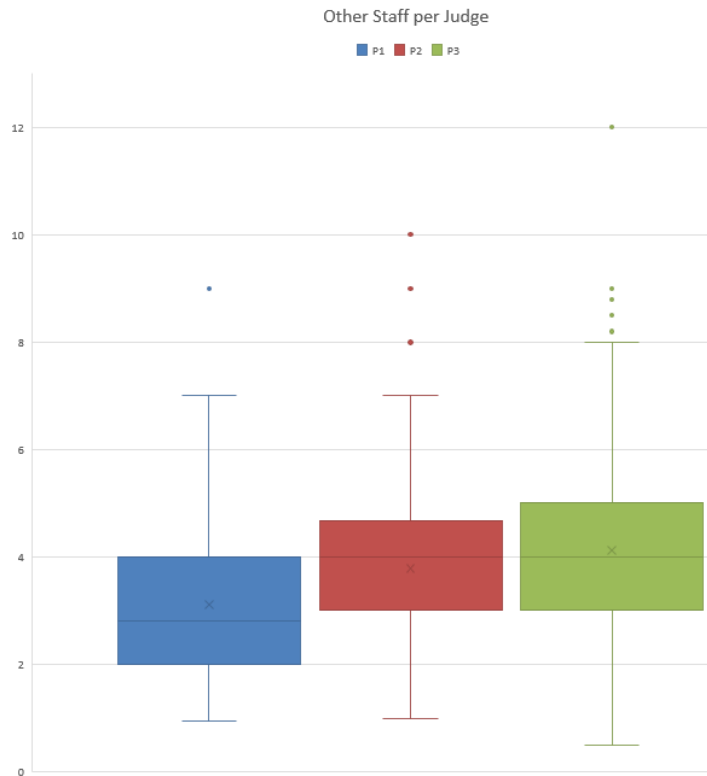
Figure 4: Other staff per judge per category

Location1	Location2	Count	Inc&pen Civil	Inc&pen Criminal	Inc&pen Labour	Inc&Pen Tutelary	Efficiency
Center		939	16,62%	18,34%	17,66%	17,63%	68,63%
	Coast zone	495					68,97%
	Countryside	444					68,26%
North		1,157	30,73%	29,33%	47,24%	31,01%	69,73%
	Coast zone	669					69,45%
	Countryside	488					70,10%
AML		537	39,98%	33,47%	25,09%	35,66%	68,19%
Alentejo		338	3,66%	6,42%	4,59%	6,36%	69,24%
	Coast zone	50					69,99%
	Countryside	288					69,11%
Algarve		181	4,94%	7,95%	2,62%	4,25%	63,88%
Islands		213	4,08%	4,50%	2,81%	5,10%	72,16%

Table 8: Benches, cases and efficiency distribution according to location (inc&pen cases)

Location1	Location2	Count	Fin Civil	Fin Criminal	Fin Labour	Fin Tutelary	Efficiency
Center		939	18,48%	19,32%	17,72%	18,82%	68,52%
	Coast zone	495					68,53%
	Countryside	444					68,51%
North		1,157	34,54%	30,56%	48,79%	33,08%	69,73%
	Coast zone	669					69,82%
	Countryside	488					69,56%
AML		537	32,70%	31,57%	24,47%	31,96%	68,19%
Alentejo		338	4,35%	6,47%	4,03%	6,36%	69,24%
	Coast zone	50					69,99%
	Countryside	288					69,11%
Algarve		181	5,02%	7,00%	2,40%	4,41%	63,88%
Islands		213	4,90%	5,08%	2,58%	5,37%	72,16%

Table 9: Benches, cases and efficiency distribution according to location (Finished cases)

The DEA analysis also produced what are called targets, that tell us how much benches could increase (decrease) their outputs (inputs) if they were to improve their performance to the level of the peer frontier benches. The results are shown in the Tables 10 and 11 according to specialization and total staff counting (judges&other staff), respectively.

	Agg_Civil	Agg_Criminal	Generic	Commerce	Enforcement	Tutelary	Labour	Grand Total
Count	734	929	728	149	171	344	310	3,365
Avg %var Judges	-21,43%	-19,87%	-5,26%	-4,96%	-8,11%	-8,71%	-6,96%	-13,46%
Avg %var Other staff	-4,52%	-8,96%	-4,47%	-11,95%	-6,06%	-16,18%	-4,49%	-7,33%
Avg %var Civil Inc&pen	-1,19%	-0,67%	-0,44%	0,00%	-4,53%	-0,79%	-2,93%	-1,13%
Avg %var Criminal Inc&pen	-53,85%	-1,09%	-0,14%	0,00%	0,00%	0,00%	-3,79%	-1,51%
Avg %var Labour Inc&pen	-0,02%	0,00%	-1,29%	-67,93%	0,00%	0,00%	-1,22%	-5,16%
Avg %var Tutelary Inc&pen	-2,19%	-21,90%	-1,04%	0,00%	0,00%	-1,23%	0,00%	-1,82%
Avg %var Civil fin	79,88%	59,91%	49,39%	53,42%	93,32%	45,09%	35,62%	59,65%
Avg %var Criminal fin	16,39%	53,16%	48,46%	0,00%	0,00%	0,00%	36,54%	48,66%
Avg %var Labour fin	35,26%	0,00%	58,07%	37,08%	0,00%	0,00%	28,53%	31,77%
Avg %var Tutelary fin	48,82%	29,53%	41,77%	0,00%	0,00%	33,21%	0,00%	37,91%

Table 10: Target variation according to specialization

Table 10 allows one to infer that, on average, benches could decrease by 13,46% and 7,33% the number of judges and other staff, respectively, without compromising the attainment of output growth targets. Regarding outputs, one could say that on average, benches could increase the percentage of finished cases, using the same inputs, by 59,65%, 48,66%, 37,91%, and 31,77% for civil, criminal, tutelary and labour cases, respectively. Regarding the specializations, civil and criminal benches, are the ones with the worst usage of Judges, as they could reduce by 21,43% and 19,87%, respectively, these inputs without compromising the growth expected in the outputs. Tutelary benches could reduce their other staff by 16,18% while commerce benches could do the same by 11,95% without compromising the attainment of output growth

targets. Looking at outputs it is clear that there is still some margin for improvement without considering extra inputs. Benches could improve by a minimum of 16,39% (civil benches solving criminal cases), to a maximum of 93,32% (enforcement benches solving civil cases).

	<= 7	<= 9	<= 11	<= 13	<= 15	<= 17	<= 25	> 25	Grand Total
Count	1,443	477	356	265	232	169	280	143	3,365
Avg %var Judges	-4,22%	-18,45%	-16,38%	-17,36%	-22,43%	-26,60%	-25,50%	-21,90%	-13,46%
Avg %var Other staff	-4,48%	-5,00%	-4,85%	-7,96%	-9,70%	-13,70%	-16,86%	-18,94%	-7,33%
Avg %var Civil Inc&pen	-1,07%	-1,54%	-1,34%	-1,15%	-0,61%	-1,73%	-0,55%	-0,99%	-1,13%
Avg %var Criminal Inc&pen	-1,11%	-0,84%	-1,19%	-2,11%	-1,45%	-0,57%	-1,03%	-13,94%	-1,51%
Avg %var Labour Inc&pen	-1,59%	-0,53%	-0,12%	-3,20%	-21,43%	-19,51%	-29,81%	-38,30%	-5,16%
Avg %var Tutelary Inc&pen	-2,18%	-2,59%	-0,29%	-0,14%	-0,21%	-1,70%	-2,39%	-1,75%	-1,82%
Avg %var Civil fin	51,81%	67,02%	68,29%	68,91%	72,38%	63,10%	60,28%	48,48%	59,65%
Avg %var Criminal fin	43,95%	53,71%	54,21%	50,43%	59,97%	53,50%	53,44%	40,97%	48,66%
Avg %var Labour fin	36,87%	29,18%	32,06%	16,96%	28,10%	31,22%	8,66%	26,24%	31,77%
Avg %var Tutelary fin	38,31%	43,67%	42,17%	39,72%	42,83%	33,51%	27,47%	19,51%	37,91%

Table 11: Target variation according to Total staff number

Regarding the variable Total staff number in Table 11, it is clear that benches with more than 15 total staff members tend to use them in a less efficient way than benches with less than 15 total staff members (judges average variation is above 20%, and other staff is mostly above 10% for those number of total staff). This leads to the same conclusion previously found by other authors, whose findings said that increasing staff does not necessarily imply efficiency proportional increases. Still regarding Total staff number, but considering outputs, it is possible to see that the output civil cases resolved has scope for improvement that has an inverted U-shape, while the output criminal cases resolved has scope for improvement below 50% when total staff number is both very low and very high, while the mid-sized benches (between 9 and 25 total staff members), have room for improvements above 50%. Benches dealing with either labour or tutelary cases, do not present a clear pattern as the ones explained above, but while tutelary values are more stable (closer to the average), benches dealing with labour cases, tend to vary much more (labour average is 31,77%, but minimum value is 8,66% and maximum value is 36,87%). This indicates that for labour situation, there might be benches with more efficient processes independently of their number of staff, and that their peers could consider learning those same practices (namely the benches within the category of <= 25 total staff number). Nevertheless, it is also possible to see that for all cases except labour's, benches become more efficient when staff is higher than 25 members, which also indicates that as benches grow in size (considering total staff number as a proxy of size), their margin for efficiency improvement decreases.

5.1 The specialization effect

The results of the frontier gap (ratio) and meta efficiency and within-group efficiency, may be found in Table 12.

Specialization	Count	Avg Meta efficiency	Avg Within-group efficiency	Avg Ratio(gap)
Enforcement	171	57,85%	61,06%	95,08%
Agg_Civil	734	59,18%	66,73%	89,18%
Commerce	149	69,21%	78,07%	88,84%
Generic	728	69,48%	84,54%	82,27%
Agg_Criminal	929	70,99%	73,03%	97,27%
Tutelary	344	77,83%	80,44%	96,85%
Labour	310	81,09%	86,68%	93,63%

Table 12: Meta Efficiency, Within-group efficiency and Gap per specialization

Looking at the results, one can notice that generic benches, which were above the average in meta efficiency, and had the second highest within-group efficiency, have the worst gap to the meta-frontier, which is 82,27%. This means that the frontier of generic benches are the farthest from the meta-frontier composed by all other benches. Looking closely, it is also possible to notice specialized benches, such as enforcement, labour, tutelary jumping into values above 90%. Agg_Civil, which, *per se*, is a mix of civil and criminal cases, is also one of the worst. Agg_Criminal, although being an aggregation of several benches, all of them deal with criminal, so it can be considered a specialized type of bench as well. Therefore, it is possible to conclude that the more specialized, the higher the efficiency of the benches, and so, there are reasons to believe that diseconomies of scope apply in the Portuguese judiciary.

In order to deeply understand how the diseconomies of scope were present, an analysis of the Gap was done according to two variables regarding number of judges and other staff ("disaggregation" of the variable total staff number used in targets analysis). Also, in order to avoid a biased analysis, only values whose number of observations (benches) was higher than 15 was considered. A summary of the values may be found in the Tables 13 and 14, for judges' number and other staff's number, respectively .

When considering the first variable, judges' number, generic benches efficiency decreases as judges increase, being the worst bench as well at every level. It is also possible to see that Agg_Criminal benches, tend to make an U shape with 98,45% efficiency when judges are = 1 and decreasing to 93,54% when judges <= 4 and increasing again as the number of judges increases to <= 10. Commerce benches follow an inverted U shape, starting with 86,76% efficiency with <= 2 judges, increasing up to 92,62% with <= 4 judges and decreasing to 91,44% with <= 10 judges. Just like generic benches, Agg_Civil benches, also decrease efficiency as judges' number increase, but they start at 92,35% efficiency and decrease to 86,75%. It is

then possible to see, that for specialized benches (especially the ones that deal only with one type of case (enforcement, tutelary and labour)), more judges tend to have a better impact at efficiency, while for non-specialized benches it is the opposite (even for benches that constitute the specialization of Agg_Civil).

Regarding the second variable, other staff's number, generic benches follow the previous tendency, starting with values around 83% and decreasing to 77,46%. For the first time, generic benches are better than commerce benches at <= 8 level, but after that, commerce efficiency surpasses generic's again. Agg_Civil benches have a potential U shape efficiency progression, starting at 92,52%, decreasing to 82,74% at <= 14 level and increasing to 87,41% when other staff is > 17.

	= 1	<= 2	<= 3	<= 4	<= 10	Grand Total
Agg_Civil	92,35%	90,11%	87,05%	87,07%	86,75%	89,18%
Agg_Criminal	98,45%	98,47%	96,39%	93,54%	97,72%	92,27%
Generic	83,69%	78,96%				82,27%
Commerce		86,76%	91,01%	92,62%	91,44%	88,84%
Enforcement	92,90%	92,26%	97,77%	99,60%		95,08%
Tutelary	94,72%	95,49%	98,82%	99,93%	99,94%	96,85%
Labour	93,54%	92,94%	95,15%			93,63%

Table 13: Gap analysis considering Judges' number

	<= 5	<= 8	<= 11	<= 14	<= 17	> 17	Grand Total
Agg_Civil	92,52%	87,63%	85,24%	82,74%		87,41%	89,18%
Agg_Criminal	96,79%	95,39%	97,05%	99,57%	99,49%	99,89%	97,27%
Generic	83,32%	80,99%	77,46%				82,27%
Commerce		78,99%	87,73%	93,07%		89,72%	88,84%
Enforcement	86,45%	94,79%	94,47%	98,57%		99,76%	95,08%
Tutelary	93,23%	97,58%	95,87%	98,59%	98,95%	99,95%	96,85%
Labour	92,35%	93,95%	96,54%				93,63%

Table 14: Gap analysis considering Other staff's number

6   Discussion

Based on the results achieved, it is possible to answer some of the questions raised in section 2, namely the first, the third (to be seen as a result of the study itself), and fourth question. Regarding the first question, "Does size matters", one can see that central benches tend to deal with more cases, but have lower efficiencies. This idea is somehow biased in the sense that central benches only deal with criminal and civil cases (that tend to lower the efficiency, mainly the civil cases), whereas other benches such as labour or commerce, do not have neither those type of cases nor central vs non-central differentiation. Nevertheless, it is possible to see that centrality of benches (associated with demand size) seems to negatively influence their efficiency.

Considering the fourth question, mainly tackled in Italy by Falavigna et al. (2018); Peyrache and Zago (2016); Nissi et al. (2019), it was seen that in Portugal, Islands have the higher efficiency, although having a small number of benches and share of cases. On the mainland, North has the highest efficiency and overall it decreases as one moves to the South (exception made to Alentejo, where half of the benches are composed by generic benches, which results in an efficiency average closer to the generic's one (69,48% is the generic efficiency while Alentejo is 69,24%). Despite this, the efficiency varies very little throughout Portuguese regions, and even when considering countryside with coast zone, the results are very close by.

This paper proposed to analyse efficiency of Portuguese first instance benches using DEA for the years of 2015-2021, and uncovering whether there were or not economies of scope in the Portuguese judicial structure. Regarding the former, it was possible to see that efficiency was, on average 68,97%, and while it was decreasing until 2018, were not for the Covid-19 pandemic, and looking at 2019 and 2021 results, one have reasons to believe that it was assuming a growing trend. When analyzing efficiency of the different specializations, those who dealt with civil cases had lower efficiencies, reasoning the belief that civil cases tend to lower efficiency of courts. The proximity level of benches also had an impact on efficiencies, with central benches having, on average, lower efficiency than the non-central. Still related with efficiency, it was also noticeable the impact of other staff in the efficiency of benches, namely the number of other staff per judge, where benches with a higher ratio, tend to have higher efficiency. Using targets' analysis, it was also possible to infer that without yet considering increased expenses on inputs, it is possible to decrease on average 13,46% the amount of judges and 7,33% the amount of other staff, maintaining the current efficiencies. This means that there is still room for saving / redistribution of human resources, which could potentially lead to efficiency increases. It is also possible to see that on average, benches could finish above 30% of each case type with current inputs. This means that there is still potential room for improvement on Portuguese

benches efficiency without yet considering increasing expenses on judiciary.

Considering the question whether Portuguese judicial system had or not economies of scope, it was found that Portuguese judicial system actually has diseconomies of scope. This means that generic benches tend to be further away from the meta frontier than the specialized benches. It is also seen that increasing judges in specialized benches tends to improve efficiency while for generic benches it is the opposite. For commerce and Agg_Criminal benches, there might still be some interest in understanding whether there are or not optimal values of judges, as the efficiency levels are not stable. These results also tackle the third question raised in the previous literature. Just as Elbialy and García-Rubio (2011) found, benches dealing with criminal cases are more efficient than the ones tackling civil cases, but when benches deal with all cases together (generic benches) their efficiency lowers (they get further away from the meta frontier). These results also go hand-in-hand with Mattsson and Tidanå (2019) results, that provided similar results for Swedish courts.

7 Conclusion

This paper uncovered some issues that need some careful attention from decision makers, in order to perceive whether the system would benefit from increasing the specialization of benches or not. It would be beneficial, in the future, to understand, if there would be a positive impact in efficiency (or not), by reassigning judges to different case types when trying to take advantage of the economies of scope results. It is important to notice though, that judges working for too long in one type of case, might produce worse results if they have to suddenly start solving cases of different types and complexities (although they have the tools to do so) than the ones solved until now, and that such approach would require some time to produce the desired effects. It would also be interesting to continue this investigation regarding other staff structuring and distribution, namely if there are optimal levels of staff for benches (according to their size, as it was seen previously, some benches had U-shape efficiencies varying with the number of staff) and if some flexibility in this human variable would or not benefit the judicial system.

Regarding efficiency overall analysis, this paper jumped an intermediary level between courts and benches, which are the municipalities. Since the economies of scope faced some challenges regarding the existence of zero values in inputs/outputs, it would make sense to try a further study that would consider a different level of aggregation and that could potentially avoid their existence (of zeros) and provide more clear and specific results regarding economies of scope.

Finally there is still a relation that was not performed in this study, namely if there are other societal-economical factors that impact benches efficiency. This study started with the mention to the umbilical relation between countries' judicial system and their economic development, therefore, it would be of utter importance to continue this investigation, using regression analysis and try to understand if there is some relation between, for example, unemployment and labour benches efficiency, divorce rates and tutelary benches efficiency. This would allow not only to tackle the current status of those relations and seek to improve benches efficiencies according to the findings of that analysis, but also the creation of prevention mechanisms to answer predictable changes in the environment during financial crisis, wars, pandemics, among others.

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