CLUSTER ANALYSIS OF EUROPEAN COUNTRIES BASED ON THE JUDICIAL COURTS' PERFORMANCE

Mária Stachová – Ján Huňady

Abstract

With the increasing need to improve the efficiency, transparency and quality of the courts, more attention is paid to monitoring their performance. Our paper aims to classify selected European countries based on similar patterns in the performance of courts at the second instance and supreme courts into clusters. Our approach will allow us to evaluate the strengths and weaknesses within relatively homogeneous groups of countries. To perform such classification, we applied cluster analysis on the dataset from the European Commission for Efficiency of Justice (CEPEJ). In the first stage, Principal component analysis (PCA) has been used to deal with the correlated variables. Next, we performed K-means clustering based on Euclidian distance and using a set of input variables, the first five principal components. We identified five clusters. Slovakia and the Czech Republic were included in the same cluster, which also comprises most of the European countries. On the other hand, Hungary is placed in a separate individual cluster. Interestingly, one of the clusters contains exclusively Slovenia, Croatia, Montenegro and Bosnia and Hercegovina. The achieved results also allow us to evaluate the situation in Slovakia compared to other countries.

Key words: cluster analysis, performance of courts, judicial efficiency, budget of courts, clearance rate.

JEL Code: C38, D63

Introduction

With increasing pressure on public budgets, the assessment of performance and economic efficiency in the public sector became even more important. In several areas, such as education, healthcare and especially infrastructure development, the evaluation of effectiveness is considered to be the standard. On the other hand, in the field of justice, these procedures are significantly less common. This is partly due to the specific nature of the field as well as missing complex datasets contacting key performance indicators. However, in recent years the situation has improved significantly. The Council of Europe European Commission for the Efficiency of

Justice (CEPEJ) has made significant progress in the collection and standardization of internationally comparable data on judicial systems from European countries. This allows comparison and assessment of courts in Europe while it takes into account some of the limits of comparability. This is an important topic in the field of economic as well as justice research. Our study uses CEPEJ data to analyze data and evaluate the performance of courts in European countries. We focus our attention, especially on cross-country comparisons of efficiency, cost-effectiveness, and specific outcomes of courts. This research is important not only from a judicial perspective, but it has very significant economic and financial consequences. For example, the quality of the legal and judicial systems of different countries significantly affects the long-term choices of companies and their growth potential (Demirgüç-Kunt and Maksimovic, 1998). Furthermore, these differences can also affect financial development (Levine et al., 2000) as well as the development of the stock markets (Lombardo and Pagano et al. 1999).

The paper is primarily aimed at the classification of selected European countries based on similar patterns in the performance of courts at the second instance and supreme courts. We classified these countries into rather homogenous clusters based on the performance of their courts. Due to the data availability and better international comparability, we focus only on taking into account the courts of the second instance courts and supreme courts. The paper provides necessary findings for defining good practices and recommendations for public policies in the justice area of justice. The next section is dedicated to a literature review of previous research focused on the comparison and classification of countries based on their performance in the specific fields public sector with a specific focus on courts. The third section describes the methodology and data used in the analysis. In the fourth section, we show and discuss the most important results. Finally, we summarized the key findings and provided some policy implications.

1   Literature review

Despite slightly growing numbers of studies focused on the productivity and efficiency of courts in Europe there is still a wide space for research in this area. As far as we know there is no other research devoted specifically to the cluster analysis of countries based on the courts' performance on the same or similar cross–country data.

Since, the influential work of Choi and Gulati (2004) who evaluate the performance of the supreme court of Justice there have been several other works on the evolution of courts' performance in general. Despite some criticism related to the accuracy of their measures, their

concept has become a standard approach. Likewise, in the private sector, the processes in the public sector can be also seen as a combination of certain inputs and outputs. In the case of justice, the courts can represent the production units, whose main outputs can be measured especially by resolved cases (Rosales-López, 2008). From a broader perspective, we can distinguish five dimensions of judicial performance, namely efficiency, independence, accessibility, accountability, and effectiveness, which refers to the degree to which both legislation and judicial decisions are actually enforced (Staats et al., 2005). Our focus is especially on efficiency which can be sufficiently measured, analyzed and compared.

The international comparison of courts' performance is less common in literature. This can be due to the unavailability of comparable data and the potential limitation of such a cross-country approach. However, there are several studies dealing with this problem. One of the first comprehensive studies assessing the efficiency of courts in different countries is Dakolias (1999). The analysis is based on indicators capturing several cases, resolved cases and pending cases per judge and the cost of the case. The study compares these indicators for eleven countries on three continents. Some more recent studies are using the same data source as our research (CEPEJ data) to examine potential causalities or determinists of judicial performance. For example, Cross and Donelson (2010) used quintile regression to analyse the effect of different judicial resources on judicial quality in 29 countries. Authors found that especially the increase in the salary of judges can lead to improved judicial quality. Ippoliti et al. (2014) used the CEPEJ dataset to examine the potential relationship between judicial performance and entrepreneurship. Furthermore, Voigt and El-Bialy (2016) used the dataset to identify the determinants of aggregate judicial performance based on robust regression models. They consider indicators capturing the size of the court, budget, legal origin of the judicial system, training courses and other factors. Palumbo et al. (2011) compare judicial performance in different OECD countries based on the combination of data from the OECD, Doing Business dataset and CEPEJ. They found rather large cross-country variation in trial length in all instances. This gap between countries has been mainly attributed to the differences in investment in computerization, the systematic production of statistics and the active management of the progress of cases (Palumbo et al., 2011).

Most of the studies focused on the evaluation of judicial efficiency are based on the non-parametric technique of data envelopment analysis (DEA) such as example Giacalone et al. (2020), Falavigna et al. (2018), Yeung and Azevedo (2011) or Deyneli (2011). According to Giacalone et al. (2020), there is a distinct heterogeneity among courts in Italy, depending on their geographical location. Despite the wide usage of the DEA models in this field, the

interpretation of the results with respect to the efficiency of courts can be rather limited on an international scale. DEA is a more descriptive, rather than an analytical tool which shows the size of efficiency differences among the courts, but not showing the reason for these differences (Voigt, 2016). Moreover, the inputs and outputs are determined by the supply as well as the demand side. The demand for court services is an important factor in determining judicial efficiency (Voigt, 2016). Dimitrova-Grajzl et al. (2012) showed that the primary driving force of output in Slovenian courts is actually the demand for their services.

We decide to analyze the performance of the courts as a multivariate problem relying on the set of indicators. Our approach is dealing not only with the number of cases, but it is also taking into account the staffing and budget. With respect to the potential effect of staffing on performance, there is no consensus in the literature so far. De Oliveira et al. (2016) argue that the number of judicial assistants has a positive effect on the productivity of the court. Santos et al. (2014) found a statistically significant relationship between the efficiency of the court and its size and workforce compositions. On the other hand, Beenstock and Haitovsky (2004), do not find a statistically significant effect of judicial staffing on court output in Israel.

The use of cluster analysis in this field of justice is rather rare so far. Only a few studies examine the typology of judicial decisions based on statistical and machine learning techniques such as cluster analysis (Boyd et al., 2013) and decision trees (Kastellec, 2010). Giacalone et al. (2020) applied classification using the k-means on the Malmquist indexes and its components evaluating the efficiency of Italian courts. They also used principal component analysis (PCA) to illustrate the results in two dimensions. A similar approach has been used also in our case on different variables and different data. Hence, our research appears to be one of the first to deal with the performance of the courts from a cross-country international perspective and perhaps the pioneer study using cluster analysis to classify the European countries based on the performance indicators of their courts.

2 Data and Methodology

Our analysis is based on the cross-country dataset from the European Commission for the Efficiency of Justice (CEPEJ) database. The database is a valuable source of information for such international comparisons of courts' performance in Europe. The CEPEJ collects and provides data on a wide range of indicators related to the efficiency, quality, and fairness of the justice system in the member states of the Council of Europe. According to Voigt and El-Bialy (2016), the CEPEJ dataset is very detailed and relatively accurate for international comparison. Nevertheless, it is necessary to state that comparing data for courts from different countries

with different geographical, economic and legal situations is still a rather debatable task. The results have some limits in terms of comparability and therefore readers should approach them with caution. To be able to compare and interpret the performance of courts in different countries, it is necessary to keep in mind their specificities, which may explain some differences among countries.

The data in the database are obtained through the system of so-called CEPEJ national correspondents, who are persons designated by the Member States to collect relevant data related to their system and deliver it directly to CEPEJ. These persons are the main partners of the CEPEJ secretariat in quality assurance. National Correspondents collect and submit responses to questions under the Evaluation Scheme on behalf of Member States, Subjects and Observer States through an online so-called "CEPEJ collect". The reference year for the evaluation cycle used in the analysis is 2020, and the data collection period for this cycle lasted from March 19 to October 1, 2021. The current procedure used for the data collection and evaluation was revised in 2020 by the CEPEJ working group for the evaluation of justice systems and adopted by CEPEJ at its 34th plenary session on December 8. After the collection, the data has been further controlled by data quality to ensure coherence and reliability for analyses. The CEPEJ Secretariat verifies the accuracy and consistency of all data through dialogue with national correspondents, especially for answers that require additional. The methodology of data collection, control and distribution is described in more detail by the European Commission for the efficiency of justice (2016) and other publicly available sources. Due to the limited data availability and more accurate international comparability, we only analyzed the data for the courts of the second instance and supreme courts. All indicators used in the analysis are summarized in Table 1. The first indicator is rather straightforward it captures the number of resolved cases in both instances. Cases are further classified into criminal and non-criminal types. There are two main indicators of efficiency available for both types of cases, namely clearance rate and disposition time. CEPEJ uses clearance rate as its preferred measure of court performance. It is defined as the number of resolved cases divided by the number of newly filed cases. This measure is used for identifying those countries that creating a backlog (clearance rate under 100%) and those reducing their backlog. Disposition time (or duration time) is another indicator. It is supposed to estimate the time needed to terminate a case. However, in the case of the supreme courts, the clearance rate and duration time are only available for criminal cases. These measures are objective but share a common drawback: they do not account for the quality of decisions. A speedy trial can be sometimes achieved at the expense of a low quality. In order to get a broader perspective on factors affecting the decision

process we also included variables related to staffing and budgetary constraints. Number of judges per 100,000 inhabitants in the country and the budget of all courts on the GDP of the country.

Tab. 1: Description of variables used as the inputs into the cluster analysis

Variable name	Description of the variable
Resolved – courts of the 2nd instance	Overall resolved cases (criminal and non-criminal cases) at courts of the second instance.
Resolved – supreme courts	Overall resolved cases (criminal and non-criminal cases) at supreme courts.
Clearance rate: other than criminal - 2nd inst.	The clearance rate is calculated as the ratio of the number of resolved cases over the number of incoming cases. It indicates whether a court is keeping up with its incoming caseload. The indicators are included separately for criminal cases and non-criminal cases. For the supreme courts, we consider only the clearance rate of criminal cases (limited data availability).
Clearance rate: criminal cases 2nd inst.	
Clearance rate: criminal cases - supreme	
Disposition time/Duration time: other than criminal - 2nd inst.	Disposition time is calculated as the number of pending cases at the end of a year divided by the number of resolved cases within that year, multiplied by 365 (days in a year). This indicator estimates how many days should be needed to resolve the pending cases based on the current capacity. The indicators are included separately for criminal cases and non-criminal cases. For the supreme courts, we consider only the disposition time of criminal cases (limited data availability).
Disposition time/Duration time: criminal cases 2nd inst.	
Disposition time/Duration time: criminal cases - supreme	
Judges per 100000 inhabitants	Total number of judges at all these instances per 100000 inhabitants in the country - relative number of judges.
Budget on GDP	The share of overall courts' budget on nominal GDP of the country.

Source: Authors based on the CEPEJ (2023).

Our aim is to classify the observed countries into groups based on the similarities and differences in all variables defined in Table 1. In the beginning, to deal with the correlation between used variables, we applied principal component analysis. For our next step, we decided to use 5 principal components that capture almost 78% of variance and helped us to reduce also dimension of our data set. To classify countries into a homogeneous group we decided to use cluster analysis. Based on the best Silhouette index, we choose the K-means clustering algorithm with Euclidean distance measure. This algorithm uses iterative techniques as follows:

Let's have n observations that we want to divide into pre-specified k clusters, so each observation belongs to the cluster with the nearest mean.

1. step: An initial set of *k* means (centroids) is selected.

2. step: Each observation is assigned to closest mean that create *k* clusters.

3. step: New centroids are re-computed for observations assigned to each cluster.

4. step: Each data point is re-assigned to new cluster with the nearest mean.

The algorithm stops when assignments no longer change.

Statistical software R (R Core Team, 2023) and package "cluster" (Maechler et al., 2021) were used to generate the results. For more information about the K-means clustering see (Hartigan, J. A. & Wong, M. A., 1979) and (MacQueen, J., 1967).

3 Results

Based on within sum of square values, we decided to work with 5 clusters. To visualize the results of clustering we used again principal components analysis and created the scatterplot of the first two principal components of court performance variables of EU countries. In Figure 1, the classification of EU countries into the clusters.

The countries were classified as follows:

- Cluster 1 (black one): Hungary
- Cluster 2 (red): France, Netherlands
- Cluster 3 (green): Azerbaijan, Bulgaria, Czechia, Denmark, Estonia, Finland, Georgia, Latvia, Lithuania, Moldova, North Macedonia, Norway, Slovakia, Sweden, Switzerland
- Cluster 4 (dark blue): Romania, Spain, Ukraine
- Cluster 5 (light blue): Bosnia and Herzegovina, Croatia, Montenegro, Slovenia

As a next step, we created clusters based on the variable Budget on GDP, which represents the share of the overall courts' budget on the nominal GDP of the country. In Figure 2 we can see the boxplots of this variable for each cluster.

As the boxplot shows, Cluster 5 contains countries (Slovenia. Croatia, Bosnia and Herzegovina, and Montenegro) with the highest values. All five countries are located in the same European region and have similar starting points. Currently, Bosnia and Herzegovina and Montenegro belong to six Western Balkan countries whose judicial system is supported by the Norwegian Courts Administration in strengthening their judicial systems. Slovenia's spending for the judicial system is above the European median and has almost double the number of judges per 100,000 compared to the European average.

Fig. 1: Scatter plot of classification of selected European countries into the clusters
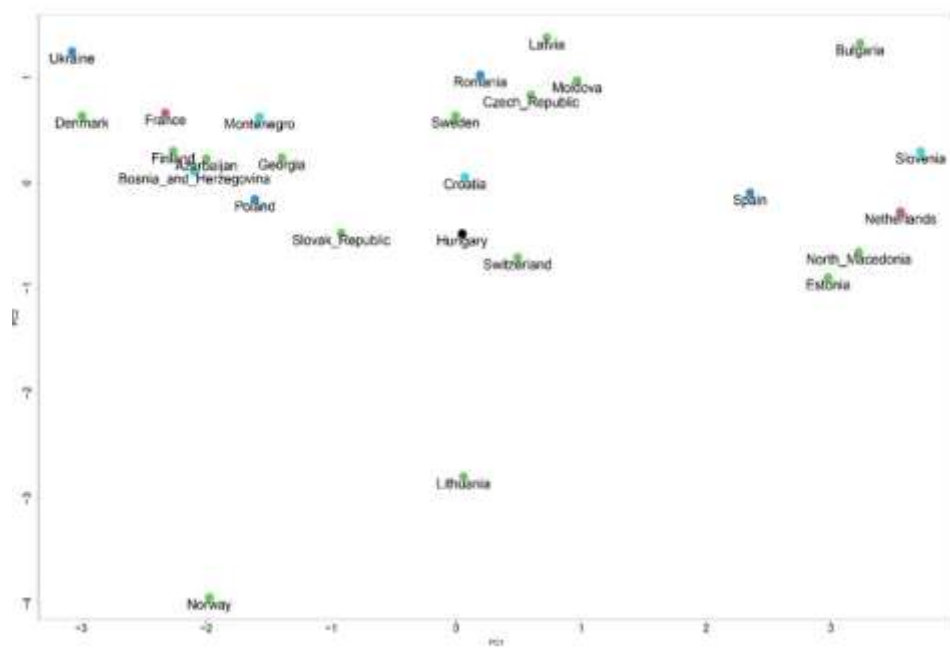
Source: Authors' work.

Fig. 2: Boxplot of values of Budget on GDP variable in the created clusters
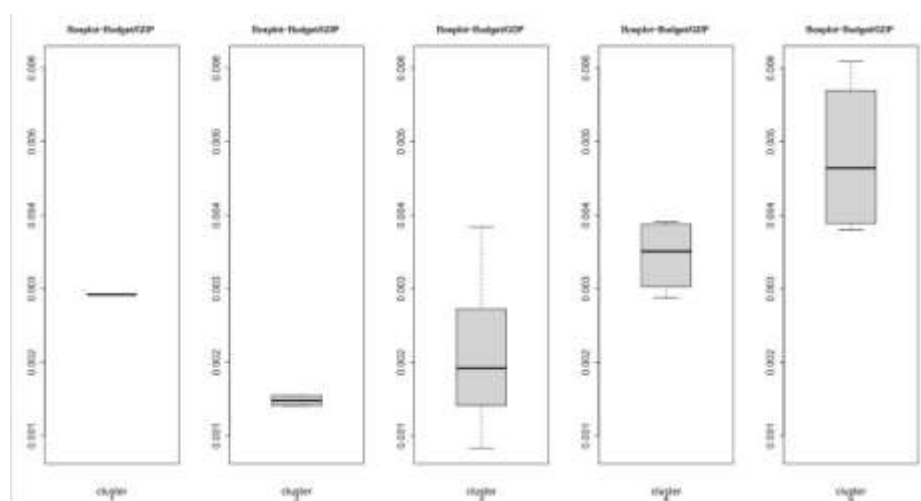
Source: Authors' work.

On the other hand, countries with the lowest relative funding of the courts are France and the Netherlands, which are both in the second cluster. The lower value of this indicator in the case of France can be partially the result of the high GDP, as France ranks third among the European countries in the case of the level of GDP. The fact that the French budget for the judiciary is much smaller than in its neighboring countries also has a significant contribution to France's placement in this cluster. This country is also significantly behind in the number of judges per 100,000 inhabitants compared to neighboring countries. The under-investment and

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potential understaffing can be the reason why France has the highest average disposition time for criminal as well as non-criminal cases out of all examined countries. The Netherlands is also included in Cluster 2. The juridical system funding in this country appears to be almost constant.

All other countries are placed in clusters with a level of shared budget somewhere between Cluster 2 and Cluster 5. It is worth mentioning Cluster 1, which contains only one country, namely Hungary. This country was undergoing a major reform of the judiciary after 2018 and this may be the main reason for this placement.

In Figure 3, we can see boxplots of the number of judges per 100,000 inhabitants for individual clusters. The situation is very similar to Figure 2. Cluster 5 with the highest values of this variable and Cluster 2 with the lowest values. This is supported by the fact that we found a very strong positive correlation between the share of the Budget on GDP and the number of judges per 100,000 inhabitants. The correlation coefficient equals 0.72. Hence, countries with higher budget allocations tend to have more judges, indicating a straightforward link between funding and staffing levels in the judicial system.

Fig. 3: Boxplot of number of judges per 100 000 inhabitants in the created clusters
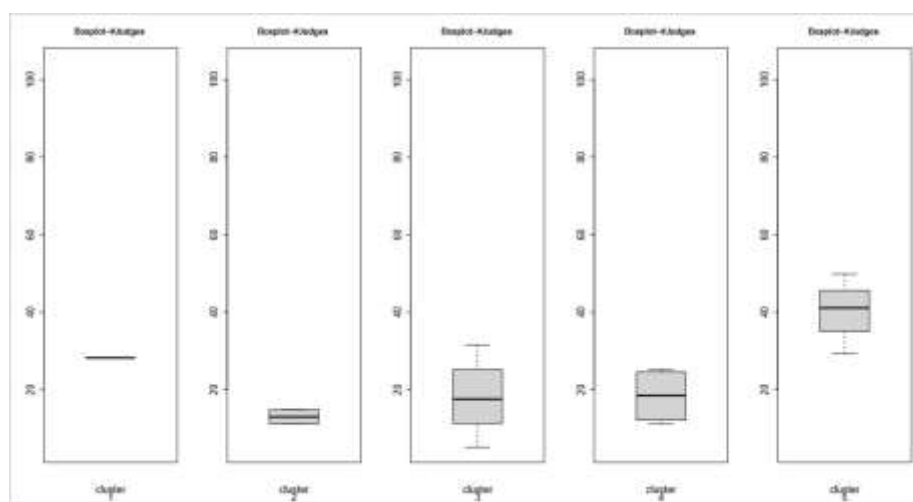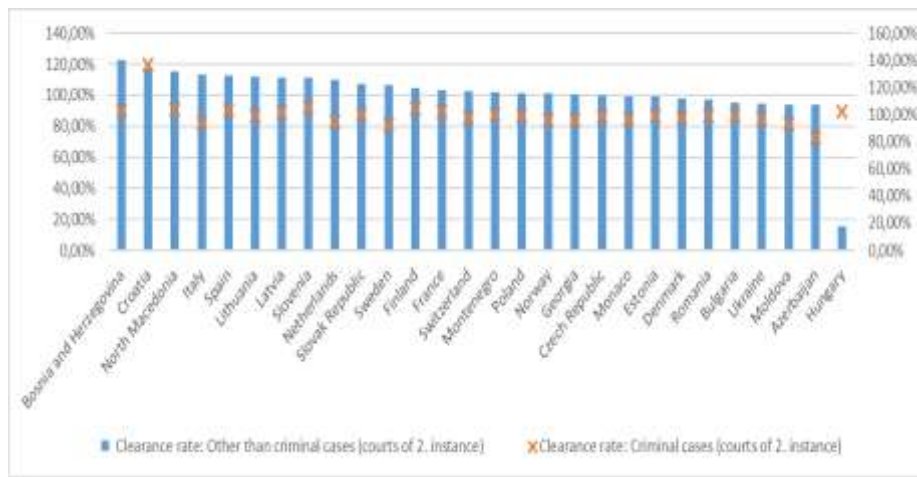

Source: Authors' work.

To provide further insight into the efficiency of courts, we focus also on variables capturing the clearance rate and disposition time (see Figures 4 and 5). Both variables complement each other and represent a slightly different angle of view on the effectiveness of courts. As can be seen in Figure 4, the clearance rate is very high in Balkan countries such as Bosnia and Hercegovina, Croatia and Nort Macedonia. This is true for criminal as well as non-criminal cases. The clearance rate over 100% represents the situation that which the courts in these countries are currently processing the cases accumulated in the past. This means that these

countries have recently significantly improved the efficiency of case processing but had problems in the past. On the other hand, a clearance rate of less than 100% signals current problems with processes and the creation of a backlog. This is especially the case of Azerbaijan, Moldova and Ukraine. Hungary has also a very low clearance rate for non-criminal cases mostly due to significant changes and reforms.

Fig. 4: Clearance rate of criminal and other than criminal cases at the courts of the second instance in European countries (higher values are better).

Source: Authors' work

Disposition time represents the average duration of the case processing in days. The international comparison of this indicator is shown in Figure 5.

Fig. 5: Disposition/Duration time of criminal and other than criminal cases at the courts of the second instance in European countries (higher values are worse).
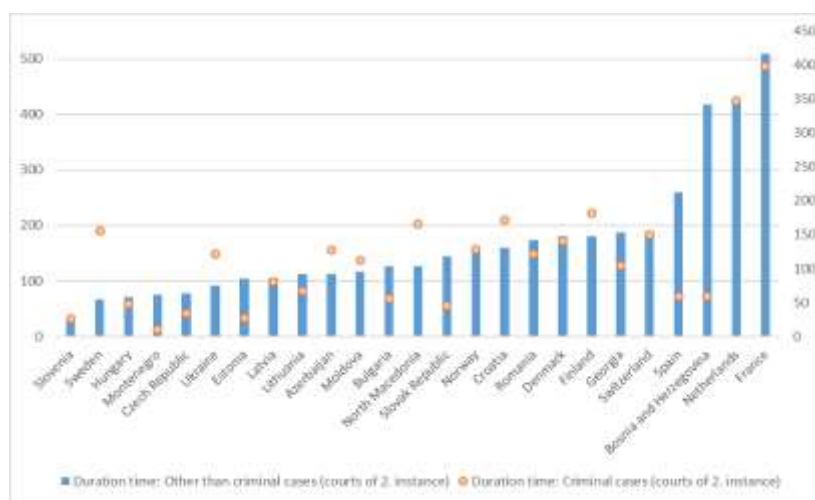
Source: Authors' work

Disposition time appears to be the higher in France followed by the Netherlands. These two countries have very long processing times for both criminal cases as well as other criminal

cases. On the contrary, the disposition time in Slovenia is low, which means very high efficiency of their judiciary system in terms of the speed of case processing. The differences between the disposition time of criminal and non-criminal cases appear to be notable in many countries, such as for example Sweden. Bosnia and Herzegovina and Spain. Hence, the performance of the courts focused on criminal cases and those dealing with other cases are different. This can be due to differences in procedures, legislative frameworks as well as funding and digitalization in both types of courts.

Conclusion

Our analysis categorizes European countries into five distinct clusters based on-court performance. Courts included in the same clusters have similar patterns in terms of court-related variables focused on founding as well as courts' efficiency indicators. The analysis indicates that all these variables are interconnected and play a crucial role in determining the efficiency of a country's judicial system. The clusters formed based on these variables provide insights into regional patterns related to courts' performance as well as budget utilization. Based on the K-means clustering we included Slovakia in the cluster with the most countries, including the Czech Republic and all three Baltic countries. Courts in these countries have similar efficiency, which is also reflected in the comparison clearance rate and disposition time of the case. Interestingly, Balkan countries such as Bosnia and Hercegovina, Croatia and Nort Macedonia show very good performance with respect to clearance rate, which may be due to significant improvement of processes compared to the past. Despite the interesting results achieved, it is necessary to emphasize that the international comparison of the court's performance has significant limits. There are many specific problems related to the judicial systems of each country. Hence, it is always essential to consider unique circumstances when aiming to enhance the efficiency and performance of courts.

Acknowledgment

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Contact

Mária Stachová

Faculty of Economics, Matej Bel University

Tajovského 10

975 90, Banská Bystrica

maria.stachova@umb.sk

Ján Huňady

Faculty of Economics, Matej Bel University

Tajovského 10

975 90, Banská Bystrica

jan.hunady@umb.sk