EU Countries Tax Evasion Clustering

Mária Stachová[1] **|** *Matej Bel Universtity, Banská Bystrica, Slovakia*
Kamil Ščerba[2] **|** *Matej Bel Universtity, Banská Bystrica, Slovakia*

Abstract

The problem of tax evasion is becoming more and more prominent, and it is causing large losses in individual state budgets. However, European policies have taken significant steps to eliminate them over the last two decades. National policies also contribute to reducing the estimated extent of tax evasion, as measured by Schneider's MIMIC model. However, these tendencies are not the same in individual countries.

Therefore, in our paper, we try to find pattern in tax evasion time trajectories of European Union countries and thus to create homogenous clusters that include countries with similar tax evasion situation. To meet our goal, we use panel data clustering method on our data with information about tax evasion of EU countries from 2000 to 2019. As a next step, we compare created cluster from the perspective of quality indicators of public institutions.

INTRODUCTION

The shadow economy is known under different names, namely the hidden economy, the gray economy, the black economy, or the economy of scarcity, or the informal economy. These synonyms point to some characteristics of the shadow economy. However, we will stick with the label shadow economy and try to approximate this term. Schneider and Enste (2000, p. 78) quote a definition attributed to several authors, which defines the shadow economy as "economic activity that is unregistered but would otherwise contribute to increasing the gross national product." Orviská (2005, p. 7) clarifies that "these are activities that are illegal, such as illegal production, sale and smuggling of drugs, but also activities that are not inherently illegal, but which individuals try to conceal for various reasons, e.g. due to the avoidance of paying taxes." According to Medina and Schneider (2018), all the reasons that lead to hiding economic activities can be divided into monetary, regulatory, and institutional. Among the monetary reasons, they include avoiding paying taxes and all social security contributions. Regulatory reasons mainly include avoiding government bureaucracy and institutional reasons include corruption, low quality of institutions and weak rule of law (Medina and Schneider, 2018).

[1] Department of Quantitative Methods and Information Systems, Faculty of Economics, Matej Bel University, Tajovského 10, 975 90 Banská Bystrica, Slovakia. E-mail: maria.stachova@umb.sk, phone: (+421)484466620.
[2] Department of Finance and Accounting, Faculty of Economics, Matej Bel University, Tajovského 10, 975 90 Banská Bystrica, Slovakia.

Although the shadow economy and tax evasion are not the same, in most cases activities in the shadow economy involve the evasion of direct or indirect taxes. Therefore, the authors advocate the opinion that the factors affecting tax evasion are most likely to affect the shadow economy as well (Schneider and Buehn, 2016). In addition, the size of the shadow economy is a basic input for estimating the extent of tax evasion, and thus also for decisions about its adequate control (Medina and Schneider, 2018). Šimonová (2017, p. 6) defines tax evasion as "the resulting effect of unconscious or purposeful reduction of tax obligations by taxpayers." Bánociová and Vravec (2015, p. 2) define them as "the result of illegal economic behavior of tax subjects oriented towards minimization, or complete elimination of tax liability towards the state, or obtaining excessive VAT deductions." Kiabel and Nwokah (2009, p. 53) argue that "tax evasion is a direct and dishonest step by which a taxpayer seeks to reduce his tax liability by illegal means." They also add that tax evasion is achieved by deliberate by an action that constitutes a criminal act according to the law. Tax evasion is the cause of large public deficits by causing a lack of financial resources and the state is unable to cover its costs.

1 DATA AND METHODOLOGY

Our data consists of 27 EU countries and their characteristics: tax evasion index over the years 2000–2019 (Schneider, 2022) measured as a percentage of GDP and quality indicators of public institutions (Table 1). Because we used time trajectories of tax evasion indices as cluster variables, we needed to deal with longitudinal character of data. For this purpose, we select the K-means algorith applied in the "kml" package (Genolini et al., 2015) of statistical system R, that is modified for panel data. This algorithm is based on the original K-means clustering (MacQueen, 1967).

This method minimizes the utility function iteratively for the time t, N objects according to an assumption of C clusters. The utility function can be expressed as follows:

$$\min \sum_{i=1}^{N} \sum_{c=1}^{C} u_{ict} d_{ict}^2, \tag{1}$$

where u_{ict} is a degree of appropriateness of the i-th object into the K-th cluster in the time t with conditions:

$$\sum_{c=1}^{C} u_{ict} = 1, \forall i, t, \tag{2}$$

$$\forall u_{ict} : u_{ict} = \begin{cases} 1 & \|\mathbf{x}_t - \mathbf{h}_\varepsilon\| = \arg\min_i \|\mathbf{x}_t - \mathbf{h}_\varepsilon\|. \\ 0 & \text{elsewhere} \end{cases}$$

We used the Euclidean distance $d_{ict} = \|\mathbf{x}_{it} - \mathbf{h}_{ct}\|$ between i-th vector of objects $\mathbf{x}_{it} = (x_{i1t}, \ldots, x_{ijt}, \ldots, x_{iJt})'$ and K-th centroid $\mathbf{h}_{ct} = (h_{c1t}, \ldots, h_{cjt}, \ldots, h_{cJt})'$ in the time t. We applied the algorithm to the standardized values of variables.

When measuring the estimated extent of the shadow economy/tax evasion described by tax evasion index, we use the MIMIC model (multiple indicators, multiple causes estimation) created by Schneider (Schneider and Enste, 2000). The model considers the shadow economy as a latent variable that is influenced by the variables entering the model as the main factors that cause the growth or decline of the shadow economy. According to Orviská (2005), the factors used in the MIMIC model include the unemployment rate, tax morale, disposable income per inhabitant, tax and social burden, and the like. On the other hand, the shadow economy has an impact on the official economy, in the form of, for example, changes in real GDP, in the rate of participation in the labor market, in the number of hours worked, and others.

The clusters created by their tax evasion index trajectories were analyzed in the next step in our study. We added variables that fall into the group of non-economic indicators and evaluate the quality of institutions. They are indicators/indexes that are captured by the research institute of the World Bank

and we know them under the term Global Governance Indicators (WGI). These indicators include the right to express oneself, political stability and the absence of violence, government efficiency, the quality of regulatory measures, the rule of law and the control of corruption. According to Hiwatari (2014), these are aggregate indicators based on many underlying assets taken from a wide range of existing data. The data reflects views on quality from various research institutes, non-governmental organizations, international organizations, and private sector companies around the world. In the following Table 1 is list of these indicators with short description and its expected impact on tax evasion.

Table 1 Global Governance Indicators

Indicator	Short description	Expected impact	Source
Voice and accountability (democracy)	It determines the degree to which the citizens of the country are able to participate in the choice of their government, but also the degree of freedom of speech, freedom of association and freedom of the media. The index is measured on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)
Political stability and absence of violence/terrorism	It evaluates the provision of freedom in the country, the provision of security, including the elimination of threats of civil discontent through protests, up to terrorism. It is rated on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)
Government effectiveness	It captures the quality of public services, the civil service and its degree of independence from political pressures, the quality of policy implementation and the credibility of the government. It is measured on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)
Regulatory quality	It assesses perceptions of the government's ability to formulate and implement policies and regulations that enable and support private sector development. It is expressed on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)
Rule of law	It captures perceptions of the extent to which law enforcement officers trust and follow society's rules, particularly regarding the quality of contract enforcement, property rights, the police and courts, and the likelihood of crime and violence. It is rated on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)
Control of corruption	It assesses perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the pursuit of private interests. It is measured on a scale from –2.5 to 2.5.	Positive	The World Bank (2021)

**Source:** Authors' work according to World Bank (2021)

Bruinshoofd (2016) examined the quality of these indicators, but also the indicator of the difficulty of doing business in the European Union compared to the rest of the world. According to the scheme, European institutions outperform the world average in all seven components. The primacy is somewhat less pronounced in terms of political stability and absence of violence. We already mentioned above that the EU average for this indicator is the lowest among all indicators of the quality of institutions.

2 RESULTS AND DISCUSSION

Based on Calinski and Harabatz criterium, the best number of clusters is 3. These clusters contain countries with a similar range of the estimated range of tax evasion for the monitored period from 2000 to 2019.

To visualize the results of clustering we used principal components analysis and created the scatterplot of the first two principal components of quality indices of EU countries. In Figure 1 can be seen the classification of EU countries into the clusters.
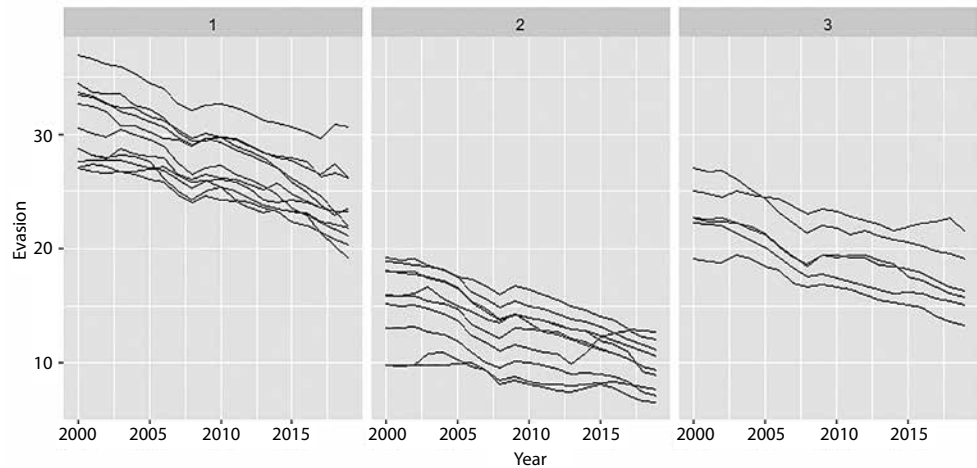
Figure 1 Classification of EU countries into the clusters
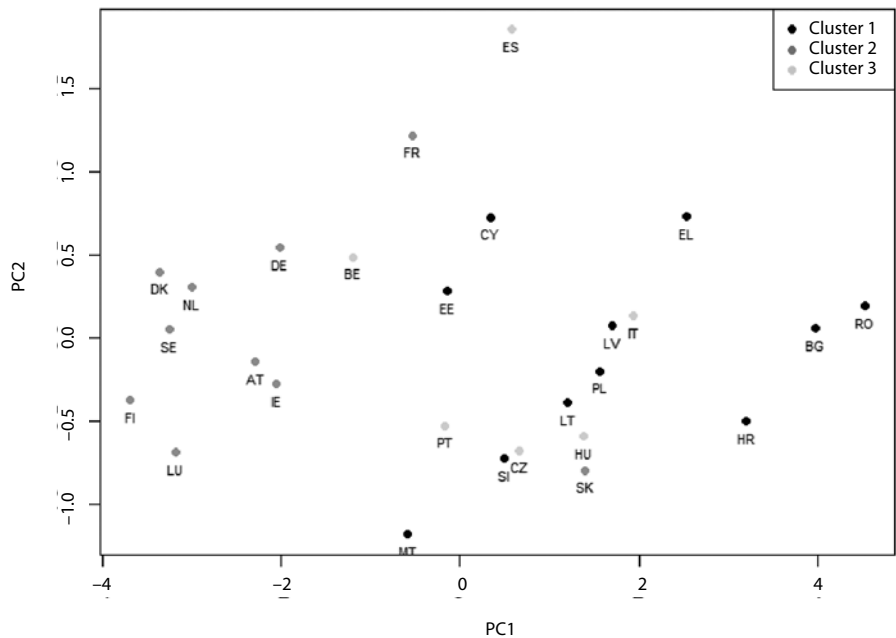
Source: Authors' work

The first cluster includes 11 countries, the second one 10 countries and the third one includes 6 countries. The time trajectories of evasion index of created clusters are shown in Figure 2.

Figure 2 The time trajectories of evasion index in created clusters

Source: Authors' work

We can see the reducing trend for the entire observed period in all countries. We know from the data that the exception is the year 2009, when there was an increase in this value for all monitored countries, probably due to the global crisis. However, most countries (except Romania, Bulgaria, Greece, Latvia, and Lithuania belonging to one cluster) saw a decrease in the estimated rate of tax evasion already in the following year 2010. We evaluate this as evidence of a relatively quick recovery from the economic crisis.

If we focus on individual member states in 2019, we see that the estimated rate of tax evasion is lower than the EU average, mainly in the states that are among the older members of the Union (except Slovakia and the Czech Republic). This suggests that tax evasion is a bigger problem in countries that have been in the EU for a shorter period. When following the older members of the EU, we can also notice a lower estimated range of tax evasion for states located further north (e.g. the Netherlands, Denmark, Ireland) than for states located in the south of Europe (e.g. Greece, Portugal, Spain). A good example from the north are the Scandinavian countries (Denmark, Sweden, and Finland). They are among the countries with the lowest estimated range of tax evasion and have even significantly improved in this value over the monitored period. The tax systems of Scandinavia are characterized by a high level of taxation. However, according to Ďurinova (2013), this tax burden is mitigated by many tax reliefs and exemptions, as well as by the provision of various services, especially in the social field. Thanks to the good social system, they are also considered as so-called welfare states. In addition, they have developed economies and a high standard of living of the inhabitants. Conversely, the highest estimated rate of tax evasion can be observed in Croatia (26.22%), Romania (26.15%) and Bulgaria (30.59%). These are the states that joined the EU as the last ones, and they are in the south of Europe.

We see the most significant improvement over the monitored period for the Baltic countries (Latvia up to 13.07 p.p.), while one of the lowest improvements for Hungary (by 3.59 p.p.). It is Hungary that has recently recorded an increase in the estimated scope of tax evasion since 2015. The author Benyik (2019) attributes this fact to the strong position of the Orbán government, which is characterized by a high level of corruption that undermines democracy and economic growth.

In the next step of our study, we analyze created clusters based on non-economic indicators that evaluate the quality of institutions.

The first indicator describes the level of democracy in the country. In connection with this indicator, the authors Feld and Tyran (2002) investigated the possibility to participate in the electoral process and its connection with compliance with tax regulations. Based on research, they state that participation in the electoral process is positively associated with compliance with tax regulations in society. They therefore agree with the view that the greater the right to express oneself, the lower the level of tax evasion. The authors' claims are also supported by our analysis, as we see in Figure 3 that cluster 2 shows the lowest values of the estimated extent of tax evasion and, on the other hand, the highest values of the democracy index with the smallest dispersion and values that move around the median. The opposite is shown by the first cluster, with the highest percentage of tax evasion, where democracy or the right to express oneself is the lowest and with greater dispersion in individual countries.

Second indicator, political stability, and absence of violence, is described by Hiwatari (2014) as the probability that a government will be overthrown by unconstitutional or violent means, including politically motivated violence and terrorism. Katz and Owen (2013) argue that the political uncertainties faced by taxpayers' stem from not knowing which political party will take control and not knowing whether the new government would catch them in tax evasion. Yamen et al. (2018) adds that based on how taxpayers perceive these political uncertainties; they may try to protect their wealth by concealing their true income and tax evasion. These authors expect tax evasion to decrease with political stability. Again, this statement is confirmed, as it can be seen in Figure 4, to the greatest extent in cluster two, where we can assume

Figure 3 Boxplots of level of Democracy index in the created clusters
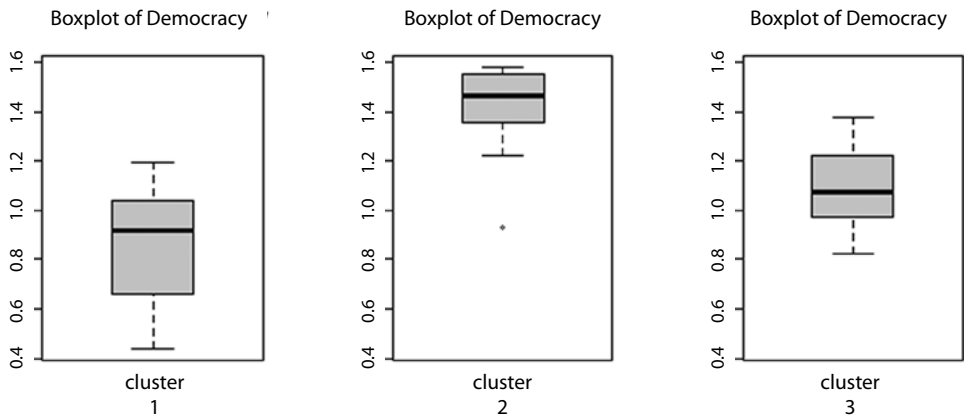
Source: Authors' work

that political stability and the absence of violence largely influenced the estimated extent of tax evasion, and the indicator values are the highest (from 0.9 to 1.2). Relatively worst is cluster one, where the estimated range of tax evasion is the highest and stability is the lowest, which, on the other hand, does not show such a large variance from the median, as, for example, in cluster 3.

**Figure 4** Boxplots of level of Stability index in the created clusters
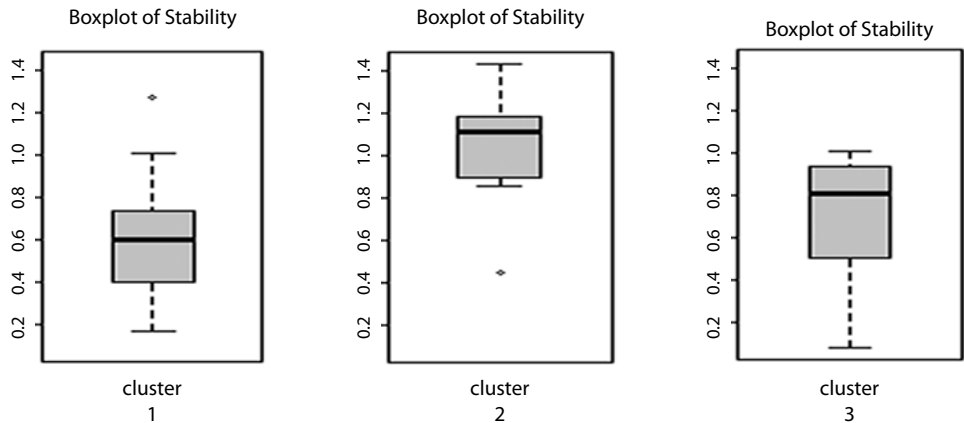
Source: Authors' work

Another indicator is the efficiency of the government, which is reflected in the quality of public services. Arsic et al. (2015) have the opinion that the quality of public services is negatively correlated with the extent of tax evasion, and a higher quality of public services means a greater willingness of the public to pay taxes, as these taxes go towards financing goods and services that meet their needs. Authors Hanousek and Palda (2004) consider tax evasion as a form of citizen dissatisfaction with the relevant government and the quality of government services. Therefore, they recommend that honest and effective governments that want to increase tax compliance pay special attention to informing their subjects about what the government is doing for them. Schneider and Buehn (2016) are also inclined

to the opinion that tax subjects often turn to illegal behavior precisely because of the inefficient provision of trust goods. They advise governments to make more efforts to strengthen institutions and create a fiscal policy that is closer to voter preferences.

In Figure 5, this index shows us the possible dependence of the relationship between tax evasion and government efficiency. The difference in the individual clusters is also noticeable, where the values of the indicator range from 0.5 to 1.2 for the first and third clusters, which is a relatively good value, but there is still a room for improvement. However, as we can see, these clusters still show relatively high values of the estimated range of tax evasion. However, we see the opposite in the second cluster, where the authors' assertions are confirmed and the government efficiency indicator shows high values, which we assume, affects the extent of the estimated scope of tax evasion. We know from the study that Finland, Sweden, Denmark, Germany, and other countries from the second cluster show high efficiency, but also the quality of the government, which was also confirmed by the results of the analysis.

**Figure 5** Boxplots of level of Government efficiency index in the created clusters
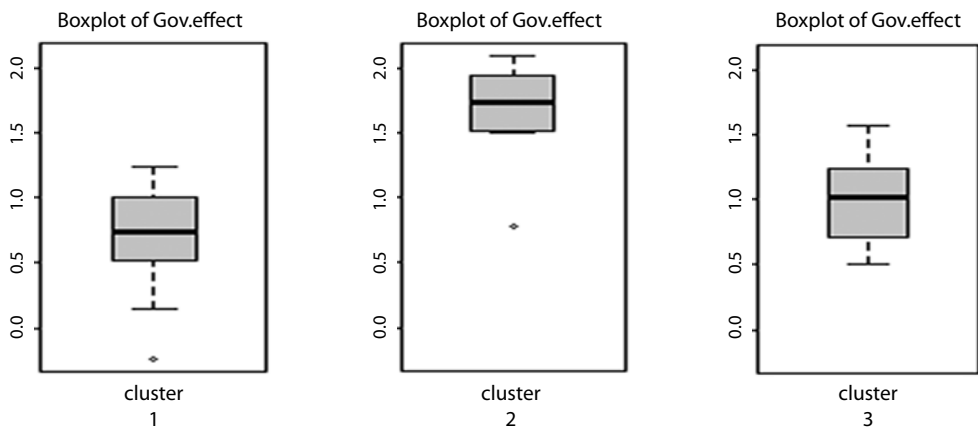
Source: Authors' work

We are also interested in the quality of regulatory measures, i.e., the government's ability to formulate and implement reliable regulations. According to Yamen et al. (2018), governments should establish clear and fair regulations to establish and maintain a good relationship with taxpayers. This could contribute to reducing the negative attitude towards the government. Also, even a simple tax system increases compliance with tax regulations. According to this, quality regulation should also lead to lower tax evasion. We see in Figure 6, quite a large heterogeneity in the results, either between the clusters or within the clusters (mainly in the 1st cluster). This index largely reflects the government's ability to create an environment in which tax evasion is better fought. As a verification of this statement and at the same time of our results, we see the results of cluster 1. This cluster includes countries such as Romania, Bulgaria, Croatia, and others, which in several studies came out as countries where governments take very few measures, or no measures to combat tax evasion. Of course, this fact changes over time, as the EU itself has begun to fight this disease to a large extent, which adopts measures across the board and countries must (or should) apply them. Whether it was the EU action plan in the fight against tax evasion, or the BEPS measures themselves from 2015 (OECD, 2019), which should eliminate tax evasion.

Another indicator is government laws. Hiwatari (2014) describes government law as the measure to which law enforcement officers' trust and follow the rules of society, particularly regarding the quality of contract enforcement, property rights, the police and courts, and the likelihood of crime and violence. Kirchler et al. (2008) emphasize in this context that, in addition to audits and the use of power, measures

Figure 6 Boxplots of level of Tax regulations index in the created clusters
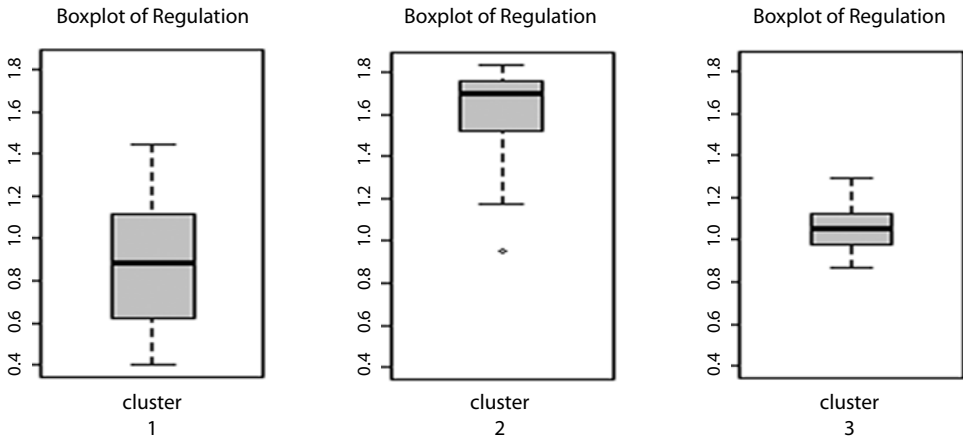
Source: Authors' work

to build trust are also necessary. These increase voluntary tax evasion compliance, which is more cost-effective than enforced compliance. Moreover, trust creates an environment in which authorities and citizens accept each other. This group of authors therefore holds that tax compliance can be achieved by increasing trust and the level of government laws. At the same time, we can connect this indicator with the previous one, where we can notice the similarity of the results, as well as the impact on the estimated scope of tax evasion. Both indicators are linked to laws, whether adoption, compliance, or implementation, which is often a problem for countries that we call "new" (they joined the EU later) and that show worse economic results compared to other countries. The large heterogeneity of index values in cluster 1, as can be seen in Figure 7, only confirms this.

Figure 7 Boxplots of level of Government laws index in the created clusters
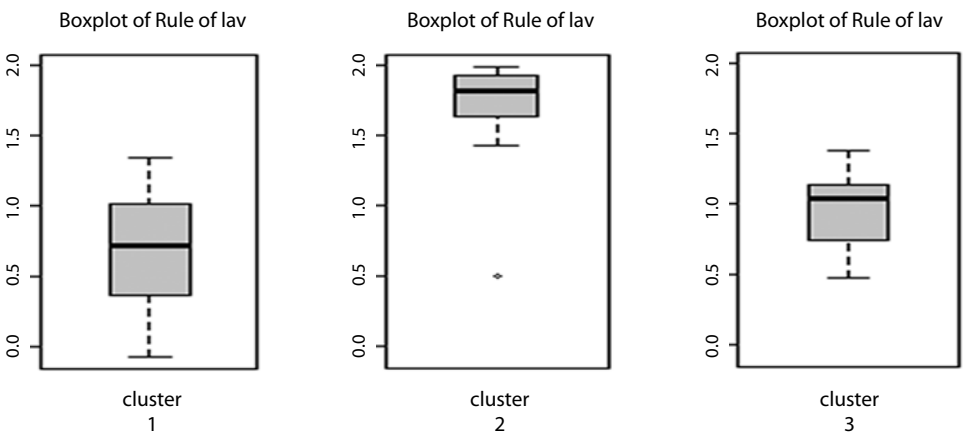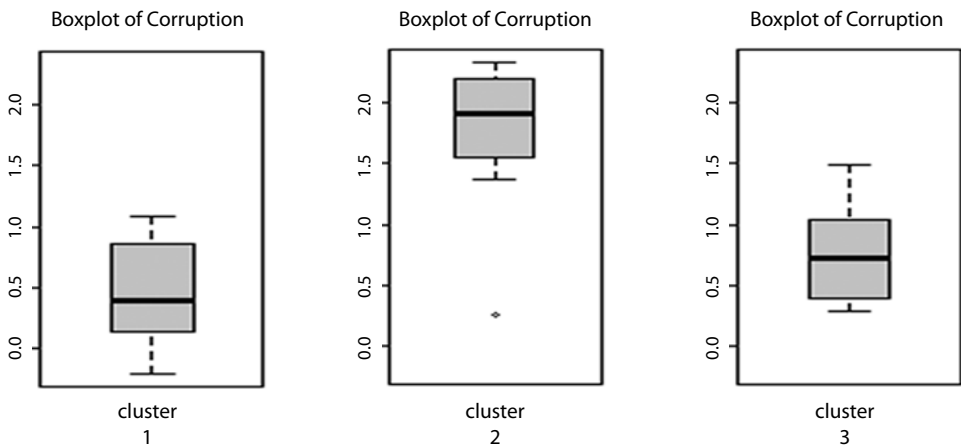

Source: Authors' work

In the next part, we focus also on corruption. Arsic et al. (2015) argue that a high level of corruption discourages taxpayers from paying taxes, because corruption gives the impression that these taxes will not be used to adequately finance the public sector but will rather lead to the private profit of certain people

or politicians. Likewise, Akinyom and Okpala (2013) draw attention to the fact that if citizens cannot be sure, due to the high level of corruption, whether the taxes they pay are used to finance public goods and services, they are unwilling to pay and are more likely to avoid tax obligations. Thus, they state that, although corruption and tax evasion are distinct and separate problems, they can easily be interconnected and reinforced. A society that has a higher level of corruption may allow more tax evasion as corrupt officials seek more income through bribes. On the other hand, a higher level of tax evasion can lead to corruption by offering more bribes (Alm, Martinez-Vazquez, McClellan, 2016).

A high level of corruption and little regulation, this is characteristic of cluster 1. This is confirmed by our analysis as well as by the authors who draw attention to this very fact. Of course, with decreasing corruption, we can assume that the estimated scope of tax evasion can also decrease. We can confirm this statement. In the cluster 3 we can see, in Figure 8, a decreasing tendency of both corruption and tax evasion, and cluster 2 shows high values of the corruption index, which means little corruption in the country, and on the other hand, we also know that countries in this cluster have a low value of the estimated extent of tax evasion.

Figure 8 Boxplots of level of Corruption index in the created clusters

Source: Authors' work

CONCLUSION

The main goal of our study was to find pattern in tax evasion time trajectories of European Union countries and thus to create homogenous clusters that include countries with similar tax evasion situation. Our next goal was to compare created cluster from the perspective of quality indicators of public institutions. For this purpose, we used K-means algorithm adjusted for panel data and based on Calinski and Harabatz criterium, we decided to use 3 clusters.

From our results can be seen that the time trajectories of tax evasion index show a decreasing trend for all countries over the observed period, with a temporary increase in 2009, likely due to the global economic crisis. In 2019, the estimated rate of tax evasion is lower than the EU average in older member states, while newer member states and countries located in the south of Europe tend to have higher estimated rates of tax evasion. Scandinavian countries (Denmark, Sweden, and Finland) show the lowest estimated range of tax evasion and perform significant improvement over the monitored period. Croatia, Romania, and Bulgaria, as the newest EU member states located in the south of Europe, have the highest estimated rates of tax evasion. The quality of institutions, including democracy, political stability, government efficiency, regulatory measures, government laws, and corruption, have a significant impact

on the estimated scope of tax evasion. Cluster 2, characterized by high values in indicators of democracy, political stability, government efficiency, and low corruption, exhibits the lowest estimated extent of tax evasion. Conversely, cluster 1 shows the highest tax evasion and lowest values in these indicators. Our study suggests a positive association between democratic participation, political stability, efficient government services, quality regulation, government laws, and lower levels of tax evasion. Corruption and lack of regulation are prominent factors associated with higher tax evasion rates, as observed in cluster 1. Overall, the findings highlight the importance of institutional quality and the role of effective governance in combating tax evasion. Countries with strong democratic systems, political stability, efficient governments, and low corruption tend to have lower levels of tax evasion.

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