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CLUSTERING OF THE EUROPEAN UNION MEMBER STATES BASED ON MONEY LAUNDERING MEASURING INDICES

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ABSTRACT. The number of enforcement actions and fines for non-compliance with anti-money laundering (AML) regulations continues climbing year after year, and the year 2021 was no exception to this tendency. Globally, authorities remain harsh, and AML fines in Europe, the United States, and the United Kingdom have been increasing (Global Anti-Money Laundering Regulations, 2021). According to the UN estimations, the amount of money annually laundered worldwide amounts to 2–5% of the world's Gross Domestic Product (GDP), or in absolute numbers - to 800 billion-2 trillion US dollars. Such high figures indicate that national governments are indeed facing a serious problem of money laundering. In this article, clustering is employed to group the EU member states by their money laundering measuring indices in order to assess the EU legal framework in terms of money laundering prevention. State clustering could help the relevant EU institutions, such as Financial Intelligence Units (FIUs), Europol, International Monetary Fund (IMF), national governments and others, to develop the most effective measures to diminish the problem of money laundering and to complement their regulatory framework. Money laundering is usually associated with criminal activities that generate large amounts of illegal financial resources. In the most general sense, money laundering refers to the process of disguising the true origin, ownership, disposal and movement of particular proceeds, property or property rights. The results of the empirical research propose that money laundering reduction calls for a higher number of suspicious transaction reports (STRs), lower levels of corruption and improvement of the legal framework in terms of money laundering prevention in the EU. The research methods cover comparative and systematic literature analysis, and hierarchical cluster analysis. The cluster analysis of the EU member states (28 countries) uses the number of reports filled with FIU between 2006-2014, the 2012-2020 Basel AML Index and the 1998-2018 CPI data.

JEL Classification: E26, G28, K42

Keywords: CPI, suspicious transaction, Basel AML Index, European Union.

Introduction

According to Europol (2017), money laundering can be treated as one of the major 'crime engines' since it supports a multibillion-dollar global criminal business. The objective of combating money laundering is becoming increasingly problematic because of the globalised and virtualised nature of financial services and the impact of digital elements, for instance, cryptocurrencies and anonymization techniques, that undermine identification of true account holders. A substantial share of illicit financial flows is controlled by the global criminal syndicates which are closely linked to extensive criminal networks and are well placed to exploit loopholes in either global or national financial systems. The complicated conditions under which anti-money laundering measures are developed and undertaken make the objective of reducing international flows of illicit funds an extremely arduous ambition.

Although it is widely recognised that money laundering has a negative impact on economic development, the scope of the negative effects is difficult to measure; nevertheless, it is obvious that the consequences of money laundering are detrimental to financial institutions – contributors of crucial importance to economic growth. In addition, money laundering negatively affects national economies by hindering tax collection and promoting informality, crime and illicit fund flows (Hendriyetty & Grewall, 2017). Researchers are still debating the appropriate measuring of the size of the informal (or grey) economy (Remeikiene et al., 2018). The informal economy goes beyond simple generation of proceeds from criminal activities prioritised by international money laundering systems (Niyatullayev & Almond, 2014; Pimonenko et al., 2021), it also covers digital shadow economy including illicit operations online (Gaspareniene et al., 2016).

Sasongko & Huruta (2018) argue that money laundering affects international capital flows, money supply and leads to fluctuations in interest and exchange rates. Money laundering also diminishes productivity by misdirecting resources, promoting crime and corruption. All these effects of money laundering slow down economic development, distort international capital flows and impede international trade, which is detrimental to long-term economic development (Bartlett, 2002). Minding the negative effects of money laundering, in particular in terms of promoting economic and social upheaval as well as a higher risk of terrorism, it can be stated that this phenomenon poses a serious risk to the global economic stability and security (Levchenko et al., 2019; Kuzmenko et al., 2020).

Over the last two decades, the EU has been able to develop a legal framework directed against money laundering. The development of this framework has been significantly affected by the simultaneous evolution of the relevant global standards, in particular establishment of the Financial Action Task Force on Money Laundering (FATF) (Mitsilegas, Vavoula, 2016).

The major purpose of this article is to hierarchically cluster the EU member states by the following characteristics: the number of the suspicious transaction reports received by an FIU, Basel AML Index and Corruption Perception Index. This clustering will allow to group the EU member states by the above-mentioned characteristics; each cluster will include the countries with similar money laundering rates, which will help to develop target recommendations concerning the fight against money laundering in particular country groups.

The following tasks are pursued: 1) to review money laundering theories analysing the origin, causes and development of this phenomenon; 2) to present the methodology that was employed for clustering the EU member states by the relevant indicators of money laundering; 3) to present the clusters of the EU member states developed in the empirical part of the research. The research *methods* cover systematic and comparative literature analysis, and hierarchical cluster analysis.

Novelty of the research. The method of clustering allowed to group the countries considering their development in the area of money laundering prevention. The research

confirmed the relationship between money laundering and corruption, which allowed to develop the target measures that could help to reduce the scope of both phenomena.

The first section of the article reviews the concept of money laundering and anti-money laundering regulations; the second section introduces and substantiates the methodology of the research; the third section provides the empirical results – clustering the EU member states by such money laundering indicators as the suspicious transaction reports received by an FIU, Basel AML Index and Corruption Perception Index.

1. Literature review

The concept of 'money laundering' was first introduced in the early twentieth century to denote the process or a number of acts that are aimed at legalizing the proceeds of illegal activities and thus facilitate their entry into cash flows in the economy. As a result, supervisors, control and inspection bodies were forced to set priorities and develop the measures to prevent money laundering through the financial and legitimate sectors of the economy. Proceeds from illegal activities were already concealed back in the Middle Ages when usury – the practice of charging an illegal interest rate for the loan of money - was criminalized. Money lenders used to launder money not to be penalised for usury (Ulribe, 2003).

Numerous economic studies suggest that the major financial agents - banks, non-bank financial institutions, stock and exchange markets – play an important role in promoting economic growth because they accumulate capital from domestic and even foreign savings and efficiently allocate this capital for investment projects that promote sustainable economic growth (Barlett, 2002; Belás et al., 2012; Li et al., 2019; Khan et al., 2020; Popova, 2021). Money laundering is detrimental to the development of the vital financial agents for two following reasons. Foremost, it internally destroys the financial agents as they often face the problem of the interrelationship between the activities of money laundering and fraudulent employee behaviour. Hosting the activities of money laundering, the financial agents become vulnerable because they are accessible to criminals who seek to gain control over the money laundering channels. Second, given that trustworthiness of financial agents is based on customer confidence (in particular, in developing countries), the risks of institutional fraud and corruption perceived by depositors and investors are an obstacle to building trust (Draskovic et al., 2019, 2020). To prevent the negative impact of money laundering, both governmental supervisors and regulators, and financial agents (i.e. banks, non-bank financial institutions, exchange and stock markets) themselves adopt anti-money laundering policies and management practices that help to build customers' trust and thus foster the development of the economically critical sector of finance. Some common anti-money laundering principles include the principle 'know your customer', strict internal control, prudential banking operations, long-term supervisory and regulatory principles.

To have a deeper insight into the phenomenon of money laundering, the statements about this phenomenon provided by different authors are reviewed in Table 1.

Table 1. Statements about money laundering

Author(s)	Statement	Characteristic
Schroeder (2001)	Money laundering poses global problems because of the extraordinary changes observed in the global markets (i.e. market globalization). Globalisation, liberalisation of international trade, expansion of the global financial network, reduction of the barriers to travelling along with internationalization of organised crime have all provided a source, opportunities and means to turn illicit proceeds into legitimate funds.	Conversion of illicit income into legal income
Reuter & Truman (2004)	Money can be laundered through different intermediaries. Bank transfers and payments by checks are the most common channels for money laundering.	The major money laundering channels are bank transfers and check payments
Issaoui (2017)	Due to its illicit origin, money laundering poses major problems for governments; the laundered money stands for the proceeds of illegal activities (drug, alcohol, human organ trafficking, etc.).	Money laundering funds other illegal activities
International Monetary Fund (IMF) (2018)	Money laundering refers to management of proceeds obtained from criminal activities that helps disguise the links between the proceeds and their illicit origin. Terrorist financing means raising money to support terrorist activities. Although the two above-mentioned sources of illegal proceeds are different, they are frequently based on the same vulnerabilities observed in financial systems that allow for anonymity and opacity in financial transactions.	Money laundering funds terrorist activities
O'Connell (2019)	Basically, money laundering refers to a practice that helps convert illicit proceeds into legal ones. The crime stems from the fact that the process disguises illegal income earned by law enforcement officers, often through complex financial transactions around the world.	Conversion of illicit income into legal income
Financial Action Task Force (FATFa)	In general, the major purpose of many crimes is making a profit for the person or group that commits an offence. Money laundering is handling of the criminal proceeds to disguise their illicit origin. A money laundering process is extremely important because it allows an offender to use the proceeds without compromising their real source.	Income management to disguise its illegal origin

Source: *compiled by the authors*

The information provided in Table 1 proposes that all authors recognise that money laundering represents a phenomenon that has negative financial effects worldwide. The term "money laundering" was probably first officially used in the 1970s and its definition has been refined over the last 30 or 40 years. The major characteristic of money laundering is conversion of illicit income into legal income in order to disguise its origin and fund other illegal activities, such as terrorism, human trafficking, arms trafficking, alcohol and drug smuggling. Governments should therefore pay close attention to complementing the national and international legal frameworks in terms of money laundering prevention.

According to Europol (2017), the fight against the global money laundering networks is a direct result of the globally recognised importance of the fight against criminal finance. The cornerstone when combating money laundering is reporting suspicious financial crime

(known as a suspicious transaction report - STR) from the private sector, acting as a protector of the financial system and the legitimate economy. At the EU level, this initiative helps to receive a substantial number of suspicious transaction reports each year, but based on the Europol's experience, only some of them (around 10 percent) are further investigated by competent authorities. There is no single title or definition of a suspicious transaction report (STR), which is also referred to as a suspicious activity report (SAR), although it is generally understood that it refers to a report prepared by the regulated private sector (either by banks and financial institutions or non-financial professionals) on the detected financial flows that are originally generated through various money laundering schemes or emerge as terrorist financing. Terrorism poses the greatest threat to both the economy and the lives of innocent people (Masood, et al., 2020). Tavares, et al. (2010) indicates the following types of Suspicious Transaction Reports (STRs) filled by each category of obligated entities: credit institutions, life insurance companies, investment firms, lawyers, notaries, tax advisors, casinos, financial institutions, and others. With reference to the Eurostat reports for 2008-2010, the largest number of the reports on suspicious financial operations come from credit institutions and transfer institutions. As of 2008, all EU member states submitted the total of 221466 reports on suspicious financial transactions; 96395 reports were submitted by credit institutions.

Law enforcement practices are heavily affected by the legal background (e.g. Virglerova et al., 2020). Common law countries as well as Scandinavian civil law countries tend to have more qualitative law enforcement than the countries that rely on French civil law (Cizo, et al., 2020). Various groups are constantly seeking to legalize money or property obtained in a criminal way or to disguise its origin. Money laundering negatively affects national economies because it stifles economic growth, weakens banks and undermines trustworthiness of the financial sector.

Chatain et al. (2009) note that national policies aimed at combating money laundering and terrorism financing must be based on three main objectives. First, it is important to ensure that criminal networks do not use the national financial system for illegal transactions. Second, it is necessary to allocate sufficient resources and efforts to identify money laundering and terrorist financing cases. Third, it is essential to prosecute and adequately penalise the persons involved in the above-mentioned illicit activities. Political will is key to achieving the above-mentioned objectives. States must establish robust anti-money laundering systems by adopting appropriate laws and regulations, empowering law enforcement agencies, providing sufficient resources to the relevant institutions, ensuring the prosecution and conviction of offenders.

The global anti-money laundering regulations have undergone fundamental changes in the past few decades (King et al., 2018). For instance, the Financial Action Task Force (FATFa), which is an inter-governmental policymaking body, was established, and its recommendations on a consistent framework of measures which countries, in particular the ones with strategically deficient jurisdictions, should implement to combat money laundering and terrorist financing were approved on 16 February 2012.

On 14 September 2020, the FATFa submitted the report titled 'Virtual Assets - Red Flag Indicators of Money Laundering and Terrorist Financing' (FATF b, 2020). The report agrees that advanced information and communication technologies provide plenty of opportunities to transfer virtual funds globally and make transfers quick and inexpensive. What is more, anonymity granted when making a transfer serves as an additional factor of attractiveness of this form of payment to potential offenders. Thus, global financial networks are widely exploited to launder the proceeds generated through the conduct of such illicit and criminal activities as drug, human and gun trafficking, child exploitation, tax evasion, etc. The major purposes of the report is to provide assistance to the relevant national authorities to

identify which virtual assets are being used as a measure of money laundering and help to understand how they are being used. The report is based on the data obtained from 100 case studies and reveals the major 'red flag' indicators which are as follows: technological systems and their characteristics that raise the level of anonymity (cryptocurrencies, mixing or tumbling services, peer-to-peer exchanges websites, etc.), geographical risks (the countries with a weak legal framework and insufficient measures to fight crime are often selected as target countries), transaction models and structures (irregular and uncommon transactions can indicate money laundering practices), a size of a transaction (if the amount of a transaction is illogical, it may indicate a financial offence), profiles of a sender and a recipient (hidden personal data, uncommon behaviour, etc. may raise suspicions), the source of the funds or assets (the proceeds can be traced to be generated through illicit activities). The report 'Virtual Assets - Red Flag Indicators of Money Laundering and Terrorist Financing' (FATF b, 2020) was developed to assist the relevant institutions, officers and other reporting agents to recognise and detect potential cases of money laundering. The data provided in the report may also be useful to law enforcement bodies, prosecutor's offices and financial intelligence units that help ensure lawfulness, assist courts in the administration of justice and defend the public interest through the application of criminal and civil law measures. The above-mentioned report complements the FATF guidance for a 'Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers' (June 2019) (FATFa report, 2020).

Another FAFT's recommendation was approved on 14 October 2020; it concerns the COVID-19 pandemic: "G20 supports the FATF's work to address money laundering and terrorist financing risks arising from the COVID-19 pandemic and so-called stablecoins". This recommendation proposes that the features of crisis inherent to the COVID-19 pandemic make preconditions for criminals to launder financial funds that are destined to support the entities affected by the pandemic. Since economic recovery is not yet expected, it is extremely important to observe the FATF Standards and apply the relevant measures to protect the economy from illicit money flows. In his remarks to the G20, Marcus Pleyer, President of the FATF, emphasised the significance of following the risk-based approach that could help to ensure that the funds destined for targeted support reach beneficiaries. By making observations, conducting case studies and exploiting the potential provided by advanced technologies, the FATF is capable of improving the current global anti-money laundering and counter-terrorist financing system, which is particularly important operating under the conditions of the global crisis. The recent report to the G20 on money laundering and terrorist financing risks concluded that although the FATF Standards are crucial for all jurisdictions, thus far only 25 out of 39 FATF member jurisdictions had implemented these standards successfully (FATF, 2020 c), which proposes that more effective action is needed on a global scale.

The analysis of the EU's anti-money laundering regulatory documents and recommendations shows that the international standards require the EU member states to integrate the provisions of the international legal instruments into their national legislation. It is also important that banks and other obliged entities undertake the relevant measures to prevent the manifestations of money laundering and terrorist financing in their activities because traceability of financial information has a significant effect on the success of the fight against the criminal phenomena mentioned above.

In summary, the phenomenon of money laundering is observed all over the world. Since it poses a serious threat to the financial system of every country, governments must make effort to eradicate the roots of money laundering and terrorist financing. Countries with a weak anti-money laundering legal framework are most commonly selected for implementation of money laundering schemes.

2. Methodological approach

The research is based on the method of a hierarchical cluster analysis. Hierarchical data grouping is a powerful technique for creating groups from data similarities. The advantage of hierarchical clustering is that this method is easy to understand and implement. The output of the algorithm dendrogram can be used to understand the overall picture as well as particular data groups with consideration of certain characteristics (Sultana, 2020).

A cluster analysis is a multidimensional statistical method that identifies target groups in a set of objects where each object is defined by a feature vector. A cluster refers to a group of similar objects. Within a cluster, the differences between objects should be least significant, while the differences of objects attributed to different clusters should be most significant. Clusters are not necessarily the same size; objects are attributed to one or another cluster based on particular similarities. The shape of a cluster depends on clustering features (Stabingiene, 2014; Cekanavicius, Murauskas, 2002). Similarities among the clusters were determined by employing the Ward's method which is recognised as most suitable for being able to form relatively few clusters with relatively many countries (Punj & Stewart, 1983; Harrigan, 1985).

Based on the Ward`s method, the distance between two clusters under consideration is estimated by applying the following formula:

$$D_{KL} = \frac{\|\bar{x}_K - \bar{x}_L\|^2}{(\frac{1}{n_K} + \frac{1}{n_L})}$$

where: *X* represents a vector mean for cluster C, and *n* denotes the number of observations.

In statistics, the Ward method is a criterion used in a hierarchical cluster analysis. The Ward minimum dispersion method is a special case of the objective function method. Ward proposed a common agglomerative hierarchical clustering algorithm in which the criterion for selecting the cluster pairs to be combined in each step is based on the optimal value of the objective function. Any function that reflects a researcher's purpose could serve as an objective function. Many standard clustering procedures are included in this very general class. To illustrate the algorithm, Ward used an example where the objective function is the error sum of squares, and this example is known as the Ward method or the Ward minimum dispersion method.

The essence of this method is forming clusters so that the differences in object features within a cluster would be least significant. Joining the elements into clusters is represented by a graph, i.e. a dendrogram indicating how many and which clusters can be formed. The elements in the clusters as well as the number of the clusters themselves depend on the method selected.

By applying a hierarchical cluster analysis, similarity of the objects (in this case – 28 EU member states) was determined considering 3 following features: Corruption Perceptions Index (CPI), Basel AML Index and Number of reports filled with FIU. All EU member states were clustered (attributed to the groups with similar objects possessing the above-mentioned features).

The reports provided by Europol, the Basel Institute on Governance and Transparency International served as official sources of the following statistical data:

1. the number of suspicious transaction reports received by an FIU from all EU member states between 2006 and 2014;
2. the Basel AML Index for 2012-2020;
3. the Corruption Perceptions Index (CPI) for 1998-2018.

Limitations of the study: Europol provides the statistics of all the EU member states concerning the number of suspicious transaction reports received by an FIU only for the period of 2006-2014.

The analytical part of the research also contains the hypotheses raised for all EU member states based on *If* analysis:

H_0: a lower Basel AML Index leads to a higher CPI;

H_1: a larger number of suspicious transaction leads to a lower Basel AML Index.

The Basel AML index is one of the indices for money laundering risk. According to the Basel Institute on Governance, it is an independent annual ranking that assesses the risk of money laundering and terrorist financing (ML/TF) around the world. This index has been estimated by the Basel Institute on Governance since 2012; it is based on the data extracted from 16 publicly available data sources, including the database of the Financial Action Task Force (FATF), the ranks provided by Transparency International, and the statistics of the World Bank and the World Economic Forum. The index evaluating money laundering risk covers 5 basic areas (according to the Basel Institute on Governance) depicted in Figure 1.

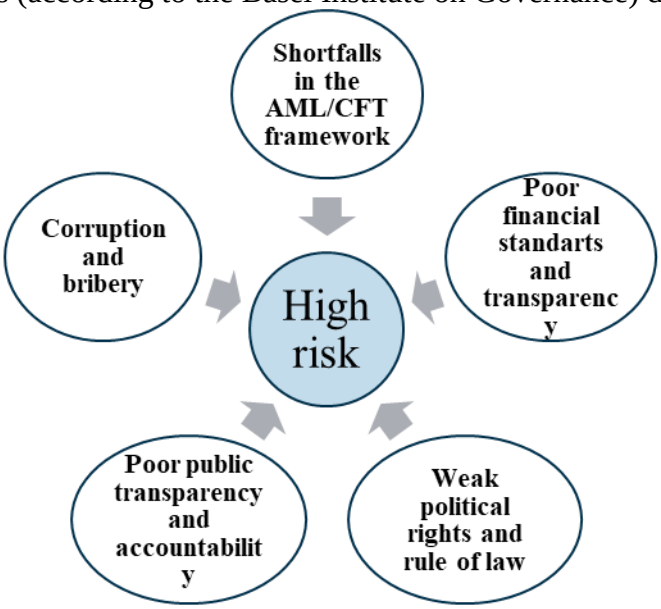

Figure 1. Key factors contributing to a high risk of ML/ TF
Source: *Basel Institute on Governance*

The Basel Institute on Governance has already announced the Basel AML Index estimated for 141 state in 2020. In the absence of quantitative data, the Basel AML Index does not measure the actual size of money laundering or amounts of illicit money in a state; this index addresses the level of risk, in other words, the vulnerability of a state to money laundering and terrorist financing activities. The lower the value of the Basel AML Index, the less vulnerable to money laundering and terrorist financing activities a state is. For instance, with reference to the report of the Basel Institute on Governance for 2020, Estonia has the lowest index of 2.36, while Afghanistan has the highest index of 8.16.

Most of the indicators selected for estimation of the Basel AML Index have their own rating systems. To ensure a unified coding system, individual indicator values (variables) are collected and normalised by employing the 'min-max' method, a 0–10 point system where 10 indicates the highest level of risk and 0 – the lowest level of risk.

When calculating the money laundering risk index, corruption risk constitutes 10 percent of the total value: the Corruption Perceptions Index (CPI) estimated by Transparency International constitutes 5 percent, and TRACE bribery Risk matrix constitutes another 5 percent.

In practice, the Bribe Payers Index (BPI) is also included when calculating the Basel AML Index. This index in 1999 was started to be calculated by the international organisation Transparency International. In 2011, 28 largest economies worldwide were ranked by the Bribe Payers Index (BPI) in terms of the expected probability that business companies in these economies would pay bribes abroad (Transparency International, 2011). 28 economies and territories for estimation of the Bribe Payers Index (BPI) were selected on the basis of the value of their foreign direct investment (FDI), exports and regional significance. The Bribe Payers Index (BPI) rates and ranks states on a 0 -10 point scale where 10 points represent the view that a state's business companies never engage in bribery when doing business abroad (Transparency International, 2011). In 2011, the highest Bribe Payers Index (BPI) was estimated for the Netherlands and Switzerland - 8.8, for Belgium - 8.7, Germany and Japan - 8.6, which proposes that business companies from these states extremely rarely participate in bribery cases when operating abroad. None of the 28 states scored a maximum of 10 points, which means that there is no state to be considered completely 'clean', or in other words, there is no state representatives of which do not engage in bribery while operating abroad. During the period under review, Mexico with 7 points, China with 6.5 points and Russia with 6.1 points were rated as the states most likely to engage in bribery.

The Corruption Perceptions Index (CPI) is one of the most commonly used indices to reflect the level of corruption in a state. The Corruption Perceptions Index (CPI) is a derived indicator that allows to classify states by the perceived prevalence of corruption among public sector employees and politicians. The international organisation Transparency International conducts annual business surveys and other expert research to find out how corruption is perceived in individual states. Foreign and local experts, correspondents and business leaders are involved in these surveys. When Transparency International annually announces the Corruption Perceptions Index (CPI), states worldwide are grouped by the perceptions of the prevalence of corruption among their public sector employees and politicians. The Corruption Perceptions Index (CPI) is derived based on the results of expert and business surveys. The states are rated on a scale from 0 to 10, where point 0 represents a high level of corruption, while point 10 means practically no corruption in a state (Transparency International).

According to Trapnell (2015), there are many data sources that aggregate various aspects of corruption, transparency, accountability and integrity, but few data sets are intended solely to measure the level of corruption, excluding policy experiments. As it is difficult to collect accurate data on corruption, there is a wealth of the data on corruption perceptions and experience.

3. Empirical results of the research

In the hierarchical cluster analysis, the EU member states were numbered from 1 to 28:

1- Austria;
2- Belgium;
3- Bulgaria;
4- Croatia;
5- Cyprus;
6- The Czech Republic;
7- Denmark;
8- Estonia;
9- Finland;
10- France;
15- Italy;
16- Latvia;
17- Lithuania;
18- Luxembourg;
19- Malta;
20- The Netherlands;
21- Poland;
22- Portugal;
23- Romania;
24- Slovakia;

11- Germany;
12- Greece;
13- Hungary;
14- Ireland;
25- Slovenia;
26- Spain;
27- Sweden;
28- The United Kingdom.

Although most Financial Intelligence Units (FIUs) provide annual suspicious transaction reports (STRs) illustrating the situation in a state, such overview at the EU level is not available. The Europol Financial Intelligence Team regularly monitors and reports on suspicious transactions within the EU thus providing the pan-European perspective. The STRs were launched in 2006; they are filled by the regulated private sector, mainly banks and other financial institutions, as well as non-financial subjects. The STRs present the financial flows that can be linked to money laundering or terrorist financing activities. These reports aim at providing insights into the extent of suspicious transactions in the EU and to highlight notable trends and developments (Europol, 2017).

The EU dendrogram by the attribute 'the total number of suspicious transaction reports received by an FIU across all European Union countries (2006-2014)' is presented in Figure 1 in the Annexes. The dendrogram indicates that the EU member states fall into 2 clusters by the above-mentioned attribute: the Netherlands and the United Kingdom are assigned to Cluster 1, while Cluster 2 includes the remaining 26 EU member states.

Figure 2 depicts the percentage distribution of the EU member states by the number of suspicious transaction reports (STRs) for the period 2006-2014.

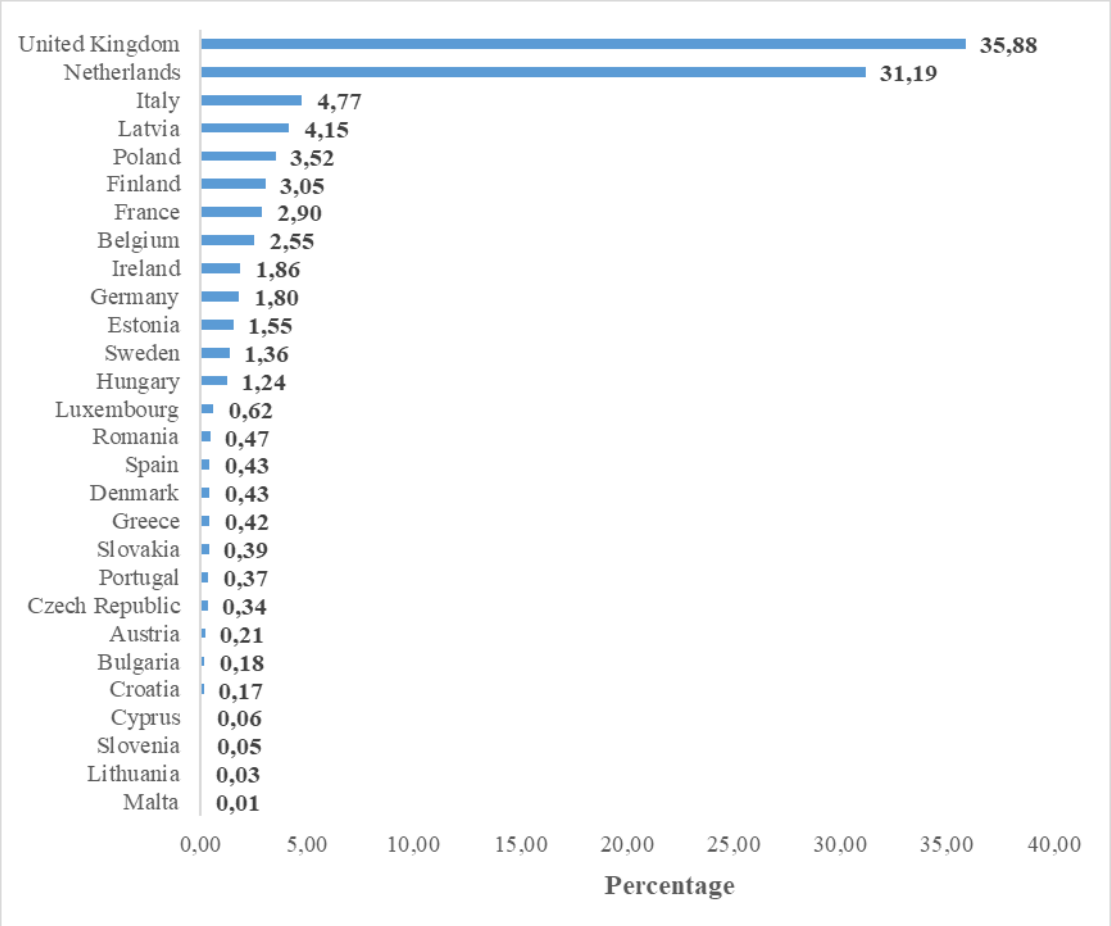

Figure 2. The total number of suspicious transaction reports received by an FIU across all European Union member states (2006-2014)

Figure 2 indicates that the Netherlands filled around 31 percent, while the United Kingdom – around 36 percent of the total number of the suspicious transaction reports over the period under consideration. According to Europol (2017), in 2014 the regulated sector reported almost 70 percent more suspicious transactions than in 2006, while the private sector reported almost 1 million suspicious transactions in 28 EU member states, i.e. almost twice as many as in 2006.

With reference to the Europol's statistics on the number of reports filled with FIU over the period 2006-2014, the Netherlands on average annually reported 225144 suspicious transactions, while the United Kingdom – 258845 suspicious transactions. All other EU member states on average annually reported 721962 suspicious transactions over the period under consideration.

Table 2 depicts clusters of the EU member states by the attribute 'Basel AML index' over the period 2012-2020. The EU dendrogram by the attribute 'Basel AML index' is presented in Figure 2 in the Annexes.

Table 2. Summary of the cluster analysis for the EU member states by the attribute 'Basel AML Index'

Cluster 1: High Basel AML Index	Cluster 2: Medium Basel AML Index	Cluster 3: Low Basel AML Index
High Risk of Money Laundering	Medium Risk of Money Laundering	Low Risk of Money Laundering
High Risk of Terrorist Financing	Medium Risk of Terrorist Financing	Low Risk of Terrorist Financing
Austria	Belgium	Bulgaria
Germany	Croatia	Lithuania
Italy	Cyprus	Slovenia
Greece	The Czech Republic	Sweden
Luxembourg	Denmark	Estonia
	France	Finland
	Hungary	
	Ireland	
	Latvia	
	Malta	
	The Netherlands	
	Poland	
	Portugal	
	Romania	
	Slovakia	
	Spain	
	The United Kingdom	

As it can be seen in Table 2, Cluster 1 covers 5 EU member states (Austria, Germany, Italy, Greece and Luxembourg) with the highest level of the risk of money laundering and terrorist financing over the period 2012-2020. According to the data provided by the Basel Institute on Governance for 2020, the highest Basel AML Index was estimated for the following 5 EU member states: Luxembourg - 4.74; Romania - 4.79; Cyprus - 4.81; Hungary - 4.99 and Malta - 5.48.

Cluster 2 covers 17 EU member states with a medium level of vulnerability to money laundering and terrorist financing. The highest Basel AML Index was estimated for Latvia – it amounted to 4.62, while the lowest Basel AML Index over the period under consideration was

estimated for Denmark – it was equal to 3.46. With reference to the 2020 report by the Basel Institute on Governance, comparing with November 2018 and November 2019, Denmark has improved its positions in two technical areas: R34 (guidance and feedback) and R35 (sanctions).

Cluster 3 covers 6 EU member states (Bulgaria, Lithuania, Slovenia, Sweden, Estonia, and Finland) with the lowest average values of the Basel AML Index over the period 2012-2020. With reference to the 2020 report by the Basel Institute on Governance, the lowest level of risk of money laundering and terrorist financing is characteristic to Estonia with the Basel AML Index amounting to 2.36.

By the attribute 'the Basel AML Index', the EU member states were divided into two clusters:

Cluster 1: Bulgaria, Lithuania, Slovenia, Sweden, Estonia, Finland.

Cluster 2: remaining 22 EU member states.

Table 3. Summary of the EU cluster analysis by the attribute 'Corruption Perceptions Index' (CPI)

Cluster 1: High risk of corruption	Cluster 2: Medium risk of corruption	Cluster 3: Low risk of corruption
Low corruption perceptions index	Medium corruption perceptions index	High corruption perceptions index
Hungary	Belgium	Denmark
Poland	France	Finland
The Czech Republic	Spain	Sweden
Italy	Estonia	The Netherlands
Latvia	Portugal	Luxembourg
Slovakia		The United Kingdom
Greece		Germany
Bulgaria		Austria
Romania		Ireland

The EU's dendrogram by the attribute 'Corruption Perceptions Index (CPI)' is presented in Figure 3 in the Annexes.

The hierarchical cluster analysis 'Corruption Perceptions Index (CPI)' did not include 5 EU member states (Cyprus, Croatia, Lithuania, Malta, Slovenia) since not all CPI data for the period 1998-2018 were presented in Transparency International's reports.

As it can be seen in Table 3, Cluster 1 covers 9 EU member states (Hungary, Poland, Czech Republic, Italy, Latvia, Slovakia, Greece, Bulgaria, Romania) with low CPIs for the period 1998-2018, which proposes that the level of corruption in these states is high. Over the period under consideration, the annual CPI averaged 50 in Hungary, 49 in Poland, 48 in Italy, and 37 (the lowest) in Romania.

Cluster 2 covers 5 EU member states (Belgium, France, Spain, Estonia, and Portugal) with medium CPIs for the period 1998-2018. For instance, over the entire period under consideration, CPI in Belgium averaged 71, in France – 70, in Spain and Estonia – 64, and in Portugal – 63.

Table 3 indicates that Cluster 3 covers 9 EU member states (Denmark, Finland, Sweden, Netherlands, Luxembourg, the United Kingdom, Germany, Austria, and Ireland) with high CPIs. For instance, over the period under consideration, the annual CPI in Denmark averaged 94, in Finland – 93, and in Sweden – 91, which proposes that these states have the lowest level of corruption among all EU member states.

Hypothesis H_0 was confirmed because in all EU member states a lower Basel AML Index determined a higher Corruption Perceptions Index over the analysed period on an annual basis. A lower Basel AML Index indicates positive tendencies because it proposes that a state is less vulnerable to money laundering and terrorist financing risks. Meanwhile, the higher is CPI, the lower is the level of corruption in a state.

Hypothesis H_1 was also confirmed because a higher number of reports filled with FIU determined a lower Basel AML Index. The higher number of reports on suspicious transactions is filled in a state, the lower is the risk of money laundering and terrorism financing.

4. Discussion

The fact that corruption and money laundering are interrelated phenomena is revealed by previous studies (Livescu, 2017; Kyriakos-Saad, et. al., 2012; Barone, et. al., 2021). Corruption can be understood as the abuse of a public service for personal gain, which is obtained in a number of ways, including bribery, extortion, fraud, embezzlement, theft of public funds. As in the case of money laundering, in order for public goods to be abused, the origin of all illicit sources must be disguised. Thus, corrupt officials steal property during the money laundering process, and if the process is successful, the illegally acquired property is misappropriated. Conversely, corruption can facilitate money laundering because corrupt officials can affect the process of laundering income and allow money launderers to evade any controls and sanctions. Previous studies confirm that the countries with low levels of corruption control generally do not or less effectively comply with anti-money laundering and anti-terrorist financing standards (AML/CFT). Clusters of the EU member states indicate that Hungary, Poland, the Czech Republic, Italy, Latvia, Slovakia, Greece, Bulgaria and Romania are the worst fighters against corruption. Denmark, Finland, Sweden, the Netherlands, Luxembourg, the United Kingdom, Germany, Austria and Ireland are the top nine countries effectively dealing with corruption. The level of corruption can also be explained with consideration of a country's economic situation, cultural and historical-political events. In addition, the countries that later accessed the EU tend to have higher levels of corruption. Undoubtedly, the countries (in our case, the United Kingdom and the Netherlands) that report larger numbers of suspicious transactions tend to have a lower risk of money laundering. The number of suspicious transaction reports in these countries is significantly larger in comparison to other EU member states.

Conclusion

The hierarchical cluster analysis of the EU member states by the attribute 'the number of suspicious transaction reports' allowed to form 2 state clusters, the first one covering the United Kingdom and the Netherlands, and the second one including the remaining 26 EU member states. According to the Europol's statistics for all EU member states over the period 2006-2014, the Netherlands fill around 31 percent, and the United Kingdom - around 36 percent of the total number of suspicious transaction reports in the EU, which proposes that the Netherlands and the UK have strong legal frameworks for money laundering prevention.

The hierarchical cluster analysis by the attribute 'Basel AML Index' allowed to form 3 state clusters: cluster 1 covers 5 EU member states (Austria, Germany, Italy, Greece, Luxembourg) with high risks of money laundering and terrorist financing over the period 2012-2020; the cluster of the states with low risks of money laundering and terrorism financing includes 6 EU member states - Bulgaria, Lithuania, Slovenia, Sweden, Estonia and

Finland; the last cluster covers the states with medium risks of money laundering and terrorism financing over the period 2012-2020, namely Belgium, Croatia, Cyprus, the Czech Republic, Denmark, France, Hungary, Ireland, Latvia, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Spain and the United Kingdom.

The hierarchical cluster analysis by the attribute 'Corruption Perceptions Index (CPI)' over the period 1998-2018 revealed Hungary, Poland, Czech Republic, Italy, Latvia, Slovakia, Greece, Bulgaria and Romania as the states with high levels of corruption; Belgium, France, Spain, Estonia and Portugal were revealed as the states with medium levels of corruption, while Denmark, Finland, Sweden, the Netherlands, Luxembourg, the United Kingdom, Germany, Austria and Ireland – as the states with low levels of corruption.

The research results allowed to confirm the initially raised hypotheses: a lower Basel AML Index determines a higher Corruption Perceptions Index, while a higher number of reports filled with FIU determines a lower Basel AML Index in the EU member states.

Clustering of the EU member states by their money laundering indices can be beneficial for national governments and anti-money laundering institutions because the results of this study can be employed when developing most effective anti-money laundering measures. In addition, the EU member states can be prompted to review and complement their current anti-money laundering legislation.

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Annexes

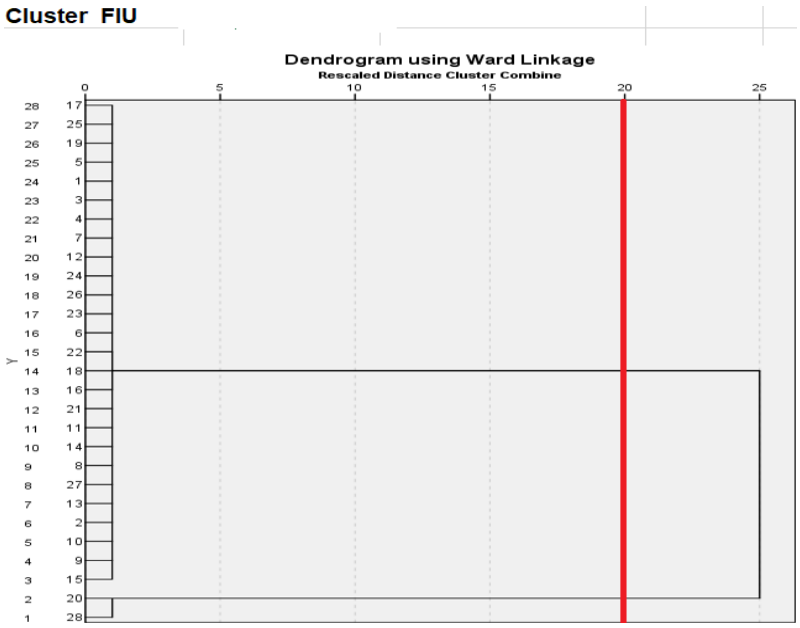

Figure 1. Hierarchical cluster analysis by the attribute 'Number of reports filled with Financial Intelligence Units (FIU)'

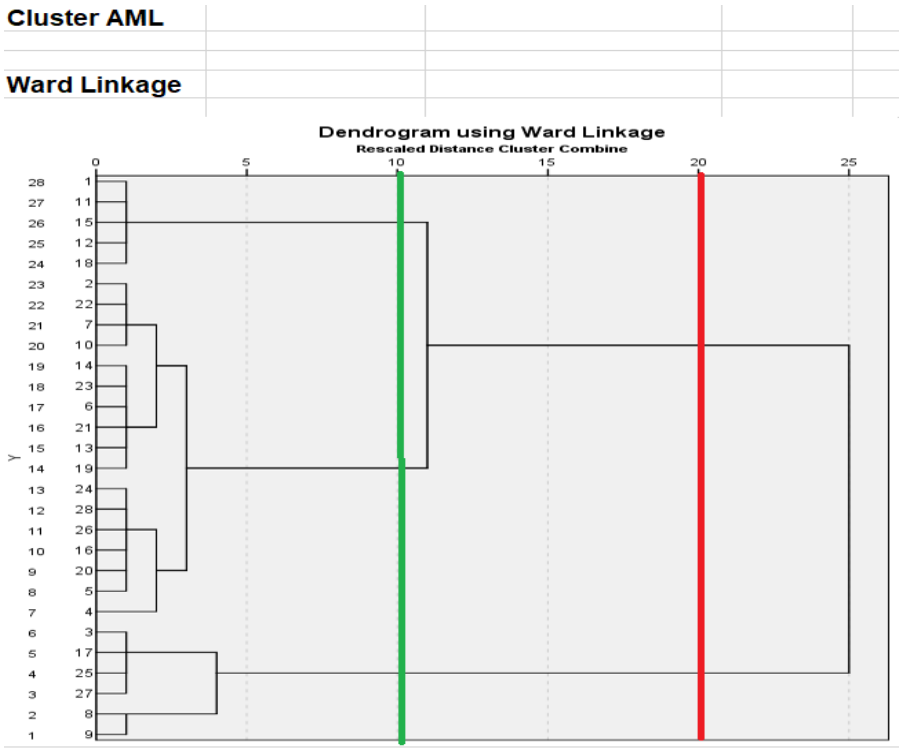

Figure 2. Hierarchical cluster analysis by the attribute 'Basel AML Index'

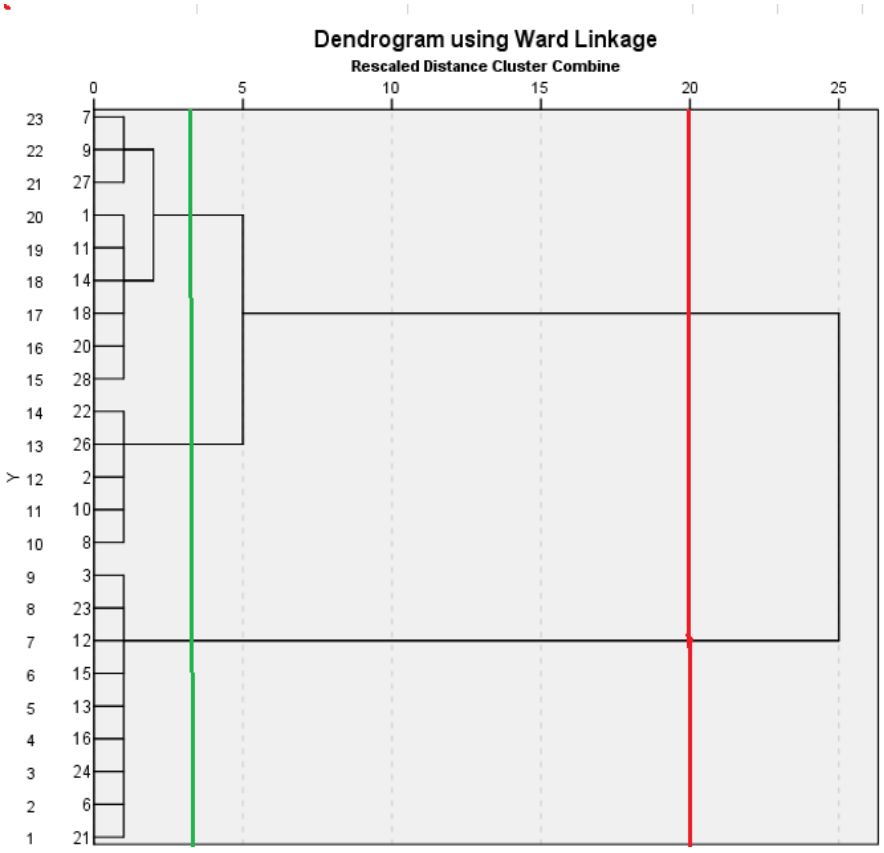

Figure 3. Hierarchical cluster analysis by the attribute 'Corruption perceptions index (CPI)'