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Illicit practices: Experience of developed countries

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Abstract. The article is devoted to finding the answer to two research questions. What illegal practices are most significant for clusters of developed countries formed by similarities in trends in corruption, shadow economy, money laundering, and crime rates? What social, economic, regulatory, and digital factors most influence them in each group? The pair correlation coefficients for illicit practices indicators confirm the presence of tight and statistically significant relationships in their trends for 36 developed countries. The agglomerative clustering and canonical analysis results identified that tackling the shadow economy is crucial for Estonia, Slovenia, and Lithuania; corruption for Portugal, Hungary, Cyprus, etc.; the shadow sector and crime levels for Denmark, Norway, Finland, Sweden, and

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New Zealand; corruption, money laundering, and crime for Canada, Germany, the USA, etc.; four illegal practices for Italy, Greece, Turkey, Croatia, Bulgaria, and Romania. The canonical analysis revealed that social and regulatory factors influence the trends of illicit practices in developed countries more than economic and digital ones. Network analysis showed their single moderate influence in most cases. Edge evidence probability analysis confirmed a high probability of a relationship between some pairs of social, economic, regulatory, digital and illegal indicators. However, Bayesian network analysis showed a low likelihood of mutual influence of single factors, confirming the importance of the group influence.

Keywords: illicit practice, corruption, crime, money laundering, shadow economy, developed countries

JEL Classification: E26, K42, O17

1. INTRODUCTION

In the modern globalised world, the problems of money laundering, corruption, the shadow economy, and crime remain relevant. These illegal practices undermine economic stability, subvert social justice, and create serious barriers to the sustainable development of society. Having more complex economic systems and advanced regulatory mechanisms, developed countries are facing new challenges when combating these problems, which requires a complex approach and innovative solutions. Can modern realities of these illicit practices really cause serious concern for governments, international organisations, and society?

Money laundering is a key element of financial crime that allows the perpetrators to transform illicit proceeds into legitimate assets, thus integrating them into the formal economy. This process contributes to financing further crime activity, international and domestic terrorism, drug trafficking, arms trafficking, etc. United Nations (2021) estimated that the world's volume of criminal proceeds legalisation is approximately 2–5% of global GDP for one year, which amounts to 2 trillion in current US dollars. For example, the UK's costs of money laundering are £100 billion per year (National Crime Agency, 2019). In 2020, in the USA, 22% of crimes from legalisation of illegal funds caused losses of more than USD 1.5 million (United States Sentencing Commission, 2020). The world's major banks spend considerable funds on combating this type of illicit activity, with a 78% reduction in fines in 2021 compared to 2020 as the positive effect. Nevertheless, some experts are concerned about the durability of the measures taken (AML Intelligence, 2022).

Corruption is one of the oldest social diseases that ruins the trust in state institutions and contributes to the shadow economy, which further fuels crime and weakens economic development. 68% of EU citizens believe that corruption is a serious problem in their countries, with 74% believing that it is connected to national public institutions, 58% – to political parties, and 55% – to local, regional, and national politicians (European Union, 2022). The governments suffering from high-level corruption face difficulties in implementing effective policies and economic reforms. However, EU's citizens are more optimistic considering this problem: only 37% consider anti-corruption measures to be impartial, 34% believe that judicial practices are ineffective, 31% believe the government is inefficient, and 31% believe that the activities of political parties are not transparent (European Union, 2022).

According to the official report of the International Monetary Fund, the size of the shadow economy in the world is approximately 31.9% of global GDP, which is equivalent to more than USD 20 trillion per year (Medina & Schneider, 2018). Although, its size has been reducing for European and OECD countries

for the last 20 years, the global pandemic triggered a severe recession in the economies of various countries and led to the growth of the shadow sector by 9.8% in 2020 compared to 2019. This fact was confirmed by the study of the Policy Department for Economic, Scientific and Quality of Life Policies at European Parliament (Schneider & Asllani, 2022). Furthermore, United Nations defines solving the problems of the informal economy in the 2030 Agenda for Sustainable Development as one of the critical goals of ensuring sustainable development "8.3.1. Proportion of informal employment in total employment, by sector and sex" (United Nations, 2023). A large share of the shadow economy hinders economic development, as it leads to losses of the state budget due to tax evasion, distorts market competition, creates obstacles for international investments, and violates social justice and stability. It creates difficulties for governments in securing effective management and implementing social programmes, reinforcing citizens' distrust in state institutions.

As to corruption, money laundering, and the shadow sector, they are all the elements of crime and form a vicious circle of illegal practices that reinforce one another. Corruption creates the conditions for the growth of the shadow economy and money laundering, as it provides criminals with the necessary protection from justice and contributes to tax evasion. In turn, revenues from criminal activities are invested into the shadow economy, fuelling it and contributing to the further criminalisation of society. Developed countries have more advanced institutional and regulatory mechanisms that can serve as a model for an effective fight against corruption, money laundering, shadow operations, and crime. That is why studying their experience helps to identify effective strategies and policies that can be adapted to the realities of less developed countries.

The purpose of this article is to investigate what illicit practices are most significant for developed countries formed by similarities in trends in corruption, shadow economy, money laundering, and crime rates, and to identify the influence of the social, economic, regulatory, and digital factors on these illegal activities. The results will contribute to creating more targeted and practical measures that can be integrated into the national policies of other countries for reducing crime rates and increasing economic stability.

1. LITERATURE REVIEW

In this article, a set of indicators of illegal practices and their influencing factors will be formed based on a critical analysis of the publications of experts and specialists on this issue, determining the structure of the literary review.

1.1. Corruption

Today, corruption is more problematic than other types of crime (Remeikienė et al., 2022). It leaves a negative influence on the development of competition between countries (Jovovic, 2021) and their economic growth (Simovic, 2021). Many factors influence corruption processes. Firstly, the global economic crisis created challenges in fighting corruption, so appropriate measures to strengthen the business environment contribute to its reduction (Kaya, 2023). Changes in a democratic society and increasing citizen participation also impact corruption processes in the country, and not always positively (Bozhenko et al., 2023a). This leads to the increasing importance of distributive policy emphasizing public administration transparency (Mishchuk et al., 2019; Ortina et al., 2023; Vasylieva et al., 2023). In addition, corruption processes are influenced by the openness of the economy, the size of the public sector, the degree of urbanization, and the share of women in the labor force (Linhartová & Halásková, 2022). That is why control of corruption is one of the factors of a healthy macroeconomy and ensuring direct investment in the country (Nguyen et al., 2021). It is also one of the determinants of stock market capitalisation in developed countries (Bui, 2023) and international trade development (Acar & Kara, 2023). Fighting

corruption positively impacts tax collection, which determines the growth or decline of the shadow economy size (Duong, 2022).

1.2. Anti-money laundering

Effective anti-corruption policies directly reinforce combating money laundering. On the one hand, legalisation processes contribute to cash flow withdrawal from the shadow sector to the legal economy (Kovalenko et al., 2022). On the other hand, they support different crime types, such as drug trafficking, underground casinos, arms trafficking, etc. (Djalilov et al., 2015; Baldavoo & Hassen, 2024). To indicate the countries' risk of money laundering and financing terrorism, the Basel Institute on Governance, an international non-governmental organisation, introduced the Basel Anti-Money Laundering Index. Its use allows defining the level of sustainability of the national financial monitoring system (Kuzmenko et al., 2023a). The main tool for fighting money laundering and financing terrorism is legislative initiatives (Filatova et al., 2023; Tung & Bentzen, 2022). Regulation of the financial services market, the quality of law enforcement and judicial activities, and digitalisation may serve as factors influencing this type of illegal practice (Lieonov et al., 2022; Asare & Samusevych, 2023). Government effectiveness and support in combating crime contribute to the developing converging processes of financial and cyber fraud prevention systems (Kuzmenko et al., 2023b; Kussainov et al., 2023). Lyeonov et al. (2022) proved that the shadow economy stimulates the development of new channels for money laundering.

1.3. Shadow economy

Corruption and money laundering may be the markers of influencing the shadow economy, changing dynamics of which are seen in such spheres as public finance, economic growth, investment climate, social justice, and even in specific areas such as environmental pollution (Tran, 2022; Nyahuna, Doorasamy & Baldavoo, 2024), carbon intensity of GDP (Bilan et al., 2020; Balcerek-Kosiarz et al., 2024), and energy consumption (Sedmíková et al., 2021). The shadow economy greatly influences the formal economy, reducing tax revenues, undermining economic stability, and aggravating social inequality (Mishchuk et al., 2018; Tiutiunyk et al., 2022a; Tiutiunyk et al., 2022b). The formation of the shadow economy primarily depends on the tax system. Its reduction is also influenced by a favourable political environment, the population welfare and low taxes in transition countries, and high taxes and market openness in developed countries (Fedajev et al., 2022; Buszko, 2022). Informal employment, production, and entrepreneurship are the common ways of tax evasion and the reason for the shadow sector growth (Mazurenko et al., 2023), although the unemployment rate causes its spread within certain regions of the country (Remeikienė & Gasparėnienė, 2022). Lyeonov et al. (2021) argue that economic, social, religious, gender and other types of inequality are the challenges for modern society and may be the factors of informal economy development. Unethical approaches to remuneration and employment create corruption precedents and contribute to informal employment (Steenbergen et al., 2023). The number of migrants, employment rate and population density serve as the main determinants of the impact on the shadow economy, which was proved by Lithuania's example (Remeikienė et al., 2021), with competitiveness and fiscal policy serving as the additional ones (Tiganasu et al., 2022).

1.4. Cyber crime

Speaking of corruption, money laundering and shadow schemes, one has to mention information technology. Thus, there are apparent transmission effects between corruption, the fight against financial crime, and economic and digital development (Surovičová et al., 2022). Recent experience showed that

digital transformation, on the one hand, leads to considerable positive changes in the financial sector, stimulates economic development and builds public trust in government institutions, but, on the other hand, causes the emergence of new forms of crime (Kozhushko, 2023; Litovtseva et al., 2022). Thus, cybercrime has become the basis for financial fraud, money laundering, and shadow transactions (Sigetová et al., 2022). The development of algorithms and systems for big data processing helps to react to cyberthreats (Onyshchenko et al., 2023b), and using artificial intelligence systems and blockchains provides transparency and security of financial transactions (Utkina, 2023). Building reliable digital infrastructure contributes to reducing cyberthreats and incidents in the financial sector and to economic growth (Koibichuk & Dotsenko, 2023; Mačiulytė-Šniukienė et al., 2022). Digital information technology enhances anti-corruption measures (Hrytsenko et al., 2022; Androniceanu et al., 2021). They also provide information transparency and security, which are essential components of the fight against corruption and financial fraud (Bozhenko et al., 2023b; Hrytsenko et al., 2023; Onyshchenko et al., 2023a). As digital influence factors, Kuzior et al. (2022) identified such indicators as the number of Internet users, active mobile broadband subscriptions, fixed broadband subscriptions, etc.

To sum up, the problems of corruption, money laundering, the shadow economy and crime are relevant, but they require research into their complex and systemic interaction to develop more effective preventive measures. The results of the literature review were taken into account in selecting indicators for this study's implementation.

2. METHODOLOGICAL APPROACH

To study the interrelationship between money laundering, corruption, the shadow economy, and crime through the prism of developed countries' experience, we suggest a methodology that includes five stages.

The *first stage* is dedicated to proving the interrelationships between four types of illicit practices. Its implementation presupposes the calculation of Pearson correlation and proving its significance. This will allow us to confirm the existence or absence of the links and their strength. Since the correlation index is calculated using the classical formula, we will not present it in this study. Before calculations, we will normalise the indices by Savage normalisation (Yarovenko et al., 2023a) for the Corruption Perception Index, which will change the direction of its impact, taking into account the direction of impact of the other three indicators of illegal practices and simplify the interpretation of the results. Natural normalisation (Yarovenko et al., 2023a) will be applied to the other indicators.

For a deeper understanding of the complex interrelationships between corruption, money laundering, the shadow economy, and crime rate, we suggest conducting a cluster analysis at the *second stage* of the methodology. It will help identify groups of countries with similar problems and determine the existence of specific patterns in these groups. The method chosen is agglomerative clustering, which gradually combines objects (countries) into clusters based on similarity criteria, such as illicit practices. That type of clustering was selected for the study because it allowed us to form groups of the most similar countries. Provided that the high correlation between the variables is confirmed in the clustering process, Principal Component Analysis will be applied to eliminate the effect of multicollinearity (Pearson, 1901).

The implementation of agglomerative clustering begins with the initialisation of objects as separate clusters $C_i^{(0)} = \{x_i\}$ $(i = 1,2, \dots, n)$. $X = \{x_{1_1}, \dots, x_{1_4}, x_{2_1}, \dots, x_{2_4}, \dots, x_{36_1}, \dots, x_{36_4}\}$ – a set of objects, i.e. aggregated and standardised values for four types of criminal practices and 36 developed countries selected for the study. The main idea of this method is to calculate the distance between the clusters. For this purpose, we choose the Single Linkage approach (1), which will help reveal specific data structures and different forms of clusters:

$$d(C_i, C_j) = \min_{x \in C_i, y \in C_j} d(x, y), \quad (1)$$

where $x,\ y$ – cluster pairs.

After that, cluster pairs with a minimum distance are formed by the formula (2):

$$\left(C_r^{(p)}, C_s^{(p)}\right) = \arg \min_{C_i^{(p)}, C_j^{(p)}} d(C_i^{(p)}, C_j^{(p)}), \quad (2)$$

where p – iteration number.

The result is formed as a new cluster $C_t^{(p+1)} = C_r^{(p)} \cup C_s^{(p)}$, and the set of existing clusters is updated with it. The algorithm is repeated until all objects are in the same cluster or the stopping condition is reached. The result of clustering is the formation of a dendrogram that reflects the process of combining clusters of countries based on similarity criteria, represented by indicators that identify the level of crime, corruption, money laundering, and shadow operations.

The number of clusters in the model will be justified using Silhouette Scores, which are calculated for different numbers of clusters (Rousseeuw, 1987). The highest value of Silhouette Score corresponds to the optimal number of clusters for further research.

The *third stage* of the methodology involves conducting a canonical analysis that will allow us to investigate the interaction of two groups of indicators – a group of indicators of illegal practices and a group of social, economic, regulatory, and digital factors. It will help us answer the questions of which factors are most significant regarding the mutual influence of indicators from both groups, and which group is the cause of the influence. Canonical analysis refers to classical statistical research methods. Its implementation is based on the approach outlined by Yarovenko et al. (2023b).

At the *fourth stage* of the methodology, Frequentist Networks will be built, i.e., graphs that visualise structural dependencies in the data. They will reveal statistically significant dependencies between economic, social, digital, regulatory factors and illicit practices, demonstrate the structure of relationships between variables, and help identify direct and indirect dependencies. The mathematical formalisation of the Frequentist Network includes the definition of the main components of the graph, such as nodes (variables) and edges (dependencies between variables), and methods for their evaluation based on the frequency approach.

All the variables N_i are represented as nodes in the graph $N = \{N_1, N_2, \dots, N_k\}$. For each pair (N_i, N_j) the degree of dependence ρ_{ij} is calculated, for which a partial correlation was chosen. It allows to assess the dependence between two variables N_i and N_j by controlling for other factors N_h. This will allow us to assess the impact of individual factors without taking into account the group effect. This measure is determined by the formula (3):

$$\rho_{N_i N_j | Z} = -\frac{P_{ij}}{\sqrt{P_{ii} P_{jj}}}, \quad (3)$$

where P_{ij} is an element of the inverse correlation matrix R^{-1}, P_{ii} and P_{jj} are the diagonal elements of the inverse matrix R^{-1}, corresponding variables N_i and N_j.

The calculated partial correlations are tested for statistical significance using the t-test for partial correlations. If the value of the t-statistic exceeds the critical value of the t-distribution with $n - p$ degrees

of freedom for a given significance level α, then an edge $E = \{e_{ij} | N_i, N_j \in N\}$ is established between nodes N_i and N_j, where e_{ij} represents the dependence between variables N_i and N_j. Otherwise, the edge is not formed.

At the *fifth stage* of the methodology, Bayesian Networks will be formed to establish the probability of links between indicators of illegal practices and social, economic, regulatory, and digital factors. They allow us to consider uncertainty and relationships between variables and predict the likelihood of illicit practices depending on the values of the influencing factors. The construction of Bayesian Networks involves determining the structure of a graph that best fits the variables, with a set of nodes N and edges E. As a rule, this is done using search methods or evaluation criteria such as BIC, AIC, etc. For each node, a conditional distribution is defined as $P(N_i|Pa(N_i))$, taking into account their parents $Pa(N_i)$. Next, parametric learning is performed by determining the joint probability distribution of variables using conditional dependencies according to the formula (4):

$$P(N_1, N_2, \dots, N_n) = \prod_{i=1}^{n} P(N_i|Pa(N_i)), \quad (4)$$

where $P(N_1, N_2, \dots, N_n)$ is joint probability distribution of all variables in the network.

To confirm the likelihood of links between illegal practices and influencing factors, an Edge evidence probability analysis will be performed, which will result in networks with confirmed or unconfirmed probabilities. The key point is to calculate the assessment of the existence of an edge between the nodes-variables N_i and N_j using the formula (5):

$$P(E_{N_iN_j} = 1|D) = \frac{P(D|E_{N_iN_j} = 1) \cdot P(E_{N_iN_j} = 1)}{P(D)}, \quad (5)$$

where $P(D)$ is the overall probability of receiving data calculated as: $P(D) = P\left(D\middle|E_{N_iN_j} = 1\right) \cdot P\left(E_{N_iN_j} = 1\right) + P\left(D\middle|E_{N_iN_j} = 0\right) \cdot P\left(E_{N_iN_j} = 0\right)$; $P(E_{N_iN_j} = 1)$ is the apriori probability of the existence of an edge calculated as: $P\left(E_{N_iN_j} = 1\right) = P\left(E_{N_iN_j} = 1\middle|D\right) \cdot P(D) + P\left(E_{N_iN_j} = 1\middle|\neg D\right) \cdot P(\neg \mathrm{D})$; $P(D|E_{N_iN_j} = 1)$ is the probability of obtaining data given the existence of an edge; D is the evidence of the existence of a connection between N_i and N_j; $P\left(E_{N_iN_j} = 1\middle|D\right)$ is the probability that an edge exists given the evidence; $P\left(E_{N_iN_j} = 1\middle|\neg D\right)$ is the probability that an edge exists without given the evidence; $P(D)$ is the probability of data availability; $P(\neg \mathrm{D})$ is the probability of missing data.

3. EMPIRICAL SECTION

3.1. Data analysis

The Basel AML Index, Corruption Perception Index, Size of the Shadow Economy, and Crime Index were chosen to study the problem of money laundering, corruption, shadow economy, and crime rates considering the experience of developed countries. The analysis is based on data from 36 developed countries. This selection is due to the following considerations. First, research on illicit practices in

developed countries can have practical implications for progressing policies that can be adopted in developing and least-developed countries. Secondly, the strong development of these countries makes it possible to level the influence on illegal practices from more general processes caused by economic, political and social instability, if it were the case of less developed countries, and to reveal the influence of more specific factors that can be important precisely for development these illicit practices. Third, developed countries provide a reliable information base for analysis and comparisons, which will contribute to the study of their successful strategies to combat these problems and may be helpful for a deeper understanding of global economic, social and political processes.

A technical reason justifies the selection of the data set period from 2012 to 2022. This period is typical of the study's complete set of empirical data and is characterized by the absence of missing values.

Size of the Shadow Economy (SE) is an indicator that allows identifying the processes of shadowing the economy in a country, which cover economic activities that are from public authorities to avoid taxes, social contributions, regulatory restrictions or money laundering. It helps to identify vulnerable sectors of the economy and assess the effectiveness of regulatory measures. The average SE values from 2012 to 2022 show a steady decline (*Figure 1*). The obvious factors that influenced this are economic recovery of many European countries after the financial crisis of 2008 (Yadav et al., 2023), which influenced GDP growth and an unemployment reduction. Many countries have implemented reforms to reduce the tax burden on small and medium-sized businesses, contributing to the business' withdrawal from the shadows. The rapid digitalisation of the economy has also contributed to the transparency and controllability of financial transactions. The introduction of international agreements on the exchange of tax information, such as the Common Reporting Standard, has also helped to reduce opportunities for shadow activities.

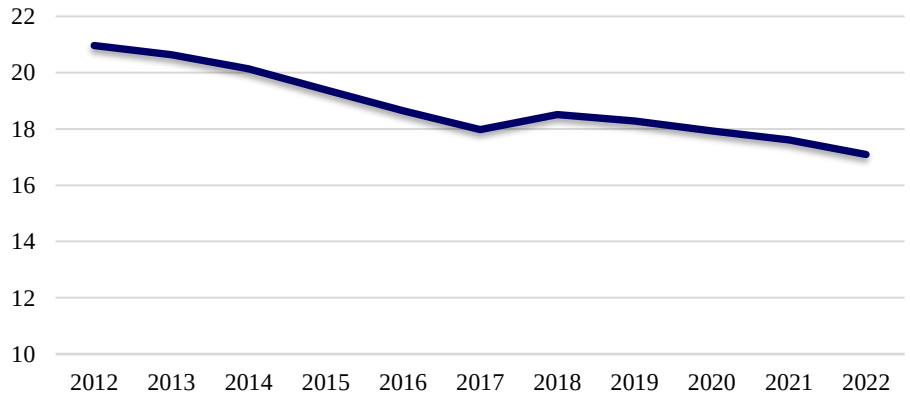


Figure 1. The average Size of the Shadow Economy values for 2012–2022

Source: *own compilation based on Schneider & Asllani (2022)*

The top 10 countries with the least progress in changing the shadow sector over 11 years are Bulgaria, Croatia, Estonia, Hungary, Lithuania, Malta, Poland, Portugal, Slovenia, and Cyprus (*Figure 2*). Leaders in the fight against the shadow economy are Austria, Finland, France, Germany, Norway, Australia, Canada, Japan, and the Netherlands. They have managed to reduce shadow transactions by 26% to 35% (*Figure 2*). This trend is sustainable if we compare the SE value of 2022 with the values of 2012 and 2021.

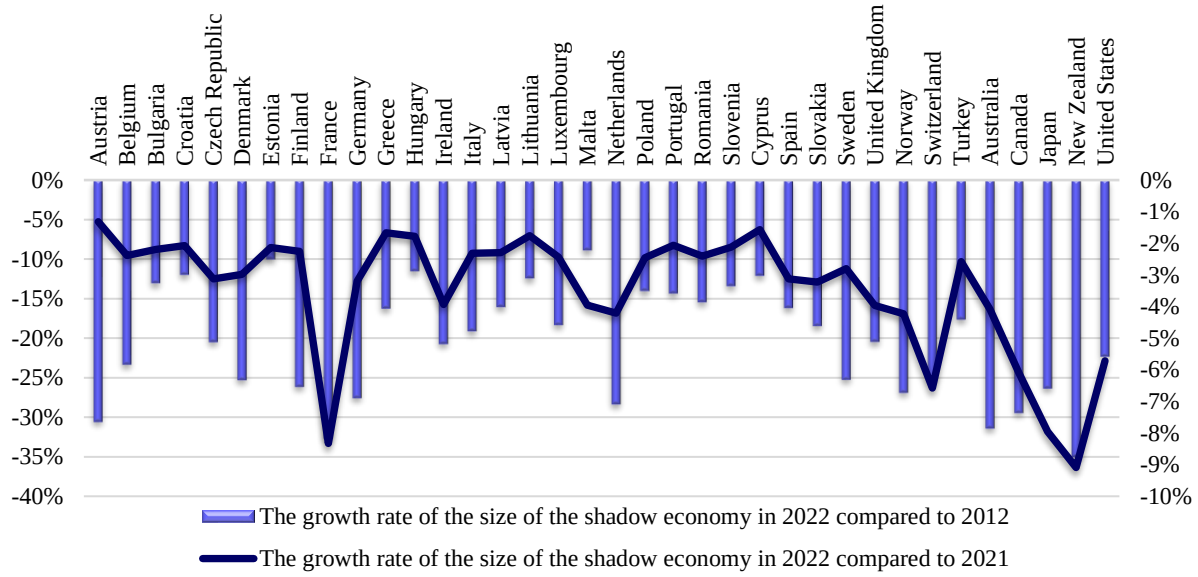


Figure 2. Growth rate of the Size of the Shadow Economy in 2022 compared to 2012 and 2021
Source: *own compilation based on Schneider & Asllani (2022)*

Corruption Perception Index is an index used to identify a country's corruption processes based on the assessment of its perception by business representatives. It allows evaluation of corruption level in the public sector, defines spheres with its high risk, and monitors the progress of anti-corruption measures. CPI contributes to the transparency and accountability of governments, encourages public scrutiny and supports international standards in the fight against corruption. Analysing the average CPI values over 11 years, we can see a clear downward trend in corruption perception since 2015 (*Figure 3*).

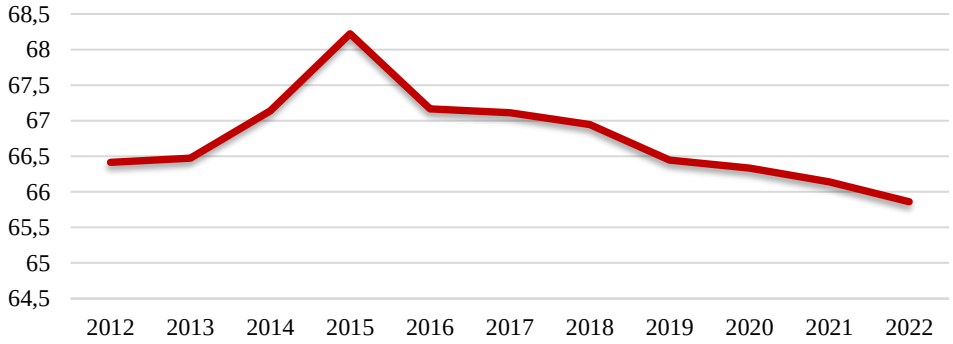


Figure 3. The average values of the Corruption Perception Index for 2012-2022
Source: *own compilation based on Transparency International (2023)*

The rise of corruption can be explained by several factors, including political and economic instability. Many European countries have faced political scandals involving high-ranking politicians and civil servants. The consequences of the Financial Crisis of 2008 also could contribute to the growth of corruption practices, as governments and businesses seek ways to fast recovery and preserving competitiveness. Expanding media coverage of corruption scandals impacts the perceived level of corruption, as it draws a population's attention and causes public discontent. Through pressure from international organisations, such as FAFT and Transparency International, on the countries with high levels of corruption, new cases and shortcomings in anti-corruption measures may be discovered. The systematic nature of corruption

episodes increases public distrust in the effectiveness of state institutions such as the judiciary system, police, and government.

Such countries as Belgium, Finland, Hungary, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovenia, Spain, Cyprus, Sweden, the United Kingdom, Norway, Switzerland, Turkey, Australia, Canada, Japan, New Zealand and the United States demonstrate a decrease in corruption perception in 2022 compared to 2012 (*Figure 4*).

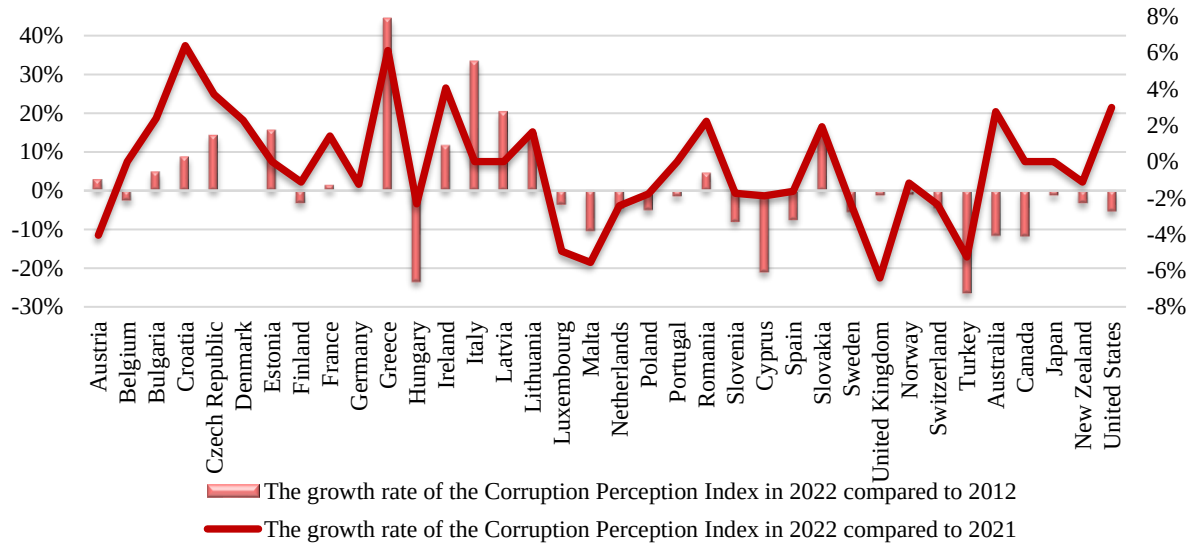


Figure 4. Corruption Perception Index growth rate in 2022 compared to 2012 and 2021

Source: *own compilation based on Transparency International (2023)*

Moreover, this tendency preserves for most of these countries when comparing their CPI in 2022 to 2021, with a decrease ranging from 1% to 6%. This indicates the growth of the corruption problem that has been a steady trend for a long time.

Basel AML Index (BAML) is an important tool to identify money laundering processes in different countries. It provides a complex approach to evaluating the risks of legalising criminal proceeds and financing terrorism. This index allows analysis of the quality of national regulators in fighting these phenomena, compliance with international standards, transparency of financial transactions, accessibility and quality of information to the public, level of corruption, and political and legal risks. *Figure 5* shows the average values of this indicator over 11 years, where we observe a positive trend in reducing money laundering risks for selected developed countries.

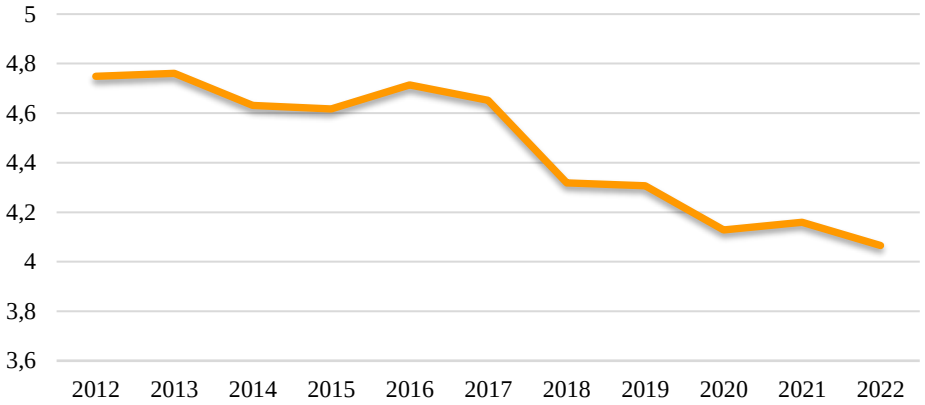


Figure 5. The average values of Basel AML Index for the period 2012–2022
Source: *own compilation based on Basel Institute on Governance (2023)*

The trend of decreasing risks of legalisation of illicit proceeds, in general, can be explained by introducing and implementing stricter regulations on fighting money laundering and financing terrorism. As the EU countries make the most of the sample, one should stress the significant impact of adopting the Fourth and Fifth EU Anti-Money Laundering Directives in practice. Implementing transparency and financial information exchange standards, such as the Standard for the Automatic Exchange of Information on Financial Accounts (CRS) from the Organisation for Economic Co-operation and Development (OECD), also influenced that in 2017 we can see a significant reduction in the risk of money laundering (*Figure 5*).

The positive trend in BAML changes is also caused by a rapid introduction of artificial intelligence technologies to detect suspicious operations and money laundering schemes, improving access to information on the beneficial owners of companies and trusts, which makes it challenging to use anonymous structures for money laundering. Strengthening cooperation between governments, international organisations, and financial institutions on money laundering contributes to the effective detection and prevention of criminal schemes. It is worth noting that increased focus on compliance issues by financial institutions and raising the awareness of their employees about risks and the need to comply with regulatory requirements also serve as positive catalysts in reducing opportunities for money laundering and financing terrorism.

In contrast to the positive dynamics of reducing the risk of money laundering in general for developed countries, there are negative trends for some of them, indicating problems in this area. For example, Bulgaria, Hungary, Malta, Romania, and Norway (*Figure 6*) demonstrate a significant BAML increase over the eleven-year period.

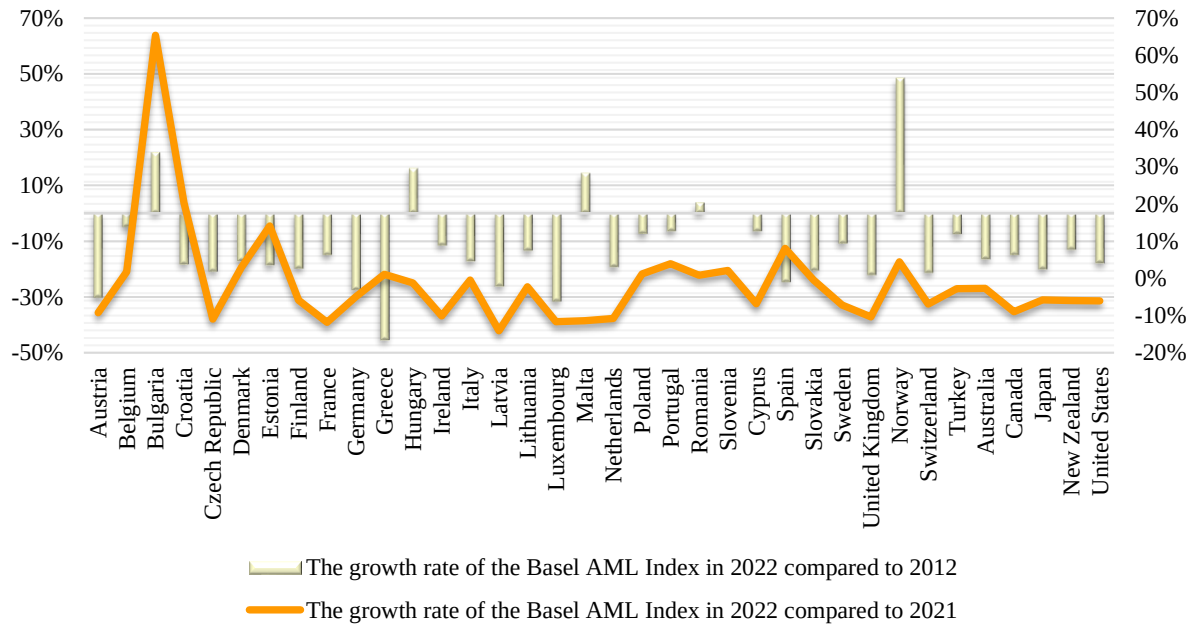


Figure 6. Basel AML Index growth rate in 2022 compared to 2012 and 2021

Source: *own compilation based on Basel Institute on Governance (2023)*

Considering the growth rate in 2022 compared to 2021, Belgium, Bulgaria, Croatia, Denmark, Estonia, Greece, Poland, Portugal, Romania, Slovenia, Spain, and Norway show an increase in money laundering risks (*Figure 6*). What could be the reason for this? These countries can face risks due to high levels of financial operations and large volume of transactions, which complicates monitoring and control. In addition, economic problems and political instability, the activity of organised criminal groups and the use of the country as a transit point for illicit financial flows may lead to an increase in financial crime. Notorious money laundering scandals in the banking sector, such as the Danske Bank case in Estonia (Coppola, 2018), can have long-term consequences for reputation and AML risks.

Crime Index is a tool used to measure the crime rate in different countries and evaluate the overall level of security, law and order. It helps to identify crime through such its types as fraud and cheating, theft and burglary, robbery and mugging, violence, murder, disorderly conduct, drug trafficking, etc. *Figure 7* shows the average values of this index for 36 developed countries for the period 2012–2022.

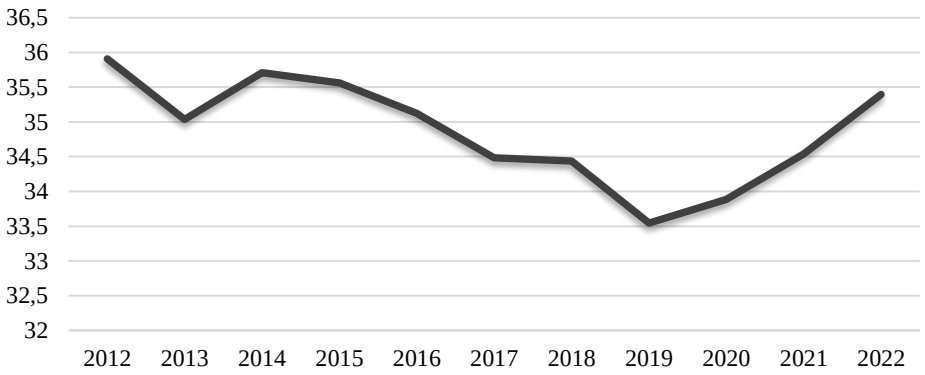


Figure 7. The average values of Crime Index for the period 2012–2022.

Source: *own compilation based on Numbeo (2023)*

Figure 7 shows an increase in crime rates starting from 2019. One of the reasons for this is the global COVID pandemic that caused significant changes in the socio-economic environment of different countries, among which are rising unemployment, closure of enterprises, and finally, the transfer of business to the online plane. Quarantine measures, lockdowns and other restrictions contributed to an increase in domestic violence rates and mental health problems that could lead to rising crime rates. Many people have found themselves in difficult financial conditions and could engage in criminal activity to meet their needs. Intensifying the introduction of digital technologies and the rise in Internet use for commercial and personal purposes impacted the rise of cybercrime, including fraud, data theft, and hacking.

Analysing the situation in relation to each country, the growth rate of crime in 2022 compared to 2012 and 2021 is shown in *Figure 8*.

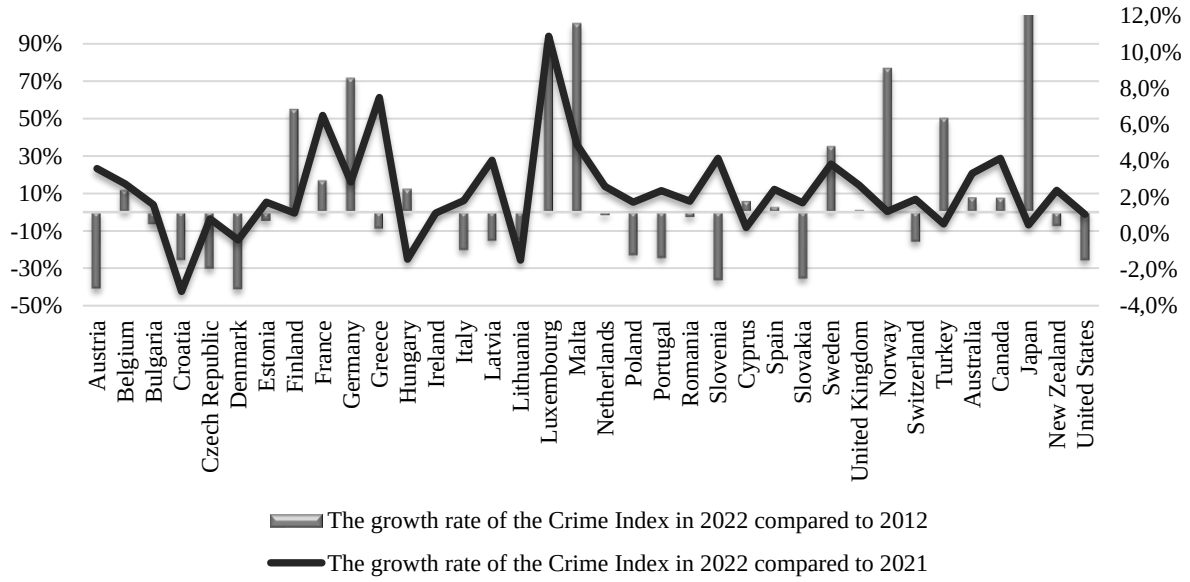


Figure 8. Growth rate of Crime Index in 2022 compared to 2012 and 2021.

Source: *own compilation based on Numbeo (2023)*

Crime rates drastically grew from 2012 to 2022 for such countries as Belgium, Finland, France, Germany, Hungary, Luxembourg, Malta, Cyprus, Spain, Sweden, the United Kingdom, Norway, Turkey, Australia, Canada, and Japan. Thus, for Luxembourg and Malta, this rate has almost doubled, and for Japan threefold (*Figure 8*). A comparison of this indicator in 2022 and 2021 shows an increase from 0.3% to 10.9% for 32 out of 36 countries (*Figure 8*). In addition to the crisis caused by the global pandemic, this negative trend could be influenced by the economic downturn, rising economic inequality, political and social polarisation, and changes in legislation and law enforcement structures.

The analysis of the Basel AML Index, Corruption Perception Index, Size of the Shadow Economy, and Crime Index allows us to draw the following conclusion. Against the backdrop of positive trends in the de-shadowing of the European economy, corruption, money laundering, and crime in general are on the rise. It leads to two research questions that require further answers. What illicit practices are most significant for clusters of countries formed by similarities in trends in corruption, shadow economy, money laundering, and crime rates? The answering of it will help identify the main mechanisms that support and reinforce illegal activities. What social, economic, regulatory, and digital factors most influence the illicit practices in each cluster of countries? The result will contribute to understanding their root causes and developing more effective policies.

To answer the research questions, the following impact factors were selected: social – Gender Inequality Index (GII), Vulnerable employment, total (% of total employment) (VE), Wage and salaried workers, total (% of total employment) (WSW), Human Development Index (HDI), Unemployment, total (% of total labour force) (UT), Net Migration (NM); economic – Economic Freedom (EF), GDP per capita, PPP (current international $) (GDPPC); digital – Individuals using the Internet (% of population) (IUI), Active mobile-broadband subscriptions per 100 inhabitants (AMBS), Total fixed broadband subscriptions (TFBS); regulatory – Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), Voice and Accountability (VA), Political Stability and Absence of Violence/Terrorism (PSAVT). These indices were taken from the World Bank database. Their choice is based on the fact that they reflect key aspects of the development of society and the economy of the countries, and also derives from the literature review of this article.

3.2. Results

The *first stage* of the proposed methodology will show whether there are interactions between the four types of illegal practices and how close these interactions are. To do so, we calculated Pearson's correlation coefficients, which are presented in *Table 1*, with regard to their statistical significance and strength of relationship.

Table 1 results show that for most countries, there exists a high or very high correlation between different pairs of illegal activities. That means that between the processes of corruption, money laundering, shadow operations, and crime there is a strong connection. We observe the following trend: the growth of one indicator leads to the growth of another, or vice versa. For example, for Australia, the increase of the shadow economy scale leads to a rise in money laundering risks; for Greece, the growth of corruption leads to the growth of money laundering risks. That means there is a direct connection between different pairs of illicit practices due to systemic problems in various institutions of the country.

However, there are also inverse relationships. For example, for Hungary, there is a negative correlation between the Basel AML Index and the Size of the Shadow Economy, i.e., a high risk of money laundering corresponds to a low level of the shadow economy, and vice versa (*Table 1*). It proves that this country has efficient anti-money laundering mechanisms, but there are problems with bringing businesses out of the shadows, or vice versa. The difference in the links between the pairs of illegal practices may be due to the differences in economic development, political stability, legal frameworks, institutional effectiveness, as well as cultural and social factors. Such cases may indicate the presence of other hidden factors that cause the reverse effect.

To determine the factors that influence the trends of illicit practices in developed countries, we will identify groups of countries. This will allow us to identify common problems in the fight against corruption, money laundering, shadow operations, and crime. For this purpose, at the *second stage*, the agglomerative clustering was carried out. Its results show the possibility of dividing observations into 2, 4, 5, or 6 clusters (*Figure 9*).

Table 1

Results of the calculated correlation coefficients between pairs of illicit practices

Country	SEI-CPI	SEI-BAML	SEI-CI	CPI-BAML	CPI-CI	BAML-CI
Australia	-0.933*	0.675*	-0.235	-0.588*	0.347	-0.119
Austria	0.580	0.925*	0.649*	0.474	0.765*	0.566
Belgium	-0.401	0.061	-0.734*	-0.503	0.271	0.068
Bulgaria	0.577	0.113	0.650*	0.170	0.726*	0.185
Canada	-0.722*	0.678*	-0.746*	-0.822*	0.612*	-0.833*
Croatia	0.170	0.621*	0.925*	0.184	0.029	0.697*
Cyprus	-0.947*	0.488	0.364	-0.410	-0.278	0.002
Czech Republic	0.740*	0.802*	0.928*	0.628*	0.598*	0.854*
Denmark	-0.678*	0.842*	0.724*	-0.564	-0.423	0.354
Estonia	0.825*	0.516	0.331	0.659*	0.521	0.375
Finland	-0.683*	0.395	0.059	-0.202	-0.318	-0.166
France	0.070	0.393	-0.094	0.571	-0.401	-0.434
Germany	0.381	0.880*	-0.896*	0.259	-0.452	-0.927*
Greece	0.903*	0.915*	0.528	0.893*	0.516	0.396
Hungary	-0.969*	-0.825*	-0.008	0.847*	0.063	-0.202
Ireland	0.634*	0.245	0.318	0.658*	-0.142	-0.277
Italy	0.884*	0.722*	0.846*	0.875*	0.681*	0.548
Japan	-0.539	0.791*	-0.797*	-0.515	0.092	-0.402
Latvia	0.888*	0.785*	0.811*	0.774*	0.830*	0.559
Lithuania	0.907*	0.667*	0.206	0.681*	0.382	0.210
Luxembourg	-0.538	0.945*	-0.366	-0.522	-0.179	-0.505
Malta	-0.832*	-0.599*	-0.837*	0.495	0.612*	0.696*
Netherlands	-0.751*	0.662*	0.637*	-0.856*	-0.530	0.571
New Zealand	-0.753*	0.613*	0.377	-0.891*	-0.103	0.062
Norway	-0.471	-0.361	-0.661*	-0.286	0.315	0.613*
Poland	-0.655*	0.106	0.869*	0.317	-0.452	0.244
Portugal	-0.191	-0.008	0.648*	-0.629*	-0.607*	0.571
Romania	0.539	-0.347	0.602*	0.429	-0.027	-0.351
Slovenia	-0.198	-0.264	0.908*	-0.635*	-0.140	-0.226
Spain	-0.398	0.654*	0.159	0.209	0.162	-0.056
Slovakia	0.793*	0.636*	0.745*	0.472	0.707*	0.851*
Sweden	-0.796*	0.282	-0.922*	-0.444	0.820*	-0.273
Switzerland	-0.713*	0.930*	0.737*	-0.764*	-0.582	0.749*
Turkey	-0.949*	0.286	-0.715*	-0.211	0.716*	0.146
United Kingdom	0.188	0.628*	-0.324	-0.495	0.598*	-0.580
United States	-0.471	0.806*	0.747*	-0.721*	-0.337	0.508

** The value is statistically significant at p≤0.05; dark grey cell colour indicates very high correlation (*$0.8 \leq r \leq 1.0$*); grey cell colour indicates high correlation (*$0.6 \leq r \leq 0.79$*); light grey cell colour indicates moderate correlation (*$0.4 \leq r \leq 0.59$*); white cell colour indicates low and very low correlation (*$0 \leq r \leq 0.39$*)*

Source: *own calculations*

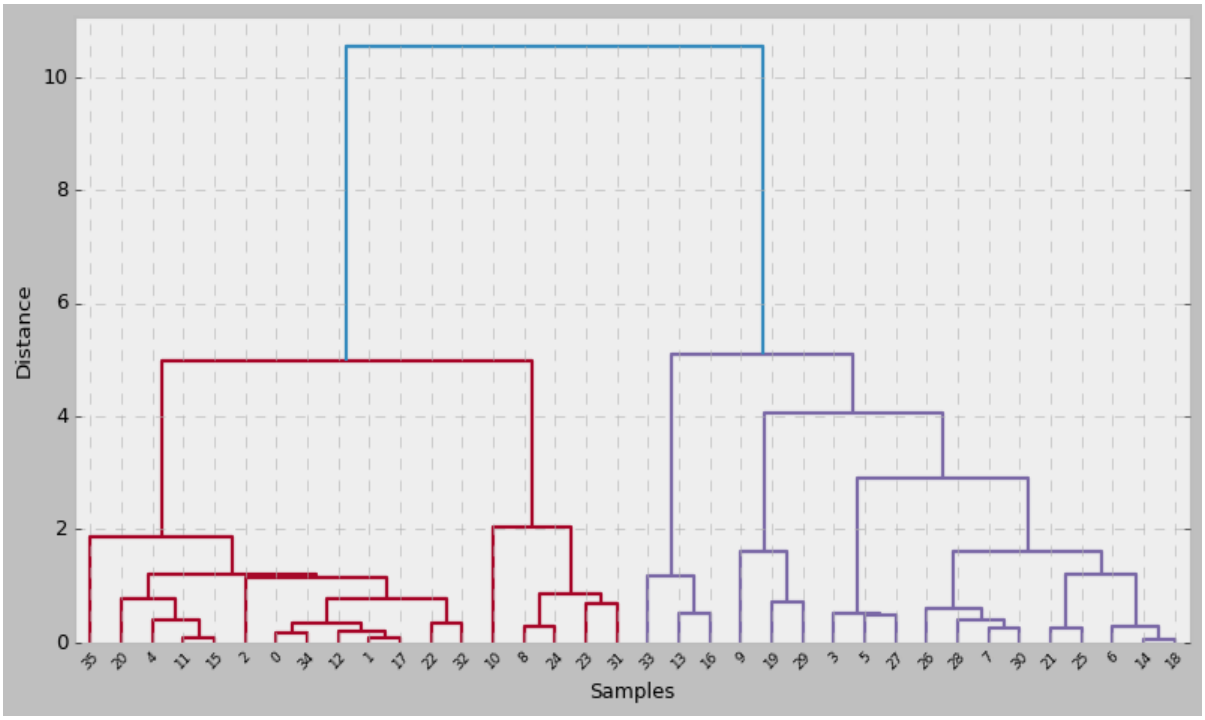


Figure 9. Dendrogram of country clusters based on similarity criteria that identify the level of crime, corruption, money laundering, and shadow operations

Source: *own calculations*

The optimal number of clusters was justified based on the calculation of Silhouette Scores (*Figure 10*). Their values confirm the feasibility of creating a six-cluster model, as they are the highest and equal to 0.510. As a result, we choose to divide the data into 6 clusters for further research.

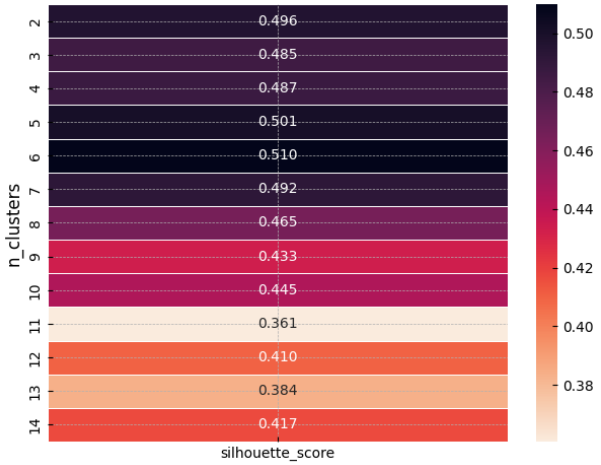


Figure 10. Results of Silhouette Scores

Source: *own calculations*

Figure 11 demonstrates a visualisation of the clusters in two-dimensional space obtained by agglomerative clustering. Each group of countries is represented by a different colour, indicating that they are similar in terms of corruption, money laundering risk, the volume of shadow transactions, and crime

rates. The graph clearly shows the clusters' boundaries, which indicates their delineation quality. In support of this, a cluster characteristic of the countries was developed (*Table 2*), formed by averaging the values of the indicators of illegal practices and calculating the coefficients of variation (CV).

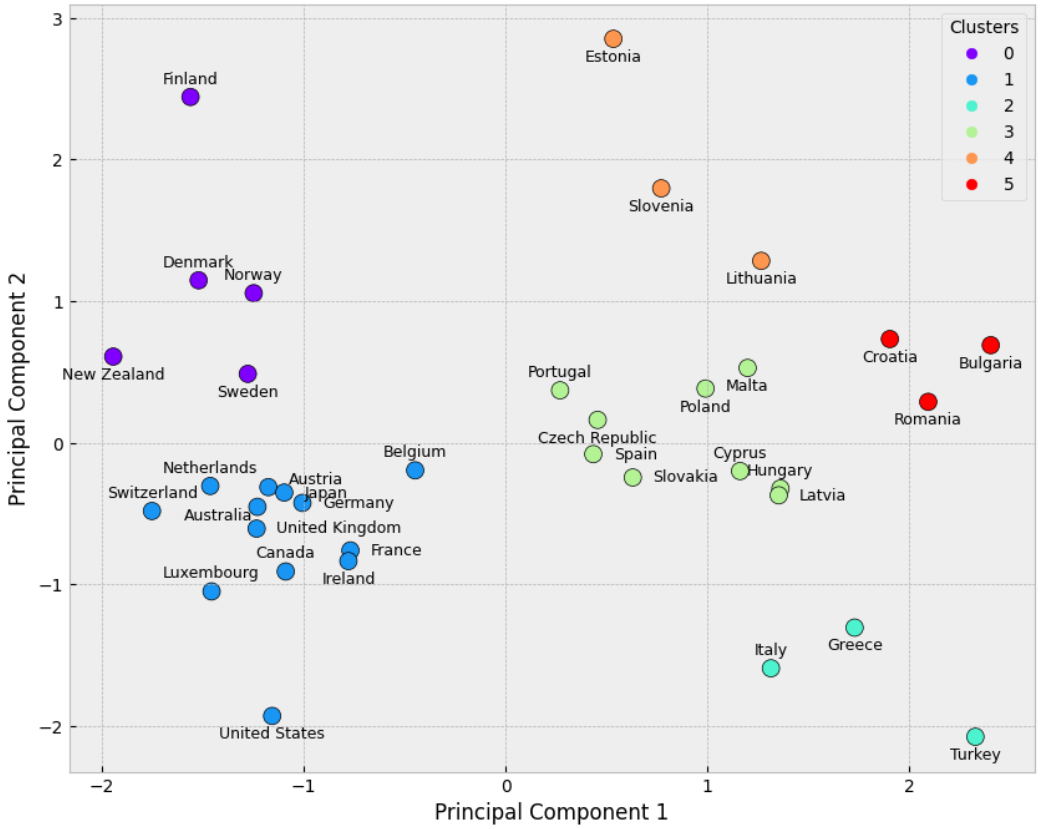


Figure 11. Results of agglomerative clustering

Source: *own calculations*

The second and third clusters are entirely homogeneous, as the coefficients of variation are less than 20%, i.e., countries are very similar. Clusters zero, four, and five are qualitative regarding the Basel AML Index, Corruption Perception Index, and Size of the Shadow Economy. Still, for the Crime Index, the coefficient of variation is between 20% and 30%. This means there is a certain level of data scatter around the mean, but it is not critical. The first cluster demonstrates a high level of agreement for the Basel AML Index and Corruption Perception Index. As for the Size of the Shadow Economy and Crime Index, the coefficient of variation indicates a moderate level of data variation, which is typical for socio-economic indicators that may show some variation.

The resulting country clusters (*Figure 11*) show that most countries are geographically close. For example, we find Sweden, Norway, Finland, and Denmark in cluster zero; France, Belgium, Luxembourg, the Netherlands, Germany, Austria, and Switzerland in cluster one; the United Kingdom and Ireland in cluster one; Poland, the Czech Republic, Slovakia, and Hungary in cluster three; Spain and Portugal in cluster three; Estonia and Lithuania in cluster four; and Bulgaria and Romania in cluster five. This suggests that the formation of illegal practices may also be influenced by the socio-cultural peculiarities of the country's development, which are dictated by territorial proximity and historical background.

Table 2

Cluster characteristics of countries

Country	SEI	CPI	AMG	CI	Country	SEI	CPI	AMG	CI
Cluster 0					*Cluster 3*				
Bulgaria	33.173	42.182	3.830	40.273	Czech Republic	17.300	54.091	4.413	30.145
Croatia	30.373	48.182	4.398	27.782					
Romania	30.509	45.273	4.681	28.827	Hungary	23.591	47.818	4.619	36.336
CV, %	5.035	6.636	10.074	21.458	Latvia	27.764	56.091	4.700	39.382
Cluster 1					Malta	26.091	55.000	4.432	29.118
Austria	9.000	73.636	4.938	26.055	Poland	25.891	59.000	4.376	33.173
Belgium	18.427	75.182	4.267	43.182	Portugal	19.964	62.545	4.205	33.973
France	12.064	70.273	4.285	47.345	Cyprus	26.818	58.545	4.939	31.800
Germany	14.036	79.818	4.970	31.227	Spain	19.927	60.000	4.587	33.155
Ireland	13.409	73.364	4.452	46.564	Slovakia	16.727	49.909	4.555	32.782
Luxem-bourg	9.000	80.818	5.387	30.245	CV, %	18.781	8.555	4.677	9.290
Netherlands	10.582	82.455	4.813	30.909	*Cluster 4*				
UK	10.927	77.909	4.410	43.100	Estonia	29.373	71.091	3.043	24.182
Switzerland	8.309	85.000	5.243	24.364	Lithuania	29.909	58.909	3.590	36.600
Australia	11.245	78.182	4.331	42.436	Slovenia	24.855	59.182	3.545	26.409
Canada	12.864	79.636	4.931	39.055	CV, %	9.900	11.030	8.950	22.781
Japan	9.436	73.636	5.430	17.173	*Cluster 5*				
USA	7.473	71.636	4.948	50.536	Denmark	14.873	89.364	3.998	27.491
CV, %	26.083	5.788	8.647	28.363	Finland	14.836	87.545	3.010	25.982
Cluster 2					Sweden	15.836	86.182	3.717	43.636
Greece	25.618	45.545	5.109	43.136	Norway	15.782	85.091	3.765	33.327
Italy	22.755	49.000	5.109	46.691	New Zealand	10.127	89.000	3.607	41.073
Turkey	29.173	41.909	6.058	38.064					
CV, %	12.439	7.796	10.101	10.171	CV, %	16.627	2.081	10.205	23.026

Source: *own calculations*

At the *third stage* of the proposed research methodology, a canonical analysis was conducted, which made it possible to determine those types of illicit practices that are critically important for a specific group of countries, considering their characteristics. Essential factors affecting illicit practices, including social, economic, regulatory and digital, were also identified. The calculations are presented in *Tables A.1-A.2* of *Appendix A*, where it can be seen that all results are statistically significant (high χ^2 value and p-value < 0.05). At the same time, the value of the canonical correlation is very high or high. The coefficient of determination demonstrates a strong explanatory power of the factors, and for the values of the third cluster - moderate.

The value of total redundancy for all clusters confirms that social, economic, regulatory, and digital factors are the reasons for the formation of criminal practices in developed countries. Their influence is very high for clusters 2, 4, and 5, high for clusters 0 and 1, and moderate for cluster 3. The value of total redundancy for the influence factors indicates that the processes of corruption, money laundering, shadow operations, and crime also affect them. The impact is high for clusters 0, 2, and 5, moderate for clusters 1 and 4, and low for cluster 3.

For the countries of the 0th cluster, the Shadow Economy Index and Crime Index turned out to be the most important. Still, they demonstrate opposite or complementary behaviour under the influence of social, economic, regulatory and digital factors (*Table A.1*). It can only indicate that these factors can reduce

the level of the shadow economy but do not necessarily affect the level of crime. For the countries of the 1st cluster, the Corruption Perception Index, Crime Index, and Basel AML Index indicators have a weight of $\geq|\pm 0.4|$ and also show the opposite effect on illicit practices in general under the influence of external factors (*Table A.1*). This result may indicate that certain socio-economic, regulatory or digital factors are effective in deterring illegal practices in the context of corruption and crime, but not as effective in combating money laundering. The second cluster demonstrates the presence of problems associated with four types of illicit practices, but the multidirectionality of their weights is observed (*Table A.1*). It can be explained as follows. In countries of this cluster, more resources may be spent on fighting general crimes (e.g. violent crime, theft, etc.), which may reduce attention to other types of illegal activities, such as corruption, the shadow economy and money laundering. Accordingly, their control mechanisms are less transparent, increasing the risks of illicit practices.

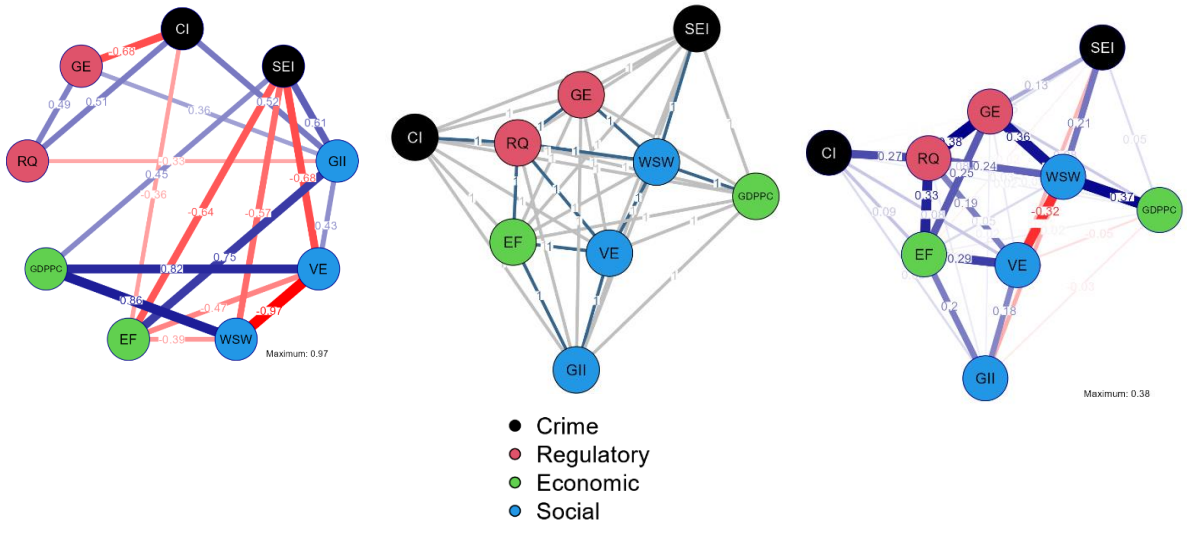
For the countries of the third cluster, the Corruption Perception Index was the most significant among all other types of illicit practices (*Table A.2*). Since the inversion of this index was used, its negative result indicates that with the increase in the positive influence of social, economic, regulatory and digital indicators, the level of corruption in these countries will decrease and vice versa. These changes will be provided by 53.3597%. The fourth group demonstrates the importance of the Shadow Economy Index among all other types of illegal practices (*Table A.2*). This is possible thanks to the historical, economic, regulatory, institutional and cultural factors of these countries (Estonia, Lithuania, Slovenia), formed as a result of the collapse of the Soviet Union and Yugoslavia. At the same time, the influence of social, economic, regulatory and digital factors is observed at 96.9436%. As they grow, the volume of the shadow sector will decrease. For the fifth cluster, all analysed types of practices were significant. Still, multidirectional action within the group is observed (*Table A.2*). It indicates that higher values of the Basel AML Index are associated with an increase in the totality of illicit practices. This result is logical since weak anti-money laundering mechanisms contribute to the growth of various forms of illicit practices. Countries with a high Basel AML Index typically have more problems with illegal financial transactions and other related practices. Also, the influence of social, economic, regulatory and digital factors is significant for different crimes and reduces them.

As a result of the canonical analysis, we can see that social and regulatory factors have a greater impact than digital and economic ones. The analysis did not reveal the significance of Net Migration and Total fixed broadband subscriptions for any of the countries. Migration processes may indirectly impact criminal practices, but they do not create the basis for changes in crime trends. Although there is no significant correlation between the number of fixed broadband Internet subscribers and corruption, money laundering, and other crimes, there is a link between the number of Internet users and active mobile subscribers. Thus, we can talk about the presence of digital traces in the implementation of illegal practices, as the level of digitalisation in developed countries is quite high (Pakhnenko & Kuan, 2023), which can be actively used by criminals to implement illicit practices.

Since the canonical analysis was not used to build canonical regressions, we present only the values of the factor structure in the results. These findings serve as input data for identifying structural relationships between factors and confirming their probability at the next stage of the methodology.

At the *fourth and fifth stages*, we conducted Frequency network analysis, Bayesian network analysis, and Edge evidence probability analysis. As a result, the respective networks are built that demonstrate the structure of the links between the factors, as well as their confirmed and unconfirmed probability.

When controlling for other factors, for countries in cluster zero, the crime rate is influenced by government effectiveness and gender inequality (*Figure 12a*). However, the quality of regulators has an inverse effect (0.51), indicating that regulators are ineffective in reducing crime. The shadow economy is moderately related to economic efficiency, the level of paid employees, and gender inequality (*Figure 12a*).



a) b) c)

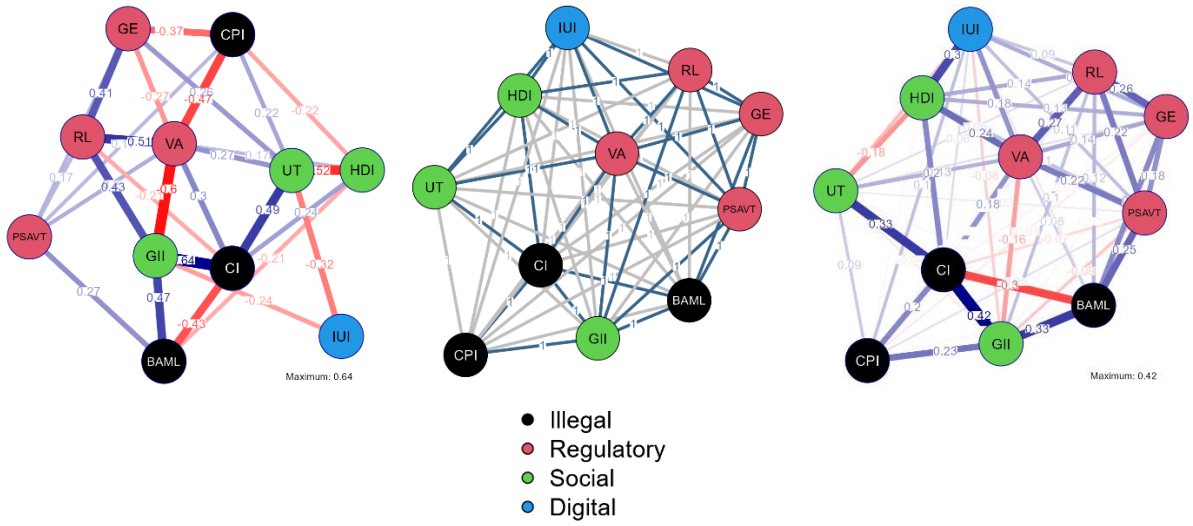
Figure 12. Results for cluster 0: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

A positive value between GDP per capita and the shadow sector may indicate high taxes and strict regulations in the country, which forces companies to go into the shadows. Otherwise, a high share of the shadow economy may be connected to the large scale of economic activity that is not included in official statistics and creates a false positive correlation. The negative relationship between the shadow economy and employment vulnerability testifies that the shadow economy may provide more stable and profitable employment opportunities than the formal sector.

Edge Evidence Probability Analysis confirmed the existence of probabilities between crime rate and regulatory quality and between the shadow economy and wage labour rate (*Figure 12b*), meaning that there exists a definite relationship. Provided the quality of regulators is high, the probability of achieving the corresponding crime rate is 27% (*Figure 12c*). Changes in employment rate guarantee a 21% change in the shadow sector (*Figure 12c*). Although we have confirmed the negative correlation between these indicators, the positive probability indicates that there are hidden factors that will influence the growth of paid employees in companies operating in the shadow economy.

For the countries in the first cluster, there is a moderate positive relationship between money laundering risks and gender inequality, provided there is no influence of other factors (*Figure 13a*). This can be explained by the fact that high gender inequality is often accompanied by general economic and social inequality, weak institutions, high levels of corruption and limited opportunities for women, which together create favourable conditions for illegal financial activities and money laundering.



a) b) c)

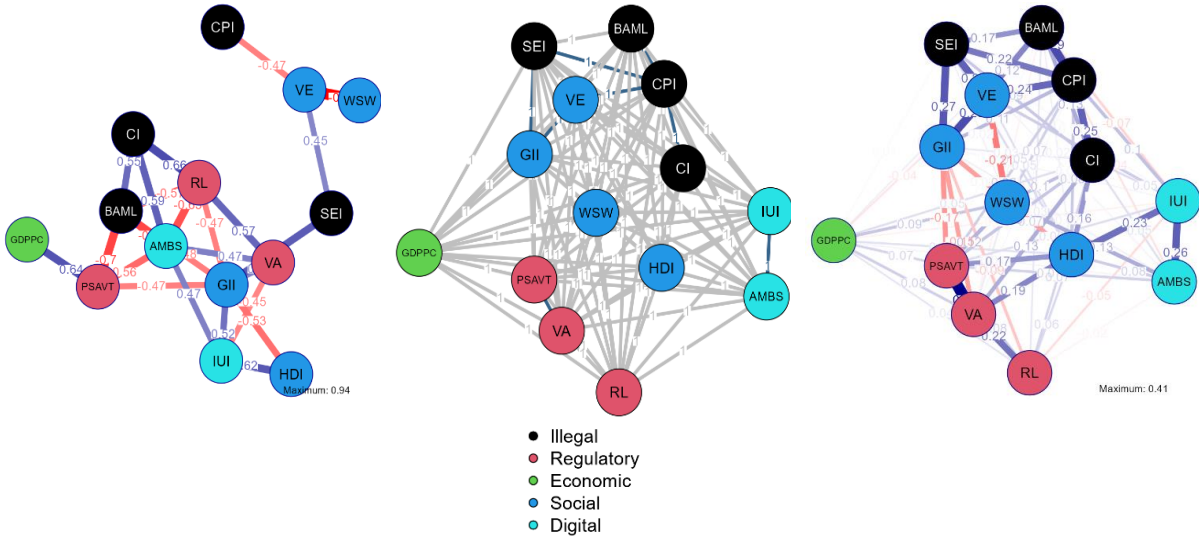
Figure 13. Results for cluster 1: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

The crime rate is closely related to gender inequality and moderately related to unemployment (*Figure 13a*). This indicates that the countries in this cluster lack equal opportunities between men and women, and have reduced income opportunities, which affects social tensions and dissatisfaction in society. The level of corruption is moderately influenced by the level of democracy and civic participation in the country (*Figure 13a*). This suggests that the countries, where citizens have more opportunities to influence government decisions and actions, may be less vulnerable to corruption due to more effective control and oversight of the authorities.

The Edge Evidence Probability analysis confirmed the probability of links between crime rate and unemployment, human development, level of democracy, corruption, gender inequality, between money laundering risk and government effectiveness, between political stability and gender inequality (*Figure 13b*). There is also a high probability of links between illegal practices. Provided that there is a high level of gender inequality, the likelihood of reaching the corresponding level of crime is 42%, the risk of money laundering is 33%, and corruption is 23%. With rising unemployment, the probability of crime will increase to 33 per cent (*Figure 13c*). Changes in employment guarantee a 21% change in the shadow sector (*Figure 12c*). The political stability and the absence of terrorism weakly affect the risk of money laundering (*Figure 13a*), but the likelihood of its existence is confirmed (*Figure 13b*). In other words, countries with greater stability and the absence of political conflicts may have a higher risk of money laundering. This may be because legalisation schemes can operate more efficiently in a stable environment without causing significant risks to their participants. In this case, the risk probability may rise to 25% (*Figure 13c*).

There is a moderate relationship between the level of democracy and corruption and the shadow economy when controlling for other factors (*Figure 14a*). Yet, the relationship with the shadow economy is positive. This suggests that a higher level of voice and accountability may be accompanied by less trust in legal institutions and processes. In such circumstances, citizens and businesses may seek alternative ways of doing business, which may increase the size of the shadow economy. There is a high correlation between the shadow economy and gender inequality (0.62). The money laundering risk shows a high negative correlation with political stability and active mobile phone subscribers, and a moderate negative correlation with the rule of law and gender inequality (*Figure 14a*).



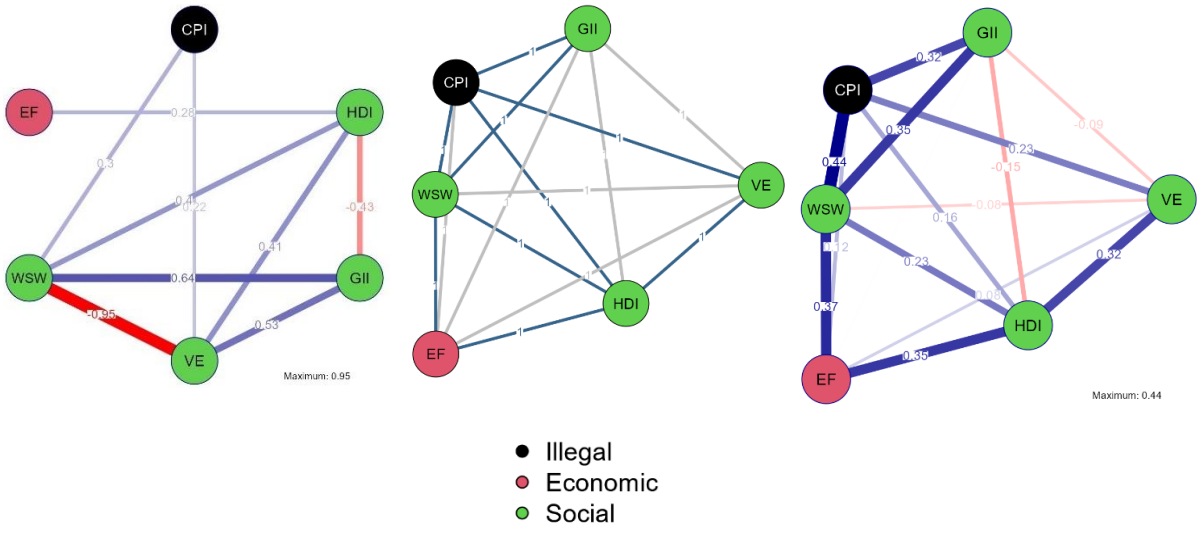
a) b) c)

Figure 14. Results for cluster 2: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

There is a moderate positive correlation between crime rates and active mobile phone users, confirming possible cybercrime problems in these countries (*Figure 14a*). The strong positive relationship between crime and the rule of law is a contradiction, but this may be due to corruption and ineffective justice systems or low public trust in the system. The probability of a correlation between corruption and crime is confirmed (*Figure 14b*) and is 25% (*Figure 14c*). The Edge Evidence Probability analysis also confirmed the probable links between the shadow economy and gender inequality, corruption, and level of democracy (*Figure 14b*). With an increase in gender inequality, the probability of an increase in the size of the shadow economy rises to 27% (*Figure 13c*). An increase in democratic freedoms can lead to a 24% increase in corruption.

The analysis of the countries in the third cluster revealed that corruption is a significant issue. However, partial correlations show its weak links with the influence factors (*Figure 15a*). This can only indicate that the countries in this cluster are characterised by the existence of either non-linear relationships or other latent factors. The Edge Evidence Probability Network demonstrates confirmed probabilities between corruption and purely social factors of influence (*Figure 15b*). An increase in gender inequality would increase the likelihood of corruption by 32 per cent, vulnerable employment by 23 per cent, and wage and salaried workers by 44 per cent (*Figure 15c*). The latter result is controversial, suggesting a complex non-linear relationship between corruption and paid labour, which requires further research.

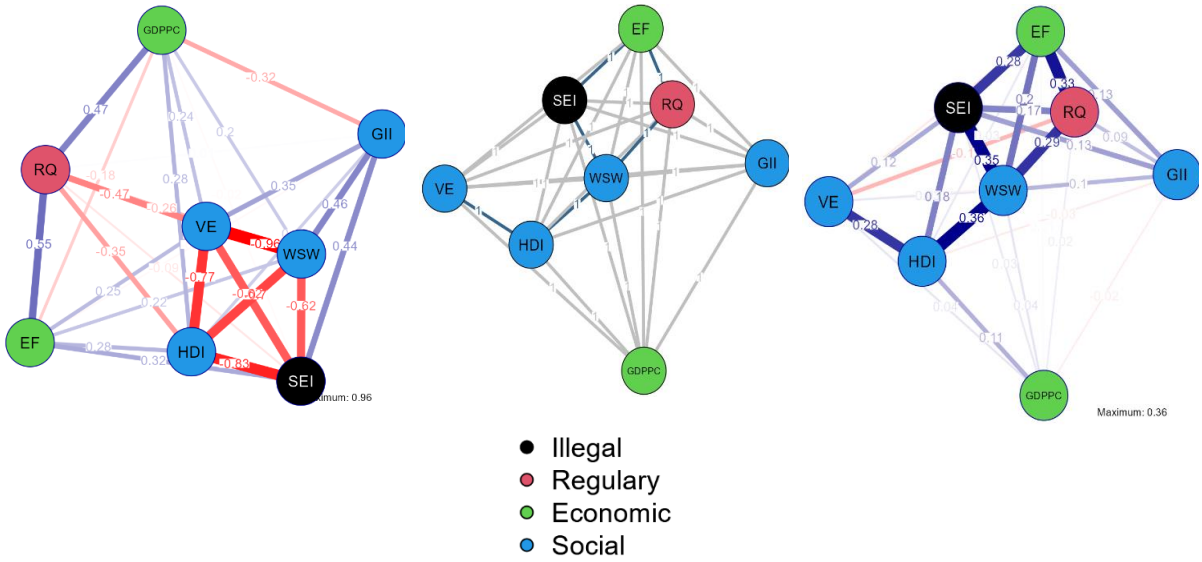


a) b) c)

Figure 15. Results for cluster 3: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

For the countries in the fifth cluster, SEI appeared to be significant, which has a very high negative partial correlation with HDI, a high negative partial correlation with WSW and VE, and a moderate positive correlation with GII (*Figure 16a*). The probability of a relationship is confirmed only for the pairs of the shadow economy and wage and salary workers, as well as for the shadow economy and economic freedom. However, the linear relationship between the latter is if when the influence of other factors is removed (*Figure 16b*). An increase in WSW would increase the probability of an increase in the shadow sector to 35% and the efficient economy to 28% (*Figure 16c*).



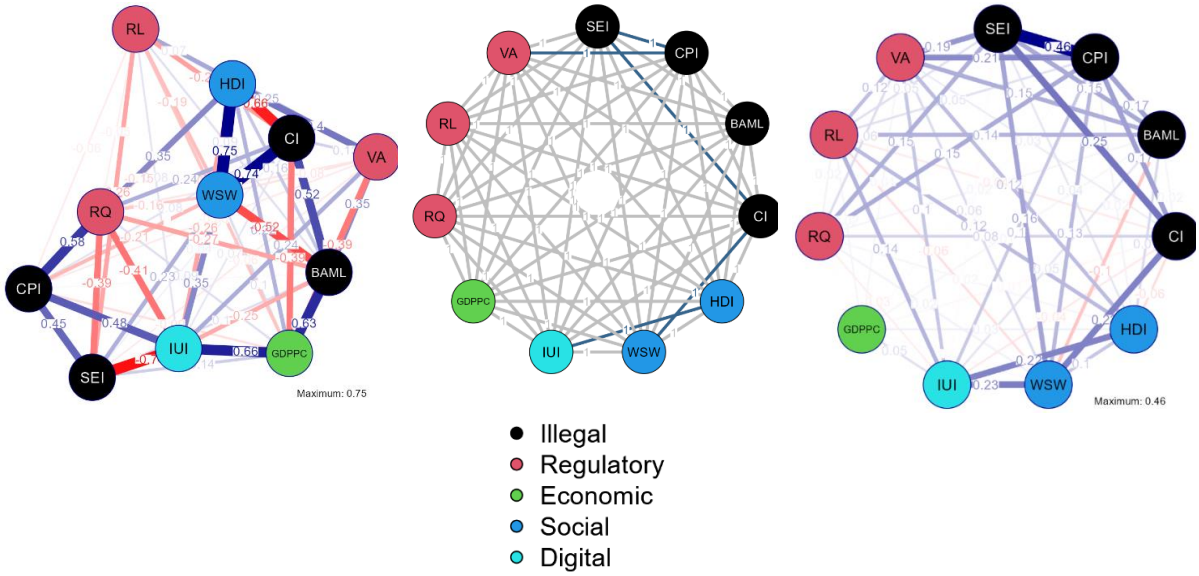
a) b) c)

Figure 16. Results for cluster 4: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

A large shadow economy scale in the country may mean that some workers earn their income informally or do not declare it, making such workers "paid" workers in the shadow economy rather than in the formal sector. This may explain the positive conditional probability between the shadow economy and paid workers. In countries with high level of economic efficiency, there may be more opportunities for tax avoidance or illegal financial transactions, which contributes to the development of the shadow economy.

Canonical analysis revealed the importance of BAML, SEI, CI and CPI indicators for the countries of the fifth group. Frequency Network Partial Correlations allowed us to examine relationships between pairs of factors while controlling for all others. SEI has a high negative correlation with IUI, CI – a high positive correlation with WSW and a high negative correlation with HDI, CPI – moderately positive with IUI and RQ, BAML – moderately negative with WSW, high positive with GDPPC (*Figure 17a*). The probability of the existence of the connection is confirmed only for pairs of CI and WSW, CPI and VA (*Figure 17b*). The growth of WSW will ensure the probability of an increase in crime to 23%, and the level of democracy will increase corruption to 21% (*Figure 17c*).



a) b) c)

Figure 17. Results for cluster 5: a) Frequency Network; b) Edge Evidence Probability Network; c) Bayesian Network

Source: *own calculations*

To sum up, the results of the Frequency Network, Edge Evidence Probability Network and Bayesian Network analysis confirm that social, economic, digital and regulatory factors have a more significant combined impact on illegal practices than individual ones. However, it should be noted that the probability of influence of individual indicators can be substantial and increase their negative effect in synergy with others.

CONCLUSION

Studying the complex problem of corruption, money laundering, the shadow economy, and crime is essential nowadays, as the analysis of their trends, made in this research, shows that these issues remain relevant. The article defines clear overall and country-specific dynamics of corruption and crime growth, as well as increasing money laundering risks in some countries. The positive trend is observed only for the

shadow economy size. A correlation analysis of the links between the four types of illegal practices demonstrated a very high correlation between them at the level of individual countries. Therefore, while implementing preventive measures to fight one of these illegal activities, it is also necessary to consider preventing the other three, as there is a strong group interaction between them.

This research revealed the existence of six clusters of developed countries, grouped by their similarity depending on the dynamics of corruption, money laundering, shadowing of the economy, and crime. At the same time, the variation coefficient showed the groups' homogeneity with a slightly moderate variation for some indicators. Visualisation of the location of countries in the clusters demonstrated that their trends may also be influenced by socio-cultural peculiarities of their development, which were formed under the influence of close geographical location and common historical events.

The canonical analysis and clustering of the countries made it possible to find an answer to the first research question. So, the shadow sector and the level of crime turned out to be problematic aspects for Finland, Denmark, Norway, Sweden and New Zealand. Corruption, money laundering and crime are significant for countries from the most numerous first cluster, such as Canada, the USA, Germany, Great Britain, and others. Corruption is one of the significant illicit practices in the countries of the third cluster, such as the Czech Republic, Poland, Hungary, Latvia and others. Estonia, Slovenia and Lithuania should focus their attention on the problems of the shadow economy. All four types of illegal practices were found to be significant for Croatia, Bulgaria, Romania, Italy, Greece and Turkey.

The canonical analysis also allowed us to identify those social, economic, regulatory, and digital factors that have the greatest group influence on illicit practices. Noteworthy is the finding that for developed countries, the significant ones are those that identify the social and regulatory aspects. The impact of the economy is not decisive for most countries, as they are developed, which reduces the influence of the economic development problems on other spheres. The digital aspect has also proven to be not critical. The reason for this may lie in the lack of impact indicators to study this issue, or this aspect is indeed of minor importance for developed countries in practice. This statement requires additional research. The results of the canonical analysis confirmed that illegal practices also have a moderate impact on the influence factors. Still, we do not have a complete picture, as they do not provide 100% of the sample variation, which indicates the existence of unaccounted-for factors that characterise other aspects of society.

Implementing the fourth and fifth stages of the methodology allowed us to analyse the influence of individual practices rather than group ones, while also controlling the others. We have also obtained a confirmation of the likelihood of relationships between the factors and the likely change in their values. This comprehensive study helped to understand which factors are key in shaping the causal relationships with illicit practices and which factors have an atypical impact, manifesting itself in unexpected correlation directions. In other words, this proved the existence of problematic aspects with these indicators in the process of their interaction. Although the conditional probabilities appeared to be relatively low, in the range of 20–40%, they showed the existence of connections without considering other factors' influence. That makes them key targets in developing strategies to fight illegal practices and identify their root causes. The given results are quite expected, as illicit practices are influenced by a number of causes. Yet, this study showed that it is noteworthy to pay attention to issues related to gender inequality, employment vulnerability, hired workers, the level of democracy, the rule of law, and the quality of regulators, which have shown a high probability of influence.

Given the strong group interactions between corruption, money laundering, the shadow economy, and crime, it is recommended that comprehensive strategies be developed that consider the interrelationships between these phenomena. Preventive measures must be targeted simultaneously at all these types of illegal activity. As social and regulatory factors have a significant influence on illicit practices, one should strengthen social support and regulatory control measures. It may include increasing the transparency of

government processes, strengthening institutions, and expanding public oversight. Development and implementation of such measures should be adapted to the specifics of each country or group of countries.

Although the digital aspect appeared insignificant in this study, it is crucial to continue to develop digital technologies for monitoring and detecting illicit practices. This may include using blockchain technologies, artificial intelligence and other innovative solutions to raise the transparency and effectiveness of control. Raising public awareness of the negative consequences of corruption, money laundering, and the shadow economy is an essential component of fighting these phenomena. Educational programmes and awareness campaigns can drastically influence illegal activity rates.

The obtained results allowed us to form potential directions for future research. Considering the insufficient significance of digital factors, it is necessary to conduct additional research to determine their impact. This may include analysing new indicators and a more in-depth study of the role of digital technologies in combating illicit practices. As unaccounted-for factors may influence illegal practices, future research should also focus on identifying and analysing them. This can create a more complete picture of the interaction of different factors and develop comprehensive measures to combat and counteract them.

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APPENDIX A

Table A.1

Results of the canonical analysis for clusters 0, 1, and 2

Parameter	Cluster 0		Cluster 1		Cluster 2	
	Variables	Factor Structure	Variables	Factor Structure	Variables	Factor Structure
Left Set						
Variables and their factor structures and canonical weights	GII	0.5600	HDI	0.5646	HDI	-0.8741
	VE	0.8459	GII	-0.6369	GII	0.8431
	WSW	-0.8078	UT	-0.5120	VE	0.7546
	EF	0.7046	IUI	0.4439	WSW	-0.6369
	GDPPC	-0.5073	GE	0.8029	IUI	-0.5891
	GE	-0.5351	PSAVT	0.7144	AMBS	-0.8248
	RQ	0.4453	RL	0.7296	GDPPC	-0.7062
	-	-	VA	0.7437	PSAVT	-0.8235
	-	-	-	-	RL	-0.5428
	-	-	-	-	VA	-0.7546
Variance extracted	48.9324 %		63.9809%		78.1799 %	
Total redundancy	39.9538%		45.3301%		72.9485%	
Right Set						
Variables and their factor structures and canonical weights	SEI	-0.9995	CPI	-0.9056	SEI	0.9596
	CI	0.2362	CI	-0.7330	CPI	0.6570
	-	-	BAML	0.4163	BAML	0.8684
	-	-	-	-	CI	-0.4097
Variance extracted	100.0000%		100.0000%		100.0000%	
Total redundancy	73.0115%		66.7555%		89.9081%	
Canonical Analysis Summary						
Canonical R	0.9250		0.8961		0.9921	
Canonical R-sqr	0.8557		0.8030		0.9842	
Chi^2	138.5425		431.0024		224.3060	
p	0.0000		0.0000		0.0000	

Source: *own calculations*

Table A.2

Results of the canonical analysis for clusters 3, 4, and 5

Parameter	Cluster 3		Cluster 4		Cluster 5	
	Variables	Factor Structure	Variables	Factor Structure	Variables	Factor Structure
Left Set						
Variables and their factor structures and canonical weights	HDI	-0.7812	HDI	0.9514	HDI	0.7406
	GII	-0.7058	GII	-0.9270	WSW	-0.4902
	VE	0.7526	VE	0.5832	IUI	0.4948
	WSW	0.7654	WSW	-0.6591	GDPPC	0.7658
	EF	0.8129	EF	-0.8082	RL	0.9428
	-	-	GDPPC	0.7764	VA	0.7459
	-	-	RQ	-0.6920	RQ	-0.4810
Variance extracted	58.4292%		61.0556%		80.7829%	
Total redundancy	31.1777%		59.1894%		65.1996%	
Right Set						
Variables and their factor structures and canonical weights	CPI	-1.0000	SEI	-1.0000	SEI	-0.8324
	-	-	-	-	CPI	-0.7621
	-	-	-	-	BAML	0.5086
	-	-	-	-	CI	-0.9786
Variance extracted	100.0000%		100.0000%		100.0000%	
Total redundancy	53.3597%		96.9436%		82.9691%	
Canonical Analysis Summary						
Canonical R	0.7305		0.9846		0.9886	
Canonical R-sqr	0.5336		0.9694		0.9773	
Chi^2	72.0757		95.9181		175.8362	
p	0.0000		0.0000		0.0000	

Source: *own calculations*