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CRIME IN THE COUNTRIES OF THE EUROPEAN UNION – TAXONOMIC ANALYSIS

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Purpose: This article aims to evaluate the variation in crime levels among European Union countries in relation to selected socioeconomic indicators. Additionally, the study seeks to examine the impact of these indicators on public safety for the years 2016 and 2023.
Design/methodology/approach: The study employed selected descriptive statistics and the TOPSIS method, a technique of multidimensional statistical analysis. The statistical data utilised in this research were obtained from Eurostat.
Findings: The results indicated the occurrence of a difference in the crime level. In 2023, residents of Slovenia, Czechia, and Poland (top three places in the ranking) can feel the safest. Seven years earlier, instead of Poland, Germany was in this group. The worst situation in terms of crime level in both years studied was in Latvia.
Research limitations/implications: The study utilised indicators available for all EU countries during the surveyed years. A significant limitation was the absence of a comprehensive set of indicators for all member states, necessitating the exclusion of specific data or the inclusion of indicators from earlier years in some cases. Furthermore, as the research was quantitative, future studies could incorporate qualitative methods to facilitate a more detailed analysis of crime-related issues.
Practical implications: The research presented in this paper can serve as a foundation for further analyses to diagnose and predict crime levels.
Social implications: The research findings presented in the article may prove useful for evaluating existing outcomes and identifying effective strategies for combating crime.
Originality/value: The article contributes to the body of knowledge and advances the discourse on crime prevention and the maintenance of public safety.
Keywords: crime, EU countries, socioeconomic indicators, TOPSIS method.
Category of the paper: Research paper.

1. Introduction

Crime, which in its everyday understanding refers to activities that violate legal norms, has been a persistent aspect of human society throughout history. While most individuals in developed Western societies have limited direct exposure to crime, either as victims or perpetrators, its impact permeates many aspects of daily life (Canter, Youngs, 2016), making it a highly pertinent issue. According to Thotakura (2014), crime is a public evil, with each society adopting its own perspective on defining this phenomenon. For a crime to occur, both criminal intent and a criminal act are required, stemming from various factors, including social, economic, biological, and psychological causes.

The detrimental effects of crime on both economic development and societal quality of life have positioned crime prevention as a top priority for many nations, leading to continuous research on this subject (Bąk, 2015).

This article aims to analyse the spatial diversity of crime across European Union countries in 2016 and 2023. By comparing these two periods, changes in public safety within the analysed countries can be assessed. Using statistical analysis and a taxonomic measure of development enabled the characterisation of crime levels in EU countries and their ranking based on crime risk. Data on identified crimes and other relevant factors influencing crime levels were sourced from the Eurostat database.

The structure of this article includes an introduction that outlines its purpose and the authors' motivation for exploring crime-related issues in EU countries. A literature review of the studied phenomenon is also provided. The following section details the methodology employed, the data sources used, and the presentation and discussion of research findings. The article concludes with a summary of the study's outcomes.

2. Crime – general characteristics

Crimes are typically categorised based on the severity of the act, with seriousness often determined by the type or length of punishment prescribed by law (Mamchia, 2023). Various classifications of crimes are presented in the literature, differentiating between broader or more specific groups. For instance, Bąk (2015) and Bąk and Cheba (2018) classify crimes into three main categories: criminal (offences against property and life and health), economic, and traffic-related crimes. A more detailed classification is offered by Sowmyya (2014) and Thotakura (2014), who identify eight distinct categories of crime:

1. Personal crimes – Offenses directed against an individual (e.g., murder, assault, sexual assault).
2. Crimes against property – Offenses targeting material property (e.g., burglary, theft, arson, vandalism).
3. Victimless crimes – Acts violating personal moral values (e.g., prostitution, illegal gambling, illegal drug use).
4. Organised crime – Coordinated offences committed by two or more individuals as part of an organised operation (e.g., kidnappings, robberies, trafficking in prohibited goods, money laundering, human trafficking, voter manipulation).
5. Juvenile delinquency – Crimes committed by individuals under 18.
6. Cybercrimes – Offenses involving computers and the Internet (e.g., cyberterrorism, online harassment, spamming, online fraud).
7. Public security violations – Offenses threatening public safety (e.g., terrorism, driving under the influence of alcohol or drugs).
8. White-collar crimes – Non-violent offences committed by individuals in positions of authority or trust (e.g., embezzlement, identity theft, fraud, corruption).

Most efforts to classify crime types tend to focus on superficial characteristics, grouping crimes with similar behavioural elements (Durrant, 2021). The challenges of distinguishing crime types have been addressed by authors such as Ward, Durrant, and Dixon (2021) and Carter, Ward, and Strauss-Hughes (2021). These scholars argue that the choice of classification method creates obstacles to advancing the understanding and management of crimes. They emphasise that identifying and categorising phenomena is essential for capturing key similarities and differences, facilitating description, prediction, and explanation. However, they contend that achieving a universal classification system is unattainable in any scientific discipline, including categorising crime types.

Many criminals exploit new and emerging opportunities provided by the Internet, with victims often unable to keep pace. Canter and Youngs (2016) highlight a paradox at the core of most cybercrimes: Internet users frequently perceive themselves as operating in a private domain, unaware that they are exposing themselves to the broader World Wide Web. This underscores a significant challenge in addressing cybercrime – the need to shift people's understanding of their role in online society and the nature of the digital environment.

Conversely, detecting white-collar crimes presents distinct challenges, primarily due to the difficulty of identifying such crimes, the perpetrators' upper-class status, and their reliance on sophisticated methods. Furthermore, existing laws and regulations are often insufficient to combat the growing prevalence of these crimes and their detrimental impact on social and state structures, exacerbated by the financial and professional dominance of the upper class (Uddin, 2024).

Each country, influenced by its unique historical, geopolitical, social, and environmental conditions, can identify specific factors that drive criminal behaviour within its borders. Understanding these causes is essential for fostering the economic development of nations and regions. Using international data is crucial to identifying common factors influencing crime rates. Such data enable governments to comprehend better the mechanisms underlying criminal activity and devise effective strategies to counteract this negative phenomenon. Since 1955, the United Nations has held congresses on crime prevention every five years in various locations worldwide. These congresses facilitate the exchange of information and best practices among nations and professionals in the field, aiming to promote more effective crime prevention and criminal justice measures globally. At the Twelfth United Nations Congress on Crime Prevention and Criminal Justice (2010), three main approaches to crime prevention were outlined:

- social crime prevention strategies aim to improve the quality of life for targeted groups by increasing access to social goods such as healthcare, a safe and healthy environment, employment, and education. The focus is on reducing factors that push socially excluded groups toward crime as their only perceived option;
- environmental crime prevention, which involves enhancing living conditions in disadvantaged neighbourhoods with low social cohesion, where crime participation or victimisation rates are high;
- situational crime prevention aims to limit opportunities and reduce the attractiveness of criminal activities while increasing the risk of detection. Techniques include the appropriate design of public spaces and housing, as well as providing support to victims.

Extensive experience and scientific research have demonstrated that the methods outlined for crime prevention, whether applied individually or in combination, are highly effective in reducing crime levels. Building on these approaches, the Fourteenth United Nations Congress on Crime Prevention and Criminal Justice (2021) expanded on the themes of the Thirteenth Congress (2015), focusing on four interconnected components: enhancing the quality of education for children and youth in the context of the rule of law, strengthening judicial integrity and combating corruption within the justice system, supporting prisoner rehabilitation and social reintegration, and preventing youth crime through sports initiatives. Despite significant global efforts to mitigate crime, the problem persists, necessitating ongoing research and the development of innovative solutions.

No one is inherently predisposed to criminality; criminal intentions and behaviours arise from numerous factors – social, economic, biological, and psychological (Sowmyya, 2014). Several scholars have explored the influence of these factors on crime, including Khan et al. (2015), Abbas et al. (2018), Jonathan et al. (2021), and Gokmenoglu, Yildiz, and Kaakeh (2022). Their research identifies key socioeconomic problems associated with crime, such as poverty, unemployment, education levels, economic growth, and drug use. These authors collectively highlight that poverty and unemployment can lead to elevated stress levels and

mental health issues, which, in turn, may drive individuals toward criminal behaviour. Anhyana and Bursa (2019) investigated the relationship between unemployment and crime rates in the EU-28 countries from 1993 to 2016. Their findings confirmed a positive correlation between these factors, indicating that efforts to reduce unemployment can also lower crime rates, thereby fostering safer and more prosperous societies.

Khan et al. (2015) found a negative relationship between crime rates and higher education levels, suggesting that greater access to education can serve as a deterrent to criminal behaviour. However, affluent areas with high GDP per capita tend to attract more criminal activity due to the more significant opportunities for illicit gains. Nonetheless, advancements in the rule of law are shown to mitigate crime rates in such regions (Gokmenoglu, Yildiz, Kaakeh, 2022). Crime often serves as a significant obstacle to socioeconomic development, as it discourages investment, increases transaction costs, and prompts migration, ultimately contributing to global disparities in economic development (Jonathan et al., 2021).

Kim, Seo & Hong (2020) examined the influence of income inequality on crime, conducting a systematic review and meta-analysis of published studies focused on European countries. Their findings revealed that income inequality significantly correlates with crime in Eastern and Northern Europe. In contrast, this relationship was weak or non-existent in Western and Southern Europe, likely due to robust welfare systems that alleviate the adverse effects of poverty.

The study by Van Dijk, Nieuwbeert, and Larsen (2022) encompasses 166 countries worldwide (including 40 in Europe, 2 in North America, 26 in Latin America and the Caribbean, 49 in Africa, 47 in Asia, and 2 in Oceania), challenges traditional theories regarding the macro causes of crime. According to the authors, conventional factors such as poverty and social inequality explain common crimes, such as theft and violence, but are less applicable to homicides and organised crime. Common crimes appear to be significantly influenced by the availability of easy theft targets and diminished social control in urban settings. However, the authors argue that urbanisation does not correlate with homicide rates or the occurrence of organised crime. Additionally, they identified governance as a critical factor, noting that all types of crime are more prevalent in countries with weaker state and democratic institutions.

Crime, as a complex phenomenon, exhibits dynamics that are not always predictable in relation to economic factors. Research by Karpavicius et al. (2024) in six European countries (Lithuania, Germany, Greece, Portugal, Finland, and Sweden) reveals that an increase in per capita consumption correlates with higher crime rates, potentially reflecting a rise in economic crime in wealthier societies. Moreover, the study suggests that increased security spending does not necessarily lead to a reduction in crime, as criminal behaviour adapts to advancements in detection methods. These findings underscore the intricate nature of the problem and emphasise the necessity for multifaceted research to develop effective strategies for combating crime and improving public safety.

3. Characteristics of selected indicators related to crime

The justice indicators utilised in this study include the number of crimes recorded by the police; however, information on the total number of legal violations is unavailable (cf. Bąk, Cheb, 2018). Each data source has inherent limitations. Police statistics may not accurately reflect the actual scale of crime, surveys can be subjective, and data from international reports may be outdated. These challenges necessitate a careful approach to data analysis that considers the specificity and potential limitations of the data (Sources of Crime..., 2024).

Analysing crime data also involves addressing issues related to privacy, the risk of data manipulation, and the need for standardisation. Protecting personal data is crucial to safeguarding the privacy of victims, witnesses, and suspects, and adherence to data protection regulations, such as the General Data Protection Regulation (GDPR) in the European Union, is imperative. Data manipulation risks include deliberate falsification, errors in data collection, and processing inaccuracies, which require transparency and accountability in data management. Furthermore, standardising data collection and reporting methods is essential to ensure consistency and comparability across different jurisdictions (Okmi et al., 2023).

The number of crimes committed in the European Union, including murder, and theft, has generally declined in recent years (Eurostat, 2024). For instance, the homicide rate across the EU-27 decreased by 6% in 2021 compared to 2016. Latvia recorded the highest number of homicides per 100,000 people in both periods, while Luxembourg (2016) and Ireland (2021) reported the lowest rates. Among the 17 countries that experienced reduced homicide rates, Malta recorded the most significant decrease, at 78%. Conversely, the largest increase occurred in Luxembourg, where the rate rose by 120%.

Even though Denmark and Sweden reported the highest theft rates per 100,000 people, these rates declined in both countries between 2016 and 2022 by 37% and 25%, respectively. In contrast, Greece and Spain were the only EU countries to experience an increase in theft rates during this period, with rises of 28% and 9%, respectively.

A concerning trend is the significant increase in cases of sexual violence registered by the police per 100,000 population in the majority (23 out of 27, or more than 85%) of EU countries in 2022 compared to 2016. Notably, the incidence of such crimes nearly tripled in Sweden and more than doubled in France and Cyprus. Conversely, reductions in sexual violence cases were observed in Lithuania, Greece, Hungary, and Slovakia.

Table 1.
Crimes by type per 100,000 population in European Union countries

Specification	Murders		Theft		Sexual Violence	
	2016	2021	2016	2022	2016	2022
Belgium	1.10	0.66	2055.54	1686.00	69.24	92.04
Bulgaria	1.08	1.00	457.48	413.08	7.74	8.29
Czechia	0.50	0.49	674.86	330.65	13.20	17.32
Denmark	0.47	0.60	3951.31	2496.21	66.46	107.19
Germany	0.46	0.39	1570.39	1254.11	45.23	59.70
Estonia	2.65	2.00	682.55	602.72	20.59	27.26
Ireland	0.52	0.15	1312.17	1230.87	53.85	62.75
Greece	0.77	0.82	530.04	680.03	4.57	3.93
Spain	0.57	0.58	351.16	383.04	18.79	35.40
France	0.47	0.82	2197.79	1964.18	53.22	126.08
Croatia	1.23	0.76	303.98	287.06	17.11	18.59
Italy	0.51	0.41	1867.31	1431.39	7.44	11.54
Cyprus	1.25	1.52	86.17	67.76	2.83	6.30
Latvia	4.54	3.55	739.99	512.91	11.17	21.27
Lithuania	3.63	1.66	691.11	343.12	7.20	5.02
Luxembourg	0.45	0.99	1727.38	2520.00	45.64	60.74
Hungary	0.97	0.67	952.06	501.76	6.10	6.06
Malta	0.80	0.18	1661.58	687.95	19.54	27.06
Netherlands	0.62	0.67	1790.76	1324.88	27.89	33.17
Austria	0.50	0.39	1651.67	1081.86	50.53	55.33
Poland	0.76	0.59	332.90	321.08	8.31	8.96
Portugal	0.78	0.87	863.57	708.70	23.91	29.21
Romania	1.56	1.34	466.08	311.37	9.05	14.15
Slovenia	0.69	0.55	1036.44	1022.60	11.14	13.72
Slovakia	0.74	0.51	407.83	250.21	12.09	11.04
Finland	1.17	1.19	2309.58	2249.83	58.10	92.07
Sweden	0.94	0.94	3810.73	2858.48	69.24	200.34

Source: Own elaboration based on Eurostat (2024).

Figure 1 compares EU countries regarding the number of prisoners per 100,000 population. In 2016, the highest rates (exceeding 200) were observed in Lithuania, Estonia, Latvia, and Czechia. These countries collectively reduced this indicator by an average of 22% over the subsequent five years. By 2022, Hungary had the highest number of incarcerated individuals per 100,000 population, reflecting an 11% increase compared to 2016. Notably, Cyprus, Croatia, and Sweden also exhibited significant increases during this period, with rises of 53%, 43%, and 40%, respectively, raising concerns about unfavourable trends in these countries.

The most commonly cited socioeconomic factors influencing crime include poverty, income inequality, unemployment, low levels of education, and limited access to social services. Poverty elevates the likelihood of involvement in property crimes, while income inequality fosters frustration and social conflict. Unemployment and inadequate education restrict access to lawful income opportunities, thereby increasing the risk of criminal behaviour. Enhanced social spending on education and healthcare can mitigate these risk factors, contributing to a reduction in crime rates (e.g. Vargas, 2023; Atrey, Singh, 2024).

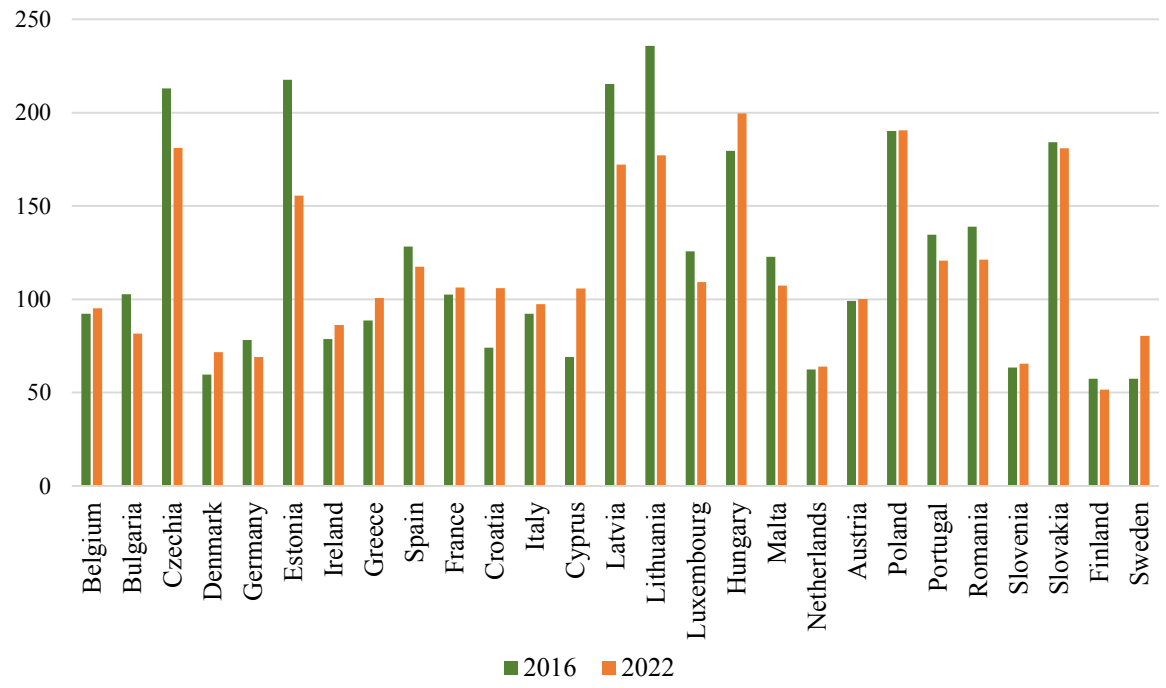

Figure 1. The number of prisoners per 100,000 population in the European Union countries.
Source: Own elaboration based on Eurostat (2024).

Significant differences in the levels of indicators influencing crime were observed across individual Member States of the European Union. The countries with the highest at-risk-of-poverty rates in both surveyed years (above 20%) were primarily post-communist nations, including Bulgaria, Estonia, Latvia, Lithuania, and Romania, as well as Spain (Table 2).

The indicator of severe material and social deprivation refers to individuals unable to afford specific goods, services, or social activities. As defined by Eurostat (2024), this metric represents the percentage of the population experiencing the enforced absence of at least seven out of thirteen factors – six pertaining to individuals and seven to households).

The list of factors at the household level includes:

- the ability to cover unexpected expenses,
- the capacity to afford a week's vacation away from home annually,
- the ability to manage arrears in payments (e.g., mortgage or rent instalments, utility bills, instalment purchases, or other loan repayments),
- the ability to purchase a meal containing meat, chicken, fish, or a vegetarian equivalent every other day,
- maintaining adequate heating at home,
- access to a car or van for personal use,
- the ability to replace worn-out furniture.

At the individual level, the factors include:

- having access to an internet connection,
- replacing worn-out clothes with new items,

- owning two pairs of properly fitted shoes, including a pair suitable for all weather conditions,
- allocating a small amount of money weekly for personal use,
- participating in regular recreational activities,
- meeting friends or family for drinks or meals at least once a month.

Among the EU-27 countries, the highest level of severe material and social deprivation was observed in Romania. However, this indicator showed a positive trend, decreasing by 45% in 2023 compared to 2016. Conversely, countries with the lowest levels of deprivation (less than 3%) included Sweden, Finland, the Netherlands, Luxembourg, and Estonia.

Unemployment rates across EU countries vary significantly. In 2016, Greece recorded the highest unemployment rate at 23.9%, while in 2023, Spain had the highest rate at 12.2%. Conversely, the lowest unemployment rates were observed in Germany (3.9% in 2016) and the Czech Republic (2.6% in 2023).

A positive trend was observed overall, with unemployment rates decreasing in 2023 compared to 2016 in all EU countries except Sweden. The most substantial reductions, exceeding 50%, were achieved in Poland, Cyprus, Greece, Slovenia, and Croatia.

Table 2.
Selected economic and social indicators in EU countries (in %)

Specification	Poverty risk index		Severe material and social deprivation index		Unemployment rate	
	2016	2023	2016	2023	2016	2023
Belgium	15.50	12.30	8.40	6.10	7.90	5.50
Bulgaria	22.90	20.60	33.50	18.00	8.60	4.30
Czechia	9.70	9.80	3.50	2.70	4.00	2.60
Denmark	11.90	11.80	2.60	4.90	6.00	5.10
Germany	16.50	14.40	4.70	6.90	3.90	3.10
Estonia	21.70	22.50	2.20	2.50	6.80	6.40
Ireland	16.80	12.00	8.00	6.00	8.40	4.30
Greece	21.20	18.90	18.40	13.50	23.90	11.10
Spain	22.30	20.20	8.50	9.00	19.60	12.20
France	13.60	15.40	6.70	6.60	10.10	7.30
Croatia	19.50	19.30	7.30	2.80	13.10	6.10
Italy	20.60	18.90	10.10	4.70	11.70	7.70
Cyprus	16.10	13.90	6.60	2.40	13.00	5.80
Latvia	21.80	22.50	12.60	6.20	9.70	6.50
Lithuania	21.90	20.60	15.40	6.10	7.90	6.90
Luxembourg	15.80	18.80	2.00	2.50	6.30	5.20
Hungary	14.50	13.10	20.60	10.40	5.00	4.10
Malta	16.50	16.60	5.20	4.10	4.70	3.50
Netherlands	12.70	13.00	2.60	2.70	7.00	3.60
Austria	14.10	14.90	3.30	3.70	6.50	5.10
Poland	17.30	14.00	5.40	3.00	6.30	2.80
Portugal	19.00	17.00	9.10	4.90	11.50	6.50
Romania	25.30	21.10	35.90	19.80	7.20	5.60
Slovenia	13.90	12.70	4.10	2.00	8.00	3.70
Slovakia	12.70	14.30	7.60	7.00	9.60	5.80
Finland	11.60	12.20	1.20	2.80	8.90	7.20
Sweden	16.20	16.10	0.70	2.50	7.10	7.70

Source: Own elaboration based on Eurostat (2024).

4. Social assistance in European Union countries

4.1. The characteristics of the statistical material

Crime is a multidimensional phenomenon characterised by numerous indicators, often referred to as diagnostic features. The study began with the selection of these diagnostic features, which include indicators of crimes recorded by the police, categorised by type, as well as socioeconomic factors that indirectly influence the propensity to break the law. These socioeconomic factors encompass indicators related to the financial condition of the population and the labour market. The empirical research relied on a database constructed from data provided by Eurostat (2024). The analysis primarily covered two years: 2016 and 2023. In instances where data for 2023 were unavailable, the most recent data – such as from 2022 or, in one case, 2021 – were utilised.

Table 3 outlines the indicators adopted for the study. It is important to note that all indicators used are classified as destimulants, indicating that higher values correspond to a worsening situation in the analysed area.

Table 3.
Indicators describing crime and selected descriptive parameters in 2016 and 2023

Symbol	Nazwa	2016			2023		
		$\bar{x}$	V_s (%)	*As*	$\bar{x}$	V_s (%)	*As*
X_{1D}	victims of human trafficking per 100,000 inhabitants	2.5	78.9	1.0	2.6	93.6	2.2
X_{2D}	prisoners per 100,000 inhabitants	120.9	45.2	0.7	115.4	36.0	0.7
X_{3D}	homicide rate per 100,000 inhabitants	1.1	86.1	2.5	0.9	73.5	2.5
X_{4D}	theft per 100,000 inhabitants	1277.1	75.1	1.3	1019.3	75.9	1.0
X_{5D}	sexual violence per 100,000 inhabitants	31.5	110.9	2.8	42.8	104.6	1.9
X_{6D}	premeditated homicides per 100,000 inhabitants	1.3	89.6	2.9	1.1	60.5	3.2
X_{7D}	people killed in road accidents per million inhabitants	57.3	30.2	0.7	48.1	30.3	0.7
X_{8D}	crime, violence, or vandalism in the area (%)	10.9	39.4	1.0	8.6	52.7	0.8
X_{9D}	threats of poverty (%)	17.1	22.9	0.2	16.2	21.9	0.2
X_{10D}	at-risk-of poverty rate for children (aged less than 18) (%)	20.1	30.6	0.7	18.2	29.9	0.4
X_{11D}	people living in households with very low work intensity (%)	9.5	34.1	0.9	6.8	30.5	0.0
X_{12D}	severe material and social deprivation index (%)	9.1	94.0	2.0	6.1	73.1	1.9
X_{13D}	people at risk of poverty or social exclusion (%)	23.5	31.5	1.4	20.5	22.2	0.6
X_{14D}	subjective poverty (%)	29.2	59.9	0.9	19.3	59.4	2.6
X_{15D}	unemployment rate (%)	9.0	47.8	2.0	5.8	37.8	1.2

Source: Own elaboration based on Eurostat (2024).

A preliminary analysis of the diagnostic features reveals significant disparities among the studied countries in terms of crime levels, as evidenced by high values of the coefficient of variation (Vs) and the asymmetry coefficient (A) for both analysed years. The X_{5D} index – sexual

violence per 100,000 inhabitants – exhibited the highest level of variation. This considerable disparity is driven, in part, by the substantial differences between the maximum and minimum values. In 2023, Sweden recorded the highest value for this indicator at 200.34 (compared to 179.48 in 2016), while Greece had the lowest value at 3.93 (with Cyprus reporting 2.83 in 2016). Most of the indicators used in the study showed high or moderate right-hand asymmetry, indicating that, for most EU countries, their values were below the average. That signifies a favourable situation for indicators classified as destimulants, as lower values represent a better outcome. Notably, the X_{11D}, which measures the percentage of people living in households with very low work intensity, exhibited a distribution close to symmetry in 2023. The difference between the highest and lowest values for this index in that year was 6.9 percentage points.

4.2. Method

The article employs the TOPSIS method, a multivariate statistical analysis technique, to classify EU countries based on their crime rates. TOPSIS, or the Technique of Order Preference by Similarity to Ideal Solution, was proposed and described by Hwang and Yoon in 1981 and is widely recognised as a multi-criteria decision-making method (Roszkowska, 2011; Parida, Sahoo, 2013; Yoon, Kim, 2017; Ghose, 2021). The core concept of TOPSIS involves evaluating decision alternatives by measuring their distance from two reference points: the Positive Ideal Solution (PIS) and the Negative Ideal Solution (NIS). The optimal decision alternative is the one closest to the PIS and furthest from the NIS. This method is also suitable for creating rankings of objects, as demonstrated in this article.

The procedure for calculating a synthetic variable using the TOPSIS method is as follows:

Step 1. The starting point is to define the matrix:

$$X = [x_{ij}] \tag{1}$$

where:

i – object number (i = 1, 2, ..., n),

j – diagnostic feature number (j = 1, 2, ..., m),

x_{ij} – the value of j-th feature for i-th object.

Step 2. In order to ensure the comparability of variables, the initial values of diagnostic features are normalized based on the formula:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{2}$$

where:

z_{ij} – the value of j-th standardized diagnostic feature for the i-th object.

Step 3. Values of normalized diagnostic features are weighted, which results in the matrix:

$$V = [v_{ij}] = [w_j z_{ij}] \tag{3}$$

for:

$$\sum_{j=1}^{m} w_j = 1 \tag{4}$$

where:

w_j – weight of j-th diagnostic feature.

Step 4. For each normalized weighted diagnostic feature from the matrix (3), two reference points are determined, which are determined by the Positive Ideal Solution and Negative Ideal Solution coordinates, respectively:

$$v_j^+ = \begin{cases} \max\limits_i v_{ij} & \text{for stimulant} \\ \min\limits_i v_{ij} & \text{for destimulant} \end{cases} \tag{5}$$

$$v_j^- = \begin{cases} \min\limits_i v_{ij} & \text{for stimulant} \\ \max\limits_i v_{ij} & \text{for destimulant} \end{cases} \tag{6}$$

where:

v_j^+ – j-th coordinate of Positive Ideal Solution,

v_j^- – j-th coordinate of Negative Ideal Solution.

Step 5. For all objects, their Euclidean distances from the positive and negative ideal value are calculated, respectively:

$$d_i^+ = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^+\right)^2} \tag{7}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^-\right)^2} \tag{8}$$

where:

d_i^+ – Euclidean distance of the i-th object from Positive Ideal Solution,

d_i^- – Euclidean distance of the i-th object from Negative Ideal Solution.

Step 6. The value of the aggregate variable denoting the relative proximity of the *i*-th object to the Positive Ideal Solution is determined as the quotient:

$$R_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{9}$$

where:
$0 \leq R_i \leq 1$.

The preferred object has the shortest distance from the positive ideal value and, at the same time, the most significant distance from the negative ideal value, i.e., it has the highest value of the coefficient R_i.

Step 7. Linear ordering of objects is performed due to the aggregate variable's non-increasing value (9).

Step 8. Using the three-median method to divide objects into typological groups with a similar level of the studied phenomenon according to formulas (Młodak, 2006):

Group I: $\mu_i > \text{med}_1(\boldsymbol{\mu})$ – very low high risk of crime,

Group II: $\text{med}(\boldsymbol{\mu}) < \mu_i \leq \text{med}_1(\boldsymbol{\mu})$ – average threat of crime,

Group III: $\text{med}_2(\boldsymbol{\mu}) < \mu_i \leq \text{med}(\boldsymbol{\mu})$ – high crime risk,

Group IV: $\mu_i \leq \text{med}_2(\boldsymbol{\mu})$ – very high crime risk.

5. Research results

Table 4 presents the classification and grouping of EU countries according to crime levels based on the synthetic measure calculated using the features listed in Table 3 for 2016 and 2023. In this ranking, a higher position indicates a lower crime rate in a given country.

Table 4.
Ordering and typological groups of European Union countries by crime level in 2016 and 2023

Country	2016			2023		
	R_i	rank	group	R_i	rank	group
Austria	0.7532	9	II	0.7475	11	II
Belgium	0.6935	20	III	0.6777	18	III
Bulgaria	0.5565	26	IV	0.6410	21	IV
Croatia	0.7560	7	II	0.7979	4	I
Cyprus	0.7094	16	III	0.7738	5	I
Czechia	0.7893	3	I	0.8070	2	I
Denmark	0.7011	17	III	0.6942	16	III
Estonia	0.6966	18	III	0.6589	19	III
Finland	0.7426	11	II	0.6555	20	III
France	0.7253	14	III	0.6051	23	IV

Cont. table 4.

Germany	0.7986	2	I	0.7611	7	II
Greece	0.6189	22	IV	0.5670	26	IV
Hungary	0.6751	21	IV	0.7229	14	III
Ireland	0.7438	10	II	0.7675	6	I
Italy	0.7281	13	II	0.7318	12	II
Latvia	0.5369	27	IV	0.5460	27	IV
Lithuania	0.5703	25	IV	0.7004	15	III
Luxembourg	0.7535	8	II	0.5685	25	IV
Malta	0.6964	19	III	0.7610	8	II
Netherlands	0.7379	12	II	0.7301	13	II
Poland	0.7878	4	I	0.8003	3	I
Portugal	0.7584	6	I	0.7499	10	II
Romania	0.5814	23	IV	0.6248	22	IV
Slovakia	0.7852	5	I	0.7517	9	II
Slovenia	0.8487	1	I	0.8660	1	I
Spain	0.7164	15	III	0.6884	17	III
Sweden	0.5795	24	IV	0.5903	24	IV

Source: Own elaboration.

Table 4 shows that Slovenia recorded the lowest crime rate in 2016. This ranking was attributed to the country's lowest values in the EU for the X_{6D} indicator (premeditated homicides per 100,000 inhabitants), as well as low values for the following indicators: X_{2D} (prisoners per 100,000 inhabitants), X_{3D} (homicide rate per 100,000 inhabitants), and X_{11D} (people living in households with very low work intensity). Germany also exhibited a low crime level in 2016, as reflected by the lowest values of indicators related to the income situation of residents (X_{14D}: subjective poverty) and the labour market (X_{15D}: unemployment rate) among EU countries. Additionally, Germany had low values for indicators such as X_{3D} (homicide rate per 100,000 inhabitants) and X_{7D} (people killed in road accidents per million inhabitants). The Czech Republic ranked third in 2016, owing to its lowest values among member countries for X_{1D} (victims of human trafficking per 100,000 inhabitants), X_{9D} (threats of poverty), and X_{13D} (people at risk of poverty or social exclusion). It also recorded low values for total homicides (X_{3D}) and premeditated homicides (X_{6D}).

Latvia recorded the highest level of crime among EU countries in 2016. It was predominantly driven by the highest values for the indicators X_{3D} (homicide rate per 100,000 inhabitants) and X_{6D} (premeditated homicides per 100,000 inhabitants), alongside elevated values for X_{2D} (prisoners per 100,000 inhabitants). Bulgaria ranked second to last, primarily due to the highest values in the EU for X_{7D} (people killed in road accidents per million inhabitants) and X_{8D} (crime, violence, or vandalism in the area). Additionally, Bulgaria exhibited high levels of poverty (X_{12D}) and social exclusion (X_{13D}).

In 2023, Slovenia maintained its position as the country with the lowest crime level. The Czech Republic moved up one place to second, attributed to maintaining the lowest values for three indicators from 2016 and adding X_{15D} (lowest unemployment rate in the EU) to this list. Poland ranked third, improving by one position, and was characterised by low values for indicators such as X_{1D} (human trafficking), X_{3D} (homicides), X_{5D} (sexual violence), X_{6D} (premeditated homicides), and X_{8D} (crime, violence, or vandalism). Poland also

experienced reductions in most indicators compared to 2016, with significant decreases in theft (11.8 percentage points) and subjective poverty (9.7 percentage points). The highest crime rate in 2023 was again in Latvia and Greece, which fell by four positions in the ranking. In this country, there was an increase in theft and the number of prisoners.

In 2023, Luxembourg experienced the most significant decline in ranking, dropping 17 places, while Cyprus and Malta each fell by 11 places. Notably, Slovenia ranked first, and Latvia ranked last, and they maintained their positions from 2016.

The maps (Fig. 2-3) illustrate the division of EU member states into groups based on similarities in level of security, providing a visual representation of the taxonomic analysis. It should be noted that the best results in both years studied were achieved by countries located in the central-southern part of Europe, with this also applying to Portugal in 2016 and Ireland in 2023. Throughout the study period, Latvia consistently exhibited the worst situation concerning the analysed phenomena, followed by Bulgaria, Sweden, Romania, and Greece. In 2023, this group expanded to include France and Luxembourg. Hungary, however, showed improvement, advancing four places in the ranking to join the third typological group.

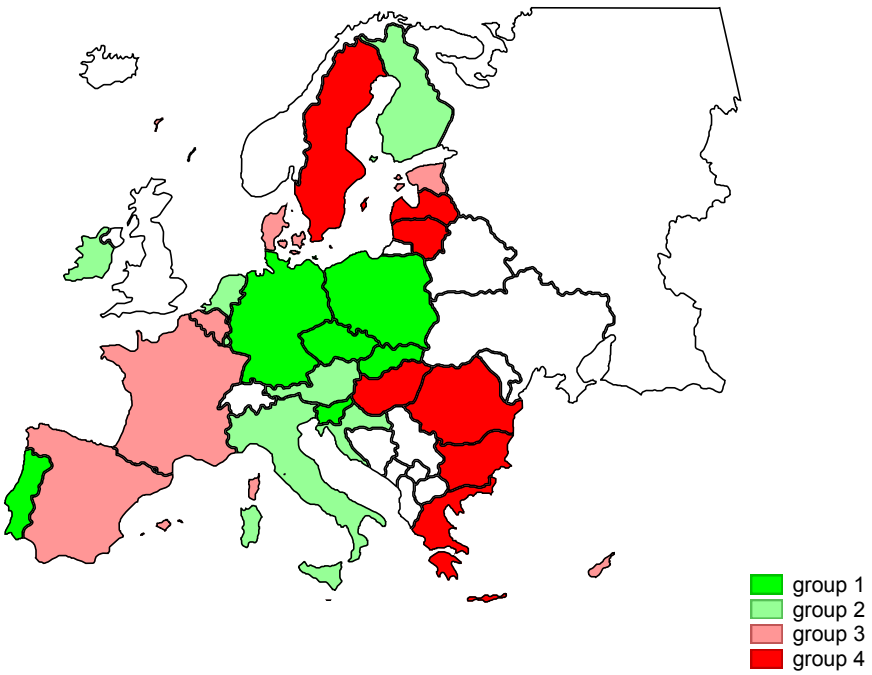

Figure 2. The division of EU countries into groups according to similarities in the level of security in 2016.

Source: Own elaboration.

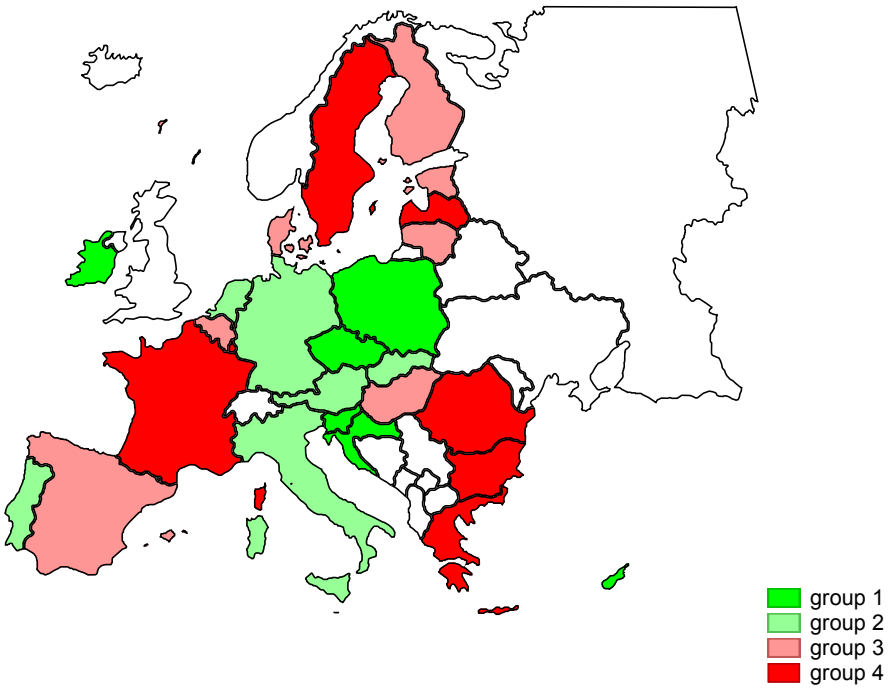

Figure 3. The division of EU countries into groups according to similarities in the level of security in 2023.

Source: Own elaboration.

6. Discussion and conclusions

This article addresses one of the most important issues that each of us faces, i.e. the problem of crime. The harmful impact of this phenomenon on the economy and the quality of life of the society has caused many countries to set combating crime as their paramount goal and new research is constantly being conducted in this regard (Gottschalk, 2024; Khalilia et al., 2024; Furger, 2024).

Analyzing the results of empirical research presented in this article, it can be seen that in most member states this phenomenon has been systematically decreasing. The number of crimes committed, such as murders and thefts, showed a decreasing trend. Jurgelewicz-Delegacz (2021) reached similar conclusions when examining selected categories of crime in EU countries in the years 2008-2018.

Taxonomic analysis based on the level of crime was carried out on 27 EU countries. The obtained results indicated the occurrence of differentiation of the phenomenon under study. It turned out that in 2023, residents of Slovenia, Czechia and Poland (top three places in the ranking) can feel the safest. Seven years earlier, instead of Poland, Germany was in this group. The worst situation in terms of crime level in both years studied was in Latvia.

However, the research presented in the article has certain limitations. Comparing crime statistics in different countries is still one of the most difficult methodological problems in criminological analyses. Countries differ in terms of penal systems and penal policies (Gruszczyńska, 2024). The main source of information in this study is statistics of the respective justice systems taken from international databases, including Eurostat, which contains only the number of crimes recorded by the police. It should be kept in mind that only a certain portion of all crimes are being reported and recorded by the law enforcement system.

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