Yayın Geliş Tarihi (Submitted): **17/10/2022**

Yayın Kabul Tarihi (Accepted): **23/06/2023**

Makele Türü (Paper Type): **Araştırma Makalesi – Research Paper**

Please Cite As/Atıf için:
Bağlıtaş, H. H. ve Atik, H.(2023), Economic security and physical safety in the European Union: A multivariate statistical analysis, *Nicel Bilimler Dergisi*, 5(1), 64-89. *doi:10.51541/nicel.1206457*

ECONOMIC SECURITY AND PHYSICAL SAFETY IN THE EUROPEAN UNION: A MULTIVARIATE STATISTICAL ANALYSIS

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ABSTRACT

In recent years, scientific papers pay attention to quality-of-life indicators beyond GDP-based measurements. Material and non-material indicators have become significant parts of life quality evaluations. The economic security concept developed by European Commission consists of disposable income and economic risk measurement. Economic security is also one of the top priorities for the European Union (EU) to achieve its goals and increase its competitiveness in the world economy. EU measures economic security, in the member countries and candidates through some indicators as a sub-dimension under quality-of-life indicators. The aim of this paper is to show the changing relative performance of the old members and the new members of the EU. While the countries that joined the EU before 2004 are accepted as old members, the countries that joined the EU after 2004 are accepted as new members. In relation with this division, Germany, France, Italy, Belgium, Netherlands, Luxembourg, Ireland, Denmark, Greece, Spain, Portugal, Sweden, Austria and Finland are accepted as old members. However, Slovenia, Slovakia, Estonia, Latvia, Lithuania, Cyprus, Malta, Poland, Hungary, Czechia, Bulgaria, Romania, Croatia are the new members. We used two multivariate statistical methods, principal components analysis, and cluster analysis to show the relative and changing performance of the member countries for the years 2008 and 2021. The aim of using principal components analysis is twofold. The first aim is to decrease

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the dimensionality before cluster analysis. The second aim is to rank the countries in terms of chosen indicators. However, the aim of cluster analysis is to group the countries which have similar performance. According to principal components analysis results, Luxembourg is the most successful country in terms of the variables used to represent economic security and physical safety in the EU. Netherlands, Czechia, Germany, and Sweden are the countries that have the highest rankings. However, Greece is the only country with the lowest economic security and physical safety levels. Countries are grouped under four clusters.

Keywords: European Union, Economic Security, Physical Safety, Clustering, Country Ranking

AVRUPA BİRLİĞİ'NDE EKONOMİK GÜVENLİK VE FİZİKSEL GÜVENLİK: ÇOK DEĞİŞKENLİ BİR İSTATİSTİKSEL ANALİZ

ÖZ

Son yıllarda bilimsel makalelerde, GSYİH tabanlı ölçümlerin ötesinde yaşam kalitesi göstergelerine dikkat çekilmektedir. Bu çalışmalarda maddi ve maddi olmayan göstergeler, yaşam kalitesi değerlendirmelerinin önemli bir parçası haline gelmiştir. Avrupa Komisyonu tarafından geliştirilen ekonomik güvenlik kavramı, harcanabilir gelir ve ekonomik risk ölçümünden oluşmaktadır. Ekonomik güvenlik de Avrupa Birliği'nin (AB) hedeflerine ulaşması ve dünya ekonomisindeki rekabet gücünü artırması için en önemli önceliklerden biridir. AB, üye ve aday ülkelerdeki ekonomik güvenliği, yaşam kalitesi göstergeleri altında bir alt boyut olarak bazı göstergeler aracılığıyla ölçmektedir. Bu makalenin amacı, AB'nin eski üyeleri ile yeni üyelerinin değişen göreli performanslarını göstermektir. AB'ye 2004 yılından önce katılan ülkeler eski üye, 2004 yılından sonra katılan ülkeler ise yeni üye olarak kabul edilmektedir. Bu ayrıma göre, Almanya, Fransa, İtalya, Belçika, Hollanda, Lüksemburg, İrlanda, Danimarka, Yunanistan, İspanya, Portekiz, İsveç, Avusturya ve Finlandiya eski üyeler olarak kabul edilmektedir. Bununla birlikte, Slovenya, Slovakya, Estonya, Letonya, Litvanya, Güney Kıbrıs, Malta, Polonya, Macaristan, Çekya, Bulgaristan, Romanya ve Hırvatistan yeni üyeler olarak bilinmektedir. Üye ülkelerin 2008 ve 2021 yılları için göreli ve değişen performansını göstermek için iki çok değişkenli istatistiksel yöntem, temel bileşenler analizi ve küme analizi kullanılmaktadır. Temel bileşenler analizinin kullanılmasının amacı iki yönlüdür. Birinci amaç, kümeleme analizinden önce boyutsallığı azaltmaktır. İkinci amaç ise seçilen

göstergeler açısından ülkeleri sıralamaktır. Ancak kümeleme analizinin amacı, benzer performansa sahip ülkeleri gruplandırmaktır. Temel bileşenler analizi sonuçlarına göre Lüksemburg, AB'de ekonomik güvenlik ve fiziki güvenliği temsil etmek için kullanılan değişkenler açısından en başarılı ülke konumundadır. Hollanda, Çekya, Almanya ve İsveç en yüksek sıralamaya sahip ülkelerdir. Ancak, Yunanistan ekonomik güvenlik ve fiziki güvenlik düzeyi en düşük olan tek ülkedir. Ülkeler dört küme altında toplanmıştır.

Anahtar Kelimeler: Avrupa Birliği, Ekonomik Güvenlik, Fiziksel Emniyet, Kümeleme, Ülke Sıralaması

1. INTRODUCTION

Economic security and physical safety are a sub dimension of Quality-of-Life Indicators published by European Statistical Office (Eurostat). Within the concept of quality of life, well-being of the population is measured in its various dimensions such as material living conditions, productive and other main activity, health education, leisure and social interactions, economic security and physical safety, governance, and basic rights, natural and living environment.

International Committee of the Red Cross (ICRC) defines economic security “as the ability of individuals, households or communities to cover their essential needs sustainably and with dignity”. Of course, essential needs can vary according to an individual's physical needs, the environment, and prevailing cultural standards of the countries. International Labour Organisation (ILO) defined economic security “an environment on which basic income and representation security are assured and in which other forms of work security is improving” (ILO, 2004). Economic security is also one of the top priorities for the EU to achieve its goals and to increase its competitiveness in the world economy. EU measures economic security, together with physical safety as we stated earlier.

Although the EU publishes economic security and physical safety statistics together under the same dimension, economic security and physical safety are examined in the literature separately. Physical safety “refers to being protected from any situation that puts any individual’s physical security at risk” (Eurostat, 2022). Physical safety is examined in the literature in different areas such as schools, hospitals, and workplaces.

The aim of this paper is to show the relative performance of the old members and the new members of the EU through economic security and physical safety indicators published by Eurostat. While the countries joined the EU before 2004 is accepted as old members, the

countries joined the EU after 2004 is accepted as new members. According to this classification, Germany, France, Italy, Belgium, Luxembourg, Netherlands, Greece, Spain, Portugal, Austria, Sweden and Finland are old members. New members contains three group of countries joined the EU in 2004, 2007 and 2013. While Slovenia, Slovakia, Estonia, Latvia, Lithuania, Cyprus, Malta, Poland, Hungary, Czechia joined the EU in 2004, Bulgaria and Romania joined in 2007. The last new country joined the EU in 2013 is Croatia.

Two multivariate statistical methods, principal components analysis and cluster analysis will be used to show the relative performance of the member countries. The aim of using principal components analysis is twofold. The first aim is to decrease the dimensionality before cluster analysis. The second aim is to rank the countries in terms of chosen indicators. However, the aim of cluster analysis is to group the countries which have similar performance.

As most of the data is only available for the year 2021, the empirical analyses will be done for this year by using 14 indicators. When the data is available for some indicators, the changing performance of the countries is also compared for the years 2008 and 2021. The reason of choosing these two years is that the data for some economic security and physical safety indicators is available only for 2008 and 2021.

To the best of our knowledge, the performance of the EU economies through economic security and physical safety has never been tested empirically so far. So, the main contribution of this paper will be the determination of the country groupings in the EU through economic security and physical safety. These empirical findings will help the policymakers in formulating the EU policies according to different country groupings which contain different member countries.

The paper will be organized as follows. After the introduction, the first section will summarise the literature. The second section will explain the data and the third section will show the changing performance of the member countries for the years 2008 and 2018 through available indicators. The fourth section is devoted to empirical results. The last section concludes the paper.

2. LITERATURE

Economic (in)security is on the economic side of the well-being concept, the literature uses different indicators such as financial well-being, financial security, and various indexes. These studies also search for the impact of gender and age differences on the improvement of

well-being concepts. Furthermore, their data has diversified frequencies and dimensions such as panel, longitudinal, and time series. In this context, Osberg and Sharpe (2002) approach economic well-being by constructing the economic security index for seven developed countries between 1980 and 1999. They put the variables such as spending flows, product resources accumulations, income distribution, and economic security into the equation. They check the economic well-being with the per capita income trend and conclude that the amount of accrual in well-being is smaller than income. They found that Denmark and Sweden had high security levels, but Spain had low security index comparatively with other European countries.

On the side of economic insecurity, Western et al. (2012*)* focus on unforeseen occasions in the daily life of US citizens. They recommend four criteria for determining economic risk parameters. These four elements are as follows households, income fluctuations, and negatively or positively affecting events and situations. The result of the analysis shows that low-income people have high levels of insecurity, and the insecurity rises with economic inequality.

As well-being has objective and subjective dimensions, it has short and long-term dynamics. In this vein, Nam et al. (2016) classify the research groups depending on saving motives as precautionary, retirement, homeownership, and educational. Families having sufficient income can realize all saving purposes and the number of children affects the saving level more than the number of adults in their analysis. *Mutchler et al. (2015)* use the Elder Index and want to measure the adequate income level of elder people in the US. They find that the Index varies across the regions and dwellings. They suggest the usage of the index for subgroups of older humans and the development of new metrics for the index. In another study related to the US, *Hacker et al. (2014)* employ the Economic Security Index. The index considers volatilities in income and medical expenses throughout the calculation of a significant reduction in yearly income level. According to the findings, insecurity has risen since the mid-1980s for all citizens. At the same time, the exposure levels of economic risk change depending on the subgroups.

In the paper of Lyons et al.(2018*)*, they analyse the five financial security parameters for OECD and non-OECD countries. They also utilize World Bank Global Findex and macroeconomics variables. Nevertheless, being in the OECD, older people save more than younger people in countries having an aging population. In developing countries, female, less educated, and lower-income people are sensitive to financial conditions. Furthermore, old-age security is more vulnerable to the variables in the analysis for non-OECD members.

Accessibility to financial services and technological devices might make a positive contribution to increases in savings and enhancing financial security.

Mahdzan et al. (2019) work with two dimensions of well-being for Malaysian households. They separate the households into low-, middle- and high-income groups. Their focus handles four variables dedicated to financial conditions and uses the locus of control. They detect that subjective financial well-being is positively related to financial behavior and the locus of control while negatively related to financial stress and financial knowledge for all households.

Dealing with gender differences in economic well-being in the United Kingdom, Kim et al. (2019) study with longitudinal data. They run hierarchical linear modeling and logistic regression for the cross-section data. They illustrate that the well-being of disabled women developed from 2009 to 2014 but this development is not sufficient because disabled men are better than those women.

Mahendru et al. (2022) search for two well-being dimensions as Romaguera-de-la-Cruz (2020) and Mahdzan et al. (2019). They construct in-depth reviews of participants and propose theoretical suggestions for their well-being in Spain. These suggestions might be in the form of consistently fulfilling commitments, feeling financially secure, having freedom of choice, and enhanced quality of life.

Economic insecurity, an important indicator of well-being, reflects the resilience and can influence important decisions regarding spending, fertility, work, and living environment. Cantó et al. (2020) work on the 27 European countries with multidimensional individual data for 2008-2016. They depict the various results for middle-income groups depending on the countries and reveal that the effect of objective well-being data is greater than subjective one in regimes for post-transition Eastern European countries. They also concluded that Mediterranean and Eastern European countries are the most insecure regions of Europe.

Romaguera-de-la-Cruz (2020) combines objective and subjective dimensions into a unique index with the counting approach method. According to them, as income increases the level of insecurity decreases in middle-income countries both Spain and France but not in Sweden. Moreover, higher education levels and flexible labor contracts have diminishing impacts on insecurity.

Noerhidajati et al. (2021) study household data for Indonesia with the help of a financial vulnerability index. Besides the results revealing the diminishing propensity of households, the middle-income group might cause the vulnerability level to increase.

Chen et al. (2022) investigate the relationship between payday loans and the financial well-being level of U.S. households. They use survey data from consumers and professionals. Moreover, they utilize a score-matching approach. They reveal that payday loans are dangerous for daily fiscal operations and there is a need for further studies because of the complicated links between financial security and payday loans. In the study of Carton et al. (2022), the financial well-being of housing tenants is the main subject of qualitative and quantitative data. They search for the effects of behavioral and contextual factors on the well-being parameter. The findings demonstrate that self-discipline and abstaining from unreasonable indebtedness determine the level of financial well-being. They recommend the consideration of lived experiences of individuals and savings rather than credits for financial transactions.

As we stated earlier, economic security and physical safety are examined separately in the literature. Diprose (2007) outlined the literature and proposed some indicators to have a comparable data for the countries to measure physical safety.

Ahmed et al. (2016), investigated physical safety and security concern in San Francisco metropolitan area by conducting interviews. According to the interview results, they argued that people with visual impairments have significant concerns about their physical safety. They also found that wearable cameras were helpful to collect some information about the crime.

Bosworth et al. (2011) examined student and teacher perceptions of school safety. They concluded that school climate and the behavior of staff are important factors effecting safety in schools.

3. DATA

Economic security and physical safety in the EU-27 is measured through 14 variables given in Table 1. The data for these variables were obtained from *Eurostat, Quality of Life Indicators-Economic Security and Physical Safety Statistics*, pertaining to the years 2008 and 2021. Empirical analyses are applied for only 2021 as the data for all variables are not available for the year 2008. The first seven variables are accepted as economic security indicators in Eurostat classification, while the last seven variables are accepted as physical safety indicators.

Table 1. Description of variables

Codes	**Economic Security Indicators**
1)Finexpenditure	Share of the total population unable to face unexpected financial expenses
2)rentpayments	Share of the population in arrears on mortgage or rent payments
3)utilitybills	Share of the population in arrears on mortgage or rent, utility bills or hire purchase
4)belowpoverty	Share of the population in arrears on mortgage or rent, utility bills or hire purchase, population below poverty threshold, population with less than 60% of median equivalised income
5)abovepowerty	Share of the population in arrears on mortgage or rent, utility bills or hire purchase, population above poverty threshold, population with more than 60% of median equivalised income
6)single	Share of the population in arrears on mortgage or rent, utility bills or hire purchase, single person with dependent children
7)twoadults	Share of the population in arrears on mortgage or rent, utility bills or hire purchase, two adults with three or more dependent children
	Physical Safety Indicators
8)homicides	Recorded homicides relative to population size, per 100 000 inhabitants
9)crime	Share of population who perceived there was crime, violence or vandalism in the area where they live
10)crimebelow	Share of population who perceived there was crime, violence or vandalism in the area where they live, population below poverty threshold
11)crimeabove	Share of population who perceived there was crime, violence or vandalism in the area where they live, population above poverty threshold
12)Crimeincities	Share of population who perceived there was crime, violence or vandalism in the cities where they live,
13)crimeintowns	Share of population who perceived there was crime, violence or vandalism in the towns where they live,
14)Crimeinruralareas	Share of population who perceived there was crime, violence, or vandalism in the rural areas where they live.

4. CHANGING ECONOMIC SECURITY AND PHYSICAL SAFETY IN THE EUROPEAN UNION BETWEEN 2008 AND 2021

Table 2 shows the share of the population unable to face unexpected financial expenses in the EU-27 and in the member countries for the years 2008 and 2021. Nearly one in three people in the EU-27 (30,01 %), reported being unable to face unexpected financial expenses in 2018. Although there is a decrease between 2008 (37,1 %) and 2021, this share is still very high. In 2021, Romania (47,3 %), Croatia (46,5 %), Greece (46,3 %), Cyprus (43,4 %), have highest shares. It should be noted that, except Greece, the countries with highest shares are new members of the EU. Malta (15,7 %), Netherlands (15,1 %), Sweden (18, 4 %) and Austria (18,6

%) are the most successful countries in terms of the share of the population unable to face unexpected financial expenses. The highest reduction was recorded in Hungary, where the share of the population unable to face financial expenses fell by 33,2 percentage points. Double-digit falls also observed in Bulgaria, Poland, Malta, Czechia, and Slovenia.

Table 2. Share of the population unable to face unexpected financial expenses in the EU, 2008 and 2021

Countries	**2008**	**2021**	**Countries**	**2008**	**2021**
Latvia	57	41,7	Poland	50,7	24,5
Croatia	62,3	46,5	Slovakia	38,5	26,1
Greece	26,6	46,3	France	34,1	27,6
Cyprus	40,1	43,4	Germany	34,9	31,9
Lithuania	40,1	36,4	Finland	29,7	23,5
Romania	41,9	47,3	Denmark	24,4	19,5
Ireland	41	29,7	Belgium	23,9	22,3
Spain	29,9	33,5	Czechia	37,9	18,1
Italy	31,9	32,7	Netherlands	19,4	15,1
Estonia	19,7	27,1	Sweden	21,3	18,4
Portugal	26,2	31,2	Austria	28,7	18,6
Hungary	67,6	34,8	Luxembourg	19,6	21,3
Slovenia	44,5	24,6	Malta	32,8	15,7
Bulgaria	57,4	36,4	EU-27	37,1	30,1

Note: EU-27 and Croatia 2010, instead of 2008.

Source: Eurostat (online data code:ilc_mdes04). Date of access: 25 June 2022.

Table 3 indicates the share of the population in arrears on mortgage or rent payments in the EU in 2008 and 2021. In 2021, Greece had the highest debt share (8,5 %) in terms of the mortgage and arrears, while Ireland (7,0 %) was the second country in terms of this kind of debt. Between 2008 and 2021, the share of the population in arrears on mortgage or rent payments increased in Greece from 5,5 % to 8,5 %, in Ireland from 5,6 % to 7,0 %, in Spain from 4,5 % to 6,5 %, and in Cyprus from 3,4% to 5,4%.

Table 3. Share of the population in arrears on mortgage or rent payments in the EU, 2008 and 2021

Countries	2008	2021	Countries	2008	2021
EU-27	3,9	3,2	Malta	1,5	1,8
Greece	5,5	8,5	Italy	4,3	2,5
Cyprus	3,4	5,4	Netherlands	2,4	1,7
France	5,8	5,4	Slovenia	2,7	1,8
Ireland	5,6	7,0	Luxembourg	1,1	2,3
Slovakia	3,0	3,6	Sweden	1,8	2,6
Finland	4,4	4,0	Czechia	2,3	1,6
Spain	4,5	6,5	Estonia	1,1	1,3
Austria	3,9	3,0	Bulgaria	1,5	1,2
Belgium	3,3	1,8	Germany	2,3	2,5
Denmark	1,1	1,9	Lithuania	0,4	0,9
Hungary	3,8	2,2	Croatia	1,7	0,7
Portugal	2,8	2,5	Poland	0,6	0,5
Latvia	3,2	1,6	Romania	0,6	1,0

Note: EU-27 and Croatia 2010, instead of 2008. Source: Eurostat (online data code: ilc_mdes06). Date of access: 25 June 2022.

Recorded homicides per 100 000 inhabitants in the EU is given in Table 4. Generally, the number of homicides per 100 000 population decreased in the EU countries, except Austria, Sweden, Cyprus and Latvia between 2008 and 2021. In 2021, the high shares recorded in Latvia (4,88 %), Lithuania (3,54 %), and Estonia (2,78 %) (See Table 4). So, it can be concluded that the new members had higher shares comparatively with the old members.

Table 4. Recorded homicides relative to population size in the EU,2008 and 2021, per 100 000 inhabitants

Countries	2008	2021	Countries	2008	2021
Latvia	4,52	4,88	Greece	1,29	0,68
Lithuania	8,9	3,54	Ireland	1,14	0,68
Estonia	6,28	2,78	Hungary	1,46	0,79
Finland	2,51	1,59	Austria	0,7	0,61
Cyprus	1,16	1,69	Portugal	1,17	0,79
Belgium	1,91	1,23	Germany	0,8	0,86
Romania	2,28	1,32	Poland	1,21	0,69
Bulgaria	2,29	0,95	Netherlands	0,91	0,70
Malta	1,47	1,17	Spain	0,89	0,63
Slovakia	1,75	1,15	Croatia	1,65	0,99
France	1,52	1,31	Italy	1,05	0,48
Sweden	0,89	1,20	Czechia	1,09	0,53
Denmark	0,96	0,88	Luxembourg	1,45	0,32
			Slovenia	0,55	0,52

Source: Eurostat (online data code: crim_off_cat). Date of access: 25 June 2022.

Table 5. Share of the population who perceived there was crime, violence, or vandalism in the area where they live, 2008 and 2021, % of total population

Countries	**2008**	**2021**	**Countries**	**2008**	**2021**
EU-27	13,1	10,7	Ireland	12,2	11,3
Bulgaria	24,7	19,1	Austria	11	5,7
Netherlands	14,8	15,7	Latvia	28,7	5,3
France	14,8	17,7	Czechia	13,9	6,1
Sweden	13,6	13,8	Slovenia	8,7	7,3
Cyprus	10,1	10,4	Denmark	16,2	7,3
Greece	12	18,1	Estonia	17,2	5,5
Germany	13	8,2	Finland	13,1	7,0
Malta	9,7	11,4	Portugal	11,7	6,6
Belgium	15,8	10,8	Hungary	13,1	5,3
Romania	13,1	8,8	Poland	7,3	4,4
Italy	14,2	8,4	Slovakia	9,3	4,3
Luxembourg	10,6	11.0	Lithuania	5,1	3,3
Spain	14,7	14,1	Croatia	4,6	2,4

Note: EU-27 and Croatia 2010, instead of 2008.

Source: Eurostat (online data code: ilc_mddw03). Date of access: 25 June 2022.

The share of the population who perceived there was crime, violence, or vandalism in the area where they live can be observed from Table 5 for the years 2008 and 2021. Between these years, there was a fall in EU-27 from 13,1 % to 10,7 %. Relatively large decreases were recorded in Latvia, Estonia, Denmark, and Hungary. However, Bulgaria (19,1%), Greece (18,1 %), France (17,7), and Netherlands (15,7 %) had the highest shares in 2021.

5. METHODOLOGIES

The methodologies employed to find out the performance of the EU members involve the use of the multivariate techniques of principal components and cluster analysis. These multivariate techniques have been used in several studies to find out the performance of the countries (Artis and Zhang, 1998; Atik and Collis, 2000; Gidengil, 1978; Jacquemin and Sapir, 1995). The difference between these studies is the variables used in empirical analysis. This paper differs from the earlier studies as economic security and physical safety indicators, which were given in the previous sections, have never been used to find out the performance of the old and the new members of the EU so far.

The first multivariate statistical technique is principal components analysis. This analysis is used in this article for two purposes. While the first purpose is to reduce the number

of variables before cluster analysis, the second reason is to show the ranking of the countries through economic security and physical safety indicators.

Cluster analysis generally preceded by principal components analysis in order to reduce the number of variables down to a smaller number of new variables (principal components) so that the computing time for cluster analysis should be reduced. Hence, the purpose of principal component analysis is to take *n* variables $X_1, X_2,\ldots,X_n$ and find combinations of these to produce uncorrelated indices like PC_1, PC_2,…,PC_n. If there is not any correlation, it means that the calculated indices measure different dimensions in the data (Manly, 1986). The "PC_i" values are called as principal components. For example, from a set of variables X_1 through to X_n,

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n$$

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$$PC_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n$$

Where a_{mn} represents the weight for the *m*th principal component and the *n*th variable.

The second statistical analysis is cluster analysis. The cluster analysis has been used for different purposes such as model fitting, prediction based on groups, hypothesis testing, data exploration, hypothesis generating and data reduction (Everitt, 1974). The purpose of data reduction is to classify the objects based on different variables. The methodology has been applied in a lot of economic study such as foreign exchange rates, import/export networks, and the relative development of the countries (Romesbourg, 1984).

Many algorithms have been developed for cluster analysis. But, two kinds of algorithms, hierarchic methods, and partitioning methods, are used most. Hierarchic techniques, which is used in this study, start with the calculation of distances of each observation to all other observations and produce a hierarchical graphical tree, called a dendrogram (Jobson, 1992).

6. EMPIRICAL ANALYSIS

The first empirical analysis is principal components analysis as discussed earlier. Most of the variables used in empirical work (See Table 1), is calculated as percentage values. However, recorded homicides relative to population size is given for per 100 000 inhabitants, differently than the other variables. So, before performing principal components analysis the statistical data is standardised.

The first empirical analysis is principal components analysis with two aims. While the first aim is to show ranking of the countries in terms of economic security and physical safety. Second aim is to reduce the data which will be used for cluster analysis. Kaiser-Meyer-Olkin (K-M-O) and Bartlett's Test of Sphericity given in Table 6 indicate that the data is suitable for the application of principal component analysis[1].

Table 6. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,713
Bartlett's Test of Sphericity	Approx. Chi-Square	603,797
	Df	91
	Sig.	,000

The results of principal components analysis will be used to decide the number of the principal components that should be retained for cluster analysis. According to Kaiser's rule, the principal components with the eigenvalues more than one should be retained for further analysis. Table 7 indicates that the first two principal components and the resultant principal component scores should be used in cluster analysis. These two components account nearly 78,270 % of the total variation of the original variables.

[1]The data set is suitable for principal components analysis as KMO test result is 0,713, which is higher than 0,50. Also, the result of Barttlett's test is significant (Sig. 0,000 < 0,05).

Table 7. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7,483	53,451	53,451	7,483	53,451	53,451
2	3,475	24,819	78,270	3,475	24,819	78,270
3	,978	6,989	85,258			
4	,660	4,715	89,973			
5	,515	3,677	93,650			
6	,296	2,116	95,766			
7	,195	1,390	97,156			
8	,167	1,196	98,352			
9	,111	,790	99,142			
10	,067	,481	99,622			
11	,026	,189	99,811			
12	,017	,125	99,936			
13	,009	,064	100,000			
14	6,329E-5	,000	100,000			

Table 8. Country rankings according to first principal components scores

Country	**Ranks**	**Country**	**Ranks**
Luxembourg	1	Spain	15
Netherlands	2	France	16
Czechia	3	Slovakia	17
Germany	4	Finland	18
Sweden	5	Romania	19
Belgium	6	Latvia	20
Italy	7	Slovenia	21
Malta	8	Ireland	22
Austria	9	Hungary	23
Estonia	10	Croatia	24
Poland	11	Cyprus	25
Portugal	12	Bulgaria	26
Denmark	13	Greece	27
Lithuania	14		

Table 8 shows country rankings according to the first principal components, which contains 53,451 % of total variance. Generally, in the literature, (Emaraand Chiu, 2016; Khatun, 2007; Kleszcz, 2021; Račić, 2018; Sharma, 2007) countries or cases are ranked according to the first principal components, as the first principal components has the highest share in total variance. These results indicate that Luxembourg is the most successful country in terms of the variables used to represent economic security and physical safety in the EU. Netherlands, Czechia, Germany, and the Sweden are the other countries which have highest rankings. Except Czechia, Malta, and Estonia, the first ten countries are the old countries. Most of the new countries (Slovakia, Romania, Latvia, Slovenia, Hungary, Croatia, Cyprus, and Bulgaria) are among the last ten countries, which represent the lower economic security and physical safety levels. This ranking is also consistent with the results of *Cantó et al. (2020)* as the Eastern members of the EU show low security in their study as well. However, differently than research done by Osberg and Sharpe (2002), Sweden and Denmark did not ranked as the most secure countries in our study. An interesting point is that Greece is the country with lowest economic security and physical safety level, although this country joined the EU in 1981.

Table 9. Component Matrix[a]

	Component	
	1	2
Zscore(crimeintowns)	,873	-,297
Zscore(utilitybills)	,863	,465
Zscore(crimeabove)	,860	-,475
Zscore(Crime)	,845	-,506
Zscore(belowpoverty)	,800	,503
Zscore(twoadults)	,794	,476
Zscore(crimeincities)	,776	-,494
Zscore(single)	,753	,516
Zscore(abovepowerty)	,734	,568
Zscore(crimebelow)	,684	-,629
Zscore(rentpayments)	,681	
Zscore(crimeinruralareas)	,651	-,464
Zscore(finexpenditure)	,372	,784
Zscore(Homicidies)	-,222	,390

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Table 9 shows the variables which effect first and second principal components. The first components, explaining 53,451 % of total variance, is highly correlated with all variables with two exceptions. The first exception is the share of the total population unable to face unexpected financial expenses, and the second exception is recorded homicides relative to population size (per 100 000 inhabitants). The correlations give an idea about the economic security and physical safety indicators which effect relative performance of the countries. So, all variables (with two exceptions) highly effect economic security and physical safety in the EU. The second principal components, explaining 24,819 of total variance is highly correlated with the share of the total population unable to face unexpected financial expenses (0,784), the share of population who perceived there was crime, violence or vandalism in the area where they live (population below poverty threshold) (-0,629), the share of population who perceived there was crime, violence or vandalism in the area where they live, (population above poverty threshold) (0,568), and the share of the population in arrears on mortgage or rent, utility bills or hire purchase, (single person with dependent children) (0,516).

The second empirical analysis applied in this paper is cluster analysis. The first two principal components scores are used as data in applying cluster analysis. Different distance metrics (Euclidean distance, squared Euclidean distance…) between cases and different clustering methods (Ward's method, within-group linkage method, between-group linkage method…) are applied to data. However, only the results using Squared Euclidean distance metrics and Ward's methods is presented here as it gives a clear classification.

When we observe Agglomeration schedule given in Table 10, after 22nd stage we have higher increases in values of coefficients. The number of these increases is four. So, we can conclude that we can have four clusters of the European countries. When we decide the number of the clusters, we should also observe dendrogram (Figure 1), which shows four cluster solutions.

Table 10. Agglomeration schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	18	20	,002	0	0	4
2	21	26	,005	0	0	12
3	13	19	,007	0	0	8
4	9	18	,022	0	1	14
5	10	15	,041	0	0	7
6	1	5	,072	0	0	16
7	10	16	,110	5	0	18
8	11	13	,168	0	3	14
9	22	25	,233	0	0	15
10	6	12	,336	0	0	21
11	7	8	,452	0	0	19
12	21	27	,574	2	0	13
13	21	24	,717	12	0	17
14	9	11	,895	4	8	15
15	9	22	1,484	14	9	18
16	1	2	2,102	6	0	22
17	21	23	2,829	13	0	23
18	9	10	3,638	15	7	24
19	7	14	4,579	11	0	20
20	7	17	5,650	19	0	23
21	4	6	6,771	0	10	22
22	1	4	9,091	16	21	24
23	7	21	14,554	20	17	25
24	1	9	21,479	22	18	26
25	3	7	32,496	0	23	26
26	1	3	52,000	24	25	0

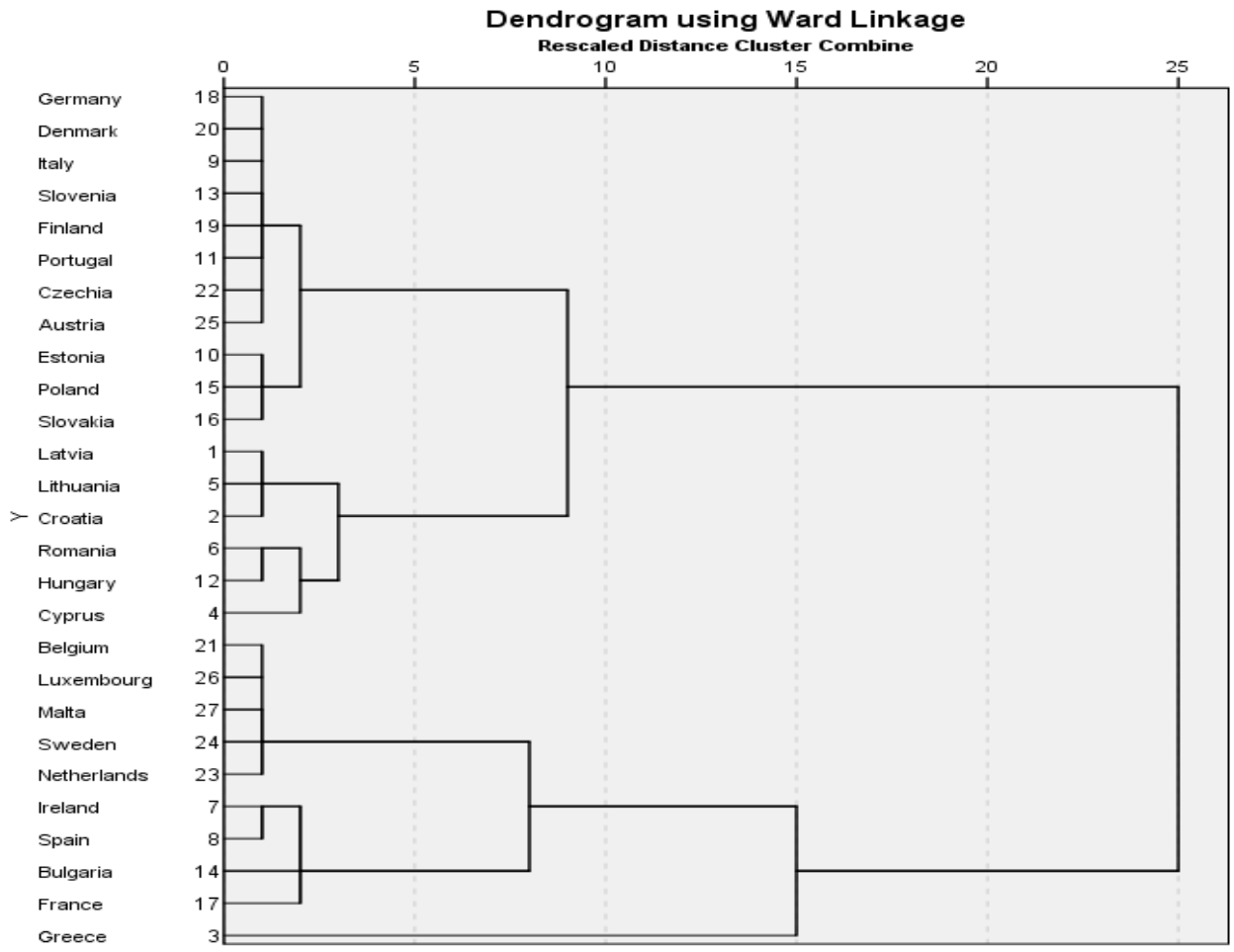

Figure 1. Dendrogram using ward linkage (rescaled distance cluster combine)

At the beginning of the analysis, we did not determine the number of the clusters and by observing agglomeration schedule and dendrogram we decided that four cluster solutions are suitable. However, we can also determine the number of clusters at the beginning of the analysis, and we can check whether three or five cluster solutions are suitable. The empirical analysis was performed by giving the number of clusters and the results given in Table 11 obtained.

Table 11. The clusters of the countries which they belong under different cluster solutions

Case	5 Clusters solution	4 Clusters solution	3 Clusters solution
1:Latvia	1	1	1
2:Croatia	1	1	1
3:Greece	2	2	2
4:Cyprus	1	1	1
5:Lithuania	1	1	1
6:Romania	1	1	1
7:Ireland	3	3	3
8:Spain	3	3	3
9:Italy	4	4	1
10:Estonia	4	4	1
11:Portugal	4	4	1
12:Hungary	1	1	1
13:Slovenia	4	4	1
14:Bulgaria	3	3	3
15:Poland	4	4	1
16:Slovakia	4	4	1
17:France	3	3	3
18:Germany	4	4	1
19:Finland	4	4	1
20:Denmark	4	4	1
21:Belgium	5	3	3
22:Czechia	4	4	1
23:Netherlands	5	3	3
24:Sweden	5	3	3
25:Austria	4	4	1
26:Luxembourg	5	3	3
27:Malta	5	3	3

The numbers in columns (in Table 11) indicates the number of the clusters which the countries belong. Three, four and five cluster solutions in Table 11 fit with dendogram. We accept four cluster solution as it is consistent with both dendogram and agglomeration schedule.

Table 12. Country groupings under four cluster solutions

Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
Germany	Latvia	Belgium	Greece
Denmark	Lithuania	Luxembourg	
Italy	Croatia	Malta	
Slovenia	Romania	Sweden	
Finland	Hungary	Netherlands	
Portugal	Cyprus	Ireland	
Czechia		Spain	
Austria		Bulgaria	
Estonia		France	
Poland			
Slovakia			

According to four cluster solutions, country groupings can be observed from Table 12. The number of the clusters, such as cluster 1, cluster 2…. never shows the higher economic security, or lower economic security. As a result, clusters can also be named such as cluster A, cluster B… so on. Clusters only shows the similar countries according to economic security and physical safety indicators included in empirical analysis. So, Germany and Denmark which constitute cluster 1 have similar economic security and physical safety levels. Similarly, six counties (Latvia, Lithuania, Croatia, Romania, Hungary and Cyprus) which belong to cluster 2 have similar performance in terms of economic security and physical safety indicators.

At the beginning of this paper, we aimed to determine whether the old and the new members[2] of the EU have similar performance in terms of economic security and physical safety indicators. We can observe from Table 12 that new members are separated into Cluster 1, Cluster2 and Cluster 3. While Cluster 2 only contains new members, Cluster 1 and 3 contains both old and new members. So, the new countries in Cluster 1 and 3 show similar performance with the old countries in these clusters. Cluster 4 contains only Greece, which is and old member and never shares similar performance with any other country. The reason for being in a separate cluster for this country is that Greece had Euro crises in 2008 as this country joined the Euro area without fulfilling the Maastricht criteria.

Table 13 is arranged to indicate the performance of the clusters according to the variables used in empirical work. While average columns show the average values of the countries which constitutes the named cluster in terms of the given variables, the columns called "rank" show the performance of the cluster comparatively with the others. For example, in

[2] Old and the new members were explained in the introduction section.

terms of the first variable (finexpenditure), the average of the countries which constitutes cluster 4 is 46,300 %. The rank for this cluster is 4, which means that this cluster is most unsuccessful comparatively with the other three clusters. We have the following observations from Table 13:

I) In terms of economic security indicators, Cluster 1 has the best performance as its rank is generally 1, except for the first and second variables. However, cluster 4 has the worst performance.

II) While Cluster 3 generally ranked second, Cluster 2 ranked third in terms of economic security indicators.

III) Except recorded homicides, cluster 2 has the best performance related with physical safety indicators. Cluster 1 generally shows second best performance behind cluster 2 for physical safety indicators. Cluster 3 generally ranked third. Except recorded homicides and crime in rural areas Cluster 4 ranked fourth.

Table 13. Cluster(Group) averages according to variables and the rankings of clusters

Variable Codes	**Cluster1**	**Rank**	**Cluster2**	**Rank**	**Cluster3**	**Rank**	**Cluster4**	**Rank**
Note: Values are in averages								
	Economic security indicators							
1)Finexpenditure	25,236	2	41,683	3	24,467	1	46,300	4
2)rentpayments	2,300	2	1,967	1	3,356	3	8,500	4
3)utilitybills	6,427	1	11,417	3	9,811	2	36,400	4
4)belowpoverty	16,718	1	27,633	3	21,556	2	61,700	4
5)abovepowerty	6,100	1	12,900	3	7,156	2	38,800	4
6)single	12,764	1	26,533	3	21,167	2	48,900	4
7)twoadults	11,200	1	19,600	3	16,633	2	46,800	4
	Physical Safety Indicators							
8)homicides	,9900	3	2,2017	4	,9100	2	,6800	1
9)crime	6,436	2	5,917	1	13,922	3	18,100	4
10)crimebelow	8,400	2	6,333	1	17,400	3	17,420	4
11)crimeabove	6,136	2	5,783	1	13,222	3	18,200	4
12)Crimeincities	10,209	2	6,917	1	19,267	3	28,800	4
13)crimeintowns	5,345	1	6,267	2	11,644	3	17,800	4
14)Crimeinruralareas	3,455	1	4,750	2	9,022	4	6,200	3

7. CONCLUSION

Economic security is generally defined as "the ability of individuals, households or communities to cover their essential needs sustainably and with dignity". Economic security is also one of the top priorities for the European EU to achieve its goals and to increase its competitiveness in the world economy. EU measures economic security, together with physical safety, in the member countries and candidates through some indicators as a sub-dimension under quality-of-life indicators.

By using 14 indicators, which represent economic security and physical safety, relative performance of the old and the new members of the EU is analyzed in this paper for the years 2008 and 2021. Empirical analysis is performed for only for 2021 as the data for most variables are not available for 2008.

Principal components result indicated that Luxembourg is the best country while Greece is the worst in the ranking through economic security and physical safety indicators. Our country ranking showed similar results with that of Cantó et al. (2020). Because, Eastern member countries indicated lower security levels than other EU members. However, differently than research done by Osberg and Sharpe (2002), Sweden and Denmark did not ranked as the most secure countries in our study.

Cluster analysis results indicated that the EU countries can be classified into four groups. The first cluster (containing Germany, Denmark, Italy, Slovenia, Finland, Portugal, Czechia, Austria, Estonia, Poland, Slovakia) has the best performance as its rank is generally 1, except for the first and second variables. The second cluster (containing Latvia, Lithuania, Croatia, Romania, Hungary Cyprus) ranked third in terms of economic security indicators. However, Cluster 3 (Belgium, Luxembourg, Malta, Sweden, Netherlands, Ireland, Spain, Bulgaria, France) generally ranked second. The last cluster, which only contains Greece, except the two variables -recorded homicides and crime in rural areas- ranked fourth.

Future research can be concentrated on the following: Economic security and physical safety also should be explored for candidate countries and European regions so that some development policies can be formulated for the countries and insecure regions. It can also be examined whether economic security and physical safety levels of the countries have increased after the countries join the EU as a full member.

ETHICAL DECLARATION

In the writing process of the study titled "Economic Security and Physical Safety in the European Union: A Multivariate Statistical Analysis", there were followed the scientific, ethical and the citation rules; was not made any falsification on the collected data and this study was not sent to any other academic media for evaluation.

ACKNOWLEDGMENTS

An earlier version of this paper is presented as "Economic Security and Physical Safety in the European Union: Performance Assessment for the Old and New Members" in The Eight International Conference on Economics arranged by Turkish Economic Association, 1-4 September 2022, Nevşehir, Turkey.

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