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STATISTICAL EXAMINATION OF SOCIOECONOMIC AND ENVIRONMENTAL VARIABLES IN EU COUNTRIES IN THE POST-INITIAL PERIOD OF COVID-19

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Abstract

The new type of Coronavirus (SARS-CoV-2) disease has had devastating effects on socio-economic, health, and environmental indicators. Although the impact of the outbreak has been similar in most countries, there are also differences. Using basic components analysis, consequences of the COVID-19 pandemic in EU nations in 2021, when it peaked internationally, were examined in this study. Government revenue, expenditure, and primary aggregates, government deficit/surplus, debt, and related data, people at risk of poverty exclusion, employment, and interaction, exports, and imports by EU/third-country Member States, GDP, and main components, streamlined energy balances, gas prices for domestic consumers, underemployment, total air emissions accounts bridging to emission inventory totals, environmental protection investments of total economy and population variables were used in the study. As a result of the study, we see that the country least affected by COVID-19 in terms of socio-economic, environmental and energy indicators is Greece and the most affected one is the Netherlands. In future studies, it can be tested by performing clustering analysis with the same data.

Keywords: *COVID-19, Principal Components Analysis, Socio-Economic and Environmental Indicators*

COVID-19 BAŞLANGIÇ SONRASI DÖNEMDE AB ÜLKELERİNDE SOSYO-EKONOMİK VE ÇEVRESEL DEĞİŞKENLERİN İSTATİSTİKSEL OLARAK İNCELENMESİ

Öz

Yeni tip Koronavirüs (SARS-CoV-2) hastalığı; sosyo-ekonomik, sağlık, çevre vb. değişkenler üzerinde yıkıcı sonuçlar doğurmuştur. Salgının etkisi çoğu ülkede benzer sonuçlar doğursa da farklılıklar da bulunmaktadır. Bu çalışmada, Kovid-19 salgınının dünya çapında zirve yaptığı 2021 yılında AB ülkelerindeki etkileri bağlamında temel bileşen analizi yapılmıştır. Çalışmada, hükümet geliri, harcamaları ve ana toplamlar, hükümet açığı/fazlası, borç ve ilgili veriler, yoksulluk veya sosyal dışlanma riski altındaki insanlar, istihdam ve faaliyet, AB/üçüncü ülkelerin Üye

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Devletleri tarafından yapılan ihracat ve ithalat, GSYİH ve ana bileşenler, basitleştirilmiş enerji dengeleri, hane halkı için gaz fiyatları, işsizlik, emisyon envanteri toplamlarına köprü oluşturan hava emisyonları hesapları toplamları, toplam ekonominin çevre koruma yatırımları ve nüfus değişkenleri kullanılmıştır. Çalışmada bu göstergeler bağlamında AB ülkelerinin yoğun COVİD-19 dönemindeki gelişmişlik düzeyleri ortaya konulmaya çalışılmıştır. Çalışma sonucunda sosyo-ekonomik, çevresel ve enerji göstergeleri açısından COVID-19'dan en az etkilenen ülkenin Yunanistan, en çok etkilenen ülkenin ise Hollanda olduğu görülmektedir. Bundan sonraki çalışmalarda aynı verilerle kümeleme analizi yapılarak test edilebilir.

Anahtar Kelimeler: *KOVİD-19, Temel Bileşenler Analizi, Sosyo-Ekonomik ve Çevre Göstergeleri.*

Introduction

In the early days of December 2019, several cases of pneumonia caused by an unknown source began to develop in Wuhan, China. The International Committee on Virus Taxonomy (ICTV) named the disease Severe Acute Respiratory Syndrome Coronavirus 2 (SARS CoV-2) when the disease's genomic sequence indicated that it was caused by a novel Coronavirus (Lai et al., 2020). The disease has evolved into a pandemic, with modest chains of transmission leading to bigger chains of infection in numerous countries, finally resulting in a widespread across the globe, affecting all continents (Anderson et al., 2020). Since the breakout of the new coronavirus (COVID-19) pandemic in 2019, countries have started putting in place containment measures to stop the virus from spreading. Several policies aimed to enhance social distance by restricting human movement, which effectively delayed transmission. Socioeconomic factors, which are varied in major metropolitan centers of low- and middle-income nations, might limit the ability to adjust to the epidemic and respond to containment efforts. COVID-19 has had many economic, social and environmental impacts.

COVID-19, which started in China in December 2019 and swiftly spread to almost every country in the globe over the next several months, has become the world's greatest health concern. Several commentators have already termed this a "Black Swan" catastrophe for the global economy. The outbreak has compounded economic effects, leading to a global catastrophe in which people die and others are losing their jobs as a result of businesses collapsing due to interruptions in producers and customers. As a consequence, the pandemic is not only a health issue but also an economic one that is hampering global development goals (Nicola, 2020; Pirouz, 2020). Companies that rely on leisure events, notably those in the tourism and media industries, have experienced depression as a result of which people have lost their jobs due to cutbacks and layoffs in workforce. As a result, demand for their services has decreased, while people's plan to spend has increased, leading to the closure and failure of numerous businesses (Ghosh, 2020). Instead, most countries are anticipating a sharp decline in economic growth, which would result in a drop in GDP. As consumption and production are reduced as a result of the COVID-19 epidemic, the world economy will be

thrown into chaos. China and India are not susceptible to such exogenous shocks, and economic development is expected to decelerate. As a result, the Indian economy has been sluggish since the introduction of demonetization and the sales and service tax (GST), and the government is looking for methods to get it back on track (Kapur, 2020). On either hand, COVID-19 put a halt to any hopes of an economic rebound in the near shortly pandemic, billions of dollars were lost in tourism, aviation, fabrics, agriculture, construction, gems/jewelry, and start-ups, all of which influence the economy and employment creation considerably (Seetharaman, 2020).

As the disease spreads to a significant number of people, social life is harmed by interruptions in community life, lockdowns, and social unrest caused by efforts to reduce the virus's impacts. When a pandemic reaches a life-threatening level, people's fear and avoidance behaviors rise, and social activity comes to a halt. The socio-economic costs generated by epidemic illnesses include labor losses as a result of the diseases' impacts. Pandemics damage national economies because of the money spent for the prevention of the disease and for the treatment in a broad sense, as well as socioeconomic situations and individual and family well-being in a strict sense. On both macro and micro levels, it is beneficial to address the societal consequences of epidemic illnesses. The relationship between internationalization and health is significant on a macro level. Infectious illnesses have a direct impact on health, according to one of the theories explaining the relationship between globalization and health. The COVID-19 virus, which was initially discovered in China in December 2019, largely demonstrates the health effects of globalization. The virus's rapid spread around the globe in less than two months has forced all governments to cope with the same problems. Isolating people physically is an effective method of reducing the transmission of infectious illnesses, including COVID-19 (Ahmed et al., 2018; Jackson et al., 2014). (Flaxman et al., 2020; Thakkar et al., 2020; Flaxman et al., 2020). While stay-at-home directives are good for general health (CDC, 2020), they can indeed be personally and economically inconvenient (Reger et al., 2020). Recent research suggests that the severe social and economic implications of current stay-at-home orders, and also the COVID-19 pandemic itself (e.g., economic disaster, prevalent exposure to distressing media coverage), may make contributions to psychological un productivity and higher loneliness, declining social assistance, depressed mood, nervousness, and financial concerns (Asmundson and Taylor, 2020; Courtet et al., 2020). Notwithstanding the fact that the economy and health receive a lot of attention (World Bank, 2020a), a growing number of studies are concentrating on the environment and climatic implications. The capacity to quantify and estimate the socio-economic and environmental implications of decreased human activity using existing information and data is a once-in-a-lifetime opportunity to evaluate overall sustainability restrictions and explore potential improvements (Stoll and Mehling, 2020; Manzanedo and Manning, 2020). Rume and Islam (2020), in combination with Zambrano-Monserrate et al.

(2020), have provided a favorable overall of the COVID-19 impacts, demonstrating the trade-off between the environmental advantages of fewer economic interactions and the environmental costs of consumption shifts. Increased penetration of safety clothing and waste and a brief decline in composting have been identified as some of the key environmental concerns of the COVID-19 epidemic (Klemes et al., 2020). COVID-19's spread has the potential to affect people's physical and mental health (Guan et al., 2020; Liang et al., 2020). The steps taken to stop the disease from spreading might have an economic impact, and the lengthy consequences could be disastrous (Cash and Patel, 2020). COVID-19's effects are also causing the global Sustainable Development Goals to go off course (Naidoo and Fisher, 2020). Border checks have also significantly disrupted storage and distribution routes, resulting in a significant reduction in food security (Yao et al., 2020). The COVID-19 pandemic is threatening the world's major health and economic systems, illustrating the magnitude of global inter-dependencies and thinner dependence on national health hazard preparedness. Much of the focus has shifted to the pandemic's response as well as the research of treatments and vaccines. Climate change, pollution, urbanization, and excessive consumption, which have all resulted in serious environmental disturbances and species loss, may appear to be less urgent. It may be tempting to seek epidemic remedies in the absence of these risks, such as using throwaway goods, minimizing public transportation use, and supporting polluted firms. Such actions may provide relatively brief quality of life and economic gains, but they will obviate this need for long-term human healthier and sustainable improvements. Climate change and other environmental stresses, as well as their effects on human and ecological health, have not abated. Therefore, considering these changing environmental issues, urgent global measures are needed to prevent the COVID-19 crisis.

This research has been organized in the following way to achieve in the post-onset period of COVID-19, it is aimed to statistically reveal the effects of the pandemic on socio-economic and environmental variables in EU countries. In this context, the second section contains a literature review, the third section contains methodology, the fourth section has data and estimation findings, and the final section contains the conclusion.

1. LITERATURE REVIEW

Ehlert (2021) looks at the relationship between socioeconomic, demographics, and health-related characteristics at the regional level and COVID-19-related cases and fatalities in Germany from the first wave until mid-June 2020. To accommodate for regional interconnections and probable spillover effects, multivariate spatial models encompass all 401 counties in Germany. Beyond the clinical variables addressed thus far, the findings add to our understanding of COVID-19 infection from a socio-economic viewpoint at the environmental level. Baldasano (2020) observed the world's biggest experiment in existence in terms of air pollution in cities during March and

April 2020. Any forecast of the results of this experiment may seem evident to scientists, but the quality of air has much improved, as predicted. It is unsurprising, to put it that way. Because of the severe drop in traffic, the lockdown has made it easier to estimate the limit of pollution reduction. Significant decreases of up to 75% have been seen in Madrid and Barcelona. We intend to present a summary of COVID-19 research related to cities, according to Sharifi and Garmsir (2020), by looking at material published during the first 8 months after the first confirmed cases were related in Wuhan, China. They were major objectives to understand the consequences of the pandemic on cities and to identify critical implications for post-COVID urban design and architecture. Early study on the consequences of early COVID -19 on cities, according to the findings, is primarily focused on four important themes: (1) ecological quality, (2) socioeconomic implications, and (3) management and governance. Andreoni (2021) In this research, the carbon dioxide fluctuations caused by the COVID-19 crisis management's socio-economic constraints are examined for 23 European nations and 10 sectors of the economy. This research is one of the first efforts to estimate the Carbon dioxide emission change that occurred in Europe during the first six months of 2020, using the most up-to-date data on GDP and carbon intensity of the industry. Bazzana (2022) The purpose of this report is to assess the possible consequences of several COVID-19 models on the Italian energy sector until 2030, with a particular focus on transportation and industries. To appropriately evaluate the intricate linkages of sectors across Italy, the research adopts a multidisciplinary approach. This method combines macroeconomic and feedback models to analyze economic circumstances, energy, and transport models to simulate the energy system's evolution, modeling techniques, and expert modeling to anticipate the reaction of travel demands and modal choice. The findings reveal that the COVID-19 epidemic might have a mid-term impact on energy usage. Rizvi (2021) This research aims Rizvi’s group nations based on social, economic, health, and environmental factors that influence disease spread so that measures to restrict disease spread may be implemented. As a result, nations with comparable characteristics can take preemptive measures to combat the epidemic. Data is collected for 79 nations, with 18 distinct feature variables (factors linked to COVID-19 dissemination) being chosen. An examination of the connection between the specified feature variables and COVID-19 reported cases and fatalities is also presented. COVID-19 has a substantial correlation with the prevalence of underlying disorders, whereas environmental and health indicators have a poor correlation with COVID-19. Viezzer and Biondi (2021) looked at 3,052 municipalities in Brazil's Atlantic Forest to see if COVID-19 values are greater in towns with increased urbanization, worse socioeconomic situations, and less forest cover. The Atlantic Forest is Brazil's most urbanized, populated, and deforested region, and it is the country's second most afflicted by COVID-19. Although lesser predictors of COVID-19, socioeconomic and environmental factors had significant relationships with health indicators.

This study adds to the body of knowledge on COVID-19 prevalence in the Brazilian community. Mofijur et. al. (2021) This study aims to provide a comprehensive assessment of the COVID-19 outbreak's impact on the natural and energy sectors, community, and the economy, and also investigate global preventative measures taken to reduce COVID-19 transmission. This study unpacks the major answers to COVID-19, examines the effectiveness of current activities, and presents the lessons gained as an assessment of the accessible information to the government, business, and industry. According to findings, a 72-hour break in waste collection and disposal from infected residences and quarantine facilities is important in preventing the virus spread answered et. al. (2022) in a cross-section of 65 nations, the study looked at the nonlinear link between COVID-19 instances and carbon damages, financial development, renewables usage, and inventive capabilities. Because of the rising number of coronavirus infections, the data demonstrate that incoming foreign direct investment grows at first, then falls. Furthermore, when research and development expenditure rise and fall, so does population density, resulting in an increase in coronavirus incidence in different nations. Following the adoption of standardized operating practices to limit coronavirus illness, continuing economic growth initially reduces and then increases. With a variation of 17.127 percent and 5.440 percent, respectively, across a time horizon, the inter-temporal connection demonstrates that green energy sources and carbon damages will likely impact coronavirus cases. Mahnoor Ali et. al. (2021) the purpose of this article is to examine how particle matter quality was reduced throughout the lockdown period (March 23 to April 15, 2020) compared to before the lockdown. The improvement in air quality in Pakistan was identified using both ground-based and satellite data, with a special focus on the four major cities of Lahore, Islamabad, Karachi, and Peshawar. Both datasets reveal a significant decrease in PM2.5 levels of pollution across Pakistan (varying from 13 percent to 33 percent in satellite observations and 23 percent to 58 percent in ground-biassed measurements). The findings reveal a greater incidence of COVID-19 dissemination in Pakistan's largest cities with poor air quality. Vavoura and Vavouras (2021) believed that the green development strategy is based on a deliberate selection of the classic economic growth model while taking specific considering specific environmental factors environmental spending grows at a significantly slower rate than per capita income. When we look at investments in environmental protection, we see a definite downward trend. Our findings suggest that the social and environmental dimensions of sustainability are losing support, while the conventional objective of economic development is regaining ground. The second goal is to assess the coronavirus pandemic's influence on the EU's sustainable development process.

2. MODEL SPECIFICATION, DATA, AND METHOD

This study is based on the principal component analysis and the clustering method analysis, which is a multivariate analytic technique frequently used in the literature and is also suitable for the purpose of our study. It may be summarized in the following manner. Principal components analysis (PCA) is a multivariate data analysis approach for reducing data dimensionality. The first major component, $Z_{dimensionality}$follows:

$$Z_1=a_{11}X_1+a_{12}X_2+\ldots a_1pXp$$

As a result, $\text{Var}\,(Z_1)=Z'_1Z_1-a'_1X'X_{a1}$ is maximized.

Within the confines of the normalization restriction.

$$a^2_{11}+a^2_{12}+\ldots a^2_{1p}=1$$

The second most important factor is

$$Z_2=a_{21}X_1+a_{22}X_2+\ldots+a_{2p}X_p$$

Subject to standardization and orthogonality requirements, Var (Z_2) is maximized.

$$a^2_{21}+a^2_{22}+\ldots+a^2_{2p}=1$$

$$Z'_2Z1=0$$

In the same way, other major components are specified. Cluster analysis is the second statistical approach. The goal of the analysis is to divide a large number of objects into a small number of individuals based on their commonalities.

The variables used in the analysis are summarized in the following table 1.

Table 1. Indicators Used in Empirical Analysis

Government revenue, expenditure, and main aggregates (Million units of national currency)
Government deficit/surplus, debt, and associated data (%)
People at risk of poverty or social exclusion by age and sex (%)

Employment and activity by sex and age - annual data (%)
Exports and imports by Member States of the EU/third countries (Current prices, million euro)
GDP and main components (output, expenditure, and income) (Current prices, million euros),
Simplified energy balances (Thousand euros of oil equivalent)
Gas prices for household consumers (Kilowatt-hour)
Unemployment by sex and age (%)
Air emissions account for totals bridging to emission inveaccounttalfor s (Grams per capita)
Environmental protection investments in total economy (Million euros)
Population ber)

Source: https:euros.europa.eu/eurostat/data/database

These variables were preferred in terms of the pandemic having the most socio-economic and environmental effects.

3. EMPIRICAL FINDINGS

In this section, the effect of the pandemic that erupted in the post-2019 period of COVID-19 on Socio-Economic and Environmental Variables in EU Countries was examined statistically and principal components analysis, a widely implemented method in the literature, was used. In this context, 12 socio-economic, energy, and environmental indicators were used for, 2021. The main objective of the principal component analysis is to reduce the original 12 variables to a smaller set of orthogonal indicators.

The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were done first in the study. These tests are used to determine whether our data is acceptable for principal component analysis. KMO statistics should exceed 0.60, and Bartlett's test should be meaningful (e.g., p0.05). We may use the analysis of the main components based on the data in Table 4 since KMO statistics is 0,481 and Bartlett's test is (0,002 0,05) significant.

Table 2.KMO and Bartlett′s Tests

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,481
Bartlett's Test of Sphericity	Approx. Chi-Square	43,880
	df	21
	Sig.	,002

The principle components analysis was used in the second stage of the study to determine the number of principal components that should be

preserved for further investigation. According to the values, the first five principal components, as well as the resulting principal component scores, should be utilized to evaluate the nations (See Table3). Because eigenvalues greater than "1" are approved for further analysis, main components with eigenvalues greater than "1" are accepted.

Table 3. KMO and Bartlett′s Tests

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	2,443	34,896	34,896
2	1,402	20,024	54,920
3	1,039	14,842	69,762
4	,803	11,477	81,239
5	,681	9,726	90,964
6	,474	6,767	97,731
7	,159	2,269	100,000

Extraction Method: Principal Component Analysis.

Table 4. Component Matrix

	Component		
	1	2	3
SMEAN (devletaçığıfazlasıborç)	,853	,153	,146
SMEAN (Yoksulluksosyaldışlanmarıski)	-,185	,695	-,284
SMEAN(istihdam)	,817	-,286	-,346
SMEAN(hanehalkgazfiyat)	-,482	-,617	-,061
SMEAN(işsizlik)	-,715	,433	,102
SMEAN(nüfus)	-,351	-,438	,432
SMEAN(havaemisyonları)	,382	,234	,785

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

The first component is substantially linked with a state deficit, redundancy, and debt (-a 0.853), poverty and social exclusion (-0.185), the employment rate (0.817), household as prices (-0.482), unemployment (-0.715), and population (-0.351), accounting for 34.8 percent of the total variance (See Table 4). These relationships also provide insight into the elements that influence socioeconomic and environmental conditions in EU nations. In the EU, for example, COVD-19 has a strong and negative relationship with socioeconomic variables.

The second major component, which accounts for 20.02 percent of the total variation, is mostly contrite called by increases in unemployment (-0.715), population, and other factors (-0.351). In the peak years of COVID-19 in EU countries.

Table 5. Principal Components' Table

Countries	PCA1	PCA2	PCA3
Belgium	,42971	,08242	,14555
Bulgaria	,16576	-1,41251	,24347
Czech	-1,36036	,91193	,20806
Denmark	-,81393	-,10850	2,35227
Germany	-,56443	1,48430	,77215
Estonia	-,45467	-1,01546	,26673
Ireland	,05330	,78059	,99592
Greece	3,07988	-,63032	,04336
Spain	2,27173	,45117	-,92075
France	,50045	1,56787	-,66108
Croatia	,55485	-,73547	-,29668
Italy	1,00318	2,74416	,16965
Cyprus	-,11052	-,78043	,80859
Latvia	-,25773	-1,54534	-,09787
Lithuania	,10842	-,84005	-,01143
Continuation of Table 5			
Luxembourg	,20600	-,56579	2,58354
Hungary	-,69259	-,10777	-,69686
Malta	-,68627	-,20850	-1,80454
Netherlands	-1,50944	-,52505	-1,51700
Austria	-,32108	,69859	-,86880
Poland	-,20472	,53058	,99568
Portugal	-,26016	-,31973	-,53830
Romania	1,18437	-1,13269	-,77022
Slovenia	-,59572	1,17333	-,88755

Slovakia	-,51645	,05363	-,23000
Finland	-,28456	-,01014	,29892
Sweden	-,92504	-,54080	-,58279

In 2021, when the COVID-19 pandemic in EU countries increased most intensely, we show the country rankings according to the first basic components scores in determining the factors affecting these variables, where government expenditures have effects on variables such as population, environment, employment, exports, etc. In table 6, we see that in the most developed table entry in terms of socio-economic, environmental, and energy indicators, the least affected country by COVID-19 is Greece and the most affected country is the Netherlands.

Table 6. Country Ranking

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

Conclusion

COVD-19 has evolved into a pandemic, with modest chains of infection leading to larger chains of transmission in many countries, finally resulting in widespread transmission around the globe, and affecting all continents. Countries have begun to take quarantine measures to halt the new coronavirus pandemic from spreading after it broke out in 2019. Several regulations were implemented to increase social distance by limiting human movement, effectively delaying transmission. Socioeconomic characteristics in low- and middle-income countries' main urban areas may hinder the ability to react to the pandemic and respond to control measures. COVID-19 has had a wide range of economic, social, and environmental outcomes.

There are not many studies in the literature that simultaneously investigate the relationships between COVID-19 and socio-economic and environment

socio-economics. There was no study that statistically revealed these relationships. In this context, the studies in the literature, the relationship between COVID-19 and socio-economic variables, or the relations between COVID-19 and the environment were examined separately.

The investigation reported in this paper is based on a multivariate prior empirical study known as a principal component study (PCA). The principal component analysis is the principally used multivariate statistical approach, with applications in practically all scientific fields. It's also the most ancient multivariate approach. PCA examines a data table that contains observations that are characterized by several dependent variables that are often inter-correlated. Its purpose is to extract the significant data from the data table and represent it as a set of new orthogonal variables known as principal components. Twelve socioeconomic, energy and environmental variables were employed in this context for the year 2021. The principal component analysis' major goal is to condense the original 12 variables into a smaller collection of orthogonal indicators.

We will show the great nation standings according to the above basic components scores in examining the factors affecting these different factors in 2021, when the COVID-19 pandemic in European nations has increased the most profoundly, where government spending has effects on variables such as community, environment, employment, exports, and so on. We can observe that Greece is the most industrialized nation in terms of socioeconomic, environmental, and energy statistics, while the Netherlands is the most afflicted.

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