Co-movement in Stock Indices and GDP During the COVID-19 Period in the Countries of the European Union

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Abstract:

Purpose: *Macroeconomic research rarely analyzes the short-run relationship between stock market indices and GDP. The study seeks to answer how close the two indicators are in the short term in times of crisis.*

Design/Methodology/Approach: *The stock market crisis caused by the COVID-19 pandemic has also developed in the European Union member states. Following the low of the European stock market in March, there was a relatively rapid rebound. There was a decline in the third quarter and strong growth in the fourth. As a result of the fear caused by the epidemic, national economies were shut down to varying degrees by governments, leading to a decline in GDP as early as the first quarter. This decline continued in the second quarter, with a strong rebound in the third and a moderate rise in the fourth. The research methodology is correlation calculation and hierarchical cluster analysis. The research hypothesizes that in the short run, stock market indices moved along with GDP. The positive correlation between the two indicators can be assumed because investors' decisions were influenced by the decline in GDP due to COVID-19. The hypothesis was not met, only in four countries, the study confirmed the co-movement of indicators.*

Findings: *The hypothesis of the research was not fulfilled, in the majority of the EU member states, the two indicators did not change together, they did not move in the same direction. The negative correlation coefficient for the Union as a whole (r = -0.16028) means that the indicators moved in the opposite direction. Of the 27 Member States, 23 were characterized by this opposite movement.*

Practical Implications: *The study's empirical results draw the attention of investors, risk managers, and economic policymakers to the fact that short-term changes in GDP do not influence their decision-making. Short-term GDP data are fundamentally inadequate indicators. This means that these data cannot predict with significant accuracy either expected GDP, stock market performance, and many other macroeconomic indicators.*

Originality/value: *The originality and value of the study are given by the fact that it examines a macroeconomic relationship that researchers rarely analyze. The study's empirical results can also be used by risk managers, investors, and economic policymakers.*

Keywords: *Stock market index, GDP, COVID-19, European Union, cluster analysis.*

JEL classification: *B26, E44.*

Paper Type: *Research article.*

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1. Introduction

With the emergence of the COVID-19 pandemic, an unprecedented amount of scientific research has been launched worldwide to examine the global effects it has caused. Tens of thousands of new scientific papers have revealed new results on important issues so far and will present in the future. Economics is also looking at many of the effects of a pandemic.

One part of the research is theoretical, and the other part is empirical research. It is still considered an epidemic, but that does not mean that the effects experienced so far are not being studied by researchers.

A relatively small number of studies have been published so far on the impact of the COVID-19 epidemic on stock exchanges in 2020 (there is significantly more research on GDP developments). Still, the number of articles on this topic will increase soon. This increase can be predicted because macroeconomic data for 2020 are now available and because prestigious journals plan to publish special issues examining the effects of COVID-19.

The study was designed to analyze the short-term relationship between two critical macroeconomic variables in the European Union in the first year of a pandemic over the past year. These two indicators are the stock index and GDP. These two statistical variables/indicators / are not macroeconomically independent of each other. They are not independent because a change in one indicator affects the evolution of the value of another. Whether this relationship will be deterministic or stochastic is not yet known will be revealed only later in the dissertation.

The results and conclusions presented in the study can be exciting and valuable for all individuals and organizations involved in the stock market. Such persons are institutional investors, investment fund managers, economic policymakers. The study may be of interest to many professionals, including asset managers, industrial managers, investment bankers, and risk managers.

The COVID-19 epidemic has led to fundamental changes in the lives of society, health, and the economy of the 21st-century world since the end of February 2020. Researchers in any science cannot reliably predict the extent of a complete economic downturn, as the global epidemic is far from over (Grima *et al.,* 2020).

Several researchers have found the crisis to be greater than the global financial crisis of the 2000s combined with the depression of the 1930s (Khan, Rabbani, Thalassinos, and Atif, 2020). This fact, of course, does not leave the interconnected world economy untouched, including the European Union. The dynamic changes are well illustrated because while writing this study; it was necessary to review findings that seemed to be a clear trend last year but have now come to light in a new light.

The effects of the pandemic first appeared in the volatility of stock prices. The more explosive price movements market participants are prepared for, the more uncertain they are about the future. Therefore, the volatility index is an excellent measure of the current level of investor fear. This investor fear was finally manifested in the fall in stock prices in March. In 2020, the stock market indices of the E.U. member states included in the study followed a fluctuating trajectory. At the same time, the development of the GDP of the member states followed a different path from the change in stock market indices.

In macroeconomic research, it is rare for analyses to examine the close relationship between the two economic indicators in the movement of the two economic indicators together in the short term over one year. The study will analyze whether there was a demonstrable relationship between the stock market index and GDP developments in the European Union member states in 2020, weighted by the COVID-19 pandemic. The study aims to be gap-filling research in the study of this relationship.

This study contributes to the literature and the research of international investment from three perspectives.

First, it documents the impact of the COVID-19 epidemic on the European Union member states' stock market indices and their GDP changes in 2020.

Second, it examines how strongly there was a correlation between the two indicators during this period.

Third, it ranks the efficiency of member states' economies and stock exchanges for 2020 using hierarchical cluster analysis.

Suppose the hierarchical cluster analysis will detect a member state for which there will be a positive correlation. In that case, this will mean that the value of both indicators of the country has increased. So the amount of GDP in 2020 is higher than in the previous year, and the closing value of the national stock market index is also higher than the opening value at the beginning of the year.

Together, these two positive values will mean that such a national economy could respond effectively to the epidemic. It made up for the macroeconomic loss it suffered during the year by the end of 2020.

The research hypothesis is that in the short run, stock market indices moved together with GDP in 2020. The positive correlation between the two indicators can be assumed because investors' decisions were influenced by the decline in GDP due to COVID-19. The decline in the economic output of the E.U. member states was followed (not linearly) by changes in their stock market indices.

2. Literature Review

Investors were unexpectedly hit by the stock market panic caused by COVID-19 when stock markets produced the fastest record fall, unprecedented since the 2008 financial recession. Crown virus sales put an end to eleven-year-old stock price rises, and a rapid decline in prices began. COVID-19 poses a significantly more significant threat to national product releases today than previous epidemics. Previous epidemics have not had as severe consequences as the current pandemic. The following part of the study presents some of the effects of previous epidemics.

Extraordinary events — such as epidemics, terrorist acts — cause shock, fear, and panic among international investors and trigger a sharp sell-off reaction (Burch, Douglas, and Fuerst, 2016). Several have examined the nature of stock market panic-like sales. Folkinshteyn, Meric, and Meric (2015) used data from five significant stock market crashes to study excessive investor reactions over 1987–2008.

More evidence was found of investors overreacting to all five stock market crashes. In their study, Siu and Wong (2004) found that, overall, the SARS epidemic had a significant but only temporary effect on the demand side of the Hong Kong macro market. In the short term, the domestic consumer and service industries, especially the travel and aviation industries, were hit by the epidemic.

Srinivas and Washer (2004) examined the development of stock indices in eight severely affected countries concerning the SARS virus. They found that the epidemic had a very negative effect on the countries' stock markets, with stock market crashes in two countries. However, the stock index of six countries was not significantly affected by the emergence of the SARS virus.

The effects of the SARS epidemic were assessed by Jonung and Röger (2006). They estimated the harmful effects of this to be smaller than the consequences of an average economic recession. In their model, they used the medical assumptions used by the U.S. Congressional Budget Office in its study of the future epidemic. These assumptions have been incorporated into the European economic model.

The short- and long-term effects of epidemics on the economy were analyzed by Bell and Lewis (2004). They concluded that the magnitude of the economic consequences and economic impacts would vary depending on the duration and characteristics of the epidemic.

Dimitri (2015) found a correlation between economic impacts and available technologies for healing and financial resources. He made his findings after examining the effects of the Ebola epidemic. He considered a dynamic, probability-based epidemic model. This provided a comprehensive insight into how health authorities can best allocate available financial resources to combat infectious diseases. Cuesta (2010) modeled the impact of the HIV / AIDS epidemic on economic growth when

the epidemic is in a mature phase, in contrast to previous studies focusing on periods of expansion. Simulations of the epicenter of a Central American epidemic have shown that the AIDS epidemic is unlikely to threaten economic growth.

Other researchers have examined the antecedents of the onset of panic and sought answers to what signs might indicate that the event of a panic-like sale will occur in the stock market. One explanation for this was found in the formation of bubbles (Thalassinos and Thalassinos, 2018). Focardi and Fabozzi (2014) view the bubble as an abnormal increase in asset prices for the economy. The exponentially growing gap between asset prices and the economy indicates the likelihood of a bubble forming.

Moreover, the bursting of the bubble is followed by panic-like stock sales. It is an obvious fact for everyone that in the case of the COVID-19 epidemic, it was not the bursting of the asset bubble that caused panic-like stock sales.

Stock market indices provide investors with information about the stock market and industries of a country. Stock indices do this by summarizing changes in stock prices in specific categories into a single indicator. As a result of the summary, the combined exchange rate changes of many hundreds of listed companies can also be tracked. An essential feature of most stock indices is that they are included in the portfolio by capitalization weighting of companies, i.e., larger companies are given more weight in the index (Hsu, 2004).

Pyemo (2017) examined the practice of periodic transformation of stock indices and concluded that changing the index's composition may affect the performance of firms whose shares are included in the index or leave the index. However, the stock market is a securities market and an information center, a necessary measure of value in the modern economy. The stock market plays an essential and complex role in the daily life of the world economy because the development of stock prices determines investors' decisions.

In summary, stock markets can influence investment choice and economic growth by mobilizing and managing savings and diversifying risks (Hou and Cheng, 2010; Arestis, Demetriades, and Luintel, 2001; Rousseau and Wachtel, 2000; Enisan and Olufisay, 2009; Levine and Zervos, 1996).

GDP measures national income and performance. From the beginning of the recording of national income, the economic policy goal has been for GDP to reflect the development and prosperity of the national economy (Syrquin, 2011). There is extensive literature on developing the GDP indicator, which is the most widely used measure of national output. There are several explanations as to which are the indicators that are most decisive in GDP growth (For more details on the role and significance of macroeconomic indicators, see Iyetomi *et al.,* (2020)).

Dao (2014) modifies the traditional neoclassical growth model to consider the increase in the number of working people relative to the total population to express value-added per worker. Sfakianakis, Magoutas, and Georgopoulos (2010) also explain education, the accumulation of physical capital, the share of the public sector in economic activity, and the orientation of economies abroad when explaining GDP growth.

There is a strong correlation between the stock market and the real economy (best characterized by GDP). Various economic events and macroeconomic processes affect the stock markets. The interaction of GDP and stock market indices has been examined in several studies. According to a survey by Fufa and Kim (2018), there is a close relationship between the long-term macroeconomic indicators of an economically developed country and its capital market.

The relationship between the two indicators depends on the stages of economic development of the nations. The more homogeneous the economies of the countries, the more stylized the relationship becomes. In their study, the correction of the Generalized method of moments (GMM) method was applied.

The interaction of GDP and stock indices were examined by Shing and Hsien (2011). Using the ARCH model, this study finds that Poland's stock market index is positively related to real GDP. In their research, Laopodis and Papastamou (2016) examined the relationship between the stock market and general economic development between 1995 and 2014 for 14 emerging countries.

Following the pandemic onset, researchers have attempted to predict the expected impacts and present some of these studies that attempt to predict the expected economic consequences.

The stock market panic triggered by the COVID-19 virus is different from previous mass stock sales, such as the bursting of asset bubbles. In this case, factory closures affecting the real economy, rising unemployment, and so on. Factors are those that directly triggered the stock market panic. Almost all sectors were negatively affected by the emergence and spread of the epidemic in early 2020. Companies in critical sectors of the economy have been forced to reorganize or temporarily cease production. Retail stores were closed, and services had to be suspended due to a lack of demand. These adverse economic developments have enormously contributed to the decline in GDP in the member states of the Union.

Wren-Lewis (2020) argued that the COVID-19 epidemic significantly impacts GDP due to declining production and changing consumer demand. His second relevant finding was that the epidemic would exacerbate the situation if banks were unable to meet the financing needs of companies due to a sudden drop in demand.

The epidemic focuses on sectors and stock market liquidity testing (Hassan and Tahat, 2020). The study documents empirical evidence that finds a statistically negative

relationship between stock market returns and the COVID-19 epidemic. The study also finds that sectoral market yields were severely affected by the COVID-19 epidemic.

However, this general finding does not apply to the healthcare and pharmaceutical sectors. These sectors have been positively affected by the coronavirus outbreak as their orders and sales have increased. Besides, the researchers found that stock market liquidity declined during the COVID-19 epidemic. Interestingly, to some extent, a significant positive correlation was found between market yield and liquidity. This relationship suggests that investors will either exit or suspend trading in the shares.

Ashraf (2020) examined stock market responses to the COVID-19 epidemic. Calculations using daily officially reported infections, deaths, and stock market yield data revealed that stock markets reacted negatively to increased morbidity due to COVID-19. As the number of certified formally patients increased, stock market yields declined. Ashraf also noted that stock markets had responded more proactively to an increase in the number of confirmed infections than the rise in deaths. In his analysis, he concluded that the adverse market reaction was strong in the initial days of confirmed cases of infection and then for 40–60 days after the first confirmed cases.

In their study, Estrada, Koutronas, and Lee (2020) present a stock market simulator that attempts to assess capital market damage caused by epidemic infectious diseases. The economic downturn caused by the pandemic is perceived by the CRS (2021) as the risk of rising unemployment and rising public debt unprecedented since the Great Depression of the 1930s. It also attempts to forecast the rate of increase in consolidated gross government debt in E.U. countries (Török, 2020). The study concludes that rising public debt will cause a problematic financing situation for Spain, Greece, and Italy. The author does not even rule out the occurrence of settled state bankruptcy shortly in managing the public debt of these three countries. For further studies on the economic effects of the COVID-19 epidemic, see also Ozili and Arun (2020), and Mckibbin and Fernando (2020).

3. Research Methodology

Different stock market indices indicate changes in the price of stocks traded on various stock exchanges. Changes in the value of a stock index follow economic processes and investor expectations. From a statistical perspective, stock indices are price indices calculated from a representative sample of stocks (based on the stock basket).

Therefore, the stock basket contains the shares taken into account in the calculation of the stock index. The stocks to be included in the index basket are selected by virtually concentrated sampling. In general, securities of companies with higher capital value are included in the sample. The shares of companies representing a significant proportion of the capital value of the stock exchange adequately represent the market. Investors primarily use equity indices to make investment decisions and analyze the

current economic situation. One of the analysis indicators will be the changes in the stock market index of the E.U., countries.

Using the cluster analysis method based on correlation calculations, I will examine how the decline in the GDP of the E.U., member states affected their stock market indices in 2020, during the COVID-19 epidemic period. The methodology used is often used to examine the closeness of the relationship between macroeconomic indicators. Using the hierarchical cluster analysis method, Deltuvaité and Sineviþiené (2014) examine the relationship between financial markets and GDP development. The homogeneity of the economic sectors of the E.U., countries is assessed by the method of correlation calculation and hierarchical cluster analysis Urbankova and Krizek (2020).

To perform the correlation calculation, the data of the stock exchange index of the member states of the European Union, broken down by quarter and month, where required. Data sources: The source of the data of the stock exchanges with the largest capitalization (DAX, CAC, and IBEX) is the Marketwach (2021) database, and the data of the smaller national stock exchanges are from the Tradingeconomics (2021a) website.

Method of calculating quarterly / monthly changes in stock exchange indices: the closing value of the current period divided by the closing value of the base period.

The countries included in the empirical study and their stock market indices are: Belgium / BEL /, Bulgaria / BSE /, Czechia / PX /, Denmark / OMXN40 /, Germany / DAX /, Estonia / OMXT /, Ireland / ISEQ /, Greece / ATHENEX /, Spain / IBEX /, France / CAC /, Croatia / ZSE /, Italy / MIB /, Cyprus / CSE /. Also, Latvia / OMXR /, Lithuania / OMXV /, Luxembourg / LUXSE /, Hungary / BUX /, Malta / MSE /, Netherland / AEX /, Austria / ATX /, Poland / WIG /, Portugal / PSI /, Romania / BET /, Slovenia / LJSE /, Slovakia / SAX /, Finland / OMXH / Sweden / OMXS /.

The correlation calculations required even quarterly GDP data of the E.U. member states, the source of Eurostat's website (2021). Estonia, Ireland, Greece, Croatia, Luxembourg, Malta, and Slovenia did not report GDP data for the fourth quarter of 2020. Data for these countries are replaced by estimates on the Tradingeconomics (2021b) website.

The quarterly data in Table 1 are for information only and are only suitable for presenting the trend. I needed more detailed data to do a more in-depth analysis. Instead of the data in the table, I used the monthly closing values of the stock market indices to examine the closeness of the relationship between the two indicators.

Moreover, I adjusted the GDP indicator to the stock market indices by calculating the monthly average change. The monthly GDP indicator is one-third of the quarterly value for all member states. To keep GDP data in sync with the values of monthly

changes in stock market indices, I divided Eurostat's quarterly GDP data by three. I placed these data in a separate Excel spreadsheet. I performed the calculation for all European Union member states. I finally determined the relationship using correlation. The correlation coefficients entered in Table 1 have already been calculated from the monthly changes in stock market indices and GDP values.

The closeness of co-movement between indicators is measured by correlation calculation Guilfford (1953). The correlation will indicate the magnitude and direction of the linear relationship between the two indicators, their relationship to each other. In the study, the explanatory (independent) variable will be the change in GDP, and the result (dependent) variable will be the change in the stock index. The correlation values are shown in the last column of the table (the Member States of the Union are listed in the order of the stock exchange indices in the Table).

The Pearson coefficients obtained by correlation calculation are classified into clusters using hierarchical cluster analysis using the SPSS Statistics 27 program. Cluster analysis is an automatic classification procedure, as it forms groups so that we have no previous idea about the properties of the groups. The feature of a cluster should be highlighted, that each cluster can be considered a group, the weaker and stronger elements, with a multitude of individuals. In my analysis performed with cluster analysis, I want to present not the individual but the typical characteristic of a broader range of individuals, the generalizable.

The procedure aims to classify the countries of the European Union into four homogeneous groups. There should be maximum similarity within the groups created by clustering and difference outside the group. I used the Between Groups method for clustering. The relationship between the indicators was acceptable for all E.U. member states. It did not prevent clustering, as the Pearson correlation coefficient did not exceed the threshold of 0.7 for any of the countries.

There is an asymmetric econometric relationship between the two macroeconomic variables (GDP, stock index). Of the two variables, GDP is the independent variable and the stock index is the dependent variable because any change in GDP affects the stock index. Conversely, however, the connection is not possible. This relationship could theoretically be functional, stochastic, or completely independent. Before analysing the relationship between the two variables, I assume that this relationship will be stochastic since both functional and complete independence can be ruled out.

The appropriate procedure for examining the stochastic relationship is the correlation calculation. Correlation answers the question of whether there is a relationship between two or more quantitative variables and, if so, how close it is. The joint change of the variables is characterized by Pearson's correlation coefficient. The sign of the correlation coefficient, retaining the sign of the covariance, indicates the direction of the relationship. The roles of the two variables (GDP and stock index) are interchangeable in the correlation study, neither has a prominent role.

The calculation of the correlation will only be the first procedure in the econometric analysis. In the second procedure, I will perform a hierarchical cluster analysis with the correlation coefficients. These two methods are often used by researchers for econometric analysis (Deltuvaité and Sineviþiené, 2014; Urbankova and Krizek, 2020).

The study uses the statistical method of correlation analysis to determine the dependence between the indicators - a multidimensional statistical technique of cluster analysis to assess homogeneity between countries.

The secondary data analysis was first performed by correlation analysis and examined the strength and direction of dependence of the selected variables and the effect of the independent variable on the dependent variable. Correlation analysis compares the interrelationships of two variables and measures the strength and direction of their dependence. I assumed that both observed variables were continuous. The correlation coefficient: a) takes the value $<-1; +1>$ indicating a perfect linear relationship (direct or indirect dependence); b) independent of the units of measurement of the original variables; dimensionless quantity; c) does not change its value when the order of the variables changes; d) valid only for the data used; f) does not necessarily prove a functional relationship between variables if it differs significantly from zero (Artl, Artlova, and Rublíková, 2002).

When testing the statistical significance of the correlation coefficient, I examined the null hypothesis H 0: p = 0 on the independence of the quantities V1 and V 2 from the alternative hypothesis H 1: p ≠ 0 on the dependence of the quantities V1 and V2 (where V1: GDP, V2: stock index). Rejection or confirmation of the null hypothesis is based on the p-value. Suppose the significance level of alpha (alpha = 0.05) is greater than the value of p. In that case, the null hypothesis must be rejected, in which case the parameter is statistically significant in the model.

The SPSS calculated a value of 0.026 <0.05 for p; therefore, the null hypothesis was rejected, the alternative hypothesis was accepted, which means that there is statistical significance between the two variables.

I used the Between Groups method for clustering. The distances of two clusters can be determined by calculating the distances for all possible point pairings and taking their average. In this method, the distance between the point and the cluster is the average distance of each point in the cluster from a given point.

The SPSS will calculate the value of the Pearson coefficient of the E.U. member states based on the data provided, and the data will be in the upper right corner of Figure 1. Its value is the average of the closeness of the relationship between the GDP and stock market indices of the E.U. countries. The study determines the classification of a given E.U. member state based on the so-called partitioning methodology. A predetermined number of clusters had to be created to classify E.U. member states, and I made four

such groups. The four clusters between -1 and 1 ranges are already suitable and sufficient to express the difference between member states. The research aimed to make the member states included in each cluster as different from the other clusters.

It was already programmed into the SPSS before clustering that the algorithm would classify the E.U. member states into four clusters based on the correlation coefficient values. The number of member states in a cluster that the SPSS algorithm will classify will be determined by the importance of the correlation coefficients of the member states. Countries classified in one cluster will be considered a homogeneous group based on the correlation value between GDP and the stock market index.

The classification of a member state into a given cluster will not affect how high or low the country's economic output is, just as the size of the capitalization of a country's stock market will be irrelevant.

The study will use E.U. correlation calculation and cluster analysis to group E.U. member states into homogeneous groups based solely on the correlation between GDP and stock market index. However, it is not the purpose of this study to examine whether changes in macroeconomic indicators in member states (such as declining GDP) include the incidence of COVID-19 mortality, closure of individual economic sectors, etc., the extent to which they contributed. Exploring these reasons would go far beyond the scope of this study, but I am confident that a large number of papers on this topic will be published in the future.

4. Data Analysis and Findings

4.1 Stock Market Index and GDP Correlation

The correlation values between the stock market index and the GDP of the E.U. member states are shown in the table below.

The value of the Pearson coefficient calculated from the stock exchange indices and GDP values of the European Union member states in 2020 is r = -0.16028. This value shows an inverse relationship between the two indicators (stock indices and GDPs), and there is only a loose relationship. The more flexible the relationship between two indicators, the closer the correlation coefficient value is to 0. This value means that the change in the stock indices of the European Union member states is only slightly justified by the decrease in the GDP of the member states in 2020.

Clearly identifiable investor panic can explain the fall in national stock indexes in the first quarter caused by the COVID-19 epidemic. The rate of decline varied from country to country, ranging from 5.5 percent (Denmark) to 39.0 percent (Greece). In the second quarter, there was a strong correction (rise) in stock market indices, between 3.4 percent (Cyprus) and 24.6 percent (Germany).

Table 1. *Stock index and GDP change in 2020, quarterly in E.U. countries, the
value of Pearson's coefficient calculated from monthly data.*

Country	Stock index change for the previous quarter (%)				GDP change on the previous quarter (%)				Pearson coefficient value (r)
-	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	-
B.E.	-29,6	17,8	-2,8	14,8	-3,4	-11,8	11,6	0,2	-0,07753
B.G.	-25,5	5,4	-4,5	3,8	0,4	-10,1	4,3	2,1	-0,65076
C.Z.	-31,0	19,2	-5,4	18,3	-3,3	-8,5	6,9	0,3	-0,09371
D.K.	-5,5	16	6,8	6,3	-1,5	-7,1	5,2	0,6	-0,15268
DE	-26,1	24,6	4,1	7,8	-2,0	-9,7	8,5	0,1	-0,21365
EE	-20,8	20,3	-5,2	16,2	-0,8	-5,5	3,3	-0,3	-0,26976
IE	-31,2	22,0	5,8	15,6	-3,5	-3,2	11,1	-1,0	0,14292
EL	-39,0	14,3	-2,3	26,6	0,1	-14,1	2,3	-1,2	-0,23699
ES	-29,5	6,7	-7,1	21,4	-5,3	-17,9	16,4	0,4	-0,01466
FR	-17,5	12,3	-2,7	15,6	-5,9	-13,7	18,5	-1,3	-0,05770
HR	-28,1	11,8	-0,9	8,1	-1,3	-15,0	6,9	2,7	-0,14064
IT	-28,2	14,8	-1,9	16,9	-5,5	-13,0	16,0	-2,0	0,21887
CY	-27,7	3,4	-11,0	30,3	-0,5	-13,1	8,9	1,4	-0,06170
LV	-13,5	17,4	6,2	1,7	-2,3	-7,1	7,1	1,1	-0,36717
LT	-15,2	22,0	5,6	4,9	0,0	-5,9	3,8	1,2	-0,29606
LU	-34,8	7,8	6,7	30,6	-1,5	-7,4	9,8	0,1	0,05280
HU	-30,6	12,0	-8,1	27,9	-0,4	-14,6	11,4	1,1	-0,18746
MT	-19,5	6,7	-12,7	16,7	-2,7	-17,1	12,7	-5,3	-0,37041
NL	-20,3	16,0	-2,1	14,6	-1,5	-8,5	7,8	-0,1	-0,24130
AT	-37,2	12,2	-7,0	33,0	-2,8	-11,6	12,0	-4,3	-0,18896
PL	-29,4	21,4	-0,3	19,5	-0,3	-9,0	7,9	-0,7	-0,27253
PT	-21,9	7,9	-7,4	20,4	-4,0	-13,9	13,3	0,4	-0,15130
RO	-23,4	13,6	4,0	8,9	0,2	-12,2	6,1	5,3	-0,26529
SI	-21,9	17,6	0,4	6,4	-4,7	-9,8	12,4	-2,0	-0,05286
SK	-7,1	4,0	5,9	-3,6	-5,1	-8,3	11,7	0,2	0,14779
FI	-19,9	16,1	9,0	7,1	-1,5	-3,9	3,2	0,2	-0,04487
SE	-16,4	12,2	9,9	2,5	0,3	-8,0	4,9	0,5	-0,19611

Source: *Eurostat (2021), Marketwach (2021), Tradingeceonomics (2021), own calculation.*

In the third quarter, a moderate decrease was observed in most member states, and in
the fourth quarter, strong growth was again observed between 1.7 percent (Lithuania)
and 33.0 percent (Austria). By the end of 2020 (1524 points), the closing value of the
FTSE Eurofirst 300 index, which covers the pan-European stock exchange index, had
practically adjusted to the opening value at the beginning of the year (1574 points)
based on Investing.com (2021). The low point of the index was 1151 points in mid-
March 2020.

There is a difference in the development of GDP values from the dynamics of changes
in the stock market indices of the E.U. member states. In the first and second quarters,
GDP fell in all member states of the European Union. Exceptions to the decline in the
first quarter are Bulgaria, Greece, Lithuania, Romania, and Sweden. The largest GDP
declined in the second quarter was between 3.2 (Ireland) and 17.9 (Spain) percent. In
the third quarter, GDP grew in all national economies by 12.5 percent across the
Union. The change was between 2.3 (Greece) and 18.5 (France) percent.

Growth in emissions from the national economy began in the second quarter due to the gradual lifting of state restrictions and the restart of economies. Some sectors showed a sharp, V-shaped bounce, but industries and countries were characterized by varying degrees of bounce (E.C., 2020). GDP declined in ten countries in the fourth quarter, with GDP growth in the other 17 economies.

Eurostat (2021) reports that the EU's economic performance fell by 6.2 percent in 2020. According to statistics for 2021, the EU economy will grow by 4.8 percent this year. Real GDP is projected to return to pre-crisis levels in the last quarter of 2021.

The performance of European stock exchanges in 2020 was an index loss. The pan-European FTSE Euro First 300 index has recovered, with the Stoxx Europe 600 index down 4 percent and the EuroStoxx50 index down 5.2 percent. Compared to their low point in March this year due to the coronavirus crisis, European aggregate indices rose by 40 percent by the end of the year and euro area indices by 50 percent. Of the leading European stock market indices, only the DAX in Frankfurt made a profit of 3.5 percent last year.

**4.2 Empirical Results of Hierarchical Cluster Analysis Based on Monthly Data**

The cluster analysis study performed with the SPSS program, based on monthly data, yields more detailed and illustrative results from the facts described in the previous subsection. These will be shown in Figure 1 of the clusters formed based on the correlation coefficients. The classification of the member states of the European Union into clusters is shown in Table 2.

5. Discussion

The research hypothesis I formulated in the study's introduction was not fulfilled because, in most E.U. member states, the two indicators did not change together. They did not move in the same direction. The correlation coefficient showing a negative value ($r = -0.16028$) means that the indicators moved in the opposite period. 23 of the 27 member states are characterized by this opposite movement.

In the first and second clusters, we find the countries that have this negative correlation. The only difference between these countries is the degree of closeness of the relationship. In the case of 1 country classified in the first cluster (Bulgaria), a close but inverse relationship can be detected between the two indicators (stock index and GDP). For the 22 E.U. member states classified in the second cluster, there is a loose but inverse relationship between stock market indices and GDP during the period under review.

Figure 1. *Summary diagram of cluster analysis using between groups method*
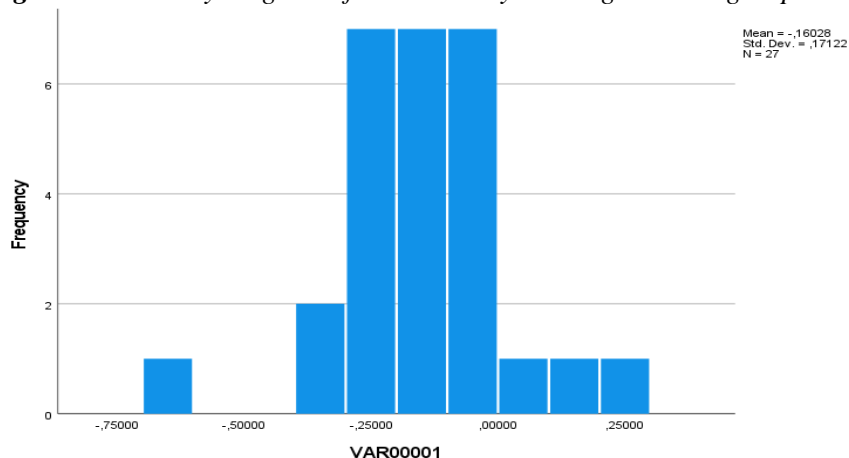
Note: y-axis: number of member states based on the closeness of the relationship between GDP and stock index,
x-axis: the proximity of the relationship between GDP and stock index between -1 and 1.
Source: *Own calculation with SPSS Statistics 27 program.*

Table 2. *Summary table of cluster analysis, using between groups method.*

Cluster 1 (-1) - (-0.5)	Cluster 2 (-0,5) – (0)	Cluster 3 (0) – (0,5)	Cluster 4 (0,5) – (1)
Bulgaria	Belgium	Ireland	-
	Czechia	Luxemburg	
	Denmark	Italy	
	Germany	Slovakia	
	Estonia		
	Greece		
	Spain		
	France		
	Croatia		
	Cyprus		
	Latvia		
	Lithuania		
	Hungary		
	Malta		
	Netherlands		
	Austria		
	Poland		
	Portugal		
	Romania		
	Slovenia		
	Finland		
	Sweden		

Source: *Own calculation with SPSS 27 program.*

It is valid for both the first and second cluster countries that this relationship is only possible in two ways: 1) the stock index of the clustered country increased and its GDP decreased, or 2) the stock index of the country classified in the cluster decreased and its GDP increased.

Most countries classified in the first and second clusters are characterized by a decrease in the cumulated value calculated from the monthly GDP data by 2020. In contrast, the cumulative stock index calculated from monthly data indicates a slight increase in most countries surveyed. The exceptions are Denmark, Germany, Estonia, Latvia, Lithuania, the Netherlands, Poland, Finland, and Sweden, where governments have seen more robust stock market growth.

A correlation coefficient showing a positive value means that the indicators moved in the same direction during the study period. For both the third and fourth cluster countries, this relationship is only possible in two ways: 1) the stock index of the clustered country increased and the GDP also increased, or 2) both the stock index and the GDP of the clustered country decreased.

In the four countries classified in the third cluster, a loose but direct relationship can be detected between the indicators. The position of Italy and Slovakia is explained by the fact that both the stock market index and the GDP value decreased in 2020.

Of the four countries, the indicators for Ireland and Luxembourg stand out. Of the four countries, the indicators for Ireland and Luxembourg stand out. The indicators show that Ireland's quarterly GDP growth was 3.8 percent of its 2019 GDP, and its stock market index was also 2.7 percent higher than the 2019 closing value. Hence, both indicators for the country increased in 2020. So both indicators for the country increased in 2020. Luxembourg's outstanding position is evidenced by the slight increase in its stock market index compared to its opening value in 2020. If we look at the country's quarterly cumulative GDP data for 2020, a 0.2 percent increase is over the 2019 data. For these two countries, the positive correlation is explained by the rise in the value of both indicators. From these data, it can be concluded that these two national economies could respond effectively to the epidemic situation.

The hierarchical cluster analysis did not find an E.U. member state. There was a close and direct relationship between changes in the stock market index and GDP in 2020 characterized by the COVID-19 epidemic, so cluster 4 is empty.

6. Conclusions

The first finding is that GDP declines have been synchronized in European Union member states due to the COVID-19 epidemic in 2020. A recession is synchronized when, in at least half of the European Union member states, the most important economic indicator is GDP. The weighted average economic indicators are also declining. This decrease occurred for all major economic indicators (Eurostat, 2021).

A second conclusion is that the research detailed in the study found evidence that COVID-19 harmed stock indices in European Union member states. Due to the panic, the rate of decline in stock indices in the first quarter approached 40 percent for several countries, and a pace is rarely seen in such a relatively short period. Empirical data show that between February 24 and March 18, there was a turbulent but relatively short period caused by a decline in global risk appetite on the supply side. Of the aggregate performance of the various financial instruments, equities came under the most significant selling pressure in this short period. This selling pressure explains the unusually high decline in stock indices in the first quarter.

The data used for the analysis show that by the end of 2020, the values of the largest European stock market indices had increased, but their closing values were lower than the closing values of 2019. This process has also taken place with the GDP of the member states of the Union. However, the closing values of GDP in 2020 fell short of the values of 2019 by a larger percentage than the stock market indices.

The study proved that there is a stochastic relationship between the two examined macroeconomic variables in the European Union member states during the studied period. However, there are only two countries for which there was a positive correlation between the two variables. These two countries are Ireland and Luxembourg. For the two countries, the positive correlation is explained by the increase in the value of both indicators. From these data, it can be concluded that these were the two national economies that were able to respond most effectively to the COVID-19 epidemic among the countries of the Union.

In the short term, the study concludes that examining the co-movement of stock market indices and GDP of the European Union member states in 2020, the empirical evidence proved no close relationship between the indicators.

So stock indices and GDPs do not correlate with each other in the short run; if they do, it is just a coincidence. The hypothesis of the research was not confirmed. In contrast, a co-movement of the two indicators can be observed in the long run (Fama, 1991). The study demonstrated precisely how the stock market indices of each E.U. member state and their GDP did not correlate with each other in the short run, in the year 2020, characterized by COVID-19.

The results of this study suggest that stock market investment decisions cannot be based on the short-term co-movement of the two indicators examined. The macroeconomic state that a stock market index and GDP of a national economy change synchronously can only be the work of chance. The study's empirical results also draw the attention of investors and economic policymakers to the fact that short-term changes in GDP should not in themselves influence the decision-making of these individuals. Short-term GDP data are fundamentally inadequate indicators. The previous finding shows that these data cannot predict with significant accuracy either expected GDP, stock market performance, and many other macroeconomic indicators.

References:

Arestis, P., Panicos, O.D., Kul, B.L. 2001. Financial Development and Economic Growth: The Role of Stock Markets. Journal of Money, Credit and Banking, 33(1), 16-41. doi: 10.2307/2673870.

Artl, J., Artlova, M., Rublíková, E. 2002. Analysis of economic time series with examples, /Analýza ekonomických casových rad s príklady/. Praha: Skripta VŠE. Retrieved from: https://nb.vse.cz/~arltova/vyuka/crsbir02.pdf.

Ashraf, B.N. 2020. Stock Markets' Reaction to COVID-19. January 2020SSRN Electronic Journal. DOI: 10.2139/ssrn.3585789.

Bell, C., Lewis, M. 2005. Economic Implications of Epidemics Old and New. World Bank. Retrieved from: https://ssrn.com/abstract=997387 or http://dx.doi.org/10.2139/ssrn.997387.

Burch, R.T., Douglas, R.E., Fuerst, E.M. 2016. Who Moves Markets in a Sudden Marketwide Crisis? Evidence from 9/11. Journal of Financial and Quantitative Analysis, 51(2), 463-487. DOI: https://doi.org/10.1017/S0022109016000211,F.

Congressional Research Service. 2021. Global Economic Effects of COVID-19, R46270. Congressional Research Service March 10, 1-145. Retrieved from: https://fas.org/sgp/crs/row/R46270.pdf.

Cuesta, J. 2010. How much of a threat to economic growth is a mature AIDS epidemic? Applied Economics, 42(24), 3077-3089. DOI: 10.1080/00036840801964849.

Dao, M.Q. 2014. Drivers of Economic Growth in Developing Countries. Journal for Studies in Economics and Econometrics, 38(1), 75-85. DOI: 10.1080/10800379.2014.12097264.

Deltuvaité, V., Sineviþiené, L. 2014. Research on the relationship between the structure of financial system and economic development. Paper presented 19th International Scientific Conference; Economics and Management 2014, ICEM 2014, 23-25, Riga, Latvia. doi: 10.1016/j.sbspro.2014.11.235.

Dimitri, N. 2015. The Economics of Epidemic Diseases. PLoS ONE, 10(9). DOI: 10.1371/journal.pone.0137964.

Enisan, A., Olufisayo, O., Akinho, O. 2009. Stock Market Development and Economic Growth: Evidence from Seven sub-Sahara African Countries. Journal of Economics and Business, 61, 162-171. https://doi.org/10.1016/j.jeconbus.2008.05.001.

Estrada, M.A.R., Koutronas, E., Lee, M. 2020. Stagspression: The Economic and Financial Impact of COVID-19 Pandemic. DOI: 10.2139/ssrn.3578436.

European Commission. 2020. European Business Cycle Indicators. 3rd Quarter 2020, Technical Paper 043. Retrieved from: https://ec.europa.eu/info/sites/info/files/economy-finance/tp043_en.pdf.

Eurostat. 2021. News release euro indicators. Retrieved from: https://ec.europa.eu/eurostat/documents/portlet_file_entry/2995521/2-16022021-AP-EN.pdf/eb164095-6de4-a6a1-cd87-60c4a645e5e1.

Fama, F.E. 1991. Efficient Capital Markets II. Journal of Finance, 1575-1617. Retrieved from: https://doi.org/10.1111/j.1540-6261.1991.tb04636.x.

Focardi, M.S., Fabozzi, J.F. 2014. Can We Predict Stock Market Crashes? The Journal of Portfolio Management, 40(5), 183-195. DOI: 10.3905/jpm.2014.40.5.183.

Folkinshteyn, D., Meric, G., Meric, I. 2015. Investor Reaction in Stock Market Crashes and Post-Crash Market Reversals. The International Journal of Business and Finance Research, 9(5), 57-70.

Fufa, T., Kim, J. 2018. Stock markets, banks, and economic growth: Evidence from more homogeneus panels. Research in International Business and Finance, 44, 504-517. DOI: 10.1016/j.ribaf.2017.07.120.

Grima, S., Dalli Gonzi, R., Thalassinos, I.E. 2020. The Impact of COVID-19 on Malta and its Economy and Sustainable Strategies. Available at SSRN: https://ssrn.com/abstract=3644833

Guilford, J.P. 1953. The Correlation of an Item With a Composite of the Remaining Items in a Test. Educational and Psychological Measurement,87-93. https://doi.org/10.1177/001316445301300109.

Hassan, A., Tahat, Y. 2020. Stock Market Returns and COVID-19 Outbreak: Evidence from the U.K. Retrieved from: https://www.researchgate.net/publication/340926380_Stock_Market_Returns_and _COVID19_Outbreak_Evidence_from_the_UK/references.

Hou, H., Cheng, S.Y. 2010. The Roles of Stock Market in the Finance-Growth, Nexus: Time Series Cointegration and Causality Evidence from Taiwan. Applied, Financial Economics, 20(12), 975-981, https://doi.org/10.1080/09603101003724331.

Hsu, C.J. 2004. Cap-Weighted Portfolios are Sub-Optimal Portfolios. December 2004SSRN Electronic Journal, 4(3). DOI: 10.2139/ssrn.647001. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=647001.

Investing.com. 2021. FTSEurofirst 300 (FTEU3). Retrieved from: https://www.investing.com/indices/ftse-eurotop-300.

Hiroshi, I., Hideaki, A., Yoshi, F., Wataru, S., Vodenska, I., Hiroshi, Y. 2020. Relationship between Macroeconomic Indicators and Economic Cycles in U.S. Scientific Reports, 10, 8420. https://doi.org/10.1038/s41598-020-65002-3.

Jonung, L., Röger, W. 2006. The Macroeconomic Effects of a Pandemic in Europe - A Model-Based Assessment. Electronic Journal. DOI: 10.2139/ssrn.920851.

Laopodis, T.N., Papastamou, A. 2016. Dynamic interactions between stock markets and the real economy: Evidence from emerging markets. International Journal of Emerging Markets, 11(4), 715-746. DOI: 10.1108/IJoEM-12-2015-0253.

Khan, S., Rabbani, R.M., Thalassinos, I.E., Atif, M. 2020. Corona virus pandemic paving ways to next generation of learning and teaching: Futuristic cloud based educational model. Retrieved from: SSRN 3669832.

Levine, R., Zervos, S. 1996. Stock Market Development and Long-run Growth. World Bank Economic Review, 10, 323-339. https://doi.org/10.1093/wber/10.2.323.

Marketwatch. 2021. Investing index. Retrieved from: https://www.marketwatch.com/investing/index/dax?countrycode=dx.

Mckibbin, W., Roshem, F. 2020. The economic impact of COVID-19, March 2020. In: Baldwin, R., Werder di Mauro, B., Economics in the Time of COVID-19. Publisher: Centre for Economic Policy Research, Project: Global Macroeconomic Impacts of COVID-19. Warwick Mckibbin's Lab, 45-53.

Ozili, K.P., Arun, T. 2020. Spillover of COVID-19: Impact on the Global Economy. March 2020SSRN Electronic Journal. DOI: 10.2139/ssrn.3562570.

Pyemo, N.A. 2017. Effects of changes in stock index compositions: A literature survey. International Review of Financial Analysis, 52. DOI: 10.1016/j.irfa.2017.06.004.

Rousseau, L.P., Sheng, X. 2007. Banks, Stock Markets and China's Great Leap. Forward. Emerging Markets Review, 8, 206-217. https://doi.org/10.1016/j.ememar.2007.05.002.

Sfakianakis, G., Magoutas A.I., Georgopoulos, D. 2010. An Empirical Analysis of Differences in GDP per Capita and the Role of Human Capital. Industry and Higher Education, 24(2), 101-107. DOI: 10.5367/000000010791191047.

Shing, Y., Wenjen, H. 2011. Impacts of Macroeconomic Variables on the U.S. Stock Market Index and Policy Implications. Economics Bulletin, 31, 883-892.

Siu, A., Wong, R.Y.C. 2004. Economic Impact of SARS: The Case of Hong Kong. Asian Economic Papers, 3(1), 62-83. https://doi.org/10.1162/1535351041747996WEF.

Srinivas, N., Washer, M.K. 2004. SARS: A Non-event for Affected Countries' Stock Markets? Applied Financial Economics, 14(15), 1105-1110. https://doi.org/10.1080/0960310042000310579.

Syrquin, M. 2011. GDP as a Measure of Economic Welfare. SSRN Electronic Journal. DOI: 10.2139/ssrn.1808685.

Thalassinos, E., Thalassinos, Y. 2018. How to Avoid Financial Crises. In: Al-Sharhan S. et al. (eds) Challenges and Opportunities in the Digital Era. I3E 2018. Lecture Notes in Computer Science, vol 11195. Springer, Cham. https://doi.org/10.1007/978-3-030-02131-3_21.

Török, L. 2020. Rise of Public Debt in E.U. Countries Dueto the Coronavirus Post-recovery, Public Debt Rates along with Different Recession Scenarios. Public Finance Quarterly, 3, 348-361. DOI: https://doi.org/10.35551/PFQ_2020_3_2.

Tradingeconomics. 2021a. Belgium Stock-market. Retrieved from: https://tradingeconomics.com/belgium/stock.

Tradingeconomics. 2021b. Estonia GDP Growth Rate, Retrieved from: https://tradingeconomics.com/estonia/gdp-growth.

Urbankova, E., Krizek, D. 2020. Homogeneity of Determinants in the Financial Sector and Investment in E.U. Countries. Economies, 8(1), 14. https://doi.org/10.3390/economies8010014.

Wren-Lexwis, S. 2020. The economic effects of a pandemic. In Economics in the Time of COVID-19. London, UK: CEPR Press, 109-113. Retrieved from: https://voxeu.org/content/economics-time-covid-19.