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Comparative Assessment the Development of Stock Market in the UK and Germany in the Face of New Challenges the COVID-19 Pandemic

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Abstract: *The accumulation and redistribution of financial resources is one of the conditions for the efficiency of economic activity, economic development, and the successful functioning of all sectors of the economy. Among the main instruments for such accumulation and redistribution, one can use stock market instruments or instruments of the banking sector of the economy. We settled on stock market instruments. However, in order to effectively manage financial resources, it is necessary to carry out a comprehensive analysis of the data that we have. This is especially important when there are global transformations of the economy under the influence of various factors of influence. One such factor is the development of the COVID-19 pandemic. The COVID-19 pandemic affects all areas of economic life, including the sphere of financial resource management. For the corresponding analysis, we have chosen the methodology of wavelet analysis. We applied the wavelet coherence estimation method for data analysis. The paper considers real data and real estimates for the analysis of the stock markets of the UK and Germany in the context of the development of the COVID-19 pandemic. Various graphs and diagrams are presented to understand the processes that are being investigated.*

Keywords—stock market; comparative evaluation; stock indices; wavelet analysis; wavelet coherence, COVID-19 pandemic.

1. INTRODUCTION

Financial resources are one of the key elements of economic development. This is due to the fact that financial resources can be transformed into any resources. At the same time, this can be done in short time intervals. Therefore, any issues related to the analysis of financial resources are relevant and important [1], [2].

There are two main models that consider the issues of accumulation and transformation of financial resources. The first model explores the issues of transformation of financial resources based on the functioning of the stock market [3]. The second model explores the issues of transformation of financial resources through the banking sector of the economy [4]. These models are competitive and their use is determined by the factor conditions of economic development for each country.

Nevertheless, in our opinion, special attention should be paid to the stock market as a source of formation and transformation of financial resources. Such attention to the stock market is due to the fact that new investment instruments are emerging, the cryptocurrency market and blockchain technology are developing [5]-[7]. It should also be noted that the stock market and the banking sector of the economy are closely interconnected [8]. Thus, all this increases interest in the stock market as an object of study. At the same time, for such a study, it is advisable to consider various stock indices that reflect the dynamics of changes in prices for financial resources, the possibility of attracting them.

It should also be noted that the importance of considering any economic issues is enhanced in a period of global change. Such changes concern all spheres of economic activity, including the sphere of formation and transformation of financial resources. An example of the global changes that are currently taking place is the COVID-19 pandemic [9]-[11]. The COVID-19 pandemic has had a significant impact on the transformation of financial markets and economic activity. Thus, the research topic chosen in this paper is relevant and has both theoretical and applied significance.

2. BRIEF OVERVIEW OF PUBLICATIONS RELATED TO THE RESEARCH TOPIC

The relevance and importance of the chosen research topic is confirmed by a large number of articles. These articles, on the one hand, deal with a direct analysis of the stock markets of individual countries. On the other hand, various authors also consider the development of stock markets in a comparative aspect. Much attention is also paid to the impact of the COVID-19 pandemic on the development of stock markets.

For example, D. Shah, H. Isah and F Zulkernine, in their study, consider various stock market forecasting tools [12]. The paper presents an overview of stock markets and a classification of forecasting methods. The authors note that various methods and approaches can be chosen for the purposes of forecasting. However, it is important to specify the

forecast horizon. The authors note that in the short term, the stock market behaves like a voting machine [12]. In the long term, it acts like a weighing machine, and therefore it is possible to predict market movements over a longer period of time [12].

K. Pahwa and N. Agarwal consider the possibility of stock market analysis based on supervised machine learning [13]. The authors note that the stock market is one of the most complex objects of study. Therefore, it is necessary to consider the possibility of using different approaches to analyze the stock market. At the same time, the authors pay special attention to machine learning algorithms for predicting the future stock price using open source libraries and existing algorithms [13]. Such an approach, according to the authors, will make the unpredictable format of the stock market more predictable [13].

S. Baek, S. K. Mohanty and M. Glambosky consider the relationship between the developments of the stock market in the context of the COVID-19 pandemic [14]. At the same time, such an analysis was made for various sectors of the US economy. For this, the authors use AR models with Markov switching. At the same time, using machine learning function selection methods, economic indicators are selected that best explain changes in volatility [14]. The authors also showed that both negative and positive information about COVID-19 is important for the development of the stock market [14]. In particular, the paper notes that changes in volatility are more sensitive to news about COVID-19 than to economic indicators [14].

The study [15] presents a comparative analysis of the efficiency of the functioning of stock markets in various countries. The paper analyzes the stock markets of developed, developing countries of the BRICS and Islamic countries. For such a study, the authors use multifractal analysis of fluctuations without a trend (MF-DFA). This approach allows for a comprehensive comparative analysis.

S. Størdal, G. Lien, Ø. Mydland and. Haugom E conduct a comparative analysis of the stock market returns in Norway and Sweden [16]. At the same time, such an analysis was carried out for the initial stages of the development of the COVID-19 pandemic. The paper shows that the impact of the COVID-19 pandemic has weakened the positive impact on stock market returns in the context of non-pharmaceutical intervention. For research, the capital asset pricing model (CAPM) was used.

The article [17] presents a comparative analysis of the functioning of the stock market in China and Pakistan in the context of the development of the COVID-19 pandemic. First of all, the authors note that the COVID-19 pandemic has disrupted the financial and economic permanence of the globe. The paper considers the non-linear behavior of Chinese and Pakistani stock markets such as the Shanghai Composite Index (SSEC) and the Karachi Stock Exchange (KSE-100 index) [17]. For the analysis, the VAR-DCC-MEGARCH model was used to determine the transfer of income and the pattern of the spread of volatility in these markets in the era of the standard and COVID-19 [17]. The study found that the spread of volatility between the KSE-100 index and the SSEC was negligible during stable periods [17]. Volatility spillover statistics during the pandemic era have confirmed that volatility in the SSEC significantly increases the uncertainty of the KSE-100 index [17].

The study [18] examines the impact of the COVID-19 pandemic on the stability of stock and commodity markets in South Asia. To conduct the study, the authors use the usual Welch test, heteroscedastic independent t-test and multivariate GMM analysis. At the same time, the profitability of stocks, gold prices and oil prices is considered. The paper notes that sometimes the impact of the COVID-19 pandemic on the stability of stock and commodity markets is contradictory [18]. It was also noted that the impact on stock market performance was short-lived and decreased during the second wave of the spread of COVID-19 [18].

The article [19] discusses various artificial neural networks that are used to analyze the stock market. The authors chose the stock market of India as the object of research. The article considers four models of neural networks (feed forward neural network, generalized regression neural network, radial basis neural network and exact radial basis neural network) [19]. The results show that the best model for predicting the stock market is a neural network model with a radial basis [19].

S. Y. Choi examines the efficiency of the US stock market [20]. This study analyzes stock market data during the development of the financial crisis and during the development of the COVID-19 pandemic. For such an analysis, a multifractal analysis of fluctuations without a trend to a series of average returns is applied to the initial data. The paper also explores the efficiency and multifractality of individual sectors of the economy during the global financial crisis (GFC) in order to analyze the features of the COVID-19 pandemic [20].

Z. Li, P. Farmanesh, D. Kirikkaleli and R. Itani in their study analyze the impact of the COVID-19 pandemic on the development of the economy as a whole, in comparison with the impact of global financial crises on the functioning of the economy [21]. This allows us to give an objective assessment of the impact of the COVID-19 pandemic on the development of the stock market.

Thus, we can say that various methods and approaches are used to study the stock market. At the same time, among such analysis tools, a method for estimating wavelet coherence is singled out [22]-[25].

It should also be noted that an important aspect of stock market research is a comparative analysis. Such an analysis is carried out in comparison between individual countries and in comparison with the factors influencing the development of the stock market. One such factor that has been particularly highlighted recently is the development of the COVID-19 pandemic.

3. WAVELET COHERENCE AS A TOOL FOR COMPARATIVE ANALYSIS

Wavelet coherence is one of the tools for comparative analysis. Wavelet coherence allows for mutual analysis of two time series ($g(t), z(t)$) [26]-[28]. With the help of wavelet coherence, it is possible to identify periods of greatest and least influence between the data series that are being analyzed. To implement the wavelet coherence method, the following expression is used [29], [30]:

$$R^2(a,b) = \frac{\left|\Theta(a^{-1}V_{g(t)z(t)}(a,b))\right|^2}{\Theta(a^{-1}\left|V_{g(t)}(a,b)\right|^2)\Theta(a^{-1}\left|V_{z(t)}(a,b)\right|^2)},$$

where:

$V(a,b)$ – is a values of cross wavelet spectra;

a, b – is a scale and center of time localization, that determine the scale of the wavelet transform;

$g(t), z(t)$ – is a data series that we explore;

Θ – is a smoothing operator;

$R^2(a,b)$ – is a squared wavelet coherency coefficient. $0 \le R^2(a,b) \le 1$. If these values tend to zero, then we have a weak correlation. Otherwise, we have a strong correlation.

4. INITIAL DATA AND THEIR BRIEF ANALYSIS

In this study, we will consider some aspects of the development of the UK and Germany stock markets in the face of the new challenges of the COVID-19 pandemic. For this analysis, we will look at the relevant data for 2021. In other words, we consider the time period from 01.01.2021 to 31.12.2021. All data is taken from official sources:

www.worldometers.info/coronavirus/,

github.com/datasets/covid-19,

datahub.io/core/covid-19,

investing.com.

We look at the overall dynamics of COVID-19 cases, the dynamics of COVID-19 diseases in the UK, in Germany, as well as the dynamics of the main UK (FTSE) and Germany (STOXX50E, GDAXI) stock indices.

On fig. 1 shows the trend in total infections per day worldwide during the COVID-19 pandemic from 01.01.2021 to 31.12.2021.

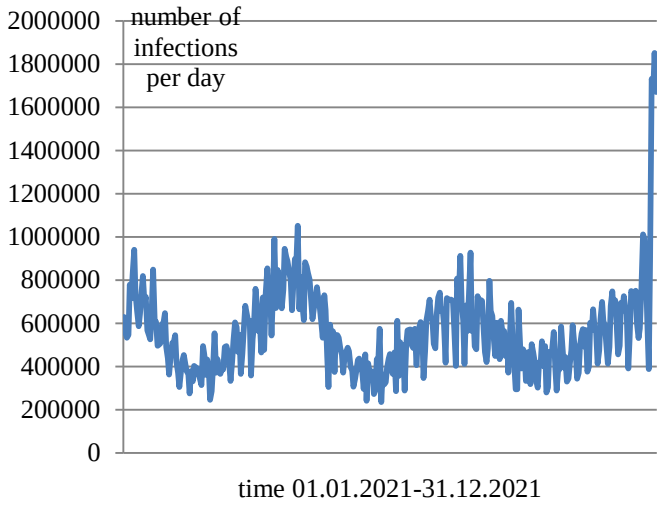

Figure 1: Trends in total infections per day worldwide during the COVID-19 pandemic (selected time period)

On fig. 2 shows the evolution of infections per day in the UK during the COVID-19 pandemic from 01.01.2021 to 31.12.2021.

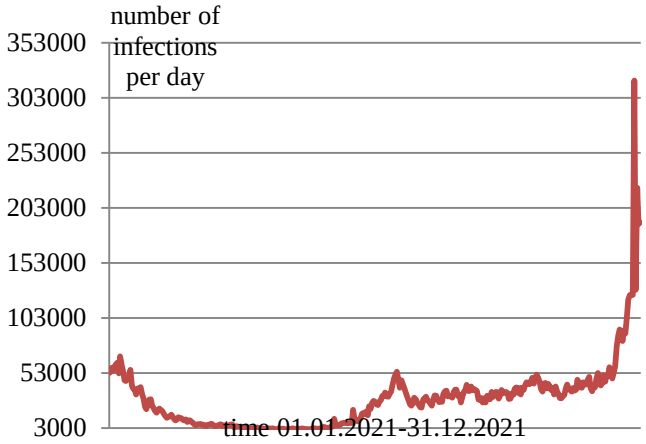

Figure 2: Evolution of infections per day in the UK during the COVID-19 pandemic (selected time period)

On fig. 3 shows the evolution of infections per day in the Germany during the COVID-19 pandemic from 01.01.2021 to 31.12.2021.

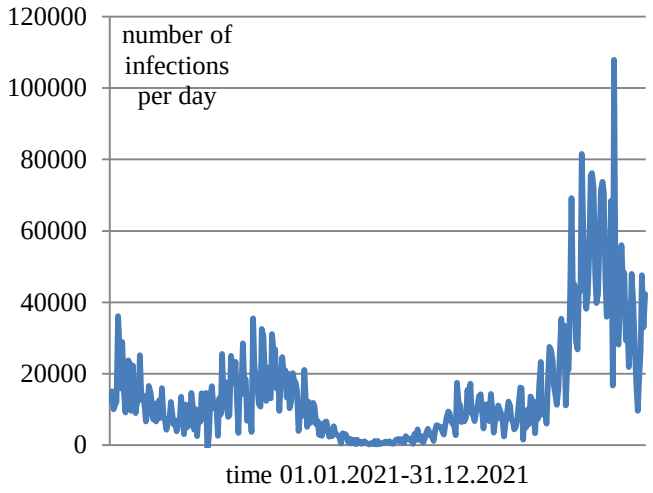

Figure 3: Evolution of infections per day in the Germany during the COVID-19 pandemic (selected time period)

We can see that the dynamics of the number of infections per day is different both in terms of global trends and for each country individually.

On fig. 4 shows the dynamics of the FTSE stock index.

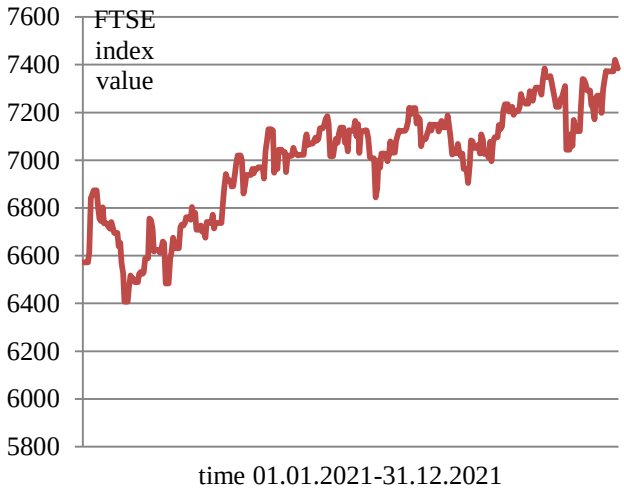

Figure 4: Dynamics of the FTSE stock index

On fig. 5 shows the dynamics of the STOXX50E stock index.

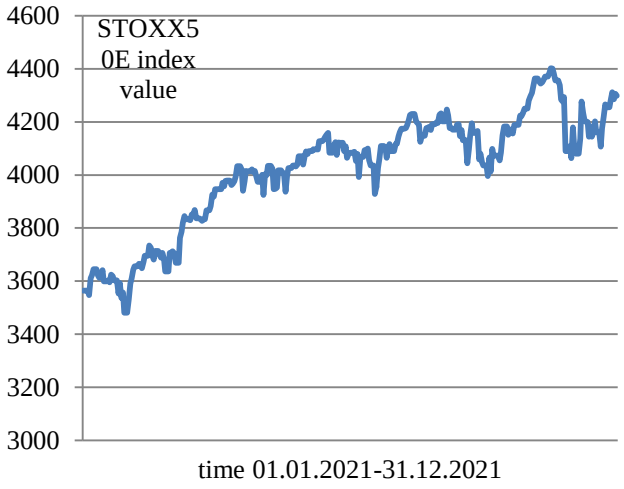

Figure 5: Dynamics of the STOXX50E stock index

On fig. 6 shows the dynamics of the GDAXI stock index.

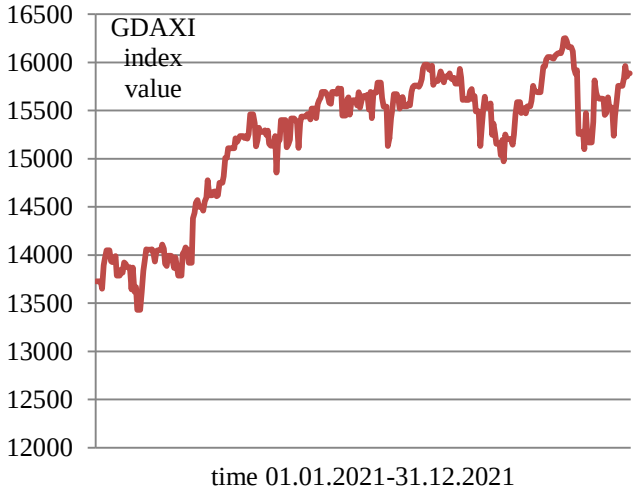

Figure 6: Dynamics of the GDAXI stock index

We can see that the dynamics of the values of the stock indices that we are considering is approximately the same. At the same time, it should be noted that such dynamics also have differences. This is different amplitude of changes in the values of the indicators that we analyze. Also different are the intervals of fluctuations in the values of stock indices, the length of such intervals. All this indicates the expediency of using wavelet coherence for a more detailed analysis.

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5. DATA FROM ANALYSIS BASED ON WAVELET COHERENCE

First of all, let's consider the relationship between the overall dynamics of the number of diseases per day and the dynamics of the values of the corresponding stock indices. Then we will consider the relationship between the dynamics of the number of diseases per day and the dynamics of the values of the corresponding stock indices of each country separately. This sequence allows us to take into account different factor conditions of the impact of the COVID-19 pandemic on the dynamics of stock indices. At the same time, we will take into account the fact that the UK and Germany stock indices are the most famous and influential global stock market indices.

On fig. 7 shows estimates of the wavelet coherence between the overall dynamics of the number of COVID-19 infections and the FTSE stock index.

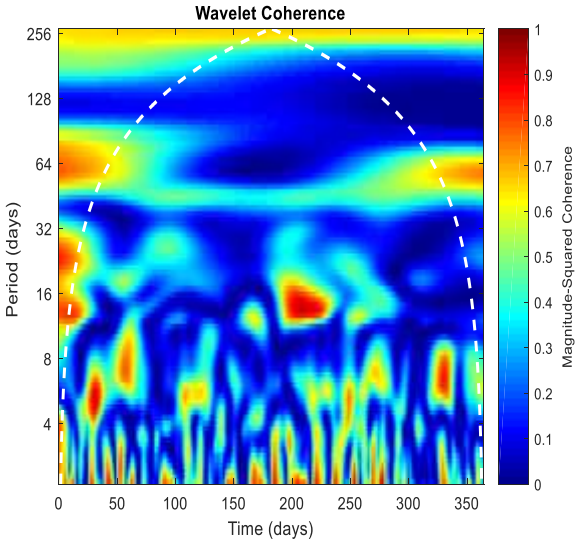

Figure 7: Estimates of wavelet coherence between the overall dynamics of the number of COVID-19 infections and the FTSE stock index

We can observe a general fragmentation of high wavelet coherence between the overall dynamics of the number of COVID-19 infections and the FTSE stock index. Moreover, such fragmentation is highly sparse. At the same time, it should be noted that in the medium term, the mutual influence between the overall dynamics of the number of COVID-19 infections and the FTSE stock index is increasing, but fragmentation is also increasing.

On fig. 8 shows estimates of the wavelet coherence between the overall dynamics of the number of COVID-19 infections and the STOXX50E stock index.

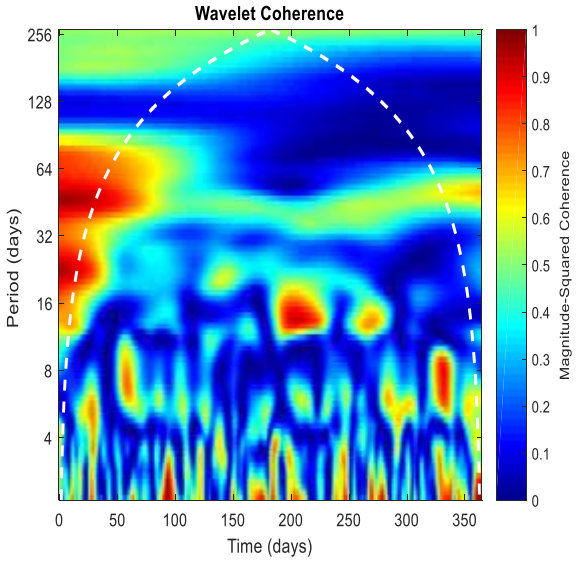

Figure 8: Estimates of wavelet coherence between the overall dynamics of the number of COVID-19 infections and the STOXX50E stock index

On fig. 9 shows estimates of the wavelet coherence between the overall dynamics of the number of COVID-19 infections and the GDAXI stock index.

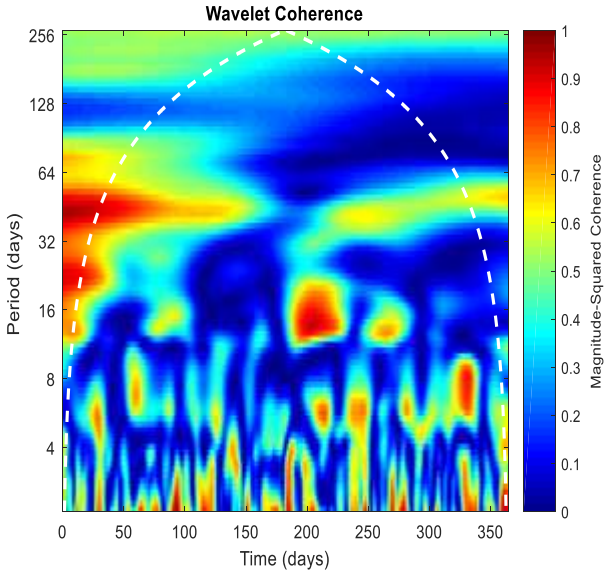

Figure 9: Estimates of wavelet coherence between the overall dynamics of the number of COVID-19 infections and the GDAXI stock index

We see that the wavelet coherence estimate in fig. 7 – fig. 9 is about the same. At the same time, it should be noted that the fragmentation in fig. 8 and fig. 9 differs from the fragmentation in fig. 7. These changes relate to the density of

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such fragmentation, its temporal duration and variability in the medium and long term.

On fig. 10 shows estimates of wavelet coherence between the total number of COVID-19 infections in the UK and the FTSE stock index.

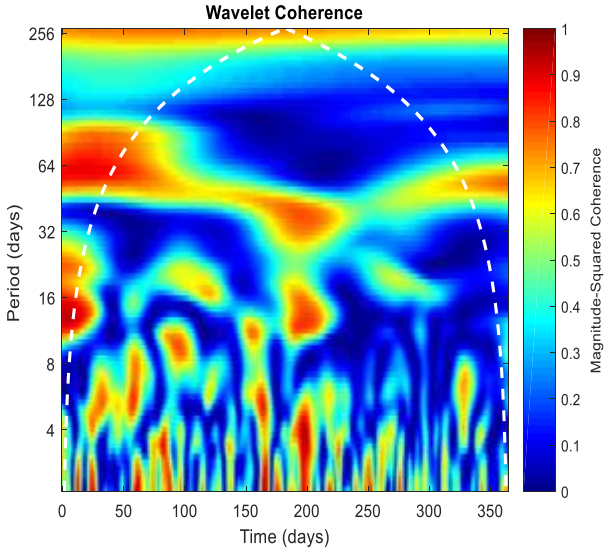

Figure 10: Estimates of wavelet coherence between total COVID-19 infections in the UK and the FTSE stock index

On fig. 11 shows estimates of the wavelet coherence between the total number of COVID-19 infections in Germany and the STOXX50E stock index.

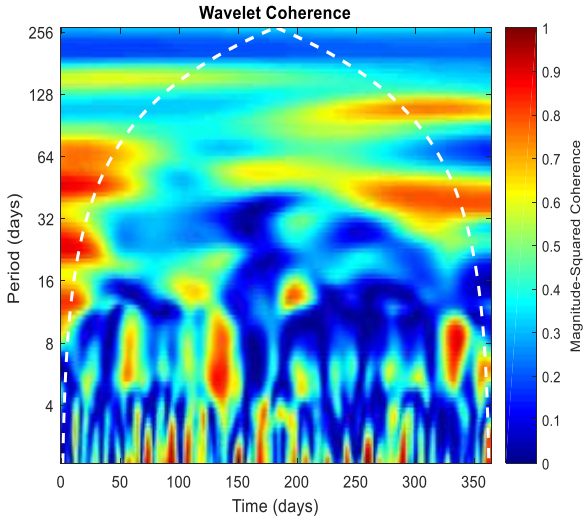

Figure 11: Estimates of wavelet coherence between the total number of COVID-19 infections in Germany and the STOXX50E stock index

On fig. 12 shows estimates of the wavelet coherence between the total number of COVID-19 infections in Germany and the GDAXI stock index.

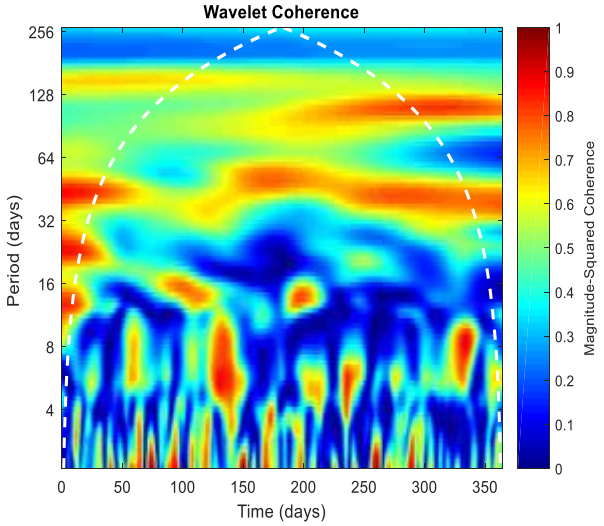

Figure 12: Estimates of wavelet coherence between the total number of COVID-19 infections in Germany and the GDAXI stock index

We see that the fragmentation of the high wavelet coherence between the dynamics of the number of COVID-19 infections and the corresponding stock indices for fig. 10 – fig. 12 is denser than for fig. 7 – fig. 9. This is explained by the fact that in fig. 10 – fig. 12 takes into account the dynamics of infections for each country separately. At the same time, in fig. 7 – fig. 9 examines the overall dynamics of infections worldwide. However, we can see roughly the same trends. This indicates the possibility of using wavelet coherence to analyze the impact of the COVID-19 pandemic on the dynamics of stock indices. At the same time, our results confirm the results of studies by other authors that the degree of impact of the COVID-19 pandemic decreases over time (see part: Brief overview of publications related to the research topic).

6. Conclusion

The paper considers the main directions for conducting a comparative assessment of the development of stock indices in different countries. The importance of conducting such an analysis in the context of global changes is emphasized. Among such changes, which are characteristic of the present, is the development of the COVID-19 pandemic.

To carry out the corresponding analysis, an estimation method based on wavelet coherence was chosen. The results of calculations for real data are presented on the example of such countries as the UK and Germany.

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