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Dynamics of the relationship between the main stock indices in the context of changes in external factors

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Abstract:

Economic development presupposes the sustainable functioning of all structural elements, among which due attention is given to the stock market. This market allows us to understand the dynamics of the supply/demand relationship, redistribute resources between various business entities, and act as a platform for investment. To implement such tasks, an analysis of the dynamics of quotes for the corresponding shares or their group, which make up various stock indices, is used. Based on this, the work analyzed the dynamics of quotes for the main stock indices. For these purposes, the features of each of the considered indices are considered separately. The paper also provides an assessment of the mutual dynamics for some pairs of major stock indices. This analysis is made on the basis of constructing estimates of wavelet coherence. This approach allows us to justify possible investment strategies and the timing of entry into the corresponding segment of the stock market. The results of the study are presented in the form of graphs and diagrams. This helps to understand the progress of the study and evaluate the results obtained.

Key words: Dynamics, Relationship, Quotes, Stock market, Stock indices, Statistical analysis, Wavelet analysis, Mutual analysis

Introduction

The stock market is one of the key elements of a market economy [1], [2]. Securities of various business entities are serviced and traded on the stock market. Thanks to the securities market, financial resources are redistributed and funds are invested in profitable sectors of the economy. Also, the stock market can be used for private investment by the population. At the same time, the dynamics of securities quotes can serve as an indicator of the supply/demand relationship. Thus, the stock market is a key structural element of market relations [3]-[6]. This determines the relevance of this work, its practical and theoretical significance. At the same time, the objectives of the research may be different and cover individual market segments.

The dynamics of prices in the stock market are constantly influenced by various factors [7], [8]. These can be both features of the functioning and development of individual sectors of the economy, and general factors. Among the general factors, various natural disasters, pandemics, and armed conflicts should be highlighted.

Therefore, the functioning of the stock market and the dynamics of securities quotes are in the constant field of view of researchers and practitioners. Such analysis helps to better understand market dynamics and develop the necessary strategies, justify the timing of entry into various market segments.

The basis of stock market analysis is quotations for securities that are in circulation on the market. At the same time, for analysis, one should consider the dynamics of various stock indices [9], [10], which are based on a certain set of different securities.

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This helps to better understand the functioning of individual areas of stock market development and the influence of external factors. For these purposes, both classical approaches to analyzing economic data [11]-[21] and non-traditional methods [22]-[34], which can reveal new directions in research, can be used.

Thus, the main goal of this work is to study the dynamics of the main stock indices. For these purposes, we review some related works and identify for research data. Next, the dynamics of stock indices are analyzed and their mutual dynamics are assessed.

Related work

Analysis of the dynamics of stock indices is constantly in the focus of attention of researchers. Therefore, you can find many different works on different topics.

For example, in a study by F. B. Duarte, J. A. Tenreiro Machado and G. Monteiro Duarte, issues of analyzing quotes for the Dow Jones and NASDAQ indices were considered [35]. The work, first of all, analyzes the dynamic properties of financial data series of world stock market indices. The authors use a variety of methods and approaches, starting with classical concepts of signal analysis, Fourier transform and fractional calculus methods. Next, the pseudophase plane approach is used. This allows you to conduct a comprehensive analysis of the data and better understand the dynamics of quotes and their trends.

The study by M. Madaleno and C. Pinho also analyzes indicators of the international stock market [36]. The authors consider a time-varying transmission model of price shocks. At the same time, stock market connections are also studied using continuous time wavelet methodology [36]. For these purposes, the work considers data for FTSE100, DJIA30, Nikkei225 and Bovespa. The consequences of the financial crisis are also taken into account. The results show that the relationship between the indices is strong, but not uniform in magnitude [36]. The authors emphasize that this is due to the fact that local phenomena are felt more strongly than others. The results also support the view that geographically and economically closer markets exhibit higher correlations and shorter-term interactions between them [36].

E. M. Bhuiyan and M. Chowdhury analyze the relationship between macroeconomic variables and stock market indices [37]. The authors consider asymmetric dynamics using the example of the USA and Canada. First, it examines how certain macroeconomic variables affect different sectors of the stock market in the United States and Canada. For these purposes, monthly data for the period 2000–2018 and cointegration analysis are used [37]. Thus, the relationship between industrial production, money supply, long-term interest rates and various industry indices is modeled. The result found that there is a stable long-term relationship between macroeconomic variables and industry indices for the United States. No such relationship has been established for Canadian data.

The study [38] examined the joint movement of stock indices for the Islamic and traditional markets. This analysis is carried out on several time scales. The authors also try to detect chain reactions during 9 major crises and measure integration between markets. The study uses wavelet decomposition to reveal the multihorizontal nature of data co-motion. The subprime crisis has been shown to exhibit contagion based on fundamental factors [38]. At the same time, Islamic markets show signs of reduced exposure to the recent crisis due to the low leverage effect [38].

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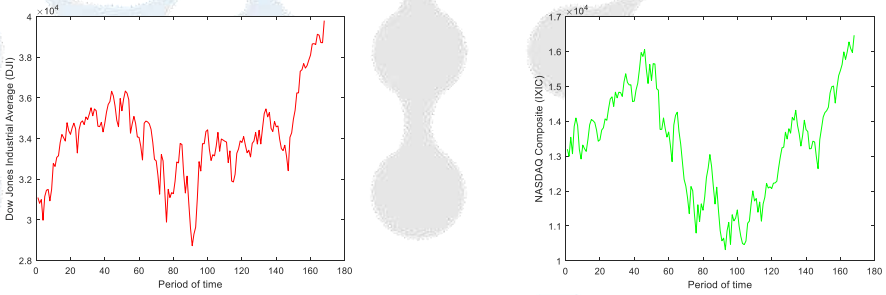
M. Youssef, K. Mokni and A. N. Ajmi explore the dynamic connectivity between stock markets during the COVID-19 pandemic [39]. For these purposes, various stock indices are considered. The study examined countries such as China, Italy, France, Germany, Spain, the USA and the UK. For the study, a VAR model (TVP-VAR) was used for daily data for the period from 01/01/2015 to 05/18/2020 [39]. It has been shown that stock markets were closely linked throughout the period, but dynamic spillovers reached unprecedented heights during the COVID-19 pandemic in the first quarter of 2020 [39]. These results have important implications for individual investors, portfolio managers, policymakers, investment banks and central banks.

Thus, the authors' research contains various aspects of analyzing the dynamics of the stock market. At the same time, various stock indices are considered as a reflection of such dynamics. The studies also contain different methods of analysis, evaluation and comparison. This helps to better understand the dynamics of the data under consideration, explore relationships and trends, and obtain the necessary information for decision-making.

Dynamics of the main stock indices as a reflection of the functioning of the stock market

This section will examine the dynamics of individual major stock indices that reflect the development of the global stock market. All data for analysis was taken from investing.com. The period from January 2021 to mid-March 2024 was considered in weekly averaging of such indices. In Fig. 1 presents data for the Dow Jones Industrial Average (DJI) and NASDAQ Composite (IXIC) stock indices.



a) Dow Jones Industrial Average (DJI) b) NASDAQ Composite (IXIC)

Figure 1: Dynamics of the Dow Jones Industrial Average (DJI) and NASDAQ Composite (IXIC) indices

In Fig. 2 shows the dynamics of quotes for DAX (GDAXI) and CAC 40 (FCHI).

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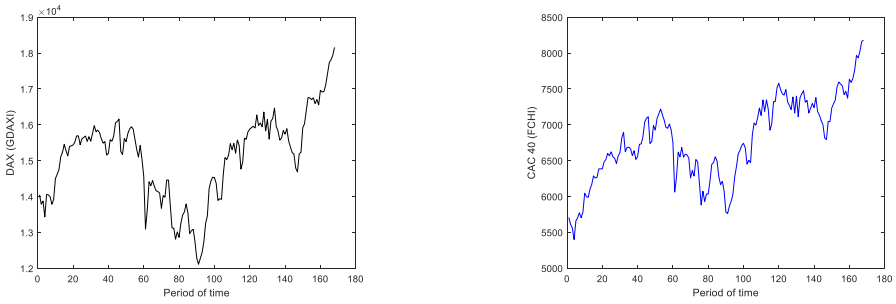

a) DAX (GDAXI) b) CAC 40 (FCHI)

Figure 2: Dynamics of the DAX (GDAXI) and CAC 40 (FCHI) indices

Shown in Fig. 1 and Fig. 2 data dynamics have some similarities. First of all, this is a drop in quotes in the middle of the period under study. Also characteristic is the rapid growth of the corresponding indices at the end of the period under study. All this suggests that such indices were influenced by the same factors. And this despite the fact that in Fig. 1 shows the dynamics of North American indices, and Fig. 2 – dynamics of some European indices.

The presented dynamics are also evidence of the close relationship between the stock markets of these regions and their economies, respectively.

At the same time, shown in Fig. 1 and fig. 2 the dynamics of quotes for the Dow Jones Industrial Average (DJI), NASDAQ Composite (IXIC), DAX (GDAXI) and CAC 40 (FCHI) indices differ in specific details. These details highlight the regional characteristics of such indices.

For example, there are different trends in changes in indices in the first half of the period under study until the quotes decline. The dynamics of the corresponding decrease in quotations for indices are also different. Moreover, in each specific case such dynamics are individual. Subsequent growth in index dynamics is also individual. At the same time, we see that the corresponding indices have different absolute values of such quotes.

Thus, against the background of relatively identical dynamics of the stock indices under consideration, their individual characteristics should be noted. This makes it advisable to conduct a comparative analysis to establish estimates of their mutual dynamics. This will allow us to better understand the influence of such dynamics of external factors or the manifestation of internal features of the formation of quotes for indices.

In Fig. 3 shows the dynamics of quotes for Nikkei 225 (N225) and BIST 100 (XU100).

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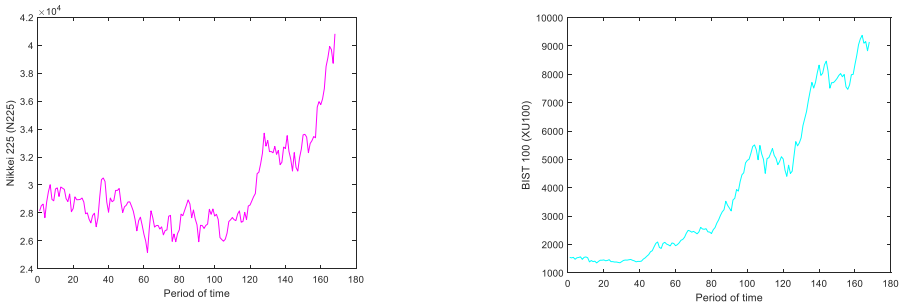

a) Nikkei 225 (N225) b) BIST 100 (XU100)

Figure 3: Dynamics of quotes for Nikkei 225 (N225) and BIST 100 (XU100)

First of all, it should be noted that the data in Fig. 3 display the dynamics of indices for stock markets of individual Asian regions. And such dynamics differ significantly from the data in Fig. 1 and Fig. 2.

In general, the dynamics of Nikkei 225 (N225) and BIST 100 (XU100) quotes is increasing throughout the entire time interval under study. At the same time, at the beginning of the period under study, a period of relative stability of such quotations can be identified. However, the Nikkei 225 (N225) at this point in time is characterized by significant variability in index values. At the same time, for BIST 100 (XU100) such variability is insignificant.

In the last third of the period under study, there is a significant increase in quotations, which is also typical for the data in Fig. 1 and Fig. 2. Here we can also identify different trends in the dynamics of the data under study. These trends highlight the regional characteristics of the functioning of individual markets. However, in this regard, we also note the influence of the same external factors.

As with previous cases of analyzing the dynamics of stock indices, it is interesting to study their mutual dynamics. This will allow us to understand the general trends in the functioning of stock markets and their interrelationships in the Asian region.

Thus, a significant addition to the study of stock index quotes is the study and analysis of their mutual dynamics. This will help not only to better understand the influence of external factors on the dynamics of quotes, but to study the dynamics of such markets and be the basis for developing investment strategies and strategies for entering a certain market segment.

Comparative assessment of the mutual dynamics of the studied data

In this case, the wavelet methodology was chosen as the basis for considering a comparative assessment of the mutual dynamics of data. This methodology emphasizes the assessment of wavelet coherence [40]-[42]. This assessment applies to data that is presented as a time series.

Wavelet coherence estimation has found wide application in the study of similar data [43]-[47]. This allows us to consider significant relationships between data, both over the entire research interval and at its individual intervals. At the same time, the depth of the corresponding

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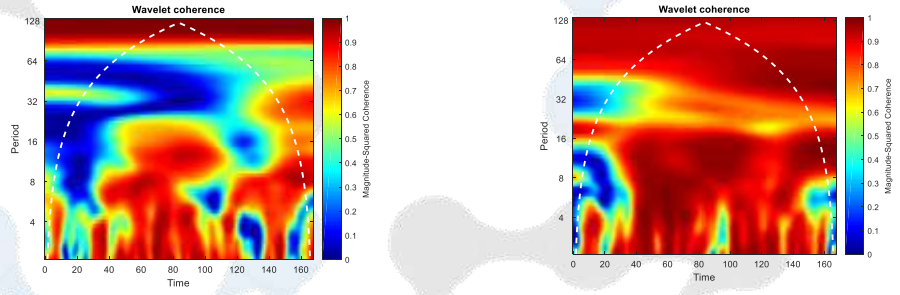
connections is also explored. This is important for developing market entry strategies and investment strategies.

First of all, let's consider estimates of the mutual dynamics of data for Fig. 1 – Fig. 3. Separately, one example will also be given to assess the dynamics of stock indices for different regions.

In Fig. 4 presents an assessment of wavelet coherence for data from the North America region (Fig. 1) and Europe (Fig. 2).

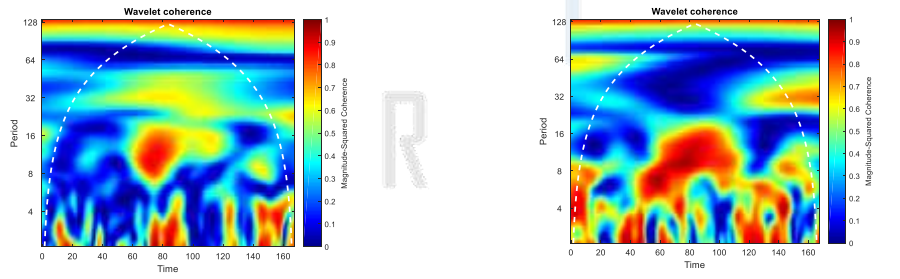
Data Fig. 4 confirm preliminary estimates of the relationship between the data for Fig. 1 and Fig. 2. This also confirms the influence of identical factors on the quotes of the corresponding stock indices. It is clear that for the European market the corresponding relationship is stronger. It is also worth noting the depth of such connections. This allows us to talk about the possibility of planning investment strategies and the timing of entering a certain segment of the stock market.



a) for the data Fig. 1 b) for the data Fig. 2

Figure 4: Wavelet coherence estimates for individual data

In Fig. 5 presents wavelet coherence estimates for individual indices of the Asian region (data from Fig. 3) and Nikkei 225 (N225)/DAX (GDAXI), respectively.



a) for the data Fig. 3 b) Nikkei 225 (N225)/DAX (GDAXI)

Figure 5: Wavelet coherence estimates for selected indices of the Asian region and Nikkei 225 (N225)/DAX (GDAXI)

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Data Fig. 5 show fragmentary consistency. This is explained by the remoteness of the markets whose stock indices are being considered. However, this also allows you to plan your entry into the stock markets and develop appropriate strategies.

Conclusion

The paper examines various issues in the study of the dynamics of major stock indices. Based on the study of literary sources, appropriate indices and a tool for their analysis were selected.

A descriptive analysis of the comparative dynamics of stock indices allows us to talk about the impact of identical factors of influence within the same regions of the functioning of stock markets.

To assess the mutual dynamics of quotes by indices, we use the wavelet methodology. Wavelet coherence estimates allow us to confirm the influence of identical factors on the dynamics of index values. This allows you to justify investment strategies and the timing of entering the stock market.

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