

# Comparative Analysis of the Dynamics of Futures for the Dow Jones, S&P 500 and Nasdaq

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**Abstract:** *The stock market plays an important role in the functioning of individual business entities and the development of the financial market as a whole. To understand such dynamics, an important aspect is to study quotes for futures, indices and stocks. Based on this, the paper examines various aspects of conducting a comparative analysis of data on futures for the Dow Jones, S&P 500 and Nasdaq indices. We consider simple aspects of statistical analysis, as well as the mutual dynamics of such indicators. For these purposes, the methodology for estimating wavelet coherence is used. The paper presents graphical estimates of such characteristics. This helps to understand the results obtained.*

**Keywords—analysis; dynamics; quotes; futures; indexes; wavelet analysis**

## 1. INTRODUCTION

The financial sector of the economy provides the necessary flow of funds for the functioning of various economic agents. This is carried out on the basis of the key principles of the development of the financial market and its components. At the same time, in modern economic conditions, two areas of activity of such a market can be distinguished [1], [2]. On the one hand, this is the banking sector of the economy. On the other hand, this is the stock market. Another important aspect of the financial sector is the interaction between individual segments of the financial market.

However, in market economic conditions, the importance and role of the stock market cannot be underestimated. This element of economic relations allows you to attract the necessary resources, act as a coordinator of investment decisions, and hedge possible risks [3]-[5]. A reflection of the versatility of the stock market is its structure. This helps to understand the basis of its functioning and carry out analysis in various directions in order to provide the decisions made with the necessary products.

At the same time, effective interaction between individual segments of the stock exchange is the basis for promoting the decisions made and a source of attracting the necessary funds.

All of the above is achieved through the use of various instruments used by stock market participants. Here you can highlight various securities, their derivatives, indices and the like [6]-[8]. Generalized indicators characterizing the development of a certain segment of the securities market also play a significant role in such a list. Quotes and sales volumes are also important market indicators. These parameters allow you to assess the current state of the stock market, understand its development trends and make some forecast calculations.

Thus, one of the components of securities market research is to conduct a comprehensive analysis. This can be done based on standard methods and approaches [9]-[15], as well as using algorithms that have proven themselves in various fields of scientific knowledge [16]-[24]. Such a synthesis of various procedures provides the most profound understanding of the nature of what is being studied. New data can also be obtained that expand the boundaries of our understanding of the processes and phenomena that are being studied.

Based on the foregoing, the main goal of this work is to conduct a comparative analysis of the dynamics of futures for the Dow Jones, S&P 500 and Nasdaq indices.

## 2. RELATED WORKS

The study of the dynamics of various stock market indicators is constantly in the field of view of researchers, which is reflected in relevant publications. At the same time, issues are analyzed both for the securities market as a whole and for its individual segments.

For example, M. Chauvet and S. Potter conduct a comparative analysis of stock market indicators in their work [25]. The authors pay special attention to monthly fluctuations in the indicators of the market under study. The article also discusses the possibility of constructing a generalized financial parameter to assess the development of the securities market. This is very important for general analysis and studying investor sentiment. This market characteristic also helps predict future developments and changes in the financial sector of the economy.

D. Chun, H. Cho and D. Ryu consider issues of stock market volatility [26]. For these purposes, data from emerging economies is examined, various economic indicators and their impact on the stock market are examined. As a specific example, data for the South Korean market is selected. Model-based predictive regressions (VKOSPI) are used for analysis.

This made it possible to identify certain patterns, which is important for understanding the development of such a market. Attention is also paid to assessing the relevant market risk.

S. S. Chen compares macroeconomic variables with leading indicators of the securities market [27]. This allows you to build various forecasting procedures, in particular recession. For such an analysis, the article considers: interest rate spreads, inflation rate, money supply, aggregate output, unemployment rate, funds rates, debt and nominal exchange rates [27]. All data applies to the US market. The features of using the proposed approach are shown.

J. Fang, Qin and B. Jacobsen conduct a comparative review of various technical market indicators [28]. First of all, the authors summarize a number of indicators that are important for technical analysis. Such data includes: moving average prices, advance/decline lines, volatility, short-term trading indices. At the same time, the work also emphasizes the need for mutual analysis of such data. For forecasting, it is important to have several indicators, which reduces the prediction error.

S. Karagianni and C. Kyrtsov study the dynamics of the Dow Jones index [29]. This study is conducted in a comparative aspect with inflation in the United States. The authors note that, as a rule, relevant publications focus on studying the linear relationship between data. However, this causes certain difficulties in interpreting the results obtained. Based on this, the work examines the nonlinear relationship between the presented market characteristics. For these purposes, the authors use quantitative analysis of repeatability, a test for structural changes, and a test for nonlinear causality [29]. This allows you to get new results.

S. Chai and C. Guo study the relationship between stock indices and futures prices [30]. The authors examine five different stock indices. Thus, the article examines the presence of a long-term relationship between spot indices and futures prices. For these purposes, the error correction cointegration model (ECM) is used. This allows you to choose the necessary strategies for entering the stock market and achieve the necessary market equilibrium.

S. J. Shieh analyzes the long-term memory of data series in futures markets for stock indices [31]. For this purpose, the ARFIMA statistical model is used. The work shows that the chosen trading strategies, in most cases, have a positive effect on such data. This is especially true for the S&P 500 and Dow Jones indices.

M. Vogl and P. G. Roetzel study chaos and stochasticity in financial markets [32]. This is done by considering the dynamics of the return of the S&P 500 index. The study uses wavelet analysis methodology. In particular, the authors use wavelet filters. The authors also use the Lorentz system, spectral decomposition, and Lyapunov exponents. This approach allowed us to conclude that the prospects for financial forecasting are ambiguous. This encourages new research.

D. Lien, G. Lim, L. Yang, and C. Zhou examine the dynamic relationship between liquidity and base money in S&P 500 index futures [33]. In particular, the article examines the nonlinear relationship between the index futures and cash bases. This brings a new perspective on the possible magnitude of future profits, risk hedging and the effectiveness of such processes. Therefore, it is important to balance liquidity with the basis of index futures.

L. G. Alves, H. Y. Sigaki, M. Perc and H. V. Ribeiro reveal the collective dynamics of the stock market and its efficiency [34]. To do this, the authors use the concept of entropy. In particular, a sliding calculation of the entropy of the logarithmic return of stock market indices is carried out on the initial data. This makes it possible to classify such indices based on analysis of long-term performance. The authors also note that the efficiency of the market is largely determined by the dynamics of the totality of its various instruments.

C. Padungsaksawasdi examines the relationship between investments in gold and the stock market [35]. At the same time, the industry aspect of this issue is also explored. To study the set goals, the PVAR methodology with GMM estimation is used. The paper presents data from the Thai stock market.

S. Alshammari and H. Obeid analyze commodity futures and stock market indices [36]. The purpose of such research is to develop hedging strategies. To do this, the authors use an asymmetric dynamic conditional correlation model. The article also evaluates hedging strategies.

We see that various statistical methods and approaches are used for appropriate analysis. At the same time, an important aspect of such studies is the analysis of the mutual dynamics of data. The above works also use and discuss various stock market indicators.

### **3. THE DOW JONES, S&P 500 AND NASDAQ INDICES AND THEIR FUTURES AS AN OBJECT OF STUDY**

Stock indices are one of the key instruments in the market. This indicator determines the weighted price for a number of securities. The set of individual securities determines a certain stock index [37], [38]. At the same time, an important aspect of the analysis of such values is not its absolute value, but the dynamics of change.

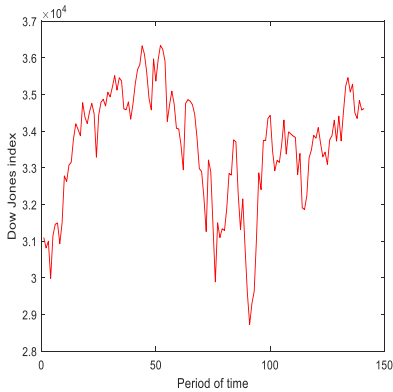
The most significant indices are:

Dow Jones – includes 30 of the largest US companies. It is intended to reflect the development of the industrial component of the American stock markets [39];

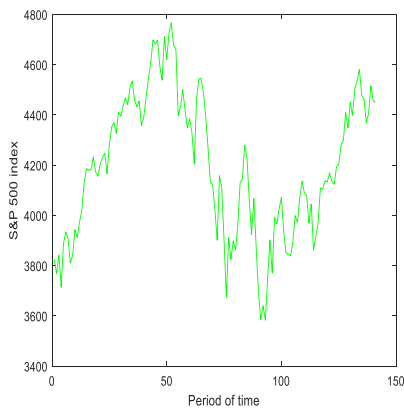
S&P 500 – calculated based on shares of 500 companies with the largest capitalization. But this index does not include privately owned companies [40];

Nasdaq – includes the 100 largest companies by capitalization whose shares are traded on the NASDAQ exchange. The index does not include financial sector companies [41].

Quotes for such indices are presented below. All data from investing.com and covers the period from January 3, 2021 to September 10, 2023. Data are presented in their weekly average.



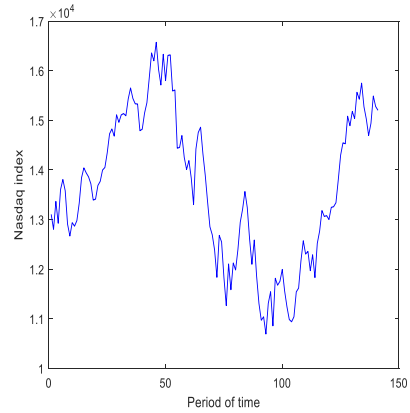
**Figure 1:** Quotes for the Dow Jones Index



**Figure 2:** Dynamics of S&P 500 values

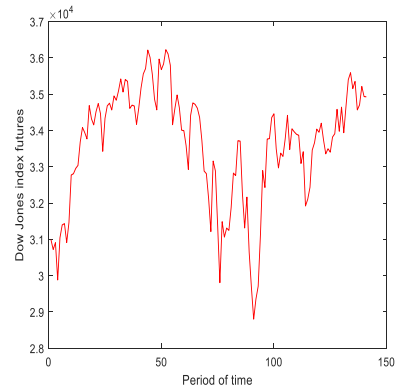
We see approximately the same dynamics for all indices that we consider. This dynamic is wavy. When the highest index values occur in November 2021, and the lowest in October 2022. We can talk about more significant volatility of the Dow Jones index compared to others. We also highlight the more similar dynamics for the S&P 500 and NASDAQ. These data indicate the need to conduct a comparative analysis of the dynamics of the stock market parameters we are considering.

In general, the presented data indicate the same factors influencing the processes that occur in the stock market and are reflected in the dynamics of index quotes.



**Figure 3:** NASDAQ index changes

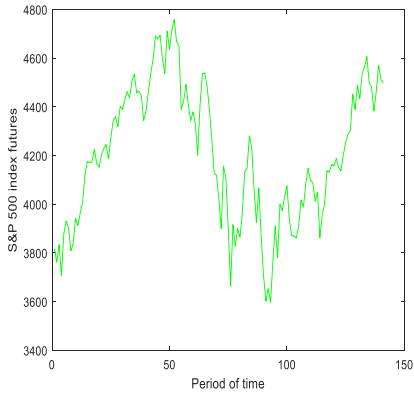
To hedge risks, futures are used, which also act as a tool for speculation. Therefore, these data are also an important object of analysis. Below are futures quotes for the relevant indices.



**Figure 4:** Dow Jones futures

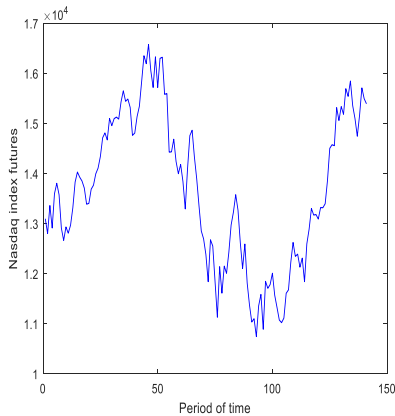
The dynamics of the Dow Jones index and its futures are identical. The correlation coefficient between such data series is very high – 0.996. However, it is necessary to take into account the fact that futures are both an instrument of speculation and a hedging instrument. Therefore, it is also important to compare the relationship between the indicators under consideration. This will be done in the next section. For now, continue the analysis for other indices.

Quotes for the S&P 500 index and its futures are also similar. This can be seen by comparing the data in Fig. 2 and Fig. 5.



**Figure 5:** Futures performance for the S&P 500

The situation is similar for the NASDAQ data (see Fig. 3 and Fig. 6).



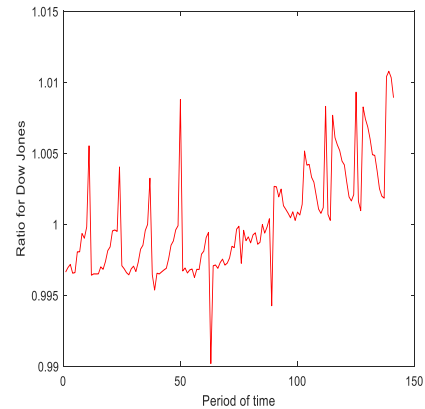
**Figure 6:** NASDAQ futures data

We can note only minor discrepancies in the dynamics of the values of the indices and their futures. Therefore, let's move on to a more detailed analysis. In particular, we study the dynamics of the ratio of such quantities.

**4. ANALYSIS OF THE RATIO OF INDEX VALUES TO THEIR FUTURES CONTRACTS**

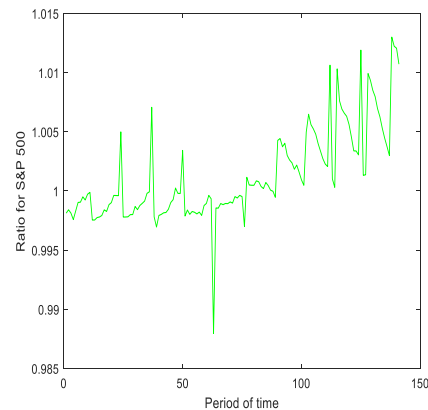
Given the fact that futures are either a speculative mechanism or risk protection, we can assume a relative increase in futures compared to index values. Moreover, such an increase can be considered as an indicator of some negative event. In this case, we are talking about the fact that the ratio of futures values is greater than the values of the index itself (greater than 1). Otherwise this ratio is less than 1. The following shows the dynamics of the ratio of futures values to index values for our data, respectively.

The Dow Jones data trend has a number of outliers greater than 1 and one significant outlier less than 1. Moreover, since September 4, 2022, the Dow Jones data trend has been consistently greater than 1.



**Figure 7:** Ratio data for Dow Jones

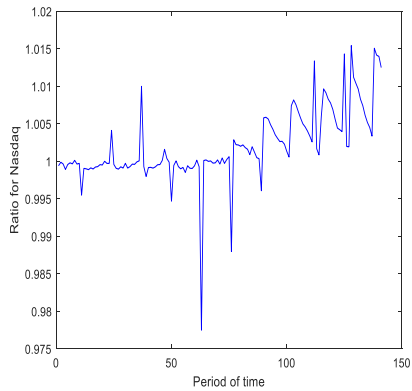
The ratio data for the S&P 500 is slightly different from that for the Dow Jones. This can be seen by comparing Fig. 7 and Fig. 8.



**Figure 8:** Data for the S&P 500

First, we note that the futures-to-index ratio for the S&P 500 has one global minimum. This value is less than for Dow Jones data. At the same time, the dynamics of data on the ratio of futures and the S&P 500 index has been constantly greater than 1 since October 2022. The dynamics of such data are somewhat different in the first 50 weeks in comparison with data from the Dow Jones. Therefore, we can talk about different reactions of the use of futures to processes from the point of view of the Dow Jones and S&P 500 indices.

The dynamics of the ratio of futures values to the NASDAQ index at different time intervals inherits both the ratios for the Dow Jones and the S&P 500. This can be seen in a comparison of Fig. 7–Fig. 9.

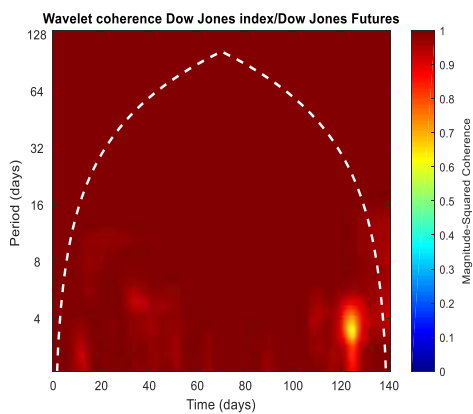


**Figure 9:** Dynamics of ratio data for NASDAQ

In Fig. 9 we also see two local minima. And starting from October 2022, the ratio of the studied variables for NASDAQ exceeds the value of 1. Based on this, we move on to studying the mutual dynamics of the data discussed above.

**5. ANALYSIS OF MUTUAL DYNAMICS FOR THE STUDIED DATA**

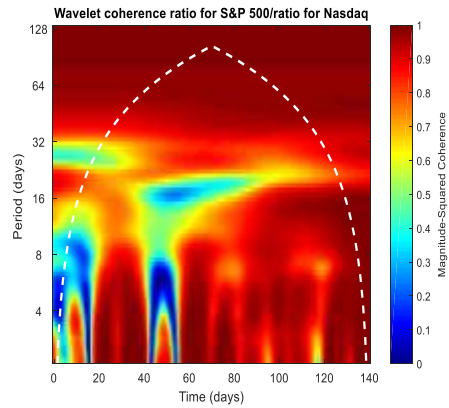
The study of mutual changes in various indicators is an important component of any analysis. This is due to the fact that it helps to detect and understand hidden trends and explain what is happening. One of the tools for such a study of a data set is wavelet coherence estimates, which have found wide application in various fields, including economics [42]-[46]. It is this approach that we use further, where some dependencies are considered.



**Figure 10:** Wavelet coherence for Dow Jones data

In Fig. 10, as one example, presents estimates of wavelet coherence between the index and Dow Jones futures. We see that such an assessment is reliable and meaningful. This was also noted earlier. Thus, the relationship between index values and its futures is stable. This indicates the objectivity of the influencing factors operating in the stock market.

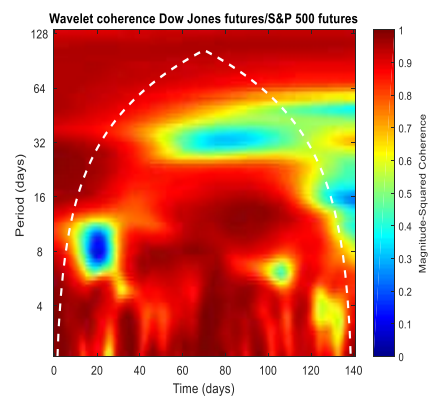
Below is the relationship between futures to index ratios for the S&P 500 and NASDAQ. Previously, we said that the data for NASDAQ inherits the indicators for the S&P 500. The presented data confirms this. Then this result can be used to select strategies in your activities in the stock market.



**Figure 11:** Consistency estimates between futures and index data for the S&P 500 and NASDAQ

Now let's look at the dynamics of the pairwise relationship between futures for the Dow Jones index, S&P 500 and NASDAQ.

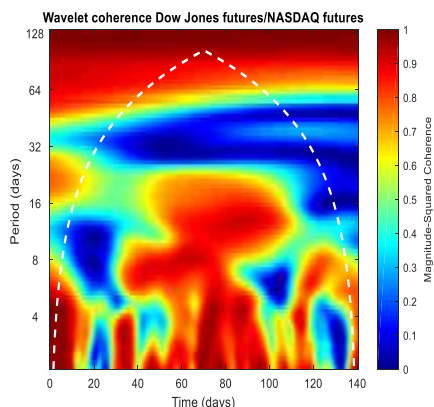
Such estimates allow us to understand the presence of identical stock market factors on the dynamics of futures indicators for different indices. This is important from the point of view of forming a portfolio of investment strategies and methods of hedging them.



**Figure 12:** Dynamics of links between Dow Jones and S&P 500 futures

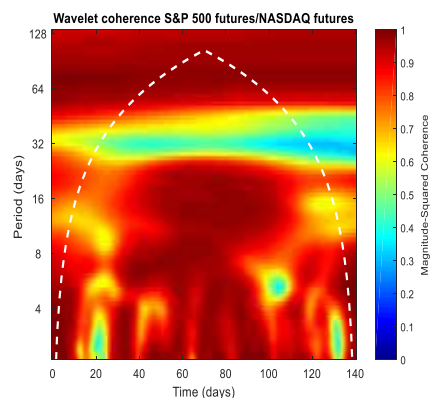
We note that presented in Fig. 12 communication is quite stable. This should be taken into account when choosing a strategy for entering the corresponding segment of the securities market.

At the same time, the dynamics of the relationship between futures on Dow Jones and NASDAQ are fragmented (see Fig. 13).



**Figure 13:** Wavelet coherence between Dow Jones and NASDAQ futures

The connection between futures for the S&P 500 and NASDAQ is the most significant of all those discussed earlier.



**Figure 14:** Estimates of mutual dynamics for S&P 500 and NASDAQ futures

We see the significance of wavelet coherence estimates for futures for the S&P 500 and NASDAQ stock indices over almost the entire interval that is being studied.

## 6. CONCLUSION

The article discusses some issues of the functioning of the global stock market. This study is based on a comparative analysis of the dynamics of futures for the main indices: the Dow Jones, S&P 500 and Nasdaq.

The dynamics of changes in quotations for indices and their futures contracts are considered. The relationships in futures values and indices for the data under consideration are shown. A conclusion is made about the objectivity of the influencing factors inherent in the stock market.

The dynamics of mutual quotations for futures based on wavelet coherence estimates is considered. This helps in choosing strategies for entering the stock market and investing in securities.

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