

Development of the Energy Sector in the Display of Key Exchange Indices

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Abstract: Economic development makes it necessary to provide a sufficient amount of resources and sources of their receipt. Among such objects, a special place is occupied by those that allow you to receive energy. This type of resource is important for the implementation of all types of activities and the functioning of any types of business entities, households. Obtaining this resource is associated with the use of minerals or the possibility of using renewable sources. In the first case, it is important to know the availability of minerals, which is generally determined by the dynamics of the respective prices. These prices are formed as a result of trading on the stock exchange and are determined by the dynamics of the respective stock indices. We consider various exchange indicators. The dynamics of the relationship of such indices is also considered. The paper presents a series of graphs and charts that allow you to understand the progress of the study. The results obtained make it possible to assess the dynamics of the development of the global energy sector.

Keywords—economy; energy; resources; petroleum; gas; traditional resources; green energy; stock indices; wavelet coherence; statistical analysis

1. INTRODUCTION

Energy occupies one of the key places in the structure of economic relations [1], [2]. This is due to the fact that this sector of the economy plays an important role in the processes of life support for the population and the technological functioning of various sectors of the economy. This result ensures the further promotion and growth of all spheres of production of other goods and services.

Energy enterprises are a source of universal resources that are necessary to ensure the activities of any business entities, households. Therefore, the development of the energy sector largely determines the dynamics of innovation in other sectors, the efficiency of industrial production, and the possibility of developing private households. This, ultimately, determines the relevance of this study and its practical significance.

The energy sector is based on the possibility of processing certain types of resources, primarily into electricity [3], [4]. Among such resources, various types of minerals (coal, gas, oil) and the so-called "green processing" are distinguished – this is the energy of water, wind, and the sun. The latter types of energy conversion are gaining popularity as they are renewable resources. However, traditional types of energy production from fossil resources are also important and occupy a significant amount in the specific structure of its production for various needs. This explains the interest in this research topic, which primarily considers such types of resources as coal, gas, fuel oil and oil.

The basis of the study of data on fossil resources for energy is data on the price and volumes offered and sold of the corresponding goods. To do this, you can use data from the stock market, where such resources are traded. Here we can look at various indices, funds and other stock trading data [5]-[7]. The analysis of such indicators allows us to understand the dynamics of prices for goods evaluate its features and make the necessary decisions. To do this, you can use classical and special approaches that have been used for analysis in this and other areas of research [8]-[20].

Also of scientific and practical interest is the analysis of the mutual dynamics of data, which allows you to justify entering the stock market, the actions of potential investors and players during exchange trading. This makes it necessary to apply appropriate methods of analysis.

Thus, the main purpose of this work is to analyze the development of the energy sector based on key stock indices. To do this, we will consider a number of indicators that are associated with fossil resources to convert their required energy. We will also look at some of the relationships between such data. But before that, it is necessary to conduct a brief analysis of the literature on the topic of the study.

2. RELATED WORKS

First of all, let's consider the works that study the development of the global energy sector.

K. P. Gallagher, R. Kamal, J. Jin, Y. Chen and X. Ma consider financing issues in the development of the energy sector [21]. Attention is paid to the benefits and risks of such actions. The analysis is based on data from China in the period

2000-2017. The authors explore various global funding institutions, including stock trading. The relationship between banks and investment funds has also been studied. It is noted that such links are subject to various types of risk. Therefore, it is important to have a diversified funding structure.

D. Gielen, F. Boshell, D. Saygin, M. D. Bazilian, N. Wagner and R. Gorini explore the importance of renewable energy sources in modern conditions [22]. The authors consider various factors of changes in the energy sector. Particular attention is paid to energy efficiency, rational use of resources. The paper shows that renewable sources can provide two-thirds of global demand. It is also important in the fight against the greenhouse effect. At the same time, it is necessary to pay attention to infrastructure issues.

O. V. Inshakov, L. Y. Bogachkova and E. G. Popkova analyze the transformation of world energy markets and their sustainable development [23]. The authors consider aggregate market indicators, their dynamics and directions of change. In this case, various planning horizons are considered. Attention is also paid to geopolitics and energy security. In this context, an analysis of the stability of energy markets, the legal regulation of world trade is carried out.

G. J. Schaeffer explores the general issues of transformation in the energy sector [24]. First of all, the author summarizes the trends in the development of the energy sector. Attention is also paid to climate change and the need to switch to renewable sources. Various scenarios of such development for the production of electricity are considered. Issues of developing new strategies in the field of energy production and energy consumption are discussed.

The foregoing indicates the importance and global nature of the general issues of the development of world energy.

At the same time, it is advisable to understand how data is analyzed in the energy market.

K. Goldmann and A. Zawadzki analyze companies in the energy sector [25]. For this, various indicators of the stock market are considered, as well as financial indicators of individual companies. For their generalization and analysis, the main statistical estimates are considered: maximum, minimum, median, average, kurtosis, and asymmetry. This made it possible to compare different companies with each other, obtain generalized results, and develop effective strategies.

M. Kazemilari, A. Mardani, D. Streimikiene and E. K. Zavadskas conduct a review of renewable energy companies [26]. To do this, we consider stock exchange data based on a minimum spanning tree. The authors examine the activities of 70 companies in the period 2010-2015. The relationship between the shares of companies is considered in terms of the Pearson coefficient and correlation. Also used are such measures as degree, closeness and intermediateness [26].

X. Liu, E. Bouri and N. Jalkh consider the dynamics of data on various types of energy [27]. For this, the relevant stock

indices and their dynamics are considered. The shares of US and European companies are analyzed in the period 2008-2020. For this, a dynamic equicorrelation model is used. Regression analysis models are also used. The paper notes that it is uncertainty that is the main factor that determines the integration in the markets of certain types of energy.

M. Shahbaz, N. Trabelsi, A. K. Tiwari, E. J. A. Abakah and Z. Jiao analyze the relationship between green investment, energy markets and stock markets [28]. Particular attention is paid to the yield on shares of green energy. The study used quantile causality approaches to explore the dynamics of data and their relationships. The Granger test is also used to assess causal relationships. Cross-correlograms are used to study cross-relationships.

We note the complexity and importance of conducting an appropriate analysis. For this, different methods and theories can be used; data can be represented by various indicators.

3. ENERGY SECTOR STOCK MARKET INDICATORS

Among various indicators of the stock market, which reflect the dynamics of the development of the global energy sector, as a rule, futures quotes for energy are singled out. These indicators include: crude oil WTI futures, gasoline RBOB futures, heating oil futures and natural gas futures. Therefore, we begin our analysis with these data. Below are the corresponding charts that reflect the dynamics of price changes in the period 01.05.2020–06.11.2023 in their weekly averaging (from the site – investing.com).

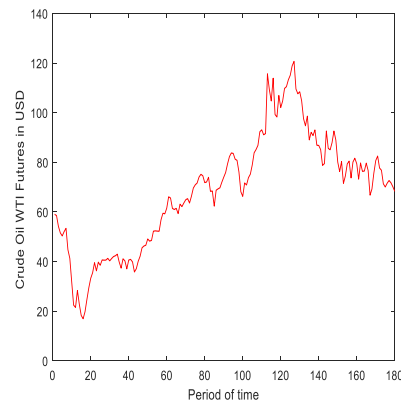


Figure 1: Crude oil WTI futures quotes

The dynamics of prices for Crude Oil WTI Futures reflects the change in demand for this type of resource. The highest value is observed on 05.29.2022. Prior to this period, there is an increase in quotations. Further, there is a decrease in the values of oil futures. We also note a moderate variability in data values in the period 01.05.2020–05.29.2022.

Quotes for Gasoline RBOB Futures somehow inherit the dynamics of Crude Oil WTI Futures values (Fig. 2). This is due

to the strong production relationship between these types of energy resources.

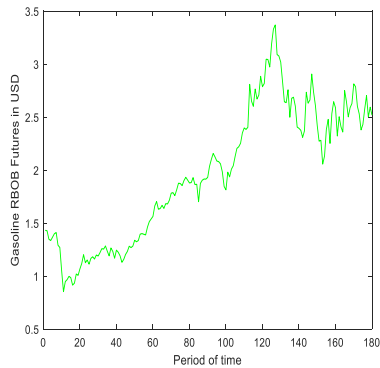


Figure 2: Gasoline RBOB futures price change

But we also note differences in the details of the two graphs. First of all, we see that the maximum for Gasoline RBOB Futures falls on 06.05.2022. This is logical and understandable. Since Gasoline RBOB Futures inherits changes from Crude Oil WTI Futures. We also see more variability in the data after its maximum value compared to the previous chart. Also, in the period 01.05.2020-06.05.2022, there is a more rapid growth in quotes for Gasoline RBOB Futures.

The ratio of crude oil futures to gasoline futures is presented in the following chart.

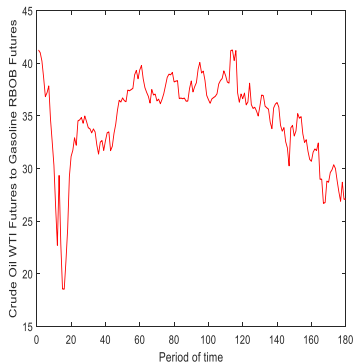


Figure 3: Relationship between oil and gasoline futures

We note the undulating dynamics of such a connection. At the same time, we observe one clearly defined minimum. Most of the data is in a certain range. This suggests that the dynamics of oil and gasoline prices have a strong relationship.

The dynamics of quotations for Heating Oil Futures is similar to the dynamics of gasoline prices. This can be seen from the data in the next graph.

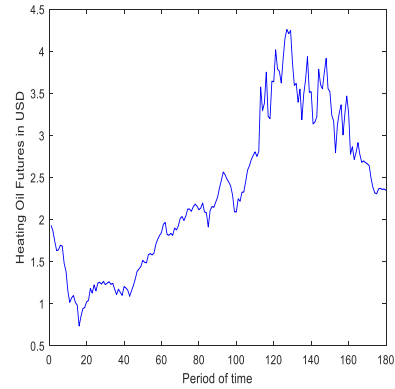


Figure 4: Heating Oil Futures Price

A more complete understanding of the dynamics of prices for gasoline and fuel oil can be judged from the data in Fig. 5.

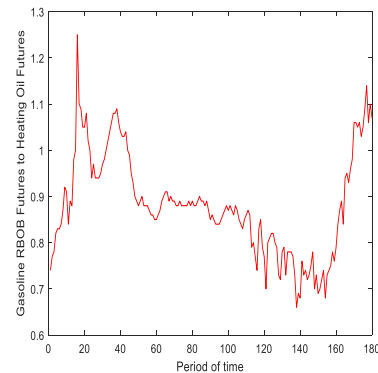


Figure 5: Relationship between gasoline and fuel oil futures

We see that the ratio of gasoline futures to fuel oil futures is in a certain range of 0.7-0.9 with some small outliers. Comparing the data in Fig. 5 and Fig. 3 it should be noted their reciprocity, which is inverse. Thus, all the data discussed above indicate that the development of the world energy market in the display of its indicators is in the same dynamics. At the same time, such dynamics is determined by the influence of the same factors.

The quotes for Natural Gas Futures are somewhat different. This difference is manifested in the dynamics of gas price peaks.

Two maximums can be distinguished here (05.22.2022 and 08.14.2022). We also note a sharp reduction in gas prices after 12.11.2022.

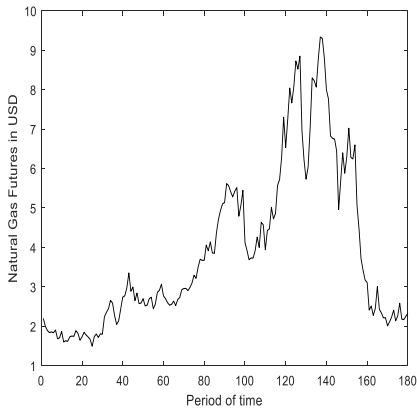


Figure 6: Dynamics of gas prices

At the same time, we state that the quotes for Natural Gas Futures are generally in line with the dynamics of prices for oil, gasoline and fuel oil. This once again emphasizes the impact of the same factors on the energy market. It also indicates the possibility of considering the development of the energy sector based on the dynamics of the relevant futures contracts.

An important point in the study of the energy resources market is the consideration of Carbon Emissions Futures.

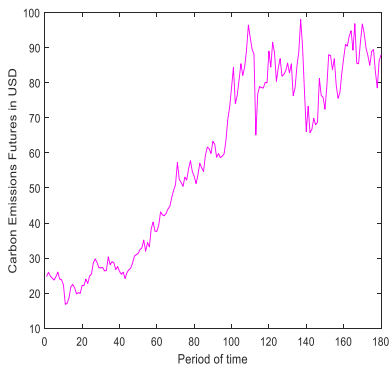


Figure 7: Price dynamics for carbon emissions futures

Quotes on futures for carbon dioxide emissions are constantly increasing. This confirms the proper attitude towards the energy market on the part of its participants, the safety of the environment.

Next, we will look at commodity indices, which also reflect the conditions for the development of the energy sector. Among such indices we consider: Dow Jones Commodity Unleaded Gasoline, Dow Jones Commodity Heating Oil and Dow Jones Commodity Energy.

In general, the dynamics of data on quotations for commodity indices is approximately the same.

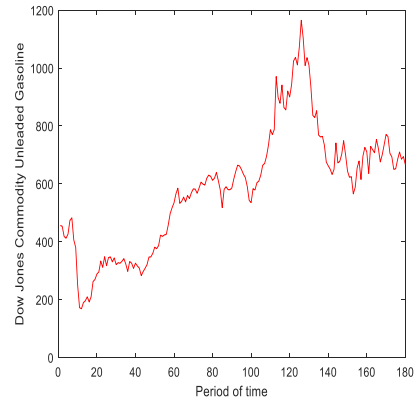


Figure 8: Dynamics of the commodity index for gasoline

It should be noted that the quotes of the commodity index for gasoline coincide with the quotes for oil (see Fig. 1 and Fig. 8). A distinctive feature is the level of such quotations, which is determined by the specifics of trading in the relevant goods. However, this emphasizes the identity of the conditions and operating factors in the market.

At the same time, some differences can be observed in the details. This also makes it expedient to analyze the mutual dynamics of various data.

Commodity heating oil also performs similarly to the gasoline commodity index, reflecting similar trends in the energy sector.

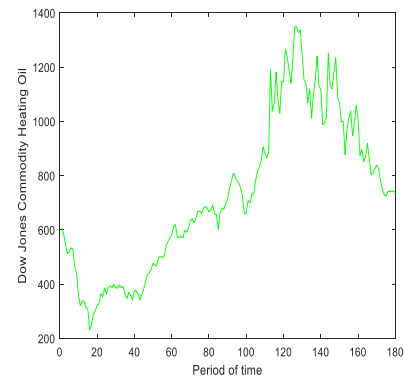


Figure 9: Commodity index for heating oil

The presented data also necessitates an analysis of the mutual dynamics of quotes in order to more fully consider the terms of trade in the energy market.

Not unique is the price dynamics of the commodity energy index.

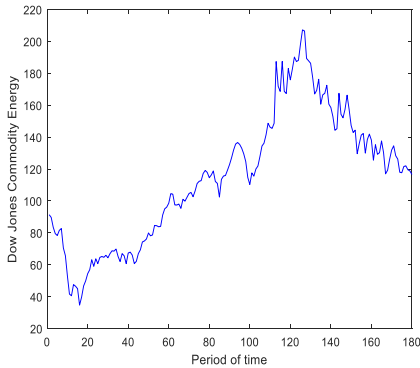


Figure 10: Dow Jones commodity energy index

With general identical trends for different energy indices, we observe differences in details, which is typical for certain time periods. It is these features that underline the conditions for the development of the energy sector.

4. WAVELET COHERENCE ESTIMATES FOR ENERGY SECTOR INDICES

To study the mutual dynamics of various data, the method of determining wavelet coherence estimates, which has already become a classical approach, is used [29], [30]. This approach makes it possible to estimate the mutual dynamics of data immediately for a certain research horizon. It is also possible to understand the depth of such links, which is essential in the process of planning and developing development strategies. At the same time, wavelet coherence estimates are widely used in the study of data presented in the form of time series [31]-[35].

Consider an estimate of the wavelet coherence between the gasoline commodity index and oil futures quotations.

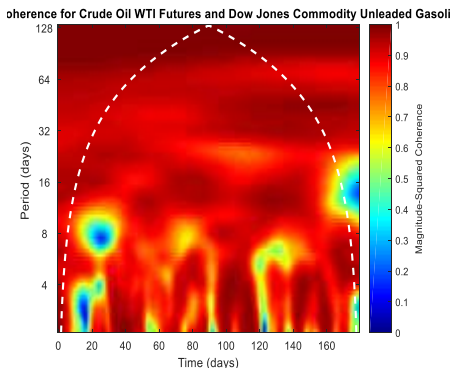


Figure 11: Relationship between commercial gasoline prices and oil futures

It should be noted that the relationship between the presented data is high and significant. At the same time, we also see separate time periods when such a relationship is insignificant. At these moments, small estimates of the relationship between the observed data, which are significant in depth, are also observed (this is shown in yellow and blue on the graph).

Comparing commodity indices for gasoline and heating oil, we note their high consistency.

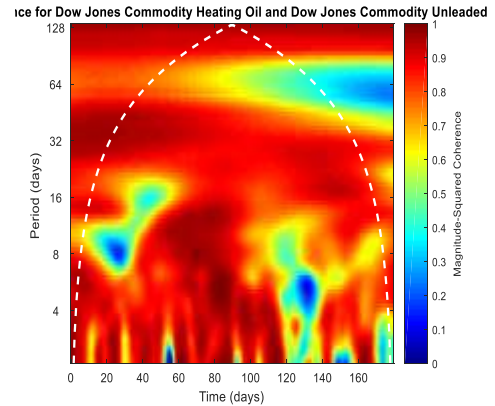


Figure 12: Wavelet coherence between heating oil and gasoline commodity indices

But the considered relationship between the indices is slightly lower than in the previous case (see Fig. 11 and Fig. 12). Moreover, we see that starting from 07.03.2022 this relationship weakens and becomes fragmented. Consequently, the conditions for the development of the energy sector are changing. This must be taken into account when forecasting and developing development strategies.

The role of the commodity index for heating oil in the general commodity energy index can be judged from the following figure.

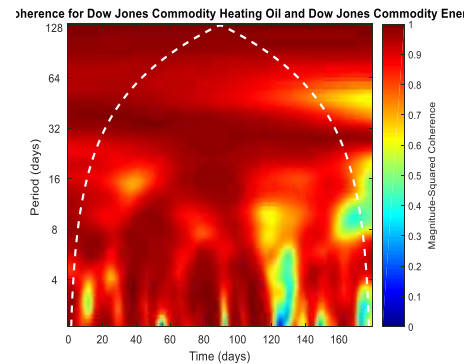


Figure 13: Relationship between the heating oil index and the Dow Jones commercial energy index

We note a high connection between these two indices, which, starting from 07.03.2022, has been weakening slightly. But this confirms the fact that the data on heating oil are significant and strongly influence the overall dynamics of the commodity energy index.

Finally, consider the relationship between carbon emissions futures and the commodity energy index.

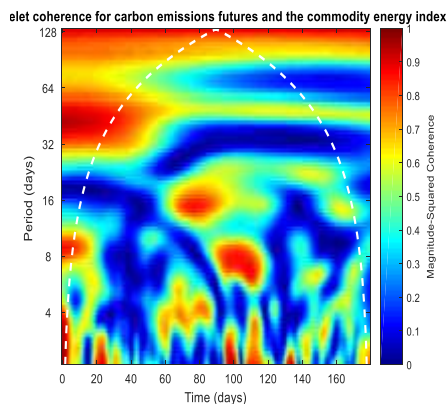


Figure 14: Wavelet coherence between emissions carbon futures and the commodity energy index

We see that such a connection is insignificant. But there is a clear explanation for this. Against the backdrop of changing demand for fossil energy resources, humanity is struggling with the negative phenomena of the energy market, which are carbon dioxide emissions.

5. CONCLUSION

The work focuses on the development of the global energy sector. The problems and ways to solve them are considered on the basis of the study of literary sources on the research topic. Particular attention is paid to the possibility of considering the development of the energy sector on the basis of various stock indices.

The dynamics of various exchange indices of the world energy market is presented. Their tendencies are briefly described. It is noted that the dynamics of such indicators is determined by the same conditions for the functioning of the energy sector and the energy market. The relationship between the indices is considered. For this, the methodology for constructing wavelet coherence estimates is used. The results obtained can be useful in planning the development of strategies for the development of the industry.

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