

Wavelet Coherence Analysis of the Relationship Between Commodity Indices and Streaming Quotes for Futures for Gold, Zinc and Nickel

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Abstract: Data analysis is one of the research tools. This process allows you to assess the current situation, to obtain additional information. This is especially important in the study of economic data, when we operate with the available information and it is necessary to make informed decisions. This paper discusses the features of the analysis of data on the stock market for such commodity as gold, zinc and nickel. The stock market is an important structural element in the formation of market relations. To study it, there are many different indicators and parameters. We highlight commodity indices and futures quotes. Their mutual analysis allows you to better understand the dynamics of the market, to reveal trends in its change. For these purposes, we use wavelet coherence estimates, which are presented in the form of diagrams. We provide a lot of graphs, which allows you to understand the course of the study and evaluate the results.

Keywords—dynamics; quotes; futures; relationship; gold; zinc; nickel; stock market; wavelet analysis; commodity indices; wavelet coherence

1. INTRODUCTION

The stock market is one of the important structural elements in building modern economic relations [1]-[4]. With the help of the securities market, an investment portfolio is formed for potential clients, it is possible to redirect financial resources between individual business entities, conditions for free relations between all participants are created and maintained. Stock market indicators are also a benchmark for meeting the supply and demand for any kind of goods and services.

A different system of indicators and indices reflects the interests of individual investors and helps them understand the current situation. This data is the basis for research and decision making. Here you can use any approaches, theories, methodologies [5]-[16]. At the same time, it is necessary to know the mutual dynamics of the parameters that reflect the essence of the processes under consideration. This helps to understand and reveal such a relationship between data that ensures the adoption of the most appropriate approaches to solving the problems. For such purposes, it is necessary to use new ideas that will help to understand hidden trends and obtain new information.

Among the indicators of the stock market, we single out commodity indices and streaming quotes for futures.

Commodity indices are, first of all, a generalized indicator that helps to understand general trends [17], [18]. This is based on the fact that this indicator is related to the price of the product and its qualitative characteristics [19], [20]. Its key

characteristic is that this indicator is based on the analysis of the deviation of the price from its average value, given a certain period of time. At the same time, the commodity index is the characteristic that is based on some type of the main product in this commodity.

On the other hand, we can consider streaming quotes for futures for a certain product (commodity). This is a tool that directly determines the price on the exchange in relation to the underlying asset when concluding a deal [21], [22].

Naturally, there is a connection between commodity indices and futures, where futures are the basis, and the commodity index is a derivative instrument. This connection allows you to better understand the dynamics of the market, its specifics in relation to the base product.

Thus, the main goal of this study is to study the mutual dynamics of commodity indices and futures streaming quotations for a number of commodities. This determines the significance and relevance of this work.

2. RELATED WORKS

Before proceeding to the analysis of the mutual dynamics of the data that we will study, we will consider a number of works that deal with similar topics. Such works concern both general trends in the analysis of the stock market, and its components of commodity indices, futures quotes.

D. P. Gandhmal and K. Kumar conduct a systematic analysis of various approaches to forecasting the stock market, which also make it possible to reveal and understand the main trends [23]. The authors note the need for such a generalization

in order to be able to correctly select assessments of the current situation. The article provides an overview of 50 research papers. Particular attention is paid to: Bayesian model, fuzzy methods, support vector machines, neural networks. The authors highlight the conditions for using each of the approaches. This helps improve new stock market research. It is also emphasized that this topic is difficult and its solution depends on many factors. This necessitates further research.

M. Nabipour, P. Nayyeri, H. Jabani, S. Shahab and A. Mosavi consider methods for analyzing the securities market using machine learning approaches [24]. The presentation of baseline indicators is also considered. The paper considers the data of the Tehran Stock Exchange. The authors compare 9 models of analysis with each other. Here, each model is evaluated on three metrics where the presentation of the data is taken into account. It is shown that the recurrent neural network and the method of evaluating long-term memory work better with continuous indicators. Therefore, the selection and presentation of data is critical to obtaining reliable results.

F. J. Garcia-Lopez, I. Batyrshin and A. Gelbukh explore the relationship between tweets and stock market dynamics [25]. The paper reveals various market indicators and explores their main trends. It also analyzes messages in social networks and their impact on price changes in the securities market. This allows you to understand the impact of messages on market dynamics, assess the conditions for its change. The authors found a close relationship between such messages and the volume of transactions in the market. Correlation analysis methods and classifiers are used for the study.

M. F. Öztekin and N. Öcal explore the relationship between commodity and stock markets [26]. This connection is seen in the context of financial crises. Correlation methods are used for analysis. This allows you to understand the dynamics of changes that occur in the markets. Such a study is carried out on the basis of a study of the dynamics of commodity indices for a number of agricultural products and precious metals. First of all, the volatility of the market and its impact on the estimates obtained are determined. The factor of financial crises in the change in market indicators is also taken into account. The necessity of portfolio diversification in commodity and stock markets is substantiated.

S. Bahloul and I. Khemakhem establish a relationship between profitability and volatility for commodities [27]. The analysis is carried out for the data of the Islamic stock market based on the study of the relevant indices. Data coverage occurs in the period 2007-2020. To study the data, the decomposition of the variance from vector auto-regression is used. The work also takes into account the impact of the COVID-19 pandemic. The authors analyze the change in the structure of markets, the features of trade in commodities. It is also noted that commodity indices are the most sensitive indicator of changes that are taking place. This is important in the context of our study.

S. Ali, E. Bouri, R. L. Czudaj and S. J. H. Shahzad evaluate the change in the influence of individual goods on the development of the stock market [28]. The authors pay special attention to the issues of hedging and diversification for individual products. The paper considers 21 goods from 49 stock markets in different countries. At the same time, the advantages of diversifying goods for the stock markets of New Zealand and Norway are highlighted. Statistical inference methods were used for the analysis.

C. Watkins and M. McAleer conduct a detailed analysis of futures contracts for metals [29]. For this, the data of the London Metal Exchange in the period 1989-1998 are examined. In particular, the authors consider contracts for copper. The paper uses a carryover cost model and a risk premium model. The authors compare these models and give their recommendations for their use in market assessment. For these purposes, the spot price, interest rate and stock level of the goods are also taken into account. Decision making is based on cointegration analysis, which takes into account trends and long-term memory of data series. In the article, the authors note the limitations on the use of the presented models.

P. L. Siklos, M. Stefan and C. Wellenreuther explore the change in prices for metals produced in China [30]. A network analysis of futures is also carried out. Autoregressive models are used for the analysis. To understand the results obtained, the visualization methodology is used in the work. This is done on the basis of network diagrams. The study examined 29 contracts that correspond with data on stock exchanges in India, the US, the UK and China.

C. T. Albulescu, A. K. Tiwari and Q. Ji consider the relationship between goods in the markets of energy, agriculture and metal products [31]. The tau Kendall approach was used for the analysis. This makes it possible to identify non-linear local dependencies, taking into account emerging conditions at the local level. The work also takes into account non-parametric relationships in the movement of various groups of goods. As a result, links were found between the energy market and commodities. This makes it possible to make diversification decisions and manage risks.

In [32], the relationship between behavior in commodity markets and the possibility of their hedging is investigated. This also takes into account the mood of the hedgers. This allows you to develop effective strategies in conjunction with the manufacturer-trader-user. Various indicators of the stock market are considered for analysis.

Thus, the complexity and versatility of the research issues under consideration should be noted. This allows us to speak about the possibility of using new approaches to the corresponding analysis. As such an approach, we propose to use the wavelet methodology. Before proceeding to such an analysis, we also consider some data that we will study further.

3. TRADING INDICES AND FUTURES PRICES FOR GOLD, ZINC AND NICKEL

In this study, we will focus our attention on individual goods from the group of metals. These are commodities such as gold, zinc and nickel. These metals are of great importance in various spheres of human activity. We consider data for the period 01.19.2020-05.14.2023 on a weekly basis (from investing.com).

We see that the dynamics of the commodity index and the values of gold futures are almost identical.

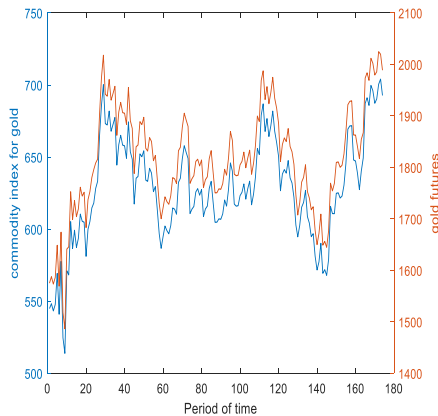


Figure 1: Commodity index and gold futures

It should be noted insignificant phase deviations in time, as well as different ratios of values in the presented data.

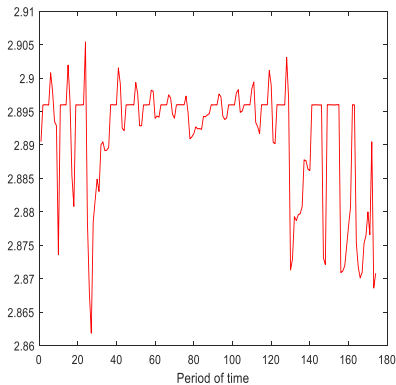


Figure 2: Commodity index vs. gold futures price

It should be emphasized that the ratio of futures to the gold commodity index does not exceed 1.5% of their average value. This reflects the stability of the dynamics of such data.

Dynamics of data for zinc is also generally identical.

This can be seen from the data shown in the figure below.

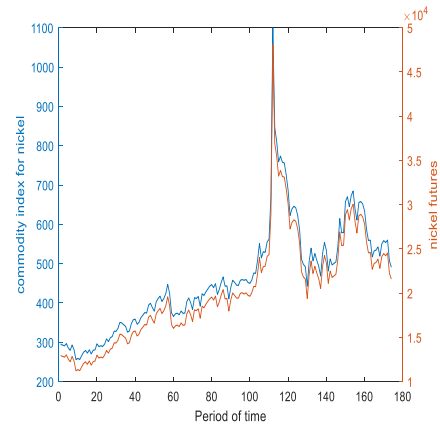


Figure 3: Trends in nickel data

As in the previous case, we see some deviations in the data over time. But they are insignificant. The ratio between the value of the commodity index and futures contracts remains significant, which is also true for gold.

We also note that there is one peak in the nickel data. It falls on 04.17.2022. Further, in general, there is a downward trend.

The ratio of indicators for nickel differs from the corresponding ratio for gold. This can be seen from the comparison of the data in Fig. 2 and Fig. 4.

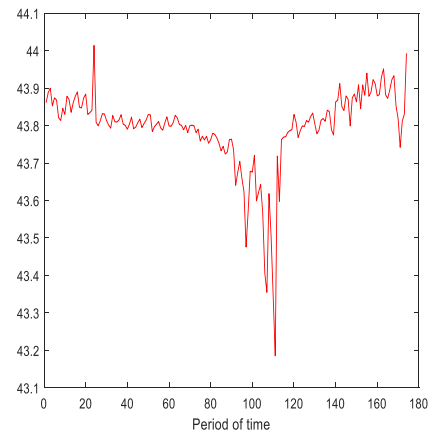


Figure 4: Futures versus commodity index for nickel

The presented dynamics has one clearly defined minimum. It falls on 04.17.2022, which corresponds to the maximum of absolute values. Next, we see an increase in the ratio of futures to the commodity index for nickel. We also see significant variability in the data. This may reflect some price fluctuations for this type of product.

In general, the ratio of futures to the commodity index for nickel does not exceed 1.9% of their average value over the entire time interval that we are studying.

Changes in the values of the commodity index and futures for zinc are also almost identical to each other.

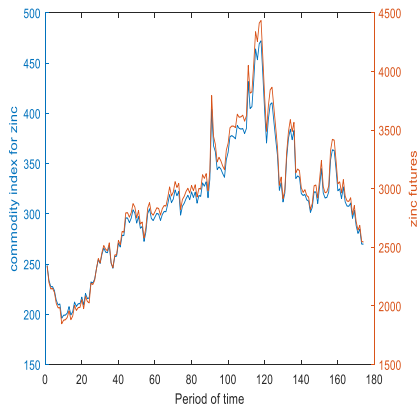


Figure 5: Dynamics of zinc values

Here, one global maximum should be noted, which falls on 05.22.2022. At the same time, we see a number of local maxima. In general, data for zinc are less variable than for nickel. The difference in the values of commodity indices and futures remains significant.



Figure 6: Trends in data ratios for zinc

We note a generally insignificant trend in the decline in the ratio of futures to the commodity index for zinc. The minimum value of this ratio is observed on 07.31.2022.

We also examine the dynamics of the composite commodity index for metals. This index is a generalization of the commodity indices of all metals. It is calculated by Dow Jones, like all commodity indexes that we consider. Such dynamics in some way inherits the previous data (see in comparison with Fig. 1, Fig. 3 and Fig. 5).

This index is important for understanding the mutual dynamics, which we will discuss in the next section.

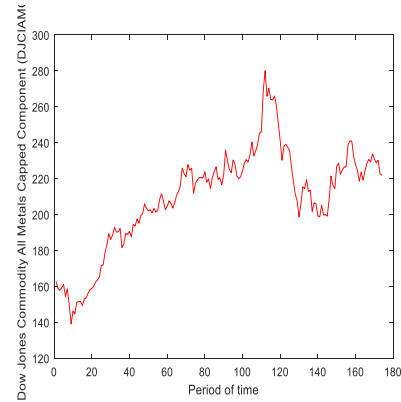


Figure 7: DJCIAMC Index

With a general upward trend in the composite commodity index for all metals, we see one global maximum.

4. WAVELET COHERENCE IN THE STUDY OF THE RELATIONSHIP BETWEEN COMMODITY INDICES AND FUTURES CONTRACTS

To study and analyze the mutual dynamics between data, we use wavelet coherence estimates [33], [34]. These estimates are used to study economic data and provide reliable results [35]-[39].

First of all, we will show an assessment of the relationship between commodity indices and futures contracts for gold, nickel and zinc.

For gold data, there is significant consistency between commodity indices and futures contracts.

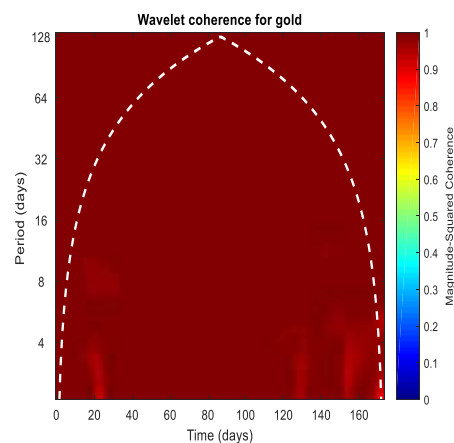


Figure 8: Consistency scores for gold data

However, at the beginning of the study period (04.19.2020-05.24.2020) and at its end (07.03.2022-11.20.2022) there is a slight weakening of such consistency. This must be taken into account when entering the relevant markets for transactions with such metal.

The wavelet coherence estimates for nickel are large and significant over the entire study interval in the period 01.19.2020-05.14.2023.

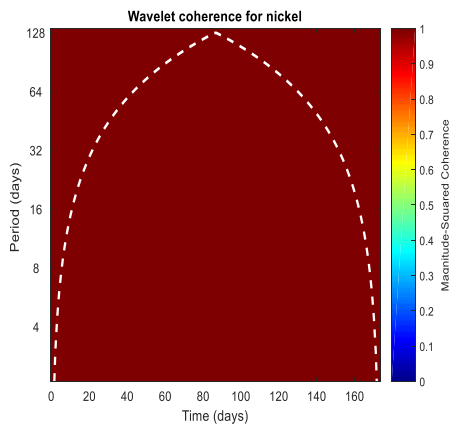


Figure 9: Wavelet consistency estimates from nickel data

Moreover, we note that these estimates are the same. This is important when developing a strategy for entering the metal market, where operations with nickel take place.

Consistency between commodity indices and futures contracts for zinc is also large and significant.

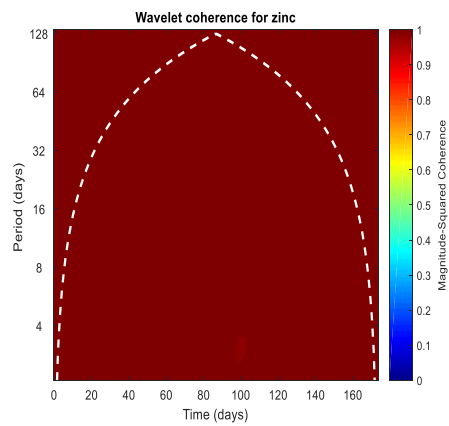


Figure 10: Wavelet coherence estimation values for zinc

However, here, as well as for gold data, there is a period when such estimates slightly decrease. This happens in the period 12.26.2021-01.30.2022. This is a distinguishing feature of the consistency for the data for zinc as opposed to nickel.

Now let's examine the consistency between the commodity indices of each of the metals with the overall composite DJCIAMC index.

We see significant consistency between the values of the DJCIAMC and gold commodity indices.

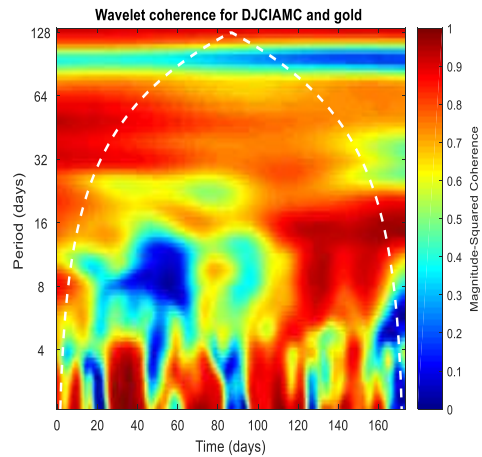


Figure 11: Consistency score for DJCIAMC and gold data

We also note the presence of periods where there is no consistency. Most likely, these are the features of the process of purchasing gold, which is associated with its subsequent use. Starting from 01.16.2022, there is an increase in the depth of the relationship between DJCIAMC and gold. This speaks, first of all, of the increased importance of data on gold in the overall composite index for all metals.

The consistency score for the nickel data is also significant.

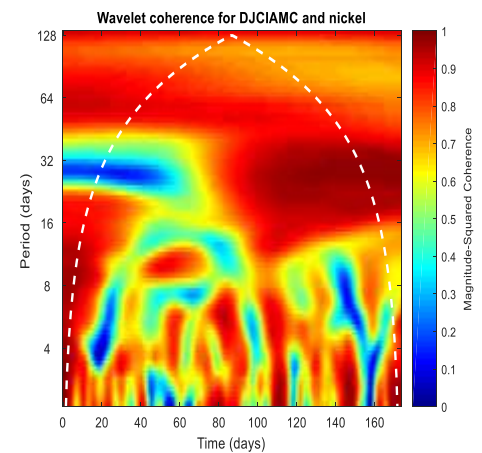


Figure 12: Wavelet coherence for nickel and DJCIAMC data

The values of such an estimate are more evenly distributed over time. This highlights the importance of nickel as an industrial metal.

The score between zinc and DJCIAMC is also representative. This estimate is the most significant of those considered earlier.

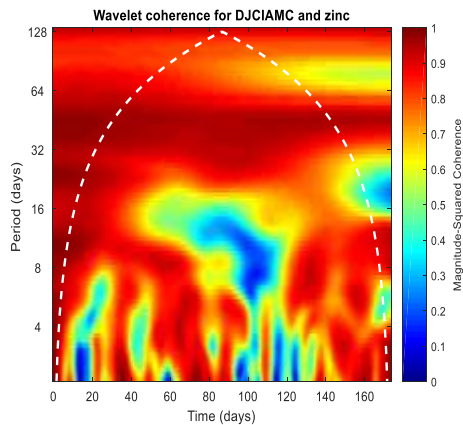


Figure 13: Result for data between DJCIAMC and zinc

In general, we see that all the metals we have considered play an important role in determining the data for the composite commodity index for metals. The methodology of wavelet coherence helps to understand this.

5. CONCLUSION

The paper reveals the features of the study and analysis of a number of indicators of the stock market related to trading in metals. This is done based on the research of relevant literature.

The dynamics of the values of commodity indices and prices for futures contracts for gold, nickel and zinc is shown. Their comparative analysis is given.

To reveal the mutual dynamics of data, the methodology for constructing wavelet coherence estimates is used. The results obtained can be used to develop strategies for entering the relevant market segments.

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