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On the Ratio of Futures Prices in the World Markets for Grain Commodities

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Abstract: *Grain products play an important role as a factor in stable economic development. These goods provide food security, security of life support and activities of people. At the same time, the market for grain products is subject to the influence of various destabilizing factors, which affects the price of such products. Generalization of prices for any goods is the price dynamics for the corresponding futures goods. Thus, in order to analyze changes in the market of grain products, it is advisable to study the dynamics of prices for futures for these products. This allows you to understand the dynamics of the formation of a parity price between supply and demand. Such dynamics is formed under the influence of market factors, the impact of destabilizing factors, the conditions for the development of the relevant market segment and the actions of investors. For the corresponding analysis, we use descriptive statistics, which allows us to analyze current trends, identify peaks in changing price dynamics. To conduct a comparative analysis of price dynamics for various grain products, we use the wavelet ideology. Such an ideology makes it possible to obtain wavelet coherence estimates. These estimates contribute to the study of the grain market, the consideration of various investment strategies. The paper presents various graphs and schemes that allow you to repeat experiments and evaluate the results.*

Keywords—dynamics; futures; analysis; ratio; stock market; grain products; descriptive statistics; wavelet analysis; parity price; wavelet coherence

1. INTRODUCTION

Food security is an important factor in achieving the overall concept of security [1], [2]. It is the availability of food in sufficient and necessary quantities that determines the possibilities for the survival and development of mankind. These issues are relevant and important, especially during periods of manifestation of various destabilizing factors that humanity faces. An example of such destabilizing factors at present are: the development of the COVID-19 pandemic; conduct of hostilities; natural disasters [3]-[5]. This ultimately determines the relevance of this research topic, its practical significance.

To minimize the risks associated with food security, the resistance of production and the uninterrupted logistics of food delivery are necessary. However supply chains are a more important factor in supporting food security. In general, this finds its change in the prices of futures contracts in the world food markets. Among such goods, one can single out grain products that form the foundation of food security.

The formation of prices for futures contracts occurs under the influence of factors that support the functioning of the securities market [6], [7]. This is a market where the issue, purchase and sale of relevant securities for certain goods and their groups is carried out [8]. Thanks to the market, a parity price is maintained for any goods, it is possible to balance between supply and demand. It is also possible to attract additional resources to support the production of the necessary goods, support the logistics chains for their delivery.

As the main factor in the efficiency of the securities market, one should single out the stability and continuity of the movement of the corresponding financial flows. These flows make it possible to meet the necessary needs for financial resources, to ensure the appropriate price parity between supply and demand for a particular product. The corresponding movement of financial flows also reflects the influence of various factors on the formation of the parity price, its objectivity and predictability for investors.

This involves a constant analysis of changes in the movement of financial flows, prices for futures contracts. Among such research and analysis tools, one can distinguish both classical [9]-[16] and non-standard ideas, methodologies, theories [17]-[21]. It is also important to consider new approaches and ideas that allow us to analyze the mutual dynamics of futures contracts for different commodity items.

Therefore, the key goal of our study will be to analyze the ratio of prices in the futures markets for a group of grain products. In such a case, we should look at descriptive statistics about futures prices for individual grain commodities and compare their movements.

2. RELATED WORKS

Researchers and practitioners pay significant interest in the problems of analyzing the securities market in general and the grain market in particular. The range of such studies is quite wide and varied, and covers different areas of research.

E. Cofas and E. Soare conduct a general research of the world market of grain products [22]. The authors note that the grain market occupies a representative place, because grain is grown on a large area and is important for both food security

and animal feed. The study considers such indicators as: crop area, production received, yield per hectare, food consumption, import, export and price [22]. The interdependence of various indicators among themselves is shown. Based on this, we can talk about the importance of conducting a mutual analysis of various data describing a particular phenomenon or object.

M. Foster explores the market for non-codified grain [23]. The author explores such grain commodities as soybeans, corn, rapeseed and cotton seeds. The author considers price premiums for GM and non-GM products. The article summarizes the data available to date on such price premiums for non-GMO products for different countries and markets [23]. The broad economic model helps to justify the price changes that we observe in the market [23]. The author also analyzes changes in consumer demand and changes in the corresponding price premiums.

A. Engiad, D. Ufer, A. M. Countryman, and D. D. Tilmani consider the fundamentals of the wheat market when climate change occurs [24]. The authors note that wheat prices are influenced by many factors, including climate, harvesting, the availability of the oil market, and changes in the pricing policy for imports [24]. The authors also emphasize that the availability of imported goods, climatic conditions, energy prices, among other factors, especially affect the possible change in prices for grain commodities. This confirms the need for a mutual analysis of the data that we are examining. Such an analysis allows a better understanding of the patterns and trends in pricing in the grain market.

F. G. Baquedano and W. M. Liefert investigate market integration and price transmission in consumer markets in developing countries [25]. The authors note that world prices for agricultural products periodically rise sharply. At the same time, in many developing countries, consumer prices for basic foodstuffs, such as bread and rice, reflected these changes [25]. Therefore, the authors consider whether prices in urban consumer markets in developing countries are related to prices in world markets for agricultural commodities. The authors in their work use the model for error correction. The proposed model is based on one equation. This allows you to explore the reaction of consumers to the prices of the grain market, taking into account market prices and exchange rates for developing countries [25]. The paper concludes on the cointegration of markets, which makes it possible to understand their development. This highlights the importance of conducting cross-analysis across different datasets.

N. Shramenko, D. Muzylev and A. Manukyan pay attention to the functioning of logistics chains that are used in Ukraine for the transportation of grain products [26]. The authors note that grain logistics is the main element of grain transportation. Therefore, this problem needs to be investigated. Here you should consider the infrastructure and its provision with everything necessary. The paper also emphasizes that it is necessary to analyze the volumes of transportation of grain products and products of their processing. It is necessary to take into account all types of transport [26]. The paper states that the efficiency of grain transportation does not correspond to a significant growth rate of its production, and, consequently, an increase in the rate of its transportation with subsequent transshipment in ports [26]. The consequence of this is the high cost of grain, and, consequently, a decrease in its competitiveness in the foreign market [26]. Thus, the analysis of prices for grain products is a relevant and important research topic.

Ceballos, F., Hernandez, M.A., Minot, N., and M. Robles investigate the transmission of grain prices and the volatility of this price transformation for different markets [27]. The authors emphasize that understanding the sources of relevant price transformations is a key factor in developing a more effective strategy for dealing with excessive price changes [27]. This article analyzes price conditions and their volatility for a number of countries in Latin America, Africa, and South Asia. The GARCH multivariate approach is used to model. The article simulates a shock that allows us to evaluate the effects of volatility. The shock is modeled at the 1% change level. This allows us to describe the conditional volatility of returns on grain commodities [27].

The study [28] examines changes for global food supply chains from Russia's war against Ukraine. The authors note that food is the most traded commodity, and the war against Ukraine has caused a significant additional disruption in food supply chains in the wake of the negative impact of COVID-19 [28]. The paper emphasizes that disruptions in food production, supply chains and food availability can have long-term consequences. For such a study, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) approach is used [28]. This approach allows finding solutions and strategies to mitigate the effects of the supply chain.

J. Swinnen and R. Vos investigate the impact of COVID-19 on the development of the food system and the sustainable functioning of households [29]. The authors note that the overall impact on food security, poverty, and nutrition was caused by the economic downturn and disruption in agri-food supply chains [29]. The authors argue that both income shocks and supply disruptions affected food security and livelihoods most where supply chains were less integrated and poverty and market informality were more prevalent pre-COVID-19 [29]. This study provides new insight into the influence of the pandemic on food price security and household well-being. These conclusions are based on scenario analysis and new research data. This provides an opportunity to explore changes in economic behavior and the functioning of food supply chains that are associated with the pandemic [29].

Thus, the study of the grain market is an important and relevant area for scientists and practitioners. The main point of such work is the study of the mutual dynamics of prices for different grain products.

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3. GRAIN PRODUCTS AS AN OBJECT OF STUDY

For research, we consider the following products: wheat, soybeans, corn, rough rice, and oats. These products are the most demanded in the grain products market. We will analyze the prices of the relevant futures. These data cover the period from 03.01.2021 to 12.02.2023 in their weekly average. All data from the site https://investing.com/.

On fig. 1 – changes in the futures for wheat.

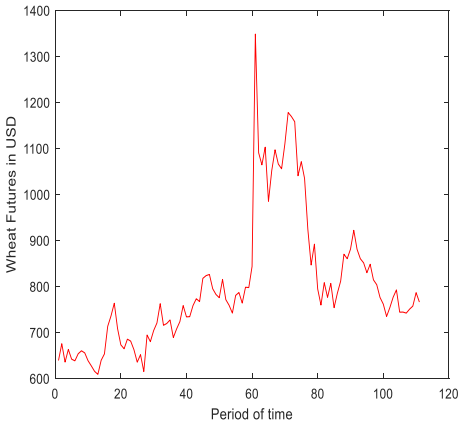

Figure 1: Wheat futures dynamics

There is a clearly defined maximum in the current trends of wheat futures. This maximum occurs in the first half of the time period we are examining. The presented data shows a sharp jump in prices for wheat futures in the corresponding period of time. Further, prices for futures for wheat are reduced. Recently, wheat futures prices have been approaching prices that were at the beginning of 2021. This is seen from fig. 1.

On fig. 2 shows the change in soybean futures prices.

We can see two highs and one low in the soybean futures chart. The minimum is typical for the first half of 2021. The first high occurs in the first part of the chart, which occurs at the end of the first quarter of 2021. The second maximum occurs at the beginning of 2022. The second maximum is stretched over a certain time interval, which lasts more than one quarter. Next, we see a sharp decline in prices, which correlates with a decline in wheat prices (see fig. 1). It should be noted that in recent years there has been an increase in soybean futures. This growth is higher than in early 2021.

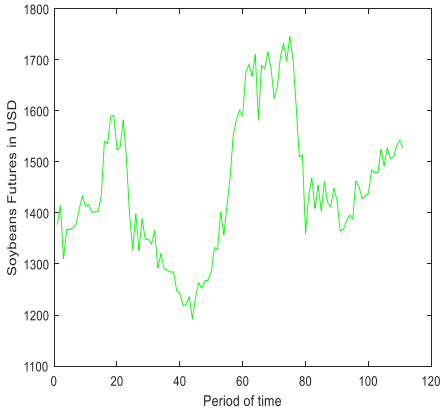

Figure 2: Soybeans futures dynamics

The dynamics of corn futures is shown on the third figure.

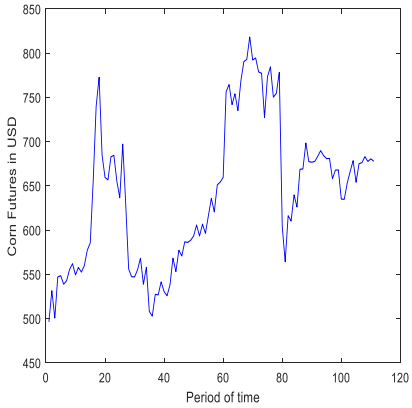

Figure 3: Corn futures dynamics

There are two pronounced highs on corn futures in this chart. The first maximum is observed at the end of the first quarter of 2021. The second maximum is observed in the middle of the first quarter of 2022.

Both with the first maximum and with the second maximum rise in prices, after a while there is a sharp decline. Thus, two local lows should be singled out in corn futures prices. In general, we can talk about a general increase in prices for corn futures from the beginning of 2021 to the present. In the first quarter of 2023, there is some stabilization in prices for corn futures.

On fig. 4 shows the prices of futures for raw rice.

The price chart of futures for raw rice is fundamentally different from the previously discussed dynamics of futures for other grain commodities. This can be seen by comparing different drawings.

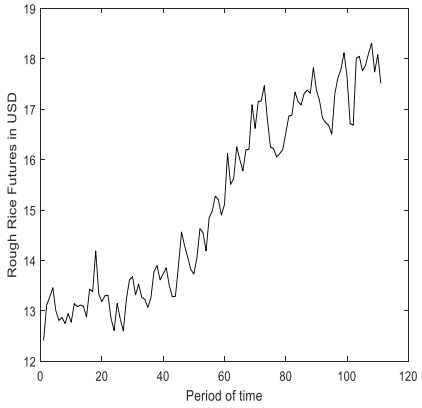

Figure 4: Rough rice futures dynamics

There are no clear highs and lows in the price dynamics of paddy rice futures in the period from 2021 to 2023. In general, such dynamics is increasing. It should be noted the volatility of price changes for rough rice. Thus, we can say that other factors act on the price change for paddy rice futures than for futures for wheat, soybeans and corn. This must be taken into account when choosing an investment strategy, entering the market of grain products.

The chart of futures for oats is shown in fig. 5.

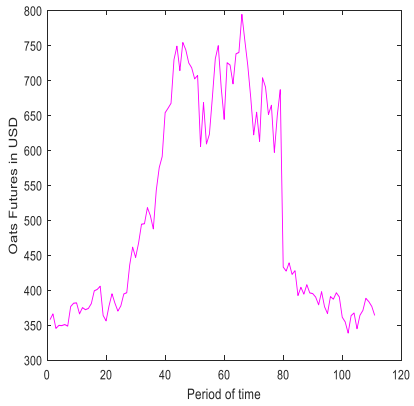

Figure 5: Oats futures dynamics

In the dynamics of prices for futures for oats, one significant maximum is observed. This high starts at the end of the first half of 2021 and ends at the end of the first quarter of 2022. The duration of such a maximum with small deviations takes almost half a year. On the chart, it is possible to distinguish periods of time where one can note both a sharp increase in prices for futures for oats, and their rapid decline. However, oat futures have recently (in the first quarter of 2023) moved closer to oat futures prices that were in early 2021.

Separate statistical characteristics (kurtosis and asymmetry) of the previously presented futures are shown in the sixth figure.

	Kurtosis	Skewness
Wheat	1,72	1,37
Soybeans	-0,57	0,37
Corn	-0,87	0,25
Rough rice	-1,55	0,16
Oats	-1,45	0,5

Figure 6: Separate statistical characteristics of the studied futures

We can note that the data in fig. 6 highlights the differences in price action for the futures we are examining.

On fig. 7 shows estimates of the correlation coefficient between different time series describing the studied futures for a group of grain products.

	Wheat	Soybeans	Corn	Rough rice	Oats
Wheat	1				
Soybeans	0,65	1			
Corn	0,75	0,83	1		
Rough rice	0,55	0,46	0,6	1	
Oats	0,59	0,17	0,24	-0,01	1

Figure 7: Correlation coefficient between different time series describing the studied futures

The correlation coefficients between the studied data are small. This also indicates the difference in the dynamics of the studied data, which were presented above. Therefore, it is interesting to compare the mutual dynamics between the studied data.

4. Mutual Price Dynamics for Futures for Grain Commodities

It is expedient to study the mutual price dynamics of futures contracts between individual grain commodities using wavelet coherence estimates [30]-[32]. This is due to the fact that the ideology of wavelets is widely used in the study of economic data [33]-[39].

On fig. 8 shows an assessment of the consistency between soybean and corn futures prices. This choice is justified by the fact that the relationships of the respective futures have the highest correlation coefficient.

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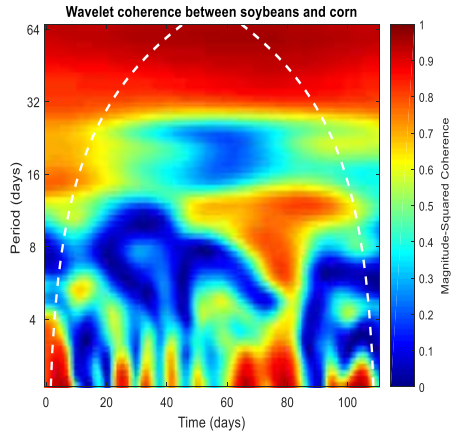

Figure 8: Soybean and corn futures price ratio estimation

We see some consistency between soybeans and corn futures prices. The greatest consistency appears at the beginning of the second half of the studied period of time. We can also point to the fact that during this period the greatest depth of such coherence is manifested. This should be taken into account when developing and adopting an appropriate investment strategy.

An assessment of the consistency between the price dynamics of raw rice and oat futures is shown in the ninth figure. The change in prices of such futures has the lowest correlation coefficient.

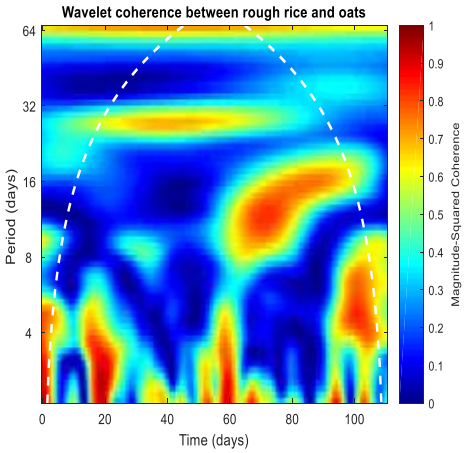

Figure 9: Evaluation of wavelet coherence between rough rice and oats futures prices

In this case, we have even less consistency in the price dynamics of paddy and oat futures (in contrast to the case of soybean and corn futures). However, one should take into account the growth of the corresponding estimates with the growth of the influence of such relationships.

On fig. 10 shows an estimate of the wavelet coherence for wheat and soybeans futures. The relationship of such futures has average values correlation coefficient.

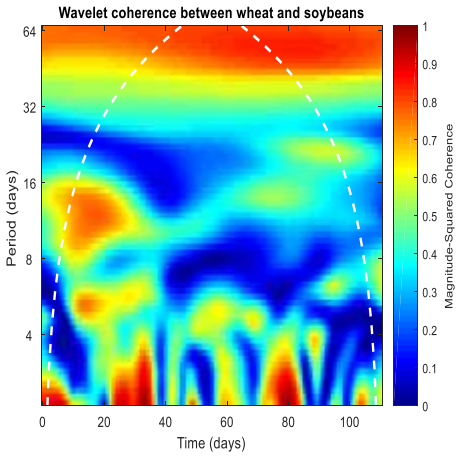

Figure 10: Evaluation of wavelet coherence between wheat and soybeans futures prices

Here, too, we see fragmentary consistency for wheat and soybeans futures.

On fig. 11 shows an estimate of the wavelet coherence between the price dynamics of soybeans and rough rice futures.

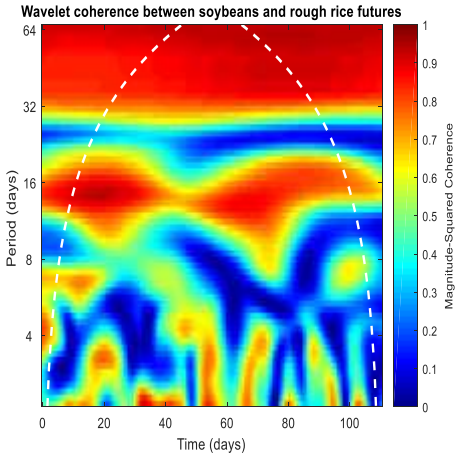

Figure 11: Evaluation of coherence between soybeans and rough rice futures prices

Here, too, the connection of the relevant data is fragmentary. At the same time, with an increase in the scale of the studied relationships, the consistency increases.

In general, fragmentary agreement between the studied data should be noted. This must be applied when developing a strategy for entering the market of grain products and choosing a specific investment strategy.

5. Conclusion

The article deals with problematic areas in the study of the ratio of futures prices for a grain product. The conceptual foundations of accounting for prices for grain products are

generalized. It is emphasized that this is related to food security, proper provision of human activities.

It is shown that the formation of prices for grain products occurs under the influence of external factors. Therefore, up-to-date stock indicators are an important source for price analysis. We have disclosed the change in prices for futures contracts for the main commodities of the grain group. This analysis is presented in the form of descriptive statistics. The main processes of price dynamics for grain products have been identified.

To study the mutual dynamics of prices for grain products, the wavelet ideology is used. The estimates obtained help in determining the time to enter the stock market with the appropriate instruments, substantiating a specific investment strategy.

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