International Journal of Academic Management Science Research (IJAMSR)
ISSN: 2643-900X
Vol. 7 Issue 5, May - 2023, Pages: 22-28

Relationship Between Price Dynamics for Individual Agricultural Products

Evgeniy Shapran[1], Maryna Tatar[2], Vyacheslav Lyashenko[3]

[1]Business, Trade and Logistics Department, National Technical University «Kharkiv Polytechnic Institute», Ukraine
[2]Finance, Accounting and Taxation Department, National Aerospace University «Kharkiv Aviation Institute», Ukraine
[3]Department MST, KhNURE, Ukraine
e-mail: lyashenko.vyacheslav@gmail.com

Abstract: *Security is one of the key concepts in the analysis of economic dynamics. Among the individual varieties of this concept, food security stands out, the basis of which is agricultural products. This is due to the fact that products are the basis of life support for the entire population, and, consequently, for the personnel of enterprises, firms, companies, and any economic entities. Various data can be used to determine the level of food security. Among such data, the dynamics of prices for agricultural products should be noted. This indicator reflects the significant supply and demand of any product. The change in prices is formed under the influence of many factors, which is reflected in the corresponding values of the stock market. We are considering price changes for different products. To do this, we use the classical methods of statistical analysis. All data are presented in the form of graphs. This allows you to better understand the dynamics of commodity prices. To analyze the mutual influence of prices on agricultural products, we use the wavelet methodology. This is presented in the paper in the form of wavelet coherence estimates, which are shown in the diagrams. The results obtained help substantiate various strategies for achieving an acceptable level of security and conditions for entering the securities market.*

Keywords—dynamics; price; statistical analysis; wavelet coherence; agricultural products; stock market

1. INTRODUCTION

The state, like any business entity, operates in an environment of various factors. Certain factors make it possible to achieve the set goals, while other factors, on the contrary, have a negative impact on the formation of control actions to achieve the goals. Thus, we can talk about security and the level of its provision both for the country as a whole and for each enterprise, company, and firm [1], [2]. This, ultimately, determines the relevance of this kind of work.

In general, from the point of view of the functioning of a certain subject, it is possible to distinguish different levels of security [3], [4]. Such a division is possible taking into account the influence of individual factors, the possibility of fulfilling the goals and objectives. You can also consider security in areas of activity, the possibility of performing individual functional tasks. Here, financial and industrial security, the likelihood of a man-made disaster in the life of personnel, and food security are singled out. Moreover, the last variety is the most important, as it affects its other types, the life support of the entire population.

For research and decision-making in relation to food security, an important aspect is the study of the dynamics of prices for agricultural products. These indicators can be obtained from the data of the corresponding segment of the stock market. Therefore, an important point in considering the issue of food security is the study of such values and their dynamics. This can be done through the use of different methods and approaches [5]-[20].

It is also important to analyze the mutual influence of price dynamics on products, which helps to understand the possibility of their mutual replacement, both in kind and in terms of financial compensation for lost opportunities. For this, we can also use our research algorithms [21]-[24].

Thus, the main purpose of this work is to consider the mutual dynamics of prices for agricultural products. To achieve this goal, we will consider different types of goods, changing the values of their prices over time. We will use the classical methods of statistical analysis, as well as special approaches to the study of dynamic patterns. This allows us to speak about the practical orientation and significance of our study.

2. RELATED WORKS

Before we consider the main purpose of this study, let's take a look at the related work. It should be noted that there are a lot of such works and they reveal the issue of analyzing changes in prices for agricultural products in different ways.

S. Nazlioglu and U. Soytas study the dynamics of prices for some agricultural products [25]. This comparison is made against the backdrop of changes in oil prices. The study focuses on emerging market economies. The authors emphasize the direct relationship between oil prices and agricultural products. This is revealed in the short and long term. Various statistical dependencies are used for the analysis. At the same time, the authors note the importance of mutual analysis of different data; emphasize the variability of price dynamics for different goods.

The study [26] pays special attention to the analysis of the links between energy prices and agricultural development. The authors state that such a relationship is very sensitive to various kinds of fluctuations. The importance of the influence of energy in the production of agricultural products is also emphasized. We can also talk about the need for cross-analysis between different statistics related to agriculture, cultivation and transportation of such products. For analysis, the authors use classical methods of statistical analysis and inference.

In their new work, S. Nazlioglu and U. Soytas explore the relationship between prices for agricultural products and oil in relation to the dollar [27]. Such an assessment is given on the basis of group cointegration, where it is important to analyze the relevant relationships. At the same time, the authors study the dynamic relationship between the selected parameters. To do this, Granger methods are used to explain the cause-and-effect relationships that occur. The work uses an extensive set of empirical data for the period 1980-2010. This emphasizes the significance of the analysis carried out by the authors.

The study [28] is devoted to the consideration of prices for agricultural products in China. For these purposes, the authors use the method of quantile regression. The authors use linear quantiles. The analysis uses data from 2000 to 2010 on a monthly basis. The authors also construct confidence intervals within which the results are significant and reliable. The developed approaches can be used to predict and substantiate strategies for the development of agricultural production.

B. Czyżewski, A. Matuszczak and R. Miśkiewicz explore the relationship between the decline in prices for agricultural products (PCS) and the growth in the welfare of the population [29]. At the same time, attention is paid to the justification of the common agricultural policy in the countries of the European Union. It is also noted that the issue of PCS education is one of the key issues in the development of such a policy. Therefore, the authors consider the dynamics of the constant elasticity of substitution and its influence on the results obtained. The authors come to the conclusion that it is necessary to use a policy of price flexibility for agricultural products. This allows you to take into account various factors and develop a common strategy for behavior in the market of agricultural products.

R. Barichello analyzes the impact of COVID-19 on agricultural trade [30]. To do this, the author examines the data for Canada. The paper concludes that COVID-19 has a negative impact on the formation of prices for goods, which are determined by the functioning of agriculture. At the same time, this influence manifests itself in two aspects: an increase in prices for production and logistics, and a decrease in consumer demand. Also an important factor of influence is the political reaction of manufacturers and business partners.

F. Taghizadeh-Hesary, E. Rasoulinezhad and N. Yoshino analyze the relationship between food and energy security [31]. A manifestation of such a relationship is the price dynamics of the relevant goods and products. At the same time, price volatility is an important aspect of assessing such a relationship. This study used the Panel-VAR model. Here we consider data from eight Asian countries. The authors note a significant impact of energy prices on food prices. The importance of conducting a mutual analysis of price dynamics is also emphasized. This allows you to better understand the processes that occur and are described in the form of price dynamics.

M. Yahya, A. Oglend and R. E. Dahl consider the relationship between energy resources and food prices using the wavelet ideology [32]. At the same time, short-term, medium-term and long-term dependencies are investigated. This approach allows us to conduct a better analysis, obtain new results and provide an explanation for the phenomena that we observe in the market.

The work [33] reveals the relationship between climate change and food security. For these purposes, multi-model estimates are used. The results and conclusions obtained vary from the choice of model. However, all models show the negative effects of climate change on food price dynamics.

Y. Bai, R. Alemu, S. A. Block D. Headey and W. A. Masters explore food policy issues [34]. To do this, the authors look at food cost data from 177 countries. The authors also take into account the diet and its quality. The issues of the influence of state policy on the formation of food security are also considered.

Based on the analysis, some related studies, it should be noted:

the problem of food price dynamics is in the focus of attention of practitioners and theorists working in the field of agriculture, security, market analysis;

various methods and theories can be used to study the data;

an important aspect is taking into account the mutual dynamics of data on the prices of agricultural products, which is the basis for the adoption of strategies, the development of food policy in the field of security.

3. Empirical Evidence for Selected Agricultural Products

First of all, it should be noted that we are considering a group of agricultural products that is not related to animal husbandry. This is a group of goods that can be attributed to crop production. We consider such goods as: coffee, cocoa, sugar, cotton and orange juice.

We are considering the period 01.10.2021-05.07.23. All data from the site https://www.investing.com/. These data reflect the performance of quotations in the US futures market.

On Fig. 1 – Fig. 5 shows the dynamics of prices for the corresponding goods. Let's analyze this data.

We see that the coffee quote chart resembles a quadratic function.

International Journal of Academic Management Science Research (IJAMSR)
ISSN: 2643-900X
Vol. 7 Issue 5, May - 2023, Pages: 22-28

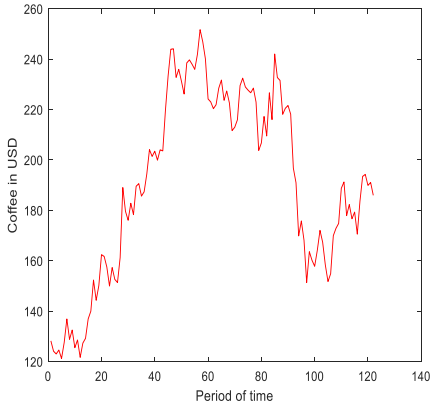

Figure 1: Coffee quotes

In the period from 01.10.2021 to 02.06.2022, there is an increase in coffee prices. Then there is a period of slight decline in quotations for futures. From 08.28.2022 to 11.13.2022 there is a significant decrease in prices, then again they increase.

Cocoa price dynamics differ from coffee price changes.

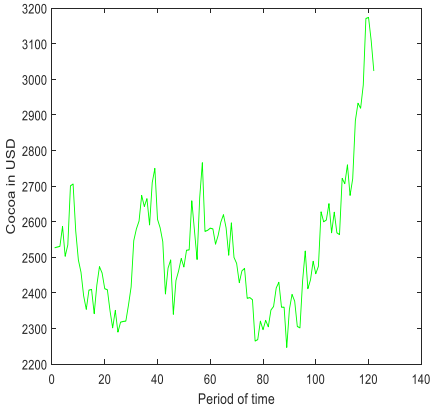

Figure 2: Change in cocoa prices

From 01.10.2021 to 10.23.2022 we see a wave-like change in cocoa prices. Since 10.30.22 there has been an increase in cocoa futures. At the same time, such growth is accompanied by a slight variability in price indicators. We also note that cocoa prices are significantly higher than coffee prices.

The dynamics of sugar futures also has a wave-like structure in a certain period of time. This can be noted for the period from 01.10.2021-01.08.2023.

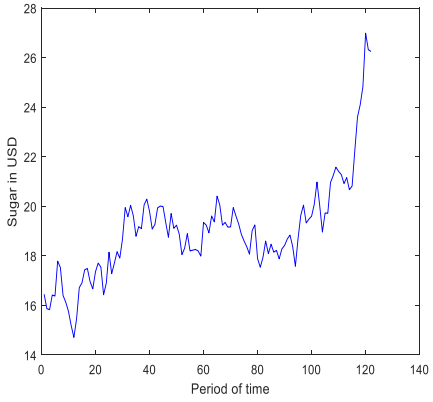

Figure 3: Sugar price developments

Since 01.08.2023, there has been an increase in quotations for sugar futures. At the same time, the wave-like presentation of sugar prices is less pronounced than for cocoa. We can also note less variability in the values of such indicators.

The dynamics of cotton prices also shows some agreement with the quadratic function. But such a graph differs from the data in Fig. 1.

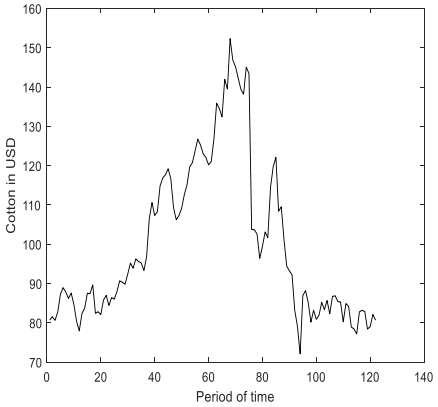

Figure 4: Cotton futures data

The dynamics of cotton prices has a clearly defined maximum, which is located in the middle of the period under study. This maximum falls on 06.05.2022. Starting from 09.18.2022, there is some stabilization in the quotations for cotton futures.

Unlike other data, cotton futures do not have a pronounced upward trend at the end of the study period. For other data, we can see an increase in the prices of agricultural commodities.

The dynamics of prices for orange juice has a general upward trend in the period from 01.10.2021 to 05.07.2023.

International Journal of Academic Management Science Research (IJAMSR)
ISSN: 2643-900X
Vol. 7 Issue 5, May - 2023, Pages: 22-28

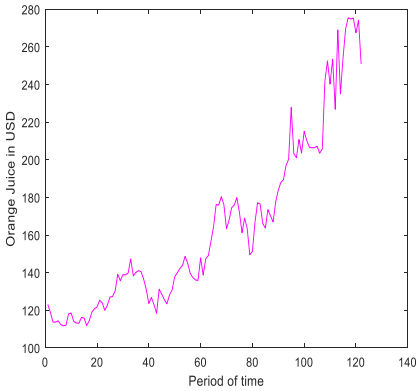

Figure 5: Price change for orange juice

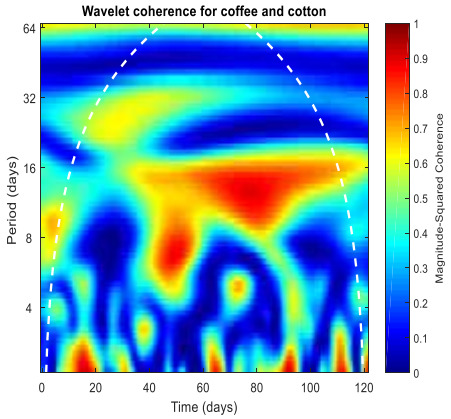

Figure 6: Relationship between coffee and cotton prices

We can also note slight fluctuations in orange juice quotes against the background of their constant growth in general.

We see that all considered quotations for futures for individual agricultural commodities are different. Each price change has its own unique dynamics. Cocoa prices have the largest absolute values. The lowest prices are for sugar.

As shown earlier, it is also important to explore the mutual dynamics in price changes. Therefore, we will consider this issue in more detail below.

4. Wavelet Coherence Estimates as a Tool for Analyzing Mutual Dynamics

Analysis of the mutual dynamics of data is one of the approaches that allow you to uncover hidden trends and get new results. For these purposes, you can use various tools, where methods of correlation analysis are distinguished. At the same time, wavelet coherence estimates are the most powerful tool for such studies [35]-[37].

These estimates have found wide application in the study of economic data, which can be represented in the form of time series. The confirmation of the above is the set of works in this direction [38]-[42].

Wavelet coherence estimates make it possible to consider the mutual dynamics at different time horizons, taking into account their depth. This can be the basis for developing a strategy for trading in agricultural products, determining the time to enter the appropriate segment of the stock market.

Below are some of the relationships between quotations for agricultural products that were discussed earlier. These estimates are shown in the form of charts, which indicate the strongest and weakest relationships between the prices of the respective agricultural products. For these purposes, a numerical scale and its color interpretation were used.

The link between quotes for coffee and cotton is characterized by a slight fragmentary degree of strength.

In general, the price relationship for coffee and cotton is weak.

The depth of links between coffee and cotton prices is more significant. This allows us to talk about the possibility of building long-term strategies to replace these goods in trade transactions.

The ratio of price dynamics between cocoa and sugar is more significant than in the previous example.

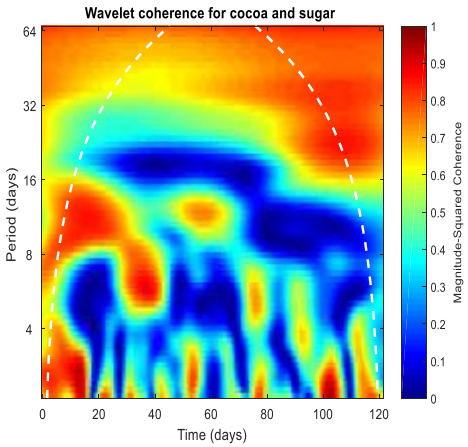

Figure 7: Wavelet coherence between cocoa and sugar data

We see a discreet fragmentation in the strength of links between cocoa and sugar futures quotes. The depth of connections is significantly manifested up to 4 weeks. This determines the depth of possible planning and development of strategies for joint trade in cocoa and sugar.

The ratio of prices for orange juice and sugar and their relationship is also determined by fragmentation. Moreover, weak correlations between quotations for these agricultural commodities prevail here.

International Journal of Academic Management Science Research (IJAMSR)
ISSN: 2643-900X
Vol. 7 Issue 5, May - 2023, Pages: 22-28

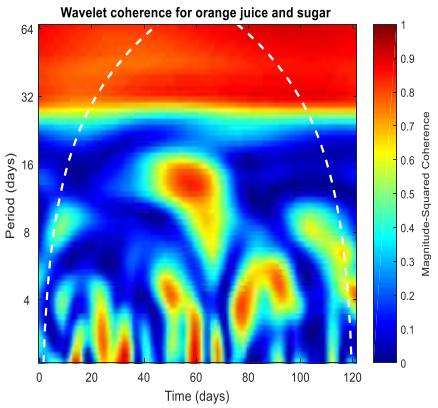

Figure 8: Wavelet coherence estimates for orange juice and sugar

We also see that the strongest correlations between the prices of orange juice and sugar appear in the period 12.12.2021-08.28.2022. This must be taken into account when developing strategies for entering the market, determining the group of goods for such an exit and the possibility of substituting goods one for another.

The dynamics of links between coffee and cocoa quotes is most pronounced in the period from 05.01.2022 to 05.07.2023.

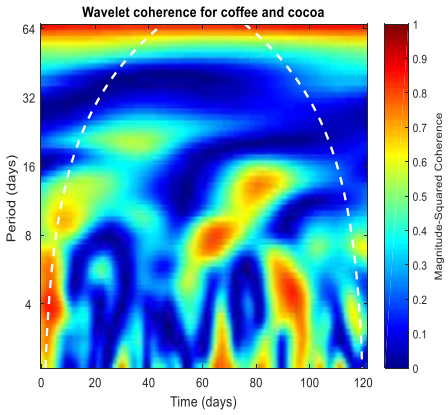

Figure 9: Relationship between coffee and cocoa prices

In this period, we also observe the depth of relationships in coffee and cocoa quotes. Most likely, other factors influenced this dynamics, which must be taken into account when developing a pricing policy and a strategy for state support in the field of agricultural production.

As in the previous case, the relationship between the prices of cotton and orange juice is most significant in a certain period: from 11.07.2021 to 05.07.2023.

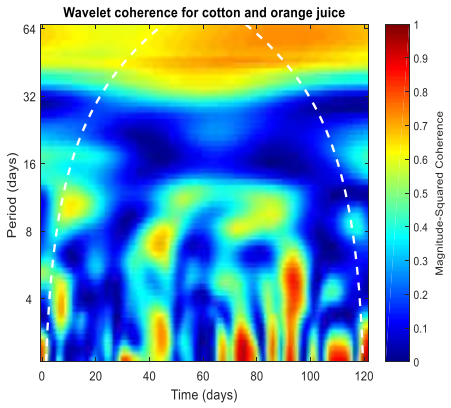

Figure 10: Wavelet coherence between cotton and orange juice prices

However, the relationship presented is fragmentary. In general, such a relationship is insignificant.

The analysis presented above showed the presence of similar trends in the relationship between quotations on futures for a number of agricultural commodities. These trends are characterized by fragmentation of the strongest periods of the relationship between commodity prices, a more significant depth of such relationships and a certain period when such relationships are most pronounced.

5. Conclusion

The paper noted the importance of analyzing data related to the production of agricultural goods. The significance of such a study is determined by the need to achieve an acceptable level of food security.

The analysis of literary sources helped to determine the main directions in the study of the dynamics of prices for agricultural products. To explore these data, we use the classic descriptive statistics approach for the data, which is presented in the form of graphs. This helps reveal major trends in futures prices for coffee, cocoa, sugar, cotton and orange juice.

To study the mutual dynamics of prices for certain types of agricultural products, we use estimates of wavelet coherence. This approach helps to determine the moment of entry into the market, the possibility of substitution of goods, the development of pricing strategies and government support measures.

6. References

[1] Yaacoub, J. P., & et al.. (2020). Security analysis of drones systems: Attacks, limitations, and recommendations. Internet of Things, 11, 100218.

[2] Bonnetain, X., Naya-Plasencia, M., & Schrottenloher, A. (2019). Quantum security analysis of AES. IACR Transactions on Symmetric Cryptology, 2019(2), 55-93.

[3] Jeong, C. Y., Lee, S. Y. T., & Lim, J. H. (2019). Information security breaches and IT security investments: Impacts on competitors. Information & Management, 56(5), 681-695.

[4] Demirkan, S., Demirkan, I., & McKee, A. (2020). Blockchain technology in the future of business cyber security and accounting. Journal of Management Analytics, 7(2), 189-208.

[5] Kuzemin, A., & Lyashenko, V. (2006). Fuzzy set theory approach as the basis of analysis of financial flows in the economical security system. International Journal Information Theories & Applications, 13(1), 45–51.

[6] Matarneh, R., & et al.. (2017). Building robot voice control training methodology using artificial neural net. International Journal of Civil Engineering and Technology, 8(10), 523-532.

[7] Jassar, A. A. (2018). An analysis of QoS in SDN-based network by queuing model. Telecommunications and RadioEngineering, 77(4), 297-308.

[8] Abu-Jassar, A. T. S. (2015). Mathematical tools for SDN formalisation and verification. In 2015 Second International Scientific-Practical Conference Problems of Infocommunications Science and Technology (PIC S&T) (pp. 35-38). IEEE.

[9] Deineko, Zh., & et al.. (2021). Color space image as a factor in the choice of its processing technology. Abstracts of I International scientific-practical conference «Problems of modern science and practice» (September 21-24, 2021). Boston, USA, pp. 389-394.

[10] Omarov, M., Tikhaya, T., & Lyashenko, V. (2019). Internet marketing metrics visualization methodology for related search queries. International Journal of Advanced Trends in Computer Science and Engineering, 8(5), 2277-2281.

[11] Rabotiahov, A., Kobylin, O., Dudar, Z., & Lyashenko, V. (2018, February). Bionic image segmentation of cytology samples method. In 2018 14th International Conference on Advanced Trends in Radioelecrtronics, Telecommunications and Computer Engineering (TCSET) (pp. 665-670). IEEE.

[12] Al-Sherrawi, M. H., & et al.. (2018). Corrosion as a source of destruction in construction. International Journal of Civil Engineering and Technology, 9(5), 306-314.

[13] Lyashenko, V., & et al.. (2018). Defects of communication pipes from plastic in modern civil engineering. International Journal of Mechanical and Production Engineering Research and Development, 8(1), 253-262.

[14] Maksymova, S., & et al.. (2017). Voice Control for an Industrial Robot as a Combination of Various Robotic Assembly Process Models. Journal of Computer and Communications, 5, 1-15.

[15] Слюніна, Т. Л., Бережний, Є. Б., & Ляшенко, В. В. (2007). Розвиток вітчизняної мережі банківських установ: особливості та регіональні аспекти. Вісник ХНУ ім. В. Н. Каразіна. Економічна серія, 755. 84–88.

[16] Sotnik, S., & et al.. (2022). Agricultural Robotic Platforms. International Journal of Academic Engineering Research, 6(4), 14-21.

[17] Дуравкин, Е. В., & Амер, Т. К. А. Д. (2005). Использование аппарата Е-сетей для анализа распределенных программных систем. Автоматика. Автоматизація. Електротехнічні комплекси та системи, (1), 47-51.

[18] Tahseen A. J. A., & et al.. (2023). Binarization Methods in Multimedia Systems when Recognizing License Plates of Cars. International Journal of Academic Engineering Research (IJAER), 7(2), 1-9.

[19] Jassar, A. T. A. (2023). Using 3D modeling systems to create a small portable milling machine controlled by an industrial cloude. Journal of Theoretical and Applied Information Technology, 101(8), 3148-3158.

[20] Mohammad, A, & et al.. (2018). Informational and Structural-Parametric Models of Inductions Micromotors. IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), 13(2), 66-76.

[21] Ляшенко В. В. (2007). Интерпретация и анализ статистических данных, описывающих процессы экономической динамики. Бизнес Информ, 9(2), 108-113.

[22] Vasiurenko, O., & et al.. (2020). Spatial-Temporal Analysis the Dynamics of Changes on the Foreign Exchange Market: an Empirical Estimates from Ukraine. Journal of Asian Multicultural Research for Economy and Management Study, 1(2), 1-6.

[23] Коц, Г. П., Кузьомін, О. Я., & Ляшенко, В. В. (2010). Сучасні методи аналізу функціонування банків: розв'язання проблемних аспектів. Восточно Европейский журнал передовых технологий, 5(3), 48-52.

[24] Lyashenko, V., & et al.. (2021). Mutual Dynamics of Certain Types of Bitcoin: Data from Wavelet Coherence. Journal of Engineering, Technology, and Applied Science, 3(2), 58-65.

[25] Nazlioglu, S., & Soytas, U. (2011). World oil prices and agricultural commodity prices: Evidence from an emerging market. Energy Economics, 33(3), 488-496.

[26] Sands, R., & et al.. (2011). Impacts of higher energy prices on agriculture and rural economies (No. 1477-2017-4002).

[27] Nazlioglu, S., & Soytas, U. (2012). Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis. Energy Economics, 34(4), 1098-1104.

[28] Li, G. Q., & et al.. (2012). Using quantile regression approach to analyze price movements of agricultural products in china. Journal of Integrative Agriculture, 11(4), 674-683.

[29] Czyżewski, B., Matuszczak, A., & Miśkiewicz, R. (2019). Public goods versus the farm price-cost squeeze: shaping the sustainability of the EU's common agricultural policy. Technological and Economic Development of Economy, 25(1), 82-102.

[30] Barichello, R. (2020). The COVID-19 pandemic: Anticipating its effects on Canada's agricultural trade. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 68(2), 219-224.

[31] Taghizadeh-Hesary, F., Rasoulinezhad, E., & Yoshino, N. (2019). Energy and food security: Linkages through price volatility. Energy policy, 128, 796-806.

[32] Yahya, M., Oglend, A., & Dahl, R. E. (2019). Temporal and spectral dependence between crude oil and agricultural commodities: A wavelet-based copula approach. Energy Economics, 80, 277-296.

[33] Fujimori, S., & et al.. (2019). A multi-model assessment of food security implications of climate change mitigation. Nature Sustainability, 2(5), 386-396.

[34] Bai, Y., & et al.. (2021). Cost and affordability of nutritious diets at retail prices: evidence from 177 countries. Food policy, 99, 101983.

[35] Torrence, C., & Webster, P. J. (1999). Interdecadal changes in the ENSO–monsoon system. Journal of climate, 12(8), 2679-2690.

[36] Heil, C.E., & Walnut, D.F. (1989). Continuous and discrete wavelet transforms. SIAM review, 31(4), 628-666.

[37] Lyashenko, V., & et al.. (2021). Wavelet ideology as a universal tool for data processing and analysis: some application examples. International Journal of Academic Information Systems Research (IJAISR), 5(9), 25-30.

[38] Orhan, A., Kirikkaleli, D., & Ayhan, F. (2019). Analysis of wavelet coherence: service sector index and economic growth in an emerging market. Sustainability, 11(23), 6684.

[39] Kirikkaleli, D., & Gokmenoglu, K. K. (2020). Sovereign credit risk and economic risk in Turkey: empirical evidence from a wavelet coherence approach. Borsa Istanbul Review, 20(2), 144-152.

[40] Choi, S. Y. (2020). Industry volatility and economic uncertainty due to the COVID-19 pandemic: Evidence from wavelet coherence analysis. Finance Research Letters, 37, 101783.

[41] Asafo-Adjei, E., & et al.. (2020). Economic policy uncertainty and stock returns of Africa: a wavelet coherence analysis. Discrete Dynamics in Nature and Society, 2020, 1-8.

[42] Rej, S., & et al.. (2022). The role of liquefied petroleum gas in decarbonizing India: fresh evidence from wavelet–partial wavelet coherence approach. Environmental Science and Pollution Research, 29(24), 35862-35883.