

US Financial Sector as a Reflection of Changes in the Prices of Shares of Leading Banks

Mykhailo Bril¹, Y.Y. Kolomiets², Vyacheslav Lyashenko³

¹Department of Public Administration and Economic Policy, Simon Kuznets Kharkiv National University of Economics, Ukraine

²Department of Finance, banking and insurance of economic faculty V.N. Karazin Kharkiv National University, Ukraine

³Department of Media Systems and Technology, Kharkiv National University of Radio Electronics, Ukraine
e-mail: lyashenko.vyacheslav@gmail.com

Abstract: *Market relations cover all areas of economic dynamics; help the interaction of different business entities. This transforms the traditional prevalence of either only the banking sector of the economy or only the stock market. Positive changes are taking place that are transforming the financial sector. This leads to the need for new research, taking into account the territorial and temporal aspects of assessing the dynamics of the respective markets. Based on this, the paper considers the US financial sector. For these purposes, we consider key market shares that reflect the dynamics of the functioning and development of leading banks. The analysis is carried out using classical statistical approaches. As separate characteristics of such consideration, quotations for bank shares and the volume of sales of these shares are studied. We also use wavelet coherence estimates to consider the mutual dynamics of the data, which helps to better understand the ongoing processes in the US financial market. The work presents a lot of graphs and diagrams, wavelet coherence estimates. This makes it possible to evaluate the reliability of the obtained results.*

Keywords— stock; banks; quotes; volume of sales; supply and demand; economic dynamics; financial sector; stock market; statistical analysis; wavelet coherence

1. INTRODUCTION

The economy as a complex object of interaction between various business entities requires financial support for such relationships. This determines the basis of economic dynamics, the continuity of the processes of its implementation and development [1]-[4].

At the same time, an important aspect of the interaction of individual enterprises, firms, different market structures is effective financial support. Thus, the financial market is one of the key links in ensuring the efficiency of economic dynamics, the development of relationships between individual business entities.

The financial market as a special structure in the system of market relations can be based either on the stock market or on the banking services market [5], [6].

In the conditions of developed economic relations, which are formed on the basis of market approaches, we observe a close relationship between such segments of the financial market. In this case, such a manifestation may be expressed in the fact that banking institutions issue shares that are traded on the stock market. This makes it possible to ensure the flow of additional resources to the banking sector, to hedge the occurrence of certain types of risks, to provide additional protection of own capital, and to promote the development of the stock market [7]-[9]. Ultimately, this forms new market interrelations and relations in this market segment.

To implement the relationship between the banking sector and the stock market, shares can be used as one of the

instruments. This type of instrument allows you to track the existing demand and form an appropriate offer for banking services of certain business entities. A reflection of this supply/demand process is the change in the share price and volume of shares traded for each institution.

A necessary condition for ensuring sustainable and effective interaction between banking institutions and the stock market, the development of the financial sector as a whole is constant monitoring and analysis of the relevant supply and demand indicators, which are reflected in the dynamics of share prices. For these purposes, it is advisable to use both classical approaches [10]-[15] and special methods of analysis that have been successfully applied in other areas of knowledge [16]-[24]. This allows you to choose the most effective tools for analysis, to get new results.

It is also advisable to choose a specific area of research, which, for example, will be limited by the territorial framework of the location and functioning of the banking sector, the stock market. As such an object of study, we consider US banking institutions or their associations in the form of financial conglomerates. An important aspect is the choice of the time frame for such consideration. At the same time, it is advisable to analyze the mutual dynamics of the data. This allows you to better understand the ongoing processes, to assess the influence of some factors on others.

Therefore, the purpose of this study is to review the dynamics of the US financial market. Such dynamics is reflected in quotes for a number of key shares of US banking institutions.

2. RELATED WORKS

First of all, it should be said about the many studies that address various issues of the functioning of the US financial sector. These are general issues of the functioning of such a market, and the analysis of the banking sector, and the study of the dynamics of stock prices.

S. Fischer examines in detail the problems of reforming the financial sector [25]. The paper focuses on macroeconomic policy, reforming the system of supervision and control over the activities of financial institutions, including banks. It also analyzes what has already been implemented in the general concept of such a reform, what still needs to be done. It takes into account such issues as: the stability of banks, the supervision of financial institutions and bankruptcy issues.

G. Kou, X. Chao, Y. Peng, F. E. Alsaadi and E. Herrera Viedma consider and analyze the possibility of predicting systemic risks in finance [26]. The authors emphasize the importance of solving such a problem, since systemic risks are the main problem for the financial sector. To do this, we use machine learning methods. A review of such methods is carried out and the choice of a specific approach for the analysis of systemic risks is justified. It also considers ways for further research, analysis of various risks in the activities of banking institutions.

D. Morelli and D. Vioto explore the problem of the relationship between the financial sector and systemic risk [27]. Such an analysis is carried out for data from China, where the insurance market, brokerage services and banks are considered. At the same time, attention is paid to the construction of estimates of such relationships. The work uses the Kolmogorov-Smirnov bootstrap test, various risk measures and statistical inference.

M. Pejić Bach, Ž. Krstić, S. Seljan and L. Turulja explore the possibility of studying financial sector indicators based on big data mining methods [28]. This approach is based on the fact that activity in the field of finance generates many different parameters. Based on extensive literature analysis, the authors determine the best approaches and methods to be used. The issues of ranking data sources, the sequence of their processing in order to obtain the most effective results are also considered.

G. Pino and S. C. Sharma explore the issues of the emergence and spread of risks in the US banking system [29]. The authors note that such risks are local and do not pose a threat to the entire banking sector. At the same time, the local distribution of risks is determined by the similar sizes of banks and the rules by which they operate. The analysis uses spatial econometrics and covers the data period from 2001 to 2012.

The work of N. Ahmad, A. Naveed, S. Ahmad and I. Butt summarizes the issues of profitability and efficiency of the banking sector based on a critical analysis of existing literature sources [30]. The authors note that boundary analysis, parametric and non-parametric approaches are used to study

banking indicators. These are such methods as stochastic boundary analysis, data coverage analysis [30].

P. Carmona, F. Climent and A. Momparler substantiate the possibility of predicting the bankruptcy of US banking institutions [31]. The authors explore the factors for predicting the emergence and development of banking crises. For this, data from 2001 to 2015 are used. At the same time, 156 US banks are considered. To build forecasts, the method of extreme gradient increase was used. The results obtained allow us to build and choose the most effective strategies for the development of the banking sector.

M. Elnahass, V. Q. Trinh and T. Li study the stability of the banking sector in the context of COVID-19 [32]. The paper considers 1090 banks from 116 countries. The basis of the analysis is an assessment of the impact of the pandemic on the key performance indicators of banks. The results are shown to be stable for US and Chinese banks. Such a study is based on the study of trends in the average indicators of different banks and their comparison with each other. Thus, a necessary component is the consideration of the mutual dynamics of various data from the field of banking services.

H. Balani conducts an empirical analysis related to the valuation of bank shares [33]. However, such analysis is carried out in the context of money laundering. At the same time, the effectiveness of banking regulation is considered. The study was conducted on the basis of cross-sectional regression analysis, which also used the territorial distribution of banks. The article shows that larger banks have higher costs and lower profits.

W. Thorbecke studies the impact of COVID-19 on the US financial sector and the economy as a whole [34]. The analysis is based on stock market data. In particular, the profitability of shares is considered. The study also evaluates the influence of various factors and concludes that macroeconomic recovery is important.

In a study by E. K. Chowdhury, B. K. Dhar and A. Stasi, the volatility of the US stock market is studied [35]. The work uses such models as Event Study, Stepwise Regression and Vector Autoregression (VAR) [35]. The authors determined the existence of a long-term relationship between the variables being studied. This confirms the need to analyze the mutual dynamics of the data.

We see that the study and analysis of the financial sector is a relevant and popular topic. Such studies are multifactorial and multidirectional. Common in such studies is a certain grouping of data and consideration of their mutual dynamics.

3. DESCRIPTIVE CHARACTERISTICS OF THE SELECTED DATA FOR THE STUDY

In our study, we study the US financial sector. Based on this, we consider US banks, which are reflected in such an instrument of the stock market as shares. At the same time, we analyze the best banking stocks. The time horizon is the period from January 3, 2021 to August 13, 2023. The data is presented

in their weekly average and taken from the website www.investing.com. Among the stocks that we will explore are:

Bank of America Corp (BAC) securities. This is an American financial conglomerate. It provides a variety of financial services to individuals and legal entities. It is one of the four largest banks in the US. Average earnings per share \$3.5. Average sales volume for three months 44170190 shares;

Comerica Inc. (CMA). This is a Texas financial company, the basis of which is the activity of the bank of the same name. Average earnings per share \$9.64. Average sales volume as of August 13, 2023 – 2882402 shares in three months;

F.N.B. Corp (FNB) is a diversified financial services corporation (Pennsylvania). The basis of the corporation is First National Bank. The average sales volume of shares is 2057897 units. Earnings per share – \$1.57;

First Republic Bank (FRCB) is an American commercial bank based in San Francisco. Profit per share – 7.53 US dollars. Average sales volume – 5454939 shares in three months;

Home BancShares Inc (HOMB) represents Centennial Bank, a bank holding company based in Conway, Arkansas. The average sales volume is 1081646 shares. The average price per share as of August 13, 2023 is \$2.12;

International Bancshares Corporation (IBOC) is a bank holding company based in Laredo, Texas. The main company is the International Commercial Bank. Average earnings per share \$6.29. The average sales volume is 216968 shares.

Among the key features of the presented types of securities, positive values of earnings per share should be highlighted. We also note the fact that such shares represent some financial conglomerates, where a certain bank plays a key role. Therefore, we believe that these indicators reflect the performance of the respective bank.

4. QUOTES OF THE BEST BANKING STOCKS FROM THE US FINANCIAL SECTOR CLUSTER

The figures below show the dynamics of stock quotes for Bank of America Corp, as well as the volume of securities sold. We see that the share price initially (until January 30, 2022) has a positive trend. Then the quotes go down. In the past three weeks, we have seen a slight increase in shares of Bank of America Corp.

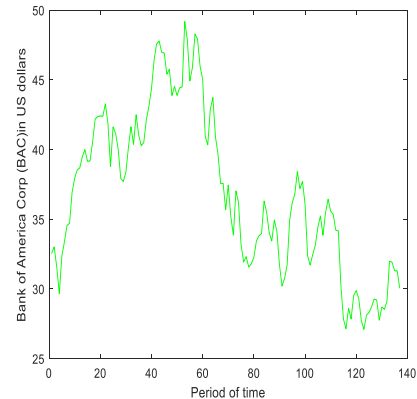


Figure 1: BAC stock price

The volatility of BAC stock quotes is significant, reflecting the overall supply/demand trend.

However, earnings per share remain positive. This can be explained by the significant volume of sales and the generally positive dynamics of such a process.

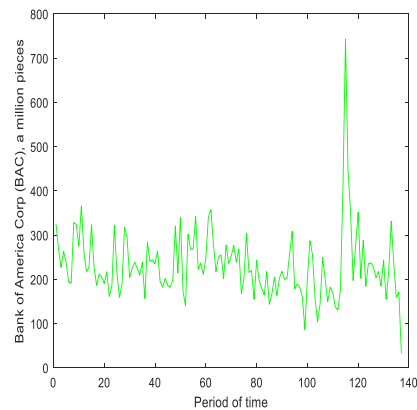


Figure 2: Sales volume for Bank of America Corp

The volume of sales of shares for BAC also has significant volatility over the entire studied time interval. On March 12, 2023, there is the largest surge in securities sales boom for Bank of America Corp. This is due to the fact that in this period there was the lowest quotation for shares - 27.82 US dollars.

Securities quotes for Comerica Inc. (CMA) differ from the data for the previous bank. The manifestation of such a difference is observed in a lesser degree of data volatility. At the same time, the highest value of the share price falls on January 9, 2022.

Further (see Fig. 3) we see a decline in prices. But this decline is not drastic. Starting from June 25, 2023, quotes are growing. This fact can be taken into account in the planning of the bank's activities.

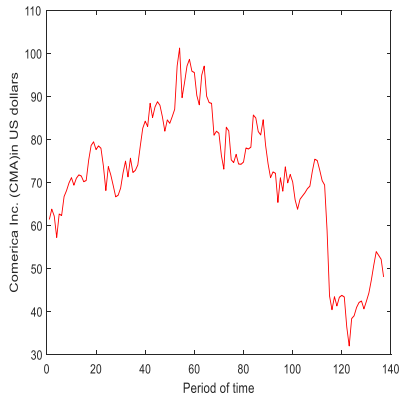


Figure 3: CMA stock quotes

Dynamics of sales volumes of Comerica Inc. also somewhat different from the previous case. This can be seen by comparing the data in Fig. 2 and Fig. 4.

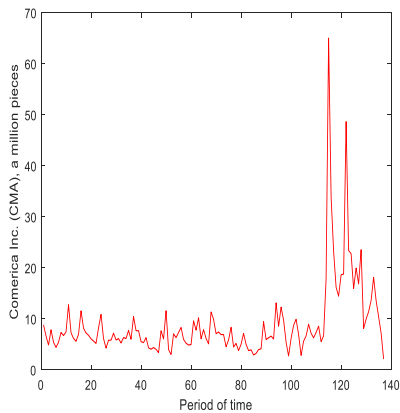


Figure 4: Selling CMA shares on a weekly average

In general, stable sales volumes for Comerica Inc since March 12, 2023 have had a number of spikes (see Fig. 4). At the same time, we see that such bursts are fading (sales volumes are gradually decreasing). Making some intermediate conclusions about the US financial sector, we can say that approximately the same factors influence here. This is primarily manifested in the trends in stock prices. Moreover, such trends are observed in the same time intervals.

Below is the data for F.N.B. Corp (FNB).

General presentation of quotes for F.N.B. Corp is different from the one discussed earlier.

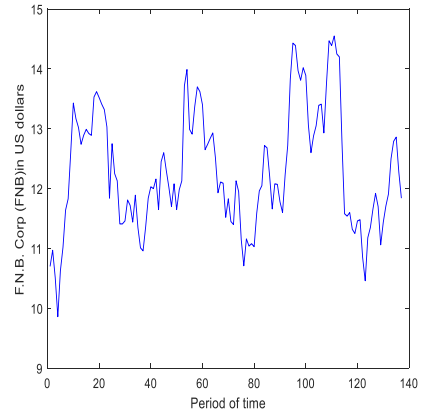


Figure 5: Stock price for F.N.B. Corp

We note a change in F.N.B. Corp in the form of a wave process. When there is an alternation of rising prices with their decrease. At the same time, several maxima of price growth can be distinguished, as well as its lowest values. In the last 3-4 weeks there has been an increase in quotations. This dynamic allows us to maintain earnings per share in a positive range of change.

FNB sales volumes are highly volatile. The data for Bank of America Corp. in some way reminds of its dynamics.

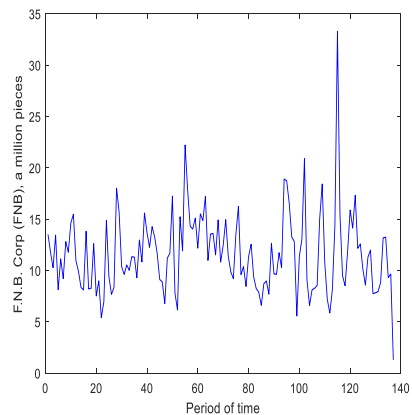


Figure 6: FNB stock sales volumes

The largest sales volume of FNB shares was on March 12, 2023. Next, we see the stabilization of the sale of securities, which returns to the standard norms of this business entity. However, since July 16, 2023, the sales volume has been sharply declining.

The dynamics of quotations for First Republic Bank (FRCB) also differs from that discussed above.

This one can be represented as a modified and inverted parabola. However, there is also a clear high on December 26, 2021. Therefore, we see the influence of the same factors on the functioning of the US financial sector.

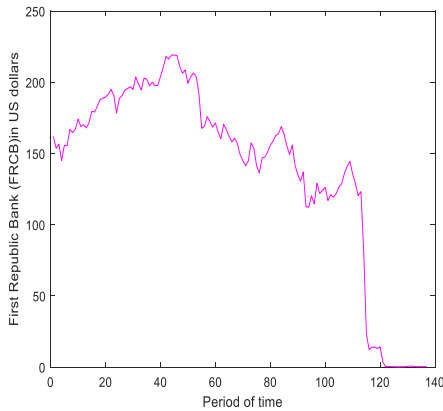


Figure 7: Meaning of FRCB share prices

It should also be noted the sharp decline in quotations since April 30, 2023.

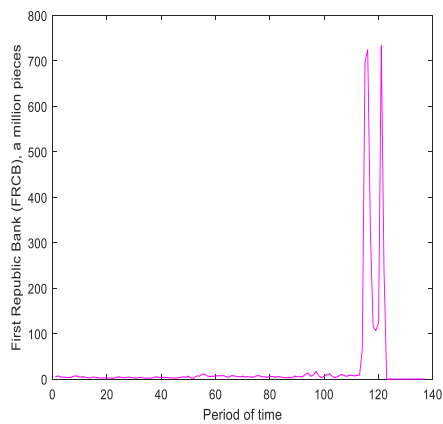


Figure 8: FRCB stock sale dynamics

The generally negligible sales volume for FRCB has seen a significant spike since March 12, 2023. However, this recovery in sales was insignificant and begins to fade from May 7, 2023. Here we see a characteristic surge in share sales volumes for a number of banks considered.

Stock quotes for Home BancShares Inc (HOMB) are a damping wave characterized by negligible interim volatility. We can observe several highs and lows. At the same time, the first absolute maximums, as for other banks, fall on December 2021 and January 2022.

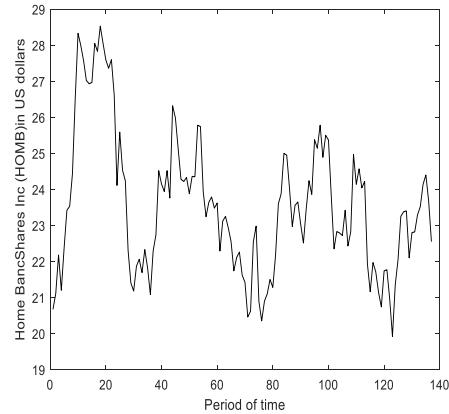


Figure 9: Home BancShares Inc stock price performance

Shown in Fig. 9 is somewhat similar to the data for F.N.B. Corp. The main difference lies in the trends. For F.N.B. Corp, we can talk about an increasing wave. In the case of Home BancShares Inc, it is about a damped wave.

Share volumes for Home BancShares Inc are generally on the rise, although we are talking about averaged weekly volumes (not cumulative).

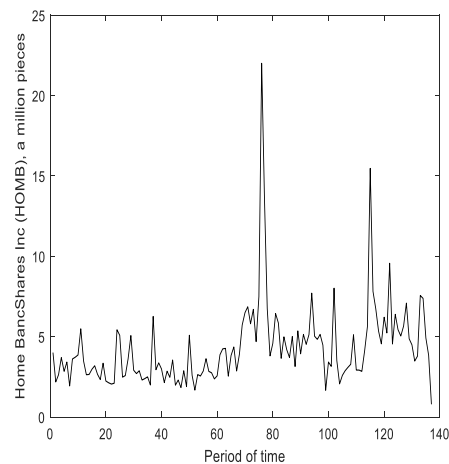


Figure 10: Sales of shares of Home BancShares Inc.

There are two significant spikes in sales here. The first falls on June 12, 2002, the second on March 12, 2023. We also note a significant drop in sales in the first weeks of August 2023. This information is important in making investment strategies and entering the market.

Stock quotes of International Bancshares Corporation (IBOC), as well as their sales volumes against the background of general trends, also have their own specifics. A characteristic manifestation of this specificity is the presence of regular bursts during the sale of shares.

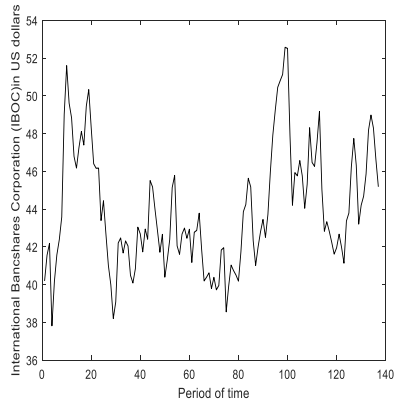


Figure 11: IBOC share price

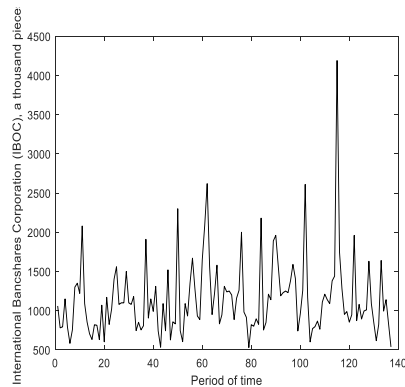


Figure 12: IBOC stock sales dynamics

On the whole, we can say that the above data generally reflect the general dynamics of the development of the US financial market. On the one hand, this is confirmed by the considered indicators for a number of leading banking stocks. On the other hand, we can note that the presented parameters of securities change under the influence of the same factors, which is manifested in the trends and timing of the changes that occur.

Nevertheless, it is also advisable to consider the mutual dynamics of the above parameters of shares. This will allow a more detailed understanding of the development of the relevant financial market.

5. MUTUAL TRENDS OF INDIVIDUAL CHARACTERISTICS OF LEADING BANKING STOCKS

One approach that is used to analyze mutual trends is wavelet coherence estimates [36]-[42]. In this case, we can consider mutual trends for indicators of one business entity or different ones. Below are some of the results of these comparisons.

First, let's look at an example of mutual trends from the point of view of different companies. Based on the fact that

stock quotes reveal the dynamics of the functioning of individual segments of the financial market, let's consider their relationship between BAC and CMA.

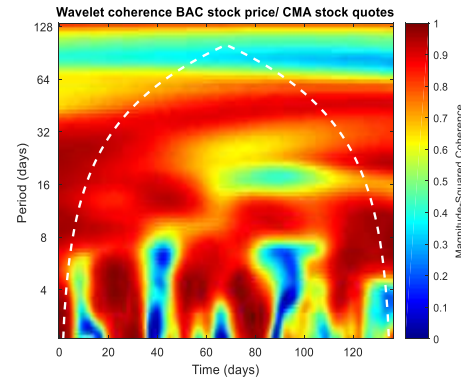


Figure 13: Assessing the Equity Price Relationship Between BAC and CMA

We see that the values of the wavelet coherence estimates are significant and effective (Fig. 13). The same is true for the depth of connections between BAC and CMA, which allows building optimistic strategies for working on the stock market. You can also talk about the balance of the US financial market, the influence of the same factors.

Another example is the consistency of share price links for FNB and Home BancShares Inc.

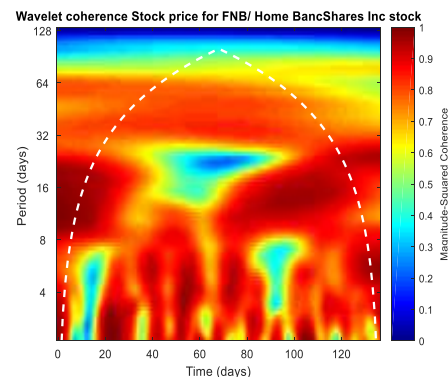


Figure 14: Wavelet Coherence of Stock Quotes for FNB and Home BancShares Inc

Here we also note significant consistency scores, as in the previous example. Moreover, we see that the distribution of such estimates is approximately the same. This once again confirms the thesis about the impact of the same factors of influence on the US financial market.

The following figures show estimates of wavelet consistency from the point of view of one business entity, but for such two of their parameters as stock price and sales volume.

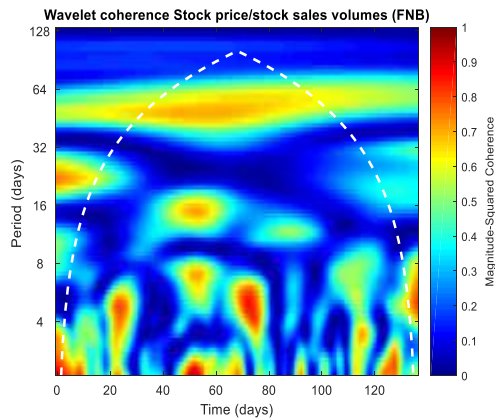


Figure 15: Consistency data for F.N.B. Corp

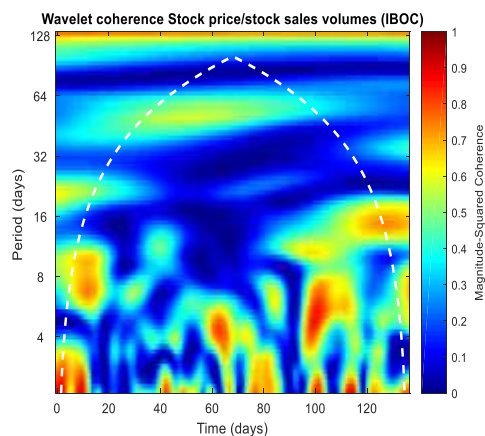


Figure 16: Wavelet consistency evaluation for IBOC data

In the classical sense of wavelet coherence, we see fragmentary consistency. But we must take into account the fact that such consistency implies the same direction of trends of different parameters. In our case, we should take into account that such trends can be multidirectional. This is both typical for share price and sales volume. Thus, we can talk about the consistency of the data presented in Fig. 15 and Fig. 16. This also speaks to the efficiency of the US financial sector.

6. CONCLUSION

The paper considers certain issues of the development of the US financial market. Such an analysis was carried out on the basis of a study of quotations for leading banking shares.

The general aspects of the development of the US financial sector are considered on the basis of the classical analysis of stock quotes and sales volumes in the context of individual business entities. This made it possible to conclude that the financial market is balanced and that the same factors influence its functioning.

The analysis of the mutual dynamics of different indicators was studied on the basis of the method of constructing wavelet coherence estimates. This confirmed the thesis about the stability of the development of the US financial market, its balance.

7. REFERENCES

- [1] Kuzemin, A., & et al.. (2005). Analysis of movement of financial flows of economical agents as the basis for designing the system of economical security (general conception). In Third international conference «Information research, applications, and education (pp. 27-30).
- [2] Kalecki, M. (2013). Theory of economic dynamics (Vol. 6). Routledge.
- [3] Sukharev, O., & Voronchikhina, E. (2020). Financial and non-financial investments: Comparative econometric analysis of the impact on economic dynamics. *Quantitative Finance and Economics*, 4(3), 382-411.
- [4] Martcheva, M., Tuncer, N., & Ngonghala, C. N. (2021). Effects of social-distancing on infectious disease dynamics: an evolutionary game theory and economic perspective. *Journal of Biological Dynamics*, 15(1), 342-366.
- [5] Boisjoly, R. P., Conine Jr, T. E., & McDonald IV, M. B. (2020). Working capital management: Financial and valuation impacts. *Journal of Business Research*, 108, 1-8.
- [6] Jünger, M., & Mietzner, M. (2020). Banking goes digital: The adoption of FinTech services by German households. *Finance Research Letters*, 34, 101260.
- [7] Bustos, O., & Pomares-Quimbaya, A. (2020). Stock market movement forecast: A systematic review. *Expert Systems with Applications*, 156, 113464.
- [8] Shah, D., Isah, H., & Zulkernine, F. (2019). Stock market analysis: A review and taxonomy of prediction techniques. *International Journal of Financial Studies*, 7(2), 26.
- [9] Adam, K., Marcet, A., & Nicolini, J. P. (2016). Stock market volatility and learning. *The Journal of finance*, 71(1), 33-82.
- [10] Lyashenko, V. (2014). Efficiency of bank crediting of real sector of economy in the context of separate banking groups: an empirical example from Ukraine. *International Journal of Accounting and Economics Studies*, 2(2), 74- 79.
- [11] Kuzemin, A., & Lyashenko, V. (2009). Methods of comparative analysis of banks functioning: classic and new approaches. *Information Theories & Applications*, 16(4), 384-396.
- [12] Baranova, V., & et al.. (2019, October). Stochastic Frontier Analysis and Wavelet Ideology in the Study of Emergence of Threats in the Financial Markets. In 2019 IEEE International Scientific-Practical Conference

- Problems of Infocommunications, Science and Technology (PIC S&T) (pp. 341-344). IEEE.
- [13] Ляшенко В. В. (2007). Інтерпретація і аналіз статистических даних, описуваючих процеси економічної динаміки. *Бізнес Інформ*, 9(2), 108-113.
- [14] 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.
- [15] 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.
- [16] 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.
- [17] 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.
- [18] 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.
- [19] 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.
- [20] Sotnik, S., & et al.. (2017). System model tooling for injection molding. *International Journal of Mechanical Engineering and Technology*, 8(9), 378-390.
- [21] Lyashenko, V. V., Babker, A. M. A. A., & Kobylin, O. A. (2016). The methodology of wavelet analysis as a tool for cytology preparations image processing. *Cukurova Medical Journal*, 41(3), 453-463.
- [22] Дуравкин, Е. В., & Амер, Т. К. А. Д. (2005). Использование аппарата E-сетей для анализа распределенных программных систем. *Автоматика. Автоматизация. Електротехнічні комплекси та системи*, (1), 47-51.
- [23] Jassar, A. T. A., Al Salaimh, S., & Al Hababsah, M. S. (2021). Improved Algorithm For Creating An Optimized Network Diagram. *TEST Engineering & Management*, 108-115.
- [24] Khan, A., & et al.. (2015). Some Effect of Chemical Treatment by Ferric Nitrate Salts on the Structure and Morphology of Coir Fibre Composites. *Advances in Materials Physics and Chemistry*, 5(1), 39-45.
- [25] Fischer, S. (2014). Financial sector reform: How far are we. *NBER Reporter*, (3), 1-8.
- [26] Kou, G., & et al.. (2019). Machine learning methods for systemic risk analysis in financial sectors.
- [27] Morelli, D., & Vioto, D. (2020). Assessing the contribution of China’s financial sectors to systemic risk. *Journal of Financial Stability*, 50, 100777.
- [28] Pejić Bach, M., Krstić, Ž., Seljan, S., & Turulja, L. (2019). Text mining for big data analysis in financial sector: A literature review. *Sustainability*, 11(5), 1277.
- [29] Pino, G., & Sharma, S. C. (2019). On the contagion effect in the US banking sector. *Journal of Money, Credit and Banking*, 51(1), 261-280.
- [30] Ahmad, N., Naveed, A., Ahmad, S., & Butt, I. (2020). Banking sector performance, profitability, and efficiency: a citation-based systematic literature review. *Journal of Economic Surveys*, 34(1), 185-218.
- [31] Carmona, P., Climent, F., & Momparler, A. (2019). Predicting failure in the US banking sector: An extreme gradient boosting approach. *International Review of Economics & Finance*, 61, 304-323.
- [32] Elnahass, M., Trinh, V. Q., & Li, T. (2021). Global banking stability in the shadow of Covid-19 outbreak. *Journal of International Financial Markets, Institutions and Money*, 72, 101322.
- [33] Balani, H. (2019). Assessing the introduction of anti-money laundering regulations on bank stock valuation: an empirical analysis. *Journal of Money Laundering Control*, 22(1), 76-88.
- [34] Thorbecke, W. (2020). The impact of the COVID-19 pandemic on the US economy: Evidence from the stock market. *Journal of Risk and Financial Management*, 13(10), 233.
- [35] Chowdhury, E. K., Dhar, B. K., & Stasi, A. (2022). Volatility of the US stock market and business strategy during COVID-19. *Business Strategy & Development*, 5(4), 350-360.
- [36] Torrence, C., & Webster, P. J. (1999). Interdecadal changes in the ENSO–monsoon system. *Journal of climate*, 12(8), 2679-2690.
- [37] Heil, C.E., & Walnut, D.F. (1989). Continuous and discrete wavelet transforms. *SIAM review*, 31(4), 628-666.
- [38] Kingsbury, N. (1999). Image processing with complex wavelets. *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences*, 357(1760), 2543-2560.
- [39] Vasiurenko, O., & Lyashenko, V. (2020). Wavelet coherence as a tool for retrospective analysis of bank activities. *Economy and forecasting*, (2), 32-44.
- [40] Omarov, M., & et al.. (2019). Internet marketing metrics visualization methodology for related search queries. *International Journal of Advanced Trends in Computer Science and Engineering*, 8(5), 2277-2281.

- [41] 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.
- [42] Shahbaz, M., & et al.. (2021). Relationship between green investments, energy markets, and stock markets in the aftermath of the global financial crisis. *Energy Economics*, 104, 105655.