

# Analysis of the Dynamics of Prices for Shares of Leading IT Companies: IBM, Intel, Apple, Microsoft, Casio Computer Co.

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**Abstract:** Analysis and comparison are research tools that allow you to consider various trends and make the necessary informed decisions. Currently, much attention is paid to IT technologies that contribute to the development of business entities, the introduction of new processes, and the formation of an innovative paradigm. This allows us to talk about the importance of IT companies in the formation of sustainable economic development, relationships between contractors and partners. Most of these companies are listed on the stock market where their securities are located. The display of such an appeal is the dynamics of prices for the relevant shares. The paper considers quotes for shares of leading high-tech companies. To do this, we use standard statistical methods, a quantitative comparison procedure, and wavelet theory. As a result of the analysis, we obtained various dependencies and data estimates, which are presented in the form of stock prices. The findings allow us to understand the dynamics that exist in the IT companies market. We can also develop approaches to the choice of investment strategies when implementing innovative solutions. The article contains many figures and diagrams. This helps to understand the progress of the research.

**Keywords—**price; dynamics; analysis; stock; comparison; IT-company; securities; stock market; wavelet analysis; wavelet coherence

## 1. INTRODUCTION

Technological processes cover all areas and directions [1], [2]. The development of a modern enterprise, a company is impossible without high-tech solutions, non-standard approaches to their justification. Such innovations make it possible to modernize and improve production, increase labor efficiency, and make the necessary and balanced conclusions in real time. All this necessitates the introduction of new IT technologies [3], [4]. It is advisable to carry out the effective formation and implementation of these technologies within the framework of a single economic entity that is engaged in the development of a certain direction. This determines the relevance of this study.

IT technologies and their development by a separate company are becoming a key element in the stable support of economic relations. One of the areas in which these business entities are engaged is the development and support of software. This allows you to develop and implement any innovative solutions with the specified parameters and conditions for their operation. This increases the importance of such IT companies that have their own quotes on the securities market [5]-[7]

The importance of technology companies is determined by their demand, which is reflected in the price dynamics of the respective shares. These securities are freely circulating on the market, which makes it possible to evaluate both the functioning of the relevant business entities and the effectiveness of their implementation, innovative proposals.

Various procedures and methods are used for these purposes [8]-[19]. As a result, you can choose the most suitable subject for investment or a potential partner, justify investment strategies, and choose the most appropriate innovative solutions.

Thus, the main purpose of this work is to study the behavior of quotations for the shares of major IT companies. To solve this problem, it is advisable to consider the dynamics of prices for a number of high-tech business entities, to compare such indicators with each other. This will reveal the main trends in the development of the high-tech market; form an approach to justify the choice of investment strategies.

## 2. RELATED WORKS

Confirmation of the importance of the chosen research topic is a lot of different works. These works concern both general issues of the functioning of the securities market of high-tech companies and the analysis of quotations of certain types of shares of such issuers.

The study by R. E. Carpenter and B. C. Petersen is devoted to the consideration of general issues of functioning and imperfections of the stock market [20]. At the same time, one of the directions of such an analysis is investment in advanced technologies through the securities market. The problematic aspects of introducing such innovations are based on excessive volatility in stock returns and insufficiently accurate information. The asymmetry of information lies in the absence of comparative analysis estimates between different types of shares of IT companies. An important aspect of this comparison is the size of the respective economic entities.

Therefore, in our work, we will analyze the leading companies that are associated with computer technology and software development.

U. Ozmel, D. T. Robinson and T. E. Stuart explore the effectiveness of investing in technology firms at the initial stages of their development [21]. The authors consider venture capital and alliances as an object of analysis. This work examines various start-ups and their entry into the securities market, evaluates the effectiveness of raising capital. The process of transformation of private capital into public capital, the impact of such a change on the profitability of the company's securities is investigated. The results substantiate the importance of the initial public offering, the choice of potential partners.

A. Anderson, J. Park and S. Jack analyze the relationship between social and entrepreneurial capital in the formation of prices for shares of high-tech enterprises [22]. The authors conduct a comprehensive comparative analysis of literary sources. This allows us to substantiate the main provisions of the theoretical basis for the study of the concept of capital from the point of view of IT companies. The paper also presents the results of empirical studies on such mutual influence. The role of mutual funds in the development of technology firms is emphasized.

The work of M. K. Khan, S. Zulfiqar and A. Hussain is devoted to innovations in high technologies and investments in IT companies [23]. The authors examine the impact of existing financial constraints on the development of technology firms. For example, Chinese business entities are selected. The article examines the relationship between the profitability of companies and cash flows in the securities market, where their shares are traded. The authors note that there are a number of financial constraints that do not allow attracting sufficient resources.

This harms the development of innovative technologies and the attraction of new investment funds. As a conclusion: the markets are inefficient, holding back the growth of liquidity.

V. Revest and A. Sapio explore the issues of financial support for small IT firms [24]. Such a review is carried out for European companies. These are mainly business entities that work with TBSF technologies. It also takes into account the asymmetry of the information received about the possibilities of raising funds in the form of equity or venture capital. A comparison is also made with US firms. Thus, the paper emphasizes the role of cross-comparison of data. The conclusion is made about the need to use preferential taxation.

The article by D. Zeghal and A. Maaloul is devoted to the study of the impact of value added on the activities of technology firms [25]. The paper uses the value added coefficient method, which allows you to evaluate the financial and stock performance of IT companies. The study also uses correlation and linear-multiple regression analysis [25]. British business entities were chosen as the object of study. The

authors note that the proposed methodology for evaluating IT companies can be a good tool to justify decision making.

In [26], the dynamics of quotations in the stock market is studied. The basis of such a study is the analysis of prices for shares of IBM. The authors use the method of critical fluctuations to substantiate the discontinuity of the indicators of the IBM IT company. A period of 20 years is considered based on the study of self-similar patterns. The Dow-Johnson index is studied in a similar way. Mutual analysis allows to obtain explicable results. It is concluded that the dynamics of IBM stock quotations and the index have the same nature with critical characteristics [26]. The presented methodology allows obtaining new results.

N. P. Singh analyzes the development opportunities of a number of IT firms [27]. Such analysis is carried out in the field of business analytics. Strategies for the growth of economic entities in the field of high technologies are being studied. This is important for understanding market expansion. The researcher is based on the main provisions of game theory.

R. I. Dzerjinsky, B. A. Krynetsky and N. V. Chernorizova conduct a comprehensive analysis of changes in the Japanese stock exchange index [28]. A special place in this study is given to the shares of Casio Computer Corporation. The authors reveal hidden periodicities in the studied data. For this, the Gompert model is used. The paper reveals the stages of changes in quotations, their growth and fall. Indicators of intensive growth and development have also been identified. An important point of such an analysis is cross-valuations.

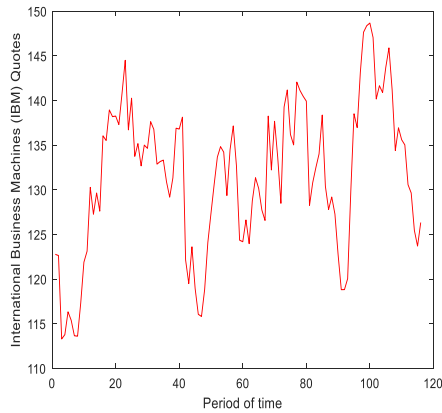
Y. Kazuno, H. Masuda and T. Arai study the features of the development of high-tech enterprises [29]. For these purposes, a multi-regional model is used that takes into account different factors and conditions for the development of IT companies. The article also reveals a system dynamics model that is able to predict future changes in the markets. This allows you to determine the necessary development strategies, subject to changes in market scenarios for entering certain segments.

And so, we see a wide range of areas in the study of the dynamics of quotations for the shares of various IT companies. At the same time, different approaches and theories are used to conduct relevant research. Changes and rapid development of the IT industry determines the ongoing analysis of key indicators of individual companies and firms, which are reflected in the dynamics of prices for their shares.

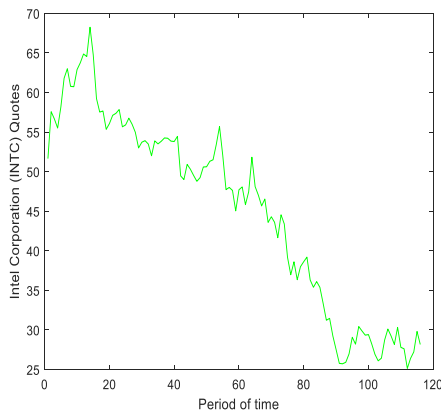
### 3. STOCK QUOTES OF LEADING IT COMPANIES AS AN OBJECT OF STUDY

For further analysis, we will consider the change in prices for shares of leading IT companies. Among such firms we single out: International Business Machines (IBM); Intel Corporation (INTC); Apple Inc (AAPL); Microsoft Corporation (MSFT) and Casio Computer Co., Ltd. (6952). The activities of these business entities are related to computer technology and software development.

Later in this section, in Fig. 1 – Fig. 5 shows charts of stock quotes for the companies we will explore. All data are presented on a weekly average, from January 2021 to the present (<https://investing.com/>).



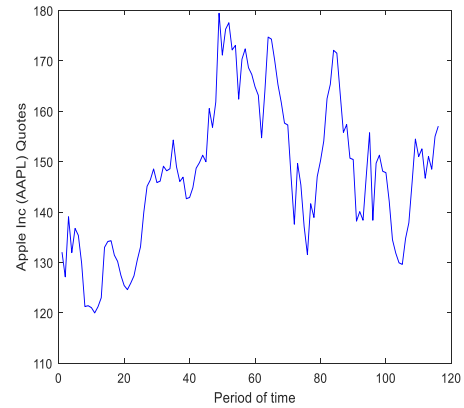
**Figure 1:** International Business Machines (IBM) stock quotes



**Figure 2:** Intel Corporation (INTC) stock price performance

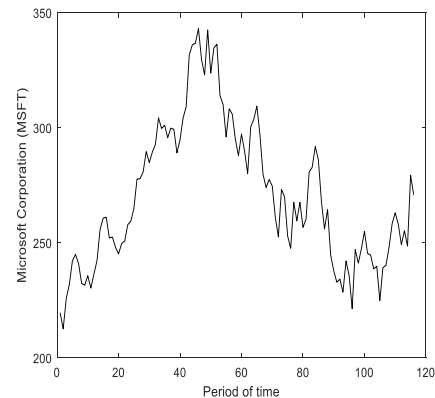
In a comparative aspect, the data in Fig. 1 and Fig. 2 are fundamentally different from each other.

In the first picture, we can see a changeable trend in quotes, and in the second picture, we see a declining trend, which indicates a decrease in the price of shares of Intel Corporation (INTC). Moreover, the first figure shows the significantly variable volatility of International Business Machines (IBM) quotes. There are several highs and lows here. In the period from 01.01.2023 to 19.03.2023, there is a decrease in the price of IBM shares. There is one characteristic maximum in the second figure. It falls on 04.04.2021. In the first quarter of 2023, we note the volatility of INTC quotes.



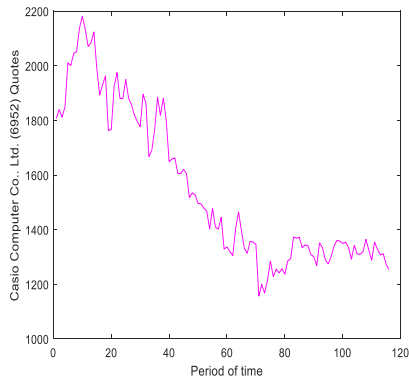
**Figure 3:** Shares of Apple Inc (AAPL)

AAPL price changes can be compared to IBM prices. But this applies only to the general circuit, starting from 02.06.2022. In smaller details, we see a significant difference. In particular, in the third figure, one can see one characteristic maximum, which falls on 14.11.2021. In the first figure, the largest maximum value falls on 08.01.2023.



**Figure 4:** Microsoft Corporation (MSFT) quotes

MSFT stock prices differ from the previous quotes, which we have already considered earlier. In the period from 01/01/2021 to 12/05/2021, a significant increase in values for Microsoft Corporation should be noted. Then there is a decline with slight periods of growth. It should also be noted that there is a significant variability in the dynamics of the data presented in Fig. 4.



**Figure 5:** Stock prices of Casio Computer Co. Ltd. (6952)

Quotes for Casio Computer Corporation are constantly declining from 01.01.2021 to 19.03.2023. This is reminiscent of trends for Intel Corporation (INTC). The greatest coincidence is typical for the period from 01.01.2021 to 09.05.2021. Next, we observe the difference in individual details. This can be seen the most from 24.07.2022 to 19.03.2023.

In general, we emphasize that all the share prices discussed above have their own characteristics and differences.

This allows you to form individual investment strategies based on the available information. For a more accurate compilation of such plans, it is also necessary to consider the ratio of such prices and their mutual dynamics.

#### 4. EQUITY PRICE RATIO AS AN ELEMENT OF ANALYSIS

The analysis of the ratio in the dynamics of data should be considered one of the elements of the study. These indicators can provide new information about the situation that is developing and help in understanding current trends. At the same time, we can do this both for absolute values and for normalized data [30], [31].

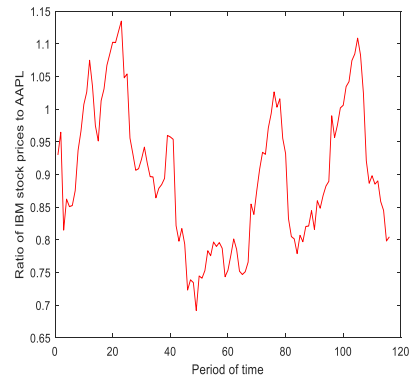
In the first case, we are talking about data from one range of values. In the second case, these are data that differ significantly from each other or are presented in different scales of their measurement.

Below we show some examples of such research.

Let's consider the first case first.

We see a variable dynamic in IBM's relationship with AAPL. It should be noted that the values for AAPL mostly exceed those for IBM.

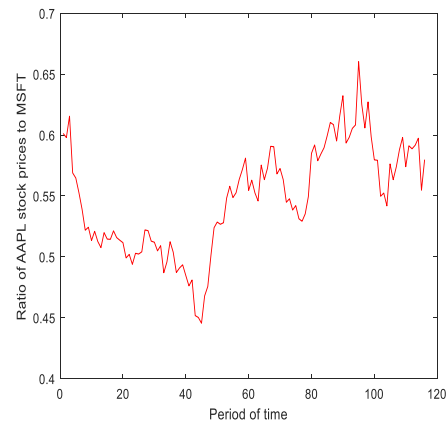
The price of IBM shares was higher during the period from 21.03.2021 to 18.07.2021, 12.06.2022 to 26.06.2022 and from 06.11.2022 to 08.01.2023.



**Figure 6:** Ratio of IBM stock prices to AAPL

In other periods, the AAPL pricing policy prevails.

This data allows us to optimize the strategy for entering the securities market of high-tech companies that operate in the field of computer technology.



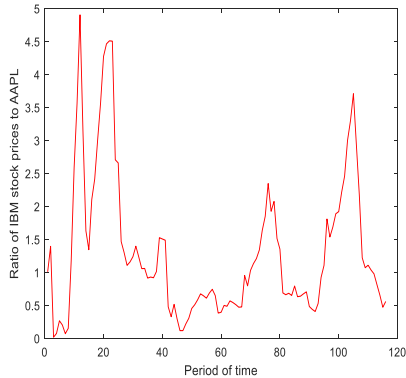
**Figure 7:** Ratio of AAPL stock prices to MSFT

The price ratio for AAPL and MSFT is highlighted by the prevailing pricing policy of Microsoft Corporation shares. The maximum values of this superiority fall on 12.09.2021 and 19.09.2021. The lowest values fall on 11.09.2022 and 18.09.2022.

Now let's look at some examples with normalized data. For the analysis to be meaningful, consider the same data ratios for technology stocks that were presented in figures six and seven.

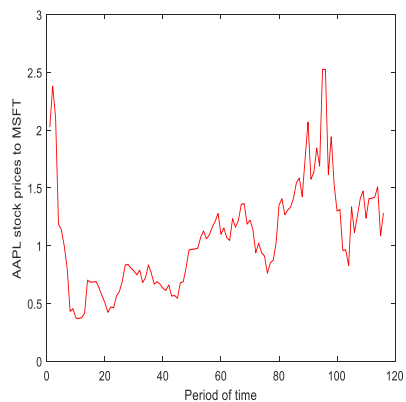
We first note the difference in how prices are displayed between IBM and AAPL for data in figures 6 and 8.

Detailed analysis reveals some overlap in quotes for IBM and AAPL shares.



**Figure 8:** Analysis of normalized data for IBM to AAPL

However, we highlight the dominance of International Business Machines stock prices. Therefore, the data in Fig. 6 and Fig. 8 help to more accurately determine the investment strategy of investing in the securities of the above firms.



**Figure 9:** Normalized price ratio of AAPL and MSFT

The data in figures 7 and 9 also differ from each other in their dynamics, as in the previous case. We see Apple Inc shares outperforming MSFT. But we can also identify areas where there is commonality in the data of the seventh and ninth figures.

In our opinion, the sequence of data changes, without reference to their absolute or relative values, is of interest. This allows you to assess the direction of the overall change in indicators. This also takes into account transitions in data dynamics. Then we can talk about the coincidence or mismatch in the quotes for the shares of IT companies.

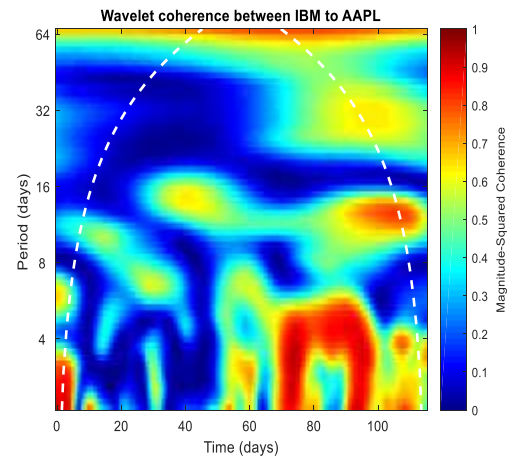
### 5. WAVELET COHERENCE ESTIMATES AS A TOOL FOR DATA COMPARISON

To study the mutual change in stock prices, a suitable tool is the wavelet analysis methodology [32], [33]. Among such

an analysis, one should single out the method for obtaining wavelet coherence estimates [34]-[36].

This approach is used in various studies that consider economic data [37]-[40].

Let's consider some of these estimates.



**Figure 10:** Assessing the relationship between IBM and AAPL stock prices

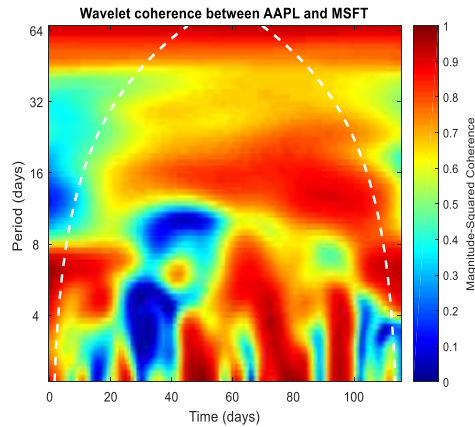
The relationship of quotes between International Business Machines and Apple Inc is negligible. The greatest manifestations of such a relationship are typical in the period from 10.04.2022 to 06.11.2022. The same observation also applies to the estimation of the depth of cross-references between the corresponding data. In general, what was noted earlier corresponds to the dynamics of prices for the shares of these IT firms.

Therefore, it is difficult to talk about building strategies for entering the stock market, relying only on the dynamics of IBM and AAPL stocks.

For these purposes, it is necessary to use all the available data that we have already considered. Then it is possible to say something about the contours of innovative development for entering the securities market of technology companies in the field of computer technology.

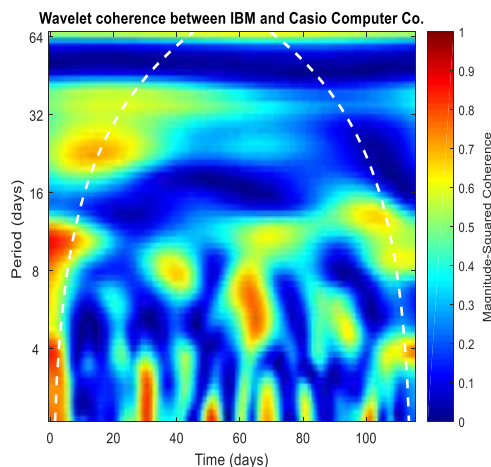
The estimate of wavelet coherence between AAPL and MSFT is high. This relationship is more significant and deeper. Its manifestation is observed in almost the entire study interval: from September 12, 2021 to March 19, 2023.

We can form effective innovative and investment strategies for entering the stock market.



**Figure 11:** Relationship between AAPL and MSFT stock quotes

Relationship between data by IBM and corporation Casio Computer shown in the following figure.



**Figure 12:** Wavelet coherence for stocks of IBM and Casio Computer Co.

This relationship is minor and fragmentary. But we can use the estimates obtained to select a specific strategy for conducting transactions with such securities. To do this, it is necessary to take into account changes in quotations for the relevant shares.

## 6. CONCLUSION

The paper substantiates the need to analyze quotes for the shares of leading high-tech companies. This is based on daily changes in such prices, conditions and factors influencing the functioning of the stock market.

We justify the procedure for conducting an appropriate study in the change in stock prices. Such an analysis consists

of three stages: classical statistical description, comparison of price ratio dynamics, constructing wavelet coherence estimates.

As a result, we can obtain data that allows us to determine the strategy for entering the securities market of IT companies.

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