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Dynamics in the Financial Markets of Europe in the Reflection of Streaming Financial Futures

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Abstract: *Financial data plays an important role in economic development. These data determine the direction and dynamics of the relevant financial flows, which are one of the foundations of interaction between various business entities. The formation of such data occurs under the influence of the relevant processes of economic dynamics, which are manifested in various segments of the financial market. One of the tools for such formation of data and the corresponding financial flows are financial futures. Based on this, the paper considers the dynamics of the main financial futures of the European financial market. The visualization of the dynamics of quotations for financial futures in the form of corresponding charts is presented. The main statistical characteristics of the dynamics of quotations for financial futures of the European financial market are summarized. The mutual dynamics of quotations for some pairs of futures that we analyze are considered. This allows you to choose the best investment strategy for entering the relevant segment of the financial market, to understand the dynamics of its development. For such an analysis, wavelet coherence estimates are used. The paper presents a lot of factual material in the form of graphs and diagrams, which helps to understand the logic of this study and its results.*

Keywords—evaluation; dynamics; quotes; financial market; financial futures; streaming data; statistical analysis; wavelet coherence

1. INTRODUCTION

In a modern market economy, various financial aspects play an important role [1]-[3]. In particular, this is due to the fact that financial resources are a universal means by which any other resources can be obtained. At the same time, financial instruments have a significant impact in the system of commodity-money relations. Such instruments form a stable movement of financial flows that permeate all relationships between various economic entities, including such an entity as the state [4]-[6]. Thus, financial flows act as the main component of the functioning of the economy, the interaction of various business entities.

For a stable and uninterrupted movement of financial flows, as a rule, they use

or a system of relationships built mainly on the basis of the functioning of the banking sector of the economy,

or a system of relationships built mainly on the basis of the functioning of the financial market, where the stock market should be singled out.

At the same time, it is also important to note the close interaction of these two systems of market relations in order to achieve financial stability.

One of the tools to achieve financial stability can be considered futures [7], [8]. Futures, as a rule, are a derivative financial instrument on the exchange of purchase and sale of the underlying asset, at the conclusion of which the parties agree only on the price and delivery time [9], [10]. At the same time, the so-called financial futures should also be distinguished among futures.

Financial futures are futures where the underlying asset is financial assets – interest rate or quotes of currency pairs, which are not intended to actually buy and sell currencies, but to play to increase or decrease the value of a certain amount of currency; assets related to the resale of long-term treasury bonds, interest bearing certificates of deposit; long-term, fixed-term exchange agreements, contracts related to the purchase and sale of currency, securities [11]-[13].

The value of financial futures quotes lies in their continuity and appropriate analysis, which allows obtaining basic and additional information. Then the continuity of quotations for financial futures allows us to talk about the so-called streaming financial futures. In this case, special significance is given to the corresponding analysis. Here we can single out classical approaches for analyzing data on quotes for financial futures, where it should be noted: technical analysis, the method of opening tail positions, fundamental analysis, and structured scenario analysis [14]-[16]. Other approaches that are widely used in other areas of research should also be considered [17]-[25]. It should also be noted the importance of mutual dynamics according to different data on quotations for financial futures. In particular, this makes it possible to

understand the overall dynamics in the financial markets, since the interaction of streaming data has a significant impact on various segments of the overall market [26], [27]. At the same time, the area of research can be some territorial community of markets, which takes into account its specifics of their functioning.

Thus, the main purpose of this study is to consider the statistical characteristics of quotations for financial futures for a certain territorial market, as well as to analyze the mutual dynamics of data for such quotations.

2. Related Works

For a better understanding of the problems of the tasks set, we consider several examples of studies that reveal the relevant issues.

The study [28] considers various aspects of the organization of the trading process in financial markets, where special attention is paid to financial futures. First of all, the authors explore the so-called gate arrays (FPGAs), which have proven to be a well-established technology for achieving low and constant latency when processing hardware-accelerated streaming packets [28]. This is very important in trading financial instruments. However, such designs have a number of disadvantages that affect the speed of decision making. Based on this, the authors propose a hybrid CPU-FPGA design to accelerate financial market servers that achieve delays at the level of microseconds [28]. This allows you to create an optimal server of the financial market at the industry level.

H. C. Lin and K. W. Hsu conduct an empirical analysis of the possibility of using data mining methods to predict futures [29]. The authors note that data mining, namely streaming data flow, has become an important component of data mining. Based on this, the authors consider data flow mining methods for predicting futures for weighted stock indices of the Taiwan Stock Exchange (TAIEX Futures) [29]. For these purposes, a binary classification is considered in order to predict the rise or fall of the respective quotes.

B. Guan, H. Wu and B. Liang analyze the hedging effect of financial futures [30]. For this, advanced machine learning algorithms are used in the work. At the same time, on the basis of machine learning algorithms, a model for analyzing the effect of hedging financial futures was built. The authors also combine the noise model of the market microstructure and the model of high-frequency financial measurements to analyze the hedging effect of financial futures [30]. This is confirmed by the corresponding experimental results. The authors also note the importance of analyzing the interaction of various financial futures. This is because financial futures should be considered as a financial asset with multiple values. This imposes its limitations on the possibility of using financial futures.

X. Zhong and D. Enke analyze the profitability of the stock market and the possibility of its forecasting based on daily data [31]. In particular, the authors comprehensively explore the process of analyzing big data to predict the direction of daily returns of the ETF SPDR S&P 500. For these purposes, the possibility of using hybrid machine learning algorithms is considered. Various types of neural networks are considered. When controlling overfitting, the regularity of classification accuracy of the corresponding approaches is revealed and demonstrated. A set of hypothesis testing procedures is also used for classification [31].

N. A. Hitam and A. R. Ismail in their study conduct a comparative analysis of the performance of machine learning algorithms for predicting cryptocurrencies [32]. The authors consider methods such as neural networks (NN), support vector machines (SVM) and deep learning. The article considers the possibility of using such methods for forecasting time series data. The authors note that SVM has a number of advantages over other forecasting models [32]. However, data manipulation due to inadequate evidence and professional analyzers, the general condition and the degree of prediction accuracy need to be improved, further research [32].

J. K. Downing explores the value of a financial futures instrument for zero-carbon electricity production [33]. At the same time, the importance of considering the mutual analysis of quotations for futures and electricity prices is noted.

The paper [34] explores the possibility of predicting the intraday profitability of stock index futures. For this, a functional model of time series is considered. Based on the analysis of the main functional component, the score of the main functional component was predicted by BM, OLS, RR, PLS and other methods, and the dynamic prediction curve was reconstructed from the predicted value [34]. For empirical analysis, the paper uses 5-minute data on the closing price of a stock index futures contract (IF1812).

M. Just and A. Łuczak consider their conditional dependency structure to classify futures [35]. For this, copula-garcha models and fuzzy clustering methods are used. The authors, first of all, consider the state of the market, identify typical patterns and determine the time of transition from one state to another. To describe the dynamics of dependences between rates of return on prices of commodity futures, we used models of multidimensional generalized autoregressive conditional heteroscedasticity based on copulas, and to measure the strength of dependences, Kendall's dynamic tau correlation coefficients were used [35].

G. Tang, R. Tian and B. Wu in their study presented an overview of clustering methods in the financial world [36]. In particular, the authors consider such clustering methods as K-mean, MST and the hierarchical approach, as well as its application in the financial sector. At the same time, the article discusses the use of such methods in credit scoring, the stock market, portfolio selection and trading strategy [36]. The authors also note that clustering can be widely used in various financial areas. It is also important to analyze the mutual dynamics of the initial data.

Thus, we see the importance of analyzing the dynamics of quotations for financial futures in particular, as well as analyzing the dynamics of the financial market in general. For such an analysis, various methods and approaches can be used. However, such an analysis must also take into account the mutual dynamics of the data being examined. It is also important to consider the data of one type of market. This makes it possible to take into account the impact of the specifics of the functioning of such a market on the corresponding data dynamics; discard factors that may influence such dynamics from the point of view of other types of market.

3. Empirical Examples of Financial Futures and Their Statistical Characteristics

As a separate segment of the market, which we will consider, there will be the European financial futures market. This choice is justified by the current situation and the difficulties that are most evident in the European financial market [37]-[39]. We will explore the European financial futures market for the period from 01.01.2021 to 16.10.2022. All data are presented on a weekly basis. This is the period when the European financial futures market showed different trends in its development. All data from the site https://www.investing.com/.

As separate objects of study, we have chosen: Euro OAT Futures, Euro BTP Futures, Euro-Buxl Futures, Euro SCHATZ Future, Euro BOBL Futures and Euro Bund Futures.

Euro OAT Futures is a long-term, interest-bearing, fixed income futures contract based on notional long-term bonds issued by the French government with a 6% coupon and a remaining maturity of 8.5 to 10.5 years (www.iotafinance.com).

Euro BTP Futures – provide an opportunity to trade on the basis of Italian debt instruments and complement the Italian cash market. Euro-BTP are meant to be traded at long, medium and short term points on the Italian yield curve to benefit from expected shifts. This is a futures contract for the interest rate on a conditional long-term Italian government bond with a remaining term of 8.5 to 11 years and a coupon of 6% (www.iotafinance.com).

Euro-Buxl Futures is an interest rate futures contract on a notional very long German government bond (Bundesanleihe) with a remaining maturity of 24 to 35 years (www.iotafinance.com).

Euro SCHATZ Future is a futures contract designated by the Federal Republic of Germany and based on short-term debt instruments with a remaining maturity of 1.75 to 2.25 years. Its coupon rate is 6% (www.iotafinance.com).

Euro BOBL Futures is a standardized futures contract based on a basket of medium-term debt issued by the German Federal Government. This is an interest rate futures contract on a conditional medium-term German government bond (Bundesobligation) with a remaining term of 4.5 to 5.5 years (www.iotafinance.com).

Euro Bund Futures is a futures contract on a conditional debt security of the Federal Republic of Germany with a term of eight and a half to ten and a half years and a 6% coupon. The nominal value of any such contract is EUR 100000. Bund futures are the most actively traded interest rate futures contracts in the Eurozone.

On Fig. 1 shows the dynamics of quotations for Euro OAT Futures for the period we are considering.

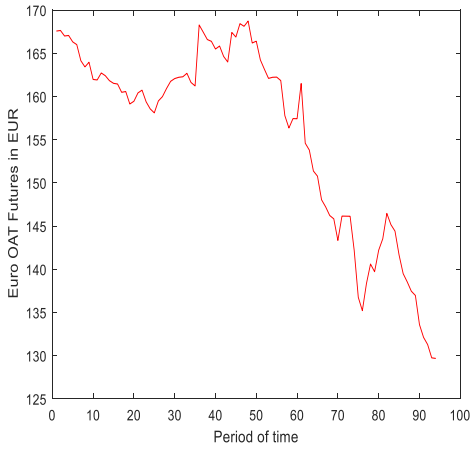

Figure 1: Euro OAT Futures quotes

We can observe a general decline in Euro OAT Futures quotes over the time period we are analyzing. This decline began in the middle of the study period. Until that time, quotes for Euro OAT Futures had mixed trends. In the second half of the period we are analyzing, there is a significant decline in quotes. At the same time, some insignificant growth peaks of Euro OAT Futures quotes can be noted. This has its impact on the dynamics of the corresponding segment of the European financial market.

The dynamics of quotations for Euro OAT Futures has the following statistical characteristics: mean – 155.64; median – 160.66; standard deviation – 11.13; sample variance – 123.98; kurtosis – -0.61; skewness is -0.82 at a significance level of 95.0%.

On Fig. 2 shows the dynamics of quotations for Euro BTP Futures for the period we are considering.

Here we can also observe a general decline in Euro BTP Futures quotes. In the first half of the time period that we are analyzing, there are slight fluctuations in quotations with their overall slight growth. In the second half of the period we are analyzing, there is a sharp decline in the corresponding quotes, where one can also note a local slight increase.

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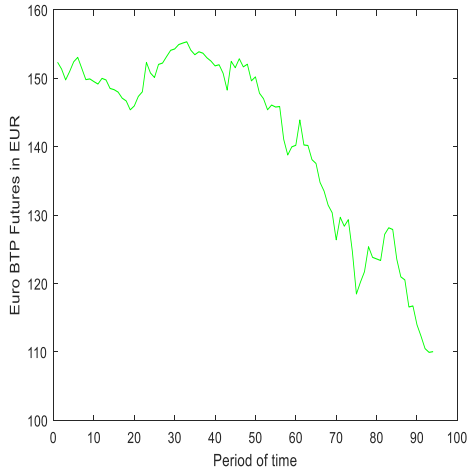

Figure 2: Euro BTP Futures quotes

The dynamics of quotations for Euro BTP Futures has the following statistical characteristics: mean – 140.99; median – 147.22; standard deviation – 13.31; sample variance – 177.21; kurtosis – -0.55; skewness is -0.89 at a significance level of 95.0%.

On Fig. 3 shows the dynamics of quotations for Euro-Buxl Futures for the period we are considering.

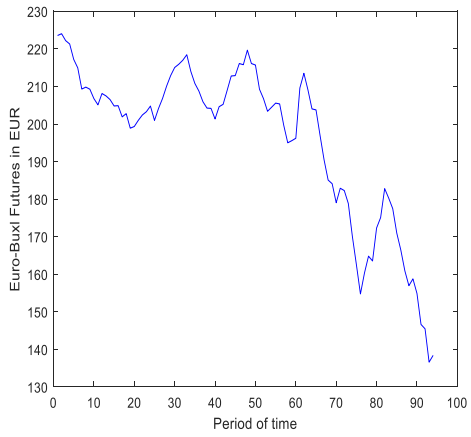

Figure 3: Euro-Buxl Futures quotes

We can observe a general decline in Euro-Buxl Futures quotes. In the first two thirds of the analyzed period, there is an alternating growth and decline dynamics of the corresponding quotes. After that, we see a significant decline in the dynamics of quotations for Euro-Buxl Futures, where we should also note some slight surge in quotations for Euro-Buxl Futures.

The dynamics of quotations for Euro-Buxl Futures has the following statistical characteristics: mean – 196.04; median – 204.20; standard deviation – 21.25; sample variance – 451.76; kurtosis – 0.28; skewness is -1.10 at a significance level of 95.0%.

On Fig. 4 shows the dynamics of quotations for Euro SCHATZ Future for the period we are considering.

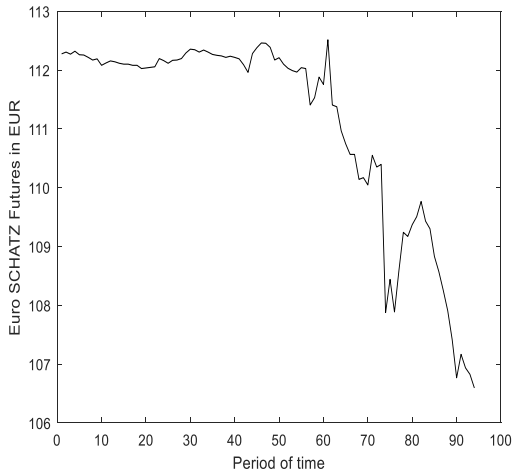

Figure 4: Euro SCHATZ Future quotes

It should be noted that the dynamics of quotations for Euro SCHATZ Future differs from the corresponding quotations, which were already considered earlier. In the first two thirds of the analyzed period, it should be noted that, on the whole, evenly the same quotes for Euro SCHATZ Future, where at the end of this period there is a slight increase. Then we see a sharp decline in Euro SCHATZ Future quotes, which is typical for other financial futures. At the same time, such a decrease has its own characteristics. So we can see against the background of a general decline in the corresponding quotations for Euro SCHATZ Future their slight growth in certain time intervals. An analysis of this growth is of particular interest from the point of view of the general dynamics of the functioning of the European financial market. Such an analysis involves studying the joint dynamics for different quotes for certain financial futures on the European market.

The dynamics of quotations for Euro SCHATZ Future has the following statistical characteristics: mean – 111.09; median – 112.07; standard deviation – 1.68; sample variance – 2.83; kurtosis – 0.47; skewness is -1.32 at a significance level of 95.0%.

On Fig. 5 shows the dynamics of quotations for Euro BOBL Futures for the period we are considering.

We see that the dynamics of quotations for Euro BOBL Futures in the first half of the analyzed period resembles the dynamics of quotations for Euro SCHATZ Future for the first two thirds of the time period that we analyze. Further quotes for Euro BOBL Futures tend to sharply decline. At the same time, several time intervals should be singled out, where there is also an insignificant and short-term growth in quotations for Euro BOBL Futures.

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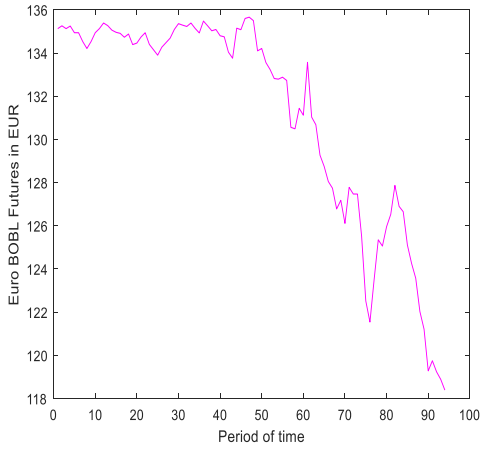

Figure 5: Euro BOBL Futures quotes

The dynamics of quotations for Euro BOBL Futures has the following statistical characteristics: mean – 131.12; median – 134.07; standard deviation – 5.01; sample variance – 25.10; kurtosis – -0.11; skewness is -1.05 at a significance level of 95.0%.

On Fig. 6 shows the dynamics of quotations for Euro Bund Futures for the period we are considering.

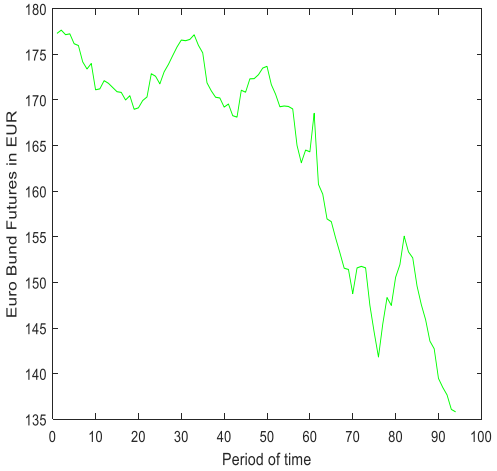

Figure 6: Euro Bund Futures quotes

The dynamics of quotations for Euro Bund Futures is generally declining. Such a decrease occurs over the entire time period that we analyze. At the same time, sometime intervals can be identified when the corresponding quotes grow.

The dynamics of quotations for Euro Bund Futures has the following statistical characteristics: mean – 163.71; median – 169.45; standard deviation – 12.11; sample variance – 25.10; kurtosis – -0.73; skewness is -0.79 at a significance level of 95.0%.

We see that the dynamics of quotations for various financial futures of the European financial market has the same components of their trends. The most characteristic component among these trends is their significant decline in the second half or last third of the time period that we are analyzing. However, this decline is rapid. This generally suggests that the European financial market has recently experienced serious difficulties. This is also confirmed by the dynamics of quotations for Euro Bund Futures. Therefore, it is important to analyze the mutual dynamics of quotations for various financial futures on the European financial market.

4. Mutual Dynamics of Quotations for Financial European Futures

To analyze the mutual dynamics of quotes for different pairs of financial futures, we will use wavelet coherence estimates. Wavelet coherence is one of the key tools for analyzing the mutual dynamics of various data, which are presented as time series [40]-[42]. Such estimates have found wide application for the analysis of economic data and the corresponding economic dynamics [43]-[46].

Let's consider some examples of wavelet coherence estimates for our data.

On Fig. 7 shows estimates of wavelet coherence between quotes on Euro OAT Futures and Euro SCHATZ Future.

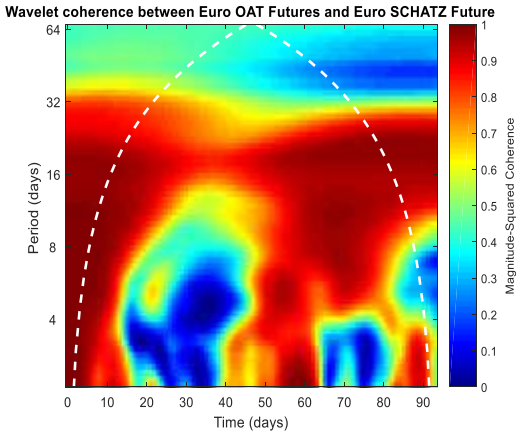

Figure 7: Estimates of wavelet coherence between quotes on Euro OAT Futures and Euro SCHATZ Future

We see a significant interdependence between quotes on Euro OAT Futures and Euro SCHATZ Future. The greatest interdependence is observed at the beginning of the period of time that we analyze, and the middle of such a period. This is due to the same dynamics of quotations at the beginning of the period under study and a significant decrease in quotations in the middle of the time period that we are analyzing.

On Fig. 8 shows estimates of wavelet coherence between quotes on Euro BOBL Futures and Euro Bund Futures.

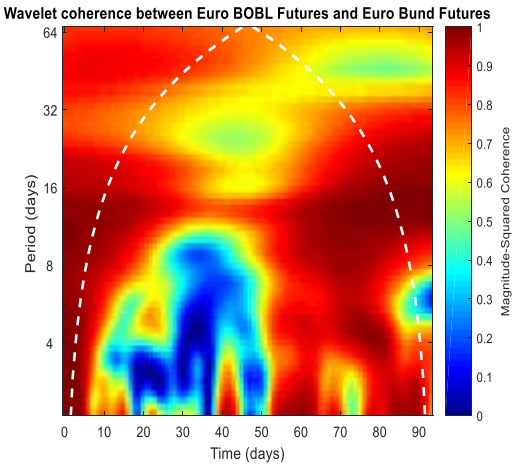

Figure 8: Estimates of wavelet coherence between quotes on Euro BOBL Futures and Euro Bund Futures

We see a significant relationship between Euro BOBL Futures and Euro Bund Futures, which is the most reliable for the second half of the time we analyze.

On Fig. 9 shows estimates of wavelet coherence between quotes on Euro SCHATZ Future and Euro BOBL Futures.

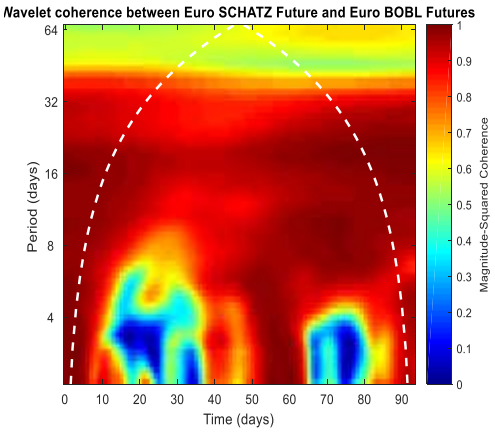

Figure 9: Estimates of wavelet coherence between quotes on Euro SCHATZ Future and Euro BOBL Futures

In this case, we can observe the greatest relationship between financial futures. This is due to the fact that the respective dynamics of Euro SCHATZ Future and Euro BOBL Futures quotes are the most comparable (see Fig. 4 and Fig. 5). We can also note the periods of incomparability of the corresponding financial futures. This is due to the fact that the dynamics of each financial future is still unique.

Thus, the analysis of mutual dynamics confirmed the conclusions of the previous section. Despite the uniqueness of the quotes of various financial futures, we can say that they reflect the general trends in the development of the European financial market. In particular, we see that the development of the financial market in Europe has certain difficulties in recent periods of time, which we analyze. The presented analysis of the mutual dynamics of futures quotes can also be used to make appropriate investment decisions.

5. Conclusion

The paper considers the key issues of analyzing the dynamics of relevant data in financial markets. A brief review of the literature on the topic of this study was carried out. The possibility and expediency of considering the dynamics in financial markets in the reflection of streaming financial futures is shown. An empirical analysis of the dynamics of quotations for a number of financial futures on the European market was carried out. Among such futures are: Euro OAT Futures, Euro BTP Futures, Euro-Buxl Futures, Euro SCHATZ Future, Euro BOBL Futures and Euro Bund Futures. Statistical characteristics of the dynamics of quotations of the corresponding financial futures are given.

A mutual analysis of the dynamics for various pairs of quotations for financial futures was carried out. For this, wavelet coherence estimates are used. These estimates reflect the general trends in the development of the European financial market. It is shown that the development of the financial market in Europe has certain difficulties in recent periods of time that we analyze.

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