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Article

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The Impact of Disturbances on the US Stock Market's Spread and Investor Sentiment Through the Perspective of Risk Management

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Abstract: The paper aims to address a topic of interest, namely: the influence and effect of the major disruptions from recent years on one of the largest important stock markets. The purpose of the paper is to show the influence of these disruptions on the US stock market, considering market efficiency and measuring the estimated Bid-Ask spread. Using daily and weekly data sets over a period of 13 years, based on the closing stock prices of 10 companies listed in the category of the NASDAQ and NYSE stock indexes and calculating the return at (*t*) and (*t+1*) for each stock, the covariance of the two returns at (*t*) and (*t+1*) and using at *t* and (*t+1*) a "rolling window" of 21 days, which represents the trading days, as well as using the weekly data series in the same way, we obtained the relationship between the spread measurement and its size, a strong negative cross-sectional relationship, for which we performed a series of statistical tests summarized in the paper. Later, we split the data for each year separately so that we'd be able to use for each year a cross-sectional regression of the spread over the logarithmic values of the size and we noticed that there is a strong negative relationship between the two of them. According to the results obtained, it can be observed that the strongest negative correlations are in 2019 and 2021 in the case of data with daily frequency and 2020, and 2021 in the case of data with weekly frequency, for an informationally efficient market, where transaction costs are zero and in which the market price contains all the relevant information. The strongly negative correlations recorded can be explained by the fact that strong negative influences took place during these periods, which contributed to the disruption of the stock market and not only. At the same time, these negative correlations on the stock market analyzed in the last period also show a wider spread increase which theoretically shows low liquidity.

Keywords: Bid-Ask spread; stock market; efficient markets; spread size; rolling window; covariance; liquidity.

Introduction

The stock market, fundamental for companies and investors who regardless of their risk appetite, is the one that shows the general state of the economy, where the skill and understanding of the available information and the evolution of the stock market are indispensable. Starting from the fact that the stock exchange represents the economic pulse and the share spread is the tempting point that leads the investor to invest, in this paper we wanted to observe how the current turbulent conditions, given the Coronavirus pandemic and the shocking invasion of Ukraine by Russia at the beginning of 2022, influences the stock market and the economy.

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The paper aims to present the method of direct deduction of the effective difference between the Bid quote (the price at which an investor sells the asset and the counterparty buys it) and the Ask quote (the price at which an investor buys the tradable asset and the counterparty sells it) from a time series of share prices on one of the most famous stock markets, the American market. By approaching the measurement and estimation of the spread in the current conditions, taking into account an ideal market, efficient from an informational point of view, we aim to observe if the events of recent years have had an impact on the analyzed securities market.

It is known that the stock market displays two quotations for any tradable asset, namely the Bid quotation and the Ask quotation. Based on these two quotations, the quoted Bid-Ask spread is estimated, which is an indicator that quantifies the liquidity of the market, and the lower it is, the higher the liquidity is and, vice versa, the higher it is, the lower the market liquidity will be. Every investor is concerned about the spread because there is no single price on the stock market. The spread represents a deviation from the theoretical value because the markets, from an informational point of view, are not efficient and, therefore, the transactions are not carried out at the real value obtained from the difference between Bid and Ask (sale price - purchase price). To this are added other factors, among which we mention the volatility or liquidity of the shares, with higher liquidity being seen for the shares with high trading volumes. That's why in this paper we wanted to observe if the calculated spread can show the disruptive effects on the stock market and the economy in the ideal conditions of an efficient market. By definition, a market is efficient from an informational point of view if all existing information regarding a financial asset is immediately reflected in its price evolution and if all the events produced are included, which also reflect future forecasts.

The spread has a tremendous impact on the net return of stocks and, empirically, in an informationally efficient market, where trading costs are zero, the market price will contain all relevant information, including that around disturbing news. The challenge of this work is to show, by measuring and estimating the spread using the classic method of an efficient market and by presenting the statistical significance of the results obtained, that where the results are insignificant, there are strong impacts on the data series, which are strongly reflected in the economy. To highlight the calculation of the spread between Bid-Ask prices, following Roll, we used daily and weekly data sets over a period of 13 years, from 04.01.2010 to 08.07.2022, for 10 companies listed on NASDAQ and NYSE, where we started from the closing prices of the shares (Table 1).

Table 1. Description of the companies

No.	Companies	Symbol	Listing markets	Activity sector
1.	Apple Inc	AAPL.O	NASDAQ Global Select Consolidated	Phones & handheld devices
2.	Ford Motor Co.	F	NYSE Consolidated	Auto & truck manufacturers
3.	Amazon.com Inc	AMZN.O	NASDAQ Global Select Consolidated	Department stores
4.	General Electric Co	GE	NYSE Consolidated	Consumer goods conglomerates
5.	Boeing Co	BA	NYSE Consolidated	Aerospace & defence
6.	Bank of America Corp	BAC	NYSE Consolidated	Banks
7.	Citigroup Inc	C	NYSE Consolidated	Banks
8.	AT&T Inc	T	NYSE Consolidated	Wireless telecommunication services
9.	Carnival Corp	CCL	NYSE Consolidated	Hotels, motels & cruise lines
10.	MGM Resorts International	MGM	NYSE Consolidated	Casinos & gaming

Source: information collected from Yahoo Finance

The paper wants to deal with a subject of interest for stock market investors, namely the calculation and measurement of the spread in the turbulent conditions of recent years with unprecedented events that seriously influenced the economic pulse and the stock market.

Literature review and model development

One of the debated works on costs, quotations, spreads, and the stock market, as it appears from the vast literature in the field, is the work on the hypothesis of efficient markets by Eugene Fama (1970), winner of the Nobel Prize in 2013, which shows that an informationally efficient market is one in which the financial asset prices completely represent all relevant facts.

Copeland and Galai (1983) showed, by writing a call and a put option for an investor who claims to have advantageous information, which it's not represented in the share price, because of the BID-ASK spread positive function at the level of price and, of course, fluctuation, and the BID-ASK spread negative function at the level of assessing market activity. The authors conclude that the effects on the BID-ASK spread produced by the information held have a strong impact and coincide with what has been demonstrated so far in the specialized literature. Galai and Wiener (2012) in their article demonstrate how the currency composition of debt influences debt cost by interaction with the risk of the company's assets. Using the Merton model, in the analysis of the credit spread of a company considering the particularities of the exchange rate, the authors concluded that if there is a positive correlation between the exchange rate and the return of a company's assets, then the foreign currency loan becomes cheaper.

Gordon and Peterson (1999), contributed to the specialized literature through their work on the stock market and the effects of the regulation imposed on share trading with the execution of short sales only when an increase in the share price is recorded (an effect also known as the uptick rule). According to specialized works, the uptick rule has a rather large role in stock market transactions, the purpose of this implementation being to limit the pressure on the trading prices of the shares and prevent a large number of sales. The authors wanted to show in their work what impact this regulation has on trading at a limited price of financial assets not yet held (a concept known as "short selling orders") and they discovered a negative effect that the uptick rule has on the execution of orders short on the forward type markets, which comes as a contradiction to one of the basic rules of this regulation, namely: the sale of shares in an approximately unrestricted absence when an increase in the number of shares of a company is recorded. Thompson and Waller (1987) provide techniques for estimating BID-ASK spreads from mid-market closing prices, as well as a measure applicable to all traded securities through an empirical implementation of four BID-ASK models over a period of 34 years applied to Aaa and Baa corporate bonds.

Gordon, Jonathan, and Peter (1997) theorized that investors self-assign into various distribution channels based on their overall level of financial literacy. The hypothesis was validated by the data from a sample applied to mutual fund investors, who were classified according to two aspects: their level of financial knowledge and the portfolio of mutual funds chosen. Rubinstein (1998) illustrates in his work the importance in the financial economy of the regular balancing of investment methods, and the need to apply the model based on logarithmic mathematical computations, beneficial in establishing the level of capital distribution between less risky and risky assets in a portfolio.

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Niederhoffer and Osborne (1966) highlighted, in their work, the interdependence between prices. After more detailed investigations, the authors conclude that after successive price changes in a certain direction, there are much smaller chances that the price will take it in the opposite direction, and the specialists or rather the dealers display the share prices displaying the highest and the smallest buy or sell order placed in the order book.

Samuelson (1965) studied forward prices and proves that they fluctuate randomly and, by postulating a stochastic model of price change, he derives a rather broad theorem in which price differences in the next period are shown to be uncorrelated with price differences from the previous period. Roll (1984) is the first to show the ease with which stock spreads can be calculated. He illustrates that, if we want to calculate the implicit spread and we are dealing with an efficient market, any change in the price level will only occur when all market participants have access to the unforeseen information, and there will be no serial dependencies at the level of successive price changes outside of the expected returns.

Abdi and Ranaldo (2017) presented in their paper a new technique developed to predict as close to reality as possible, the BID-ASK spread based on the daily prices available at the time of testing. The authors develop a model similar to Roll's model (1984), their model is based on the differences between share prices due to commissions applicable to each transaction. They have created an estimator to measure this difference and help to correctly evaluate the share price. In their work, the authors bring improvements to Roll's model, improvements that start from the use of wider databases due to their accessibility compared to Roll's measure that uses only closing prices as a database. Another improvement consists in the creation of an estimator that does not depend in any way on the time evolution of transactions (sale or purchase) in contrast to Roll's method which needs this dynamic to achieve its measurement goal. Bratianu and Vasilache (2009) show that the knowledge economy consists of tangible resources that can be physical objects that we can see or touch and intangible resources that are conceptual or virtual objects, without material existence as in the case of the Bid-Ask spread.

Hatmanu and Cautisanu (2021) carried out an analysis of the devastating effects produced by the Coronavirus pandemic on the characteristic index of the Romanian Stock Exchange. The results obtained by the authors showed that the Coronavirus pandemic produced a negative impact with long-term repercussions, but in the European context, a positive influence was also found. Ferreruela and Martín (2022) in their work analyze the financial markets in Spain and especially the effects produced by the Coronavirus pandemic on them. The results they reached were that the COVID-19 pandemic caused a decrease in liquidity, a fact that leads to negative effects mainly on sales. Gofran, Gregoriou, and Haar (2022) in their work, they examined the impact that the spread of the Coronavirus pandemic had on the stock exchanges, or better said, on the stock markets in several countries from Europe and Asia as well as the United States of America. The conclusion reached was that this Coronavirus pandemic produced and continues to produce some negative effects characterized by the short-term loss of liquidity, which can be seen from the visible increase in BID-ASK spreads. Bratianu and Bejinaru (2020) assessed the pandemic as a unique occurrence, considered a global health crisis, which has significantly affected economies, societies, and people's lives around the world. Following the analysis carried out, the authors mention in their article the extensive changes in the attitude of consumers following the Coronavirus pandemic. At the same time, the authors suggest that in the context of the COVID-19 pandemic, the business environment has changed and a new one has emerged, which requires new approaches and strategies from managers to adapt and survive. They note that this new business environment, which will remain after the pandemic ends, is still uncertain and only a guess based on mathematical models and

the intuition of business experts. It is important for managers to be prepared to adapt quickly and find new ways to recover from the pandemic.

Będowska-Sójka et. al (2022), through their work, the authors managed to capture a new vision of how liquidity reacts in periods when the market recorded periods of growth and decline. They use a measure based on two properties of insolvability, namely: the cluster of insolvability and the risk of insolvability in the financial market. The measure used is Amihud illiquidity which measures the lack of financial flexibility of a share or a market. It is calculated as the ratio of the difference between the closing price and the average price traded on that day and the volume traded on that day. This measure can be used to assess the level of risk of illiquidity of a stock or market.

Umar et. al (2021) wanted to highlight in their work the effect that the global pandemic had on the ease of trading financial instruments (liquidity) on the stock market in the regions of the Asian continent as analysis data. The conclusion reached by the authors, using the GARCH models as a measure of analysis, showed that the moment when the information about the pandemic and the spread of the infection was made public, had a strong but short-lived effect on the liquidity of the stock market at the level the entire analyzed sample.

Tiwari, Abakah, Karikari, and Gil-Alana (2022) have carried out an analysis on a rather important subject, namely to what extent the global health pandemic of the last period influences the liquidity of the stock market, having as a data sample several values from the countries of the Asian continent, Oceania and the group formed by the countries of the great powers economic. The authors used liquidity indicators with daily frequency over a period of 1 year. The authors applied in their work a statistical method for analyzing the relationships between two signals in time, the method also called "wavelet coherence". This method measures the degree of similarity of fluctuations in two signals as a function of time scale, using the wavelet transform. The result is a coherence matrix that shows the degree of similarity between the two signals at different time scales. Together with the Granger causality test, the authors concluded that there is an influence between the incidence of the disease and liquidity on the stock market. The Amihud measure of illiquidity is the most used indicator of stock liquidity in the financial literature.

Barardehi, Ruchti, and Weidenmier (2019) in their work they wanted to highlight the significance of the liquidity of stocks. The measure by which they did this is the method of measuring the liquidity of assets being recognized as "compensation cost of monetary advance". The compensation cost of monetary advance or the Amihud method is based on the idea that assets with lower liquidity have a higher cost to trade, which means they should have a lower return than assets with higher liquidity. This indicator is used in portfolio analysis and risk assessment. Through their work, the authors emphasize the major need to eliminate the price movement due to the information received at the time of designing a liquidity evaluation method.

Nimalendran and Petrella (2020) provided a study comparing different models regarding the restrictions that are imposed and how the relative proportions of the various components of the Bid-Ask spread are affected. The paper shows that access to quotations and transactions, as well as increased transparency, led to the development of theoretical models and empirical methods for decomposing Bid-Ask differences into their components. Hagströmer (2021) through his work he wanted to show that in the conditions of a market with "discrete prices" (that is, asset prices are not continuous, but can only take certain specific values), the standard approach of estimating the bid-ask spread by utilizing the spread's midpoint may be inaccurate. This is because the traditional method assumes that prices are continuous and therefore that the spread can

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be any value between the bid and ask. However, in markets with discrete prices, the spread can only take on certain specific values, which may not be accurately captured by the traditional method. Through this method, the author shows in his work that there is a possibility of an overestimation of the difference between demand and supply in the case of stocks with low prices.

Gofran, Liasidou and Gregoriou (2022) through their work, the authors illustrate the negative effects of the Covid 19 pandemic, which resulted in a decrease in tourism in areas of the European Union and Great Britain. At the same time, through the analysis carried out, the authors indicate that the European securities market that trades shares issued by companies has decreased its effectiveness in the tourism industry due to the Covid-19 pandemic. Davis, Liu, and Sheng (2021) the authors performing an analysis at the level of prices, through their work show that in several countries and especially in countries in Asia, there were many decreases in the level of transactions with stocks as a reaction to the effects produced by the Covid19 pandemic, compared to provide the method used to determine the value of a financial asset (also known as the standard asset pricing model).

Research methodology

The methodology of the paper follows the effective measurement of the spread on a stock market, under ideal efficient market conditions, in order to determine whether or not the events of the last period had an impact on the analyzed stock market. To achieve the covariance required to calculate the default spread, the yield of the two series of daily and weekly data at t and t+1, respectively t and t+5, was first calculated. The covariance of the data series used in the paper was realized using a rolling window of 21 days, and the spread was calculated according to Roll's formula:

$$\boldsymbol{Spread} = \mathbf{2} \cdot \sqrt{-\boldsymbol{cov}} \qquad 1$$

where variable "cov" is used to represent the concept of first-order serial covariance to analyze the relationship between the changes in price over time. Therefore, using this formula for the calculation of the spread, we are forced to use only the negative values resulting from the covariance calculation. To obtain the effective spread we've also used Roll's formula:

$$\hat{\boldsymbol{s}}_{\boldsymbol{j,t}} = \mathbf{2} \cdot \sqrt{-\hat{\boldsymbol{c}}_{\boldsymbol{j,t}}} \qquad 2$$

where variable $\hat{\boldsymbol{c}}_{\boldsymbol{j,t}}$ represents the concept of serial covariance of returns to analyze the relationship between the returns of a specific stock (*j)* over time (year *t*) and $\hat{\boldsymbol{s}}_{\boldsymbol{j,t}}$ represents an estimate of the difference between the highest price a buyer is willing to pay for a security and the lowest price a seller is willing to accept (also known as the bid-ask spread, which can be used as a measure of liquidity, market efficiency, and volatility in a specific market).

In estimating the Bid-Ask spread, to show the statistical significance of the results, we were guided by the t-statistic (values highlighted between brackets followed by the symbol "*") and not by the obtained probabilities. Given the formula for testing the parameters for a specified confidence level (95% in our case), we have two hypotheses: the first hypothesis, in which $\alpha_1 = 0$, is statistically insignificant, and the second hypothesis, in which $\alpha_1 \neq 0$ and therefore statistically significant.

For testing the parameters, the formula $t_{\alpha 1} = \frac{\hat{\alpha}_1 - 0}{\hat{\sigma}_{\alpha 1}}$ was used, and if $|t_{\alpha 1}| > t_{\alpha/2}$ the null hypothesis is rejected, the hypothesis in which the parameter α_1 is statistically insignificant, and, otherwise, accept the hypothesis that the parameter is insignificant. As a rule, the value $t_{\alpha/2}$ is chosen depending on the number of observations and the *t-statistic* table. To calculate the correlation between spread and size, the "Cross-Sectional Rank Correlation", we calculated the Spearman correlation coefficient. Spearman rank correlation measures the strength of association between two variables in a single value between -1 and +1. According to the specialized literature, the Spearman correlation coefficient is specified as the Pearson correlation coefficient, and the calculation formula is:

$$r_s = \rho R(X), R(Y) = \frac{cov(R(X), R(y))}{\sigma_{R(X)}\sigma_{R(Y)}} \qquad 3$$

where the coefficient ρ represents Pearson's correlation coefficient of course implemented on rank variables; the part that represents the numerator $cov(R(X), R(y))$ as the formula shows, represents the covariance of the ranking or ordering of the values; the denominator of the fraction $\sigma_{R(X)}\sigma_{R(Y)}$, represents the well-known standard deviations of the ranking of the values.

To describe as correctly as possible what the meaning of "correlation coefficient" means, we can think of that "r" that is found in specialized literature and that is defined by having the formula:

$$r = \frac{cov(x, y)}{\sigma_x \sigma_y} \qquad \in [-1, 1];\ \sigma_x, \sigma_y > 0 \qquad 4$$

where: r and cov have the same sign and if $r > 0$ then we have a direct relationship between variables; if $r < 0$ then we have an indirect relationship between variables; if $r = 0$ then we can say that we don't have any relationship between variables. So, thinking about the r coefficient and the criteria it fulfills, we can say that then we are referring to a positive correlation, i.e. r is in the interval [0,1] it means that the analyzed variables are positively interconnected (that is, when a variable increases then and the other variable tends to increase). Or we can also say that when we refer to a positive correlation, we say that the variables tend to change in the same direction. When $r = 1$ then we refer to a perfectly positive correlation, and the analyzed variables are perfectly correlated and change in the same direction. When we refer to a negative correlation, then r is in the range $[-1, 0]$, and the variables tend to change in different directions (that is, when one variable increases, the other decreases) while if r is -1 then there is a strong negative correlation.

As part of the empirical analysis, daily and weekly values of the shares of 10 American companies listed on the NASDAQ and NYSE indices were collected over a period of 13 years, from 04.01.2010 to 08.07.2022, based on their closing prices. Using these data, we sorted them in chronological order in Excel, obtaining a total number of 3,150 daily observations per company, ensuring that transactions take place on the same days for all 10 companies, and a similar procedure was used for the weekly data for which we obtained 653 observations.

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Empirical results

In the framework of the empirical analysis, to calculate the covariance we've first calculated the yield at t and t+1 for each share, according to the formula: $\ln(\frac{P_t}{P_{t-1}}) \cdot 100$, the only difference being that at t+1 the selection in Excel also applies on the result from the first cell, not as in the case of the normally calculated yield, in which 0 is passed for the first cell or a space is left, which, in the case of the yield at t+1, happens at the last value. Later in our analysis, we calculated the covariance that we achieved using the two returns at t and t+1 with the help of the Excel formula "COVARIANCE.S (Rd_t, Rd_{t+1})", calculated at 21 days, which represents the 21 trading days of the stock market. Using the "rolling window" method, we set the area for calculating the covariance of 21 days, and, where the data were positive, we stopped the calculation because the formula for the spread is designed to be the square root of negated covariance. Following the results obtained for the covariance, we can say that most of the chosen companies presented a positive covariance, a fact that led to the spread of presenting errors, and these data were extracted and were no longer taken into account in future analysis.

The same procedure was used for the weekly data series, where 653 observations were downloaded, and the return was calculated at t and t+5 for each share. The covariance of the two returns at t and t+5 was calculated using the Excel formula "COVARIANCE.S (Rd_t, Rd_{t+5})" using the 21-day "rolling window" equal to the number of trading days. After obtaining the spreads, both for daily and weekly data, we created for each company a Pivot Table in Excel, in which we calculated the average value of close-price daily/weekly, yield daily/weekly, covariance daily/weekly, spread daily/weekly, outstanding shares, size daily/weekly (obtained by multiplying the close price and outstanding shares) and the average value of ln(size) (representing the logarithm applied to size). After making these pivot tables, we applied a filter on them by which we excluded the non-values, so that the resulting average values are used throughout the work. For a clearer picture of the analyzed period and companies, in Figure 1 we observe the average of the daily closing prices, and in Figure 2 we observe the average of their covariances.

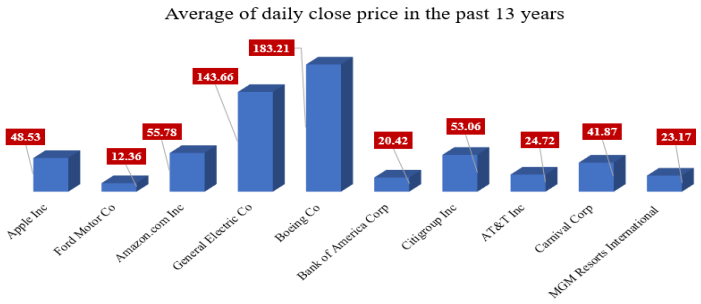

Figure 1. Average of daily close price in the past 13 years
Source: own processing

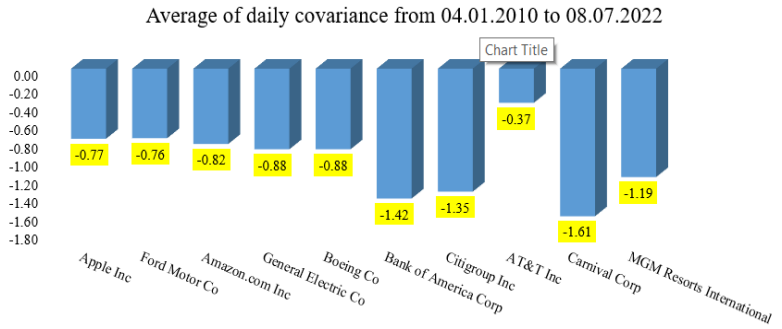

Figure 2. Average of daily covariance in the past 13 years
Source: own processing

The same procedure was applied to the series of weekly data, which can be seen in Figure 3 and Figure 4.

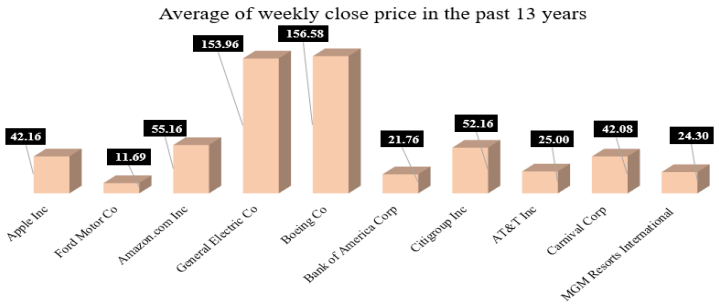

Figure 3. Average of weekly close price in the past 13 years
Source: own processing

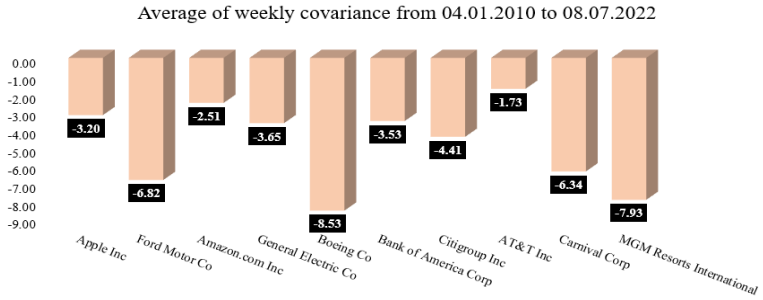

Figure 4. Average of weekly covariance in the past 13 years
Source: own processing

Because stock trading is expensive, the stock market dealer's compensation must include a Bid-Ask spread that's a small part of the price included in the underlying value of the asset. When we refer to the concept of "market with informational efficiency" we are talking about a market in which the prices on this market adapt quickly to new information and of course reflect all the relevant information, making it difficult to obtain the frequency of abnormal returns through applying advantageous information or technical analysis. In other words, in such a market, all relevant information is fully reflected in the prices of traded assets. Thus, in such an informationally efficient market, both the average price between demand and supply as well as the underlying value of the asset fluctuates randomly, which indicates that the price of an asset in such a market is in a permanent change being adjusted by demand and offer. At the same time, when we refer to this market, the midpoint between bid and ask is seen as the real value of the asset given the fact that it represents the balance between demand and supply.

Following Roll's (1984) paper, we wanted to estimate the difference between the demand and the implied offer, and due to this fact, we observed a negative inverse relationship on the one hand between "cov" (which represents the concept of serial covariance of the first order) and the real spread and on the other hand part between the estimated bid-ask difference and the size.

To be able to see if there is a negative cross-section relationship, the first step performed was to split the data for each year separately so that a cross-sectional regression of the spread on the logarithmic values of the size could be performed annually and then we entered the data into EViews, Panel Options section. For this, the data obtained in the Pivot Tables had to be arranged in the form of a panel (as can be seen in Tables 1 and 2).

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Table 2. Arrangement of daily data in the form of Panel

Stock	Year	Spread	Size	Log Size	Stock ID
Apple	2010	1.01	239,104	5.38	1
Apple	2011	1.48	348,362	5.54	1
Apple	2012	1.35	541,733	5.73	1
Apple	2013	0.98	447,083	5.65	1
Apple	2014	0.88	572,330	5.76	1
Apple	2015	1.21	688,269	5.84	1
Apple	2016	0.93	568,630	5.75	1
Apple	2017	0.75	773,226	5.89	1
Apple	2018	1.54	948,226	5.98	1
Apple	2019	1.09	966,561	5.99	1
Apple	2020	2.66	1,625,052	6.21	1
Apple	2021	1.19	2,308,283	6.36	1
Apple	2022	2.75	2,739,862	6.44	1
Ford	2010	1.55	53,504	4.73	2
Ford	2011	2.05	57,175	4.76	2
Ford	2012	0.77	41,917	4.62	2
Ford	2013	0.90	61,542	4.79	2
Ford	2014	0.92	63,278	4.80	2
Ford	2015	0.68	60,067	4.78	2
Ford	2016	1.14	49,675	4.70	2
Ford	2017	0.90	46,607	4.67	2
Ford	2018	1.45	41,518	4.62	2
Ford	2019	1.46	37,158	4.57	2
Ford	2020	2.40	30,824	4.49	2

Source: information collected from Yahoo Finance and processed by the authors

Table 3. Arrangement of weekly data in the form of Panel

Stock	Year	Spread	Size	Log Size	Stock ID
Apple	2010	4.48	241,227	5.38	1
Apple	2011	3.89	340,561	5.53	1
Apple	2012	3.75	502,950	5.70	1
Apple	2013	2.43	437,943	5.64	1
Apple	2014	1.99	585,321	5.77	1
Apple	2015	4.20	698,483	5.84	1
Apple	2016	3.30	548,929	5.74	1
Apple	2017	1.56	799,105	5.90	1
Apple	2018	2.65	936,255	5.97	1
Apple	2019	2.34	1,025,323	6.01	1
Apple	2020	3.97	1,674,237	6.22	1
Apple	2021	3.46	2,497,613	6.40	1
Apple	2022	2.12	2,779,863	6.44	1
Ford	2010	2.70	51,157	4.71	2
Ford	2011	3.52	47,635	4.68	2
Ford	2012	3.49	44,779	4.65	2
Ford	2013	3.26	56,100	4.75	2
Ford	2014	2.16	61,820	4.79	2
Ford	2015	1.84	60,183	4.78	2
Ford	2016	2.88	49,281	4.69	2
Ford	2017	1.45	48,439	4.69	2
Ford	2018	2.14	44,140	4.64	2
Ford	2019	5.39	37,677	4.58	2
Ford	2020	8.29	28,007	4.45	2
Ford	2021	3.23	57,822	4.76	2

Source: information collected from Yahoo Finance and processed by the authors

The graphs in Figure 5, respectively Figure 6, resulting from the calculation, show, in the case of the daily data series, sudden increases and decreases in share prices during the analyzed period.

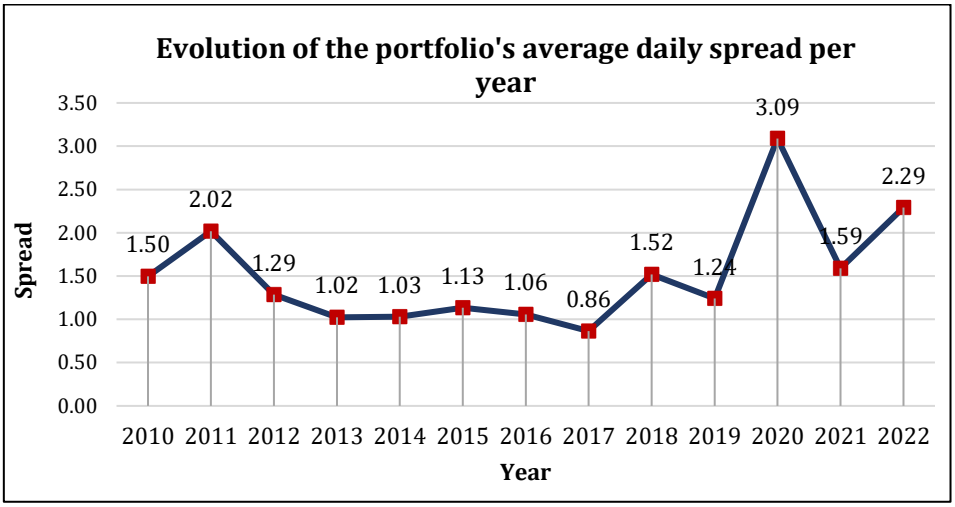

Figure 5. The evolution of the daily Spread in the period 2010-2022
Source: own processing

From the point of view of the results obtained on the shares of the 10 analyzed companies, the spread in recent years, starting with 2020, has increased beyond the highest value obtained in the analyzed period, reaching a maximum of 3.09 units and also the year 2021 is characterized by an increased spread with the value of 1.59 units, like the spread from the analyzed half of the year 2022. In 2021, compared to the analyzed years, a difference of 0.43 units compared to 2011 and 1.5 units compared to 2020 is observed, and for 2022, analyzed up to July, a high value of 2.29 is observed units, in fact, the second maximum point of the spread encountered in the analyzed period.

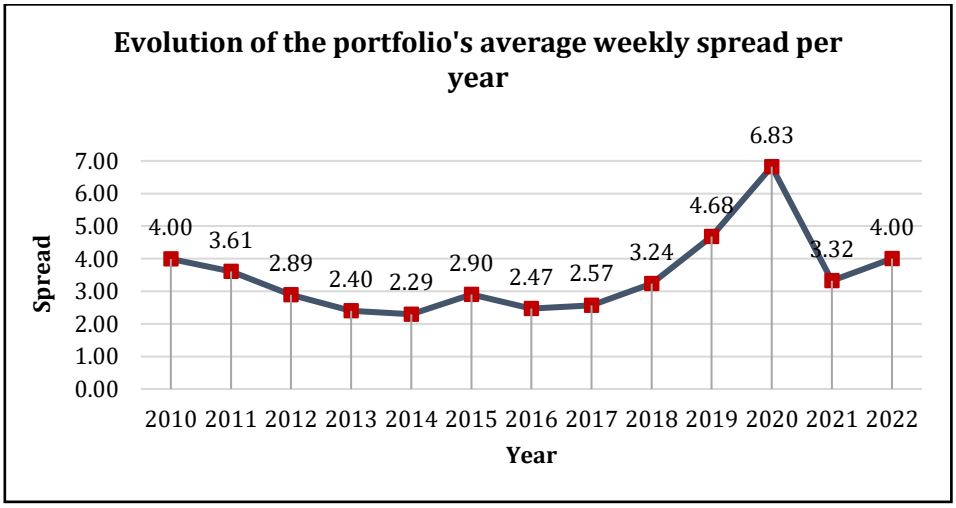

Figure 6. The evolution of the weekly Spread in the period 2010-2022
Source: own processing

Weekly data series are characterized by results obtained like those obtained in the case of daily data. Thus, the highest value of the spread, just as with the daily data series, is obtained in the year 2020 at 6.83 units, so that in the year 2021 the value of the weekly spread will decrease by almost half, and up to half of 2022 to increase again reaching the value of 4 units, a large value for the weekly data of the spread if we take into account that

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the value of growth to 4 and over 4 units in the 13 years analyzed occurs only three times, in the years 2010, 2019 and 2020.

Table 4. Results of the estimated Bid-Ask Spread and correlation between spread and size

	Sample size (Observations)		**Cross-Sectional Mean Spread $\bar{s}$ (t-statistic)**		**Cross-Sectional Regression** $s_{j,t} = a + b \cdot log_e(Size_{j,t-1})$		**Cross-Sectional Spearman Rank Correlation between spread and size**	
Year	**Daily**	**Weekly**	**Daily**	**Weekly**	**Daily**	**Weekly**	**Daily**	**Weekly**
2010	1503	340	1.49 (8.67)	3.68 (5.99)	-0.77 (-5.89)**	-1.72 (-7.40)**	-0.33 (-1.00)	0.01 (0.05)
2011	1422	319	1.94 (11.16)	3.47 (14.85)	-0.40 (-3.85)**	0.46 (8.47)**	-0.50 (-1.65)	0.17 (0.50)
2012	1302	373	1.21 (8.60)	2.98 (8.91)	-0.11 (-1.15)	-0.17 (-0.55)	-0.18 (-0.52)	-0.05 (-0.15)
2013	1406	287	1.01 (14.79)	2.43 (9.93)	-0.29 (-8.69)**	-0.81 (-2.91)**	-0.53 (-1.77)	-0.23 (-0.68)
2014	1226	340	1.00 (11.93)	2.33 (8.68)	-0.25 (-4.99)**	-1.33 (-3.32)**	-0.31 (-0.92)	-0.52 (-1.75)
2015	1524	344	1.12 (9.83)	2.91 (8.60)	-0.19 (-0.78)	0.26 (0.93)	0.15 (0.45)	0.26 (0.76)
2016	1405	312	1.05 (18.35)	2.36 (9.97)	-0.20 (-22.97)**	-0.58 (-20.36)**	-0.47 (-1.52)	-0.33 (-1.00)
2017	1321	367	0.84 (10.35)	2.43 (7.67)	-0.38 (-5.07)**	-0.77 (-3.33)**	-0.57 (-1.97)	-0.17 (-0.50)
2018	1606	331	1.51 (15.61)	3.05 (9.51)	-0.18 (-2.21)	-0.43 (-1.21)	-0.29 (-0.88)	-0.12 (-0.36)
2019	1522	238	1.22 (17.02)	4.32 (5.24)	-0.19 (-6.89)**	0.87 (6.03)**	-0.68 (-2.64)	-0.04 (-0.12)
2020	1613	402	3.21 (8.30)	7.14 (7.02)	-0.02 (-0.09)	-2.58 (-9.93)**	-0.03 (-0.10)	-0.63 (-2.33)
2021	1534	350	1.57 (7.92)	3.05 (8.66)	-0.55 (-16.21)**	-0.63 (-3.65)**	-0.67 (-2.60)	-0.61 (-2.18)
2022	429	55	2.27 (8.01)	3.68 (5.90)	0.22 (1.30)	-0.50 (2.62)**	0.17 (0.49)	-0.26 (-0.76)
Total NS	**17.813**	**4,058**	***1.49***	***3.37***	***-0.25***	***-0.53***	***-0.32***	***-0.19***
Total PS	**13.487**	**2,272**	***(11.58)***	***(8.53)***	***(-5.96)***	***(-2.66)***	***(-1.12)***	***(-0.65)***

Legend: *The row "Total NS" represents the total number of negative spreads remaining after the elimination of non-values; The row "Total PS" represents the total number of positive spreads.*

Source: information processed by the authors

From Table 4, the "Sample Size" column illustrates the total number of data observations with the daily or weekly frequency used per year. It should be mentioned that these observations represent the total number of spreads recorded for each company, with the spreads that recorded non-value being eliminated. Thus, in the entire period studied, from the total spreads of the analyzed companies, from which the 21 days for the rolling window were subtracted, a total number of 31,300 observations (for daily data) and 6,330 observations (for weekly data). Out of those, only a number of 17,813 observations (daily spreads) and 4,058 observations (weekly spreads) represented negative spreads. In the "Years" column we wanted to show that, in total, we had a number of positive spreads of 13,487 (in the case of data with daily frequency) and a number of 2,272 in the case of data with a weekly frequency.

To create the third column, "Cross-Sectional Mean Spread s (t-statistic)", it was necessary to divide the data series by years, which was carried out with the help of EViews through the "Resample" function, where we added each period for which data resampling was carried out, for each individual year. The obtained results show, in the case of data with daily frequency, an average value of the default spread of 1.49%, respectively 3.37% in

the case of data with a weekly frequency. Normally, the effective average spread should register lower values than the quoted spread, given that it represents about 0.125 of a dollar, so 0.18% of the sale of a share. From a statistical point of view, the results obtained in Table 3 show that, for most of the years from the analyzed period, both daily and weekly data, high levels of statistical significance were recorded, such as the year 2010, which registered a significant statistical value of 5.89 units in the case of the daily data, respectively 7.40 units in the case of the weekly data. For the year 2011, a statistical significance is also observed for the two types of data frequency, namely, we have identified a statistical significance of 3.85 units in the case of daily data and a statistical significance of 8.47 units in the case of weekly data.

In the rest of the years 2013, 2014, 2016, 2017, and 2021 we have observed a statistical significance among the data, with values such as 8.69 units and 2.91 units (for the year 2013), 4.99 and 3.32 units respectively (for the year 2014), 22.97 and 20.36 units respectively (for the year 2016), 5.07 units and 3.33 units (for 2017), 6.89 units and 6.03 units respectively (for 2019). In 2021, values with a significance threshold of 16.21 units were recorded for data with daily frequency and 3.65 units for data with weekly frequency, thus following that for the analyzed half of 2022 we obtained a level of statistical significance only for data with a weekly frequency of 2.62 units.

To see the correlation between spread and size, the "Cross-Sectional Rank Correlation", we've calculated the Spearman correlation coefficient to determine the correlation between the two variables. Considering that we are referring to a bivariate correlation analysis that includes in a single value the two variables with an interval between -1 and +1, in the case of daily data, except for 2015 and the first half of 2022, where positive values were recorded (0.15 for 2015 and 0.17 for the first half of 2022) we can say that there is a negative relationship between the spread and size. The strongest negative relationship is registered in 2019 (-0.68). We cannot say the same thing in the case of the weekly data because, unlike the data with daily frequency, there are 3 years in which we observe positive values, so there are positive correlations. A similarity can be observed in the case where a significant negative value (-0.63) has been recorded in 2020. In total, we can say that, for the 17,813 negative spreads (related to data with daily frequency), respectively 4,058 (related to data with frequency monthly), on average, there is a negative correlation between spread and size. Precisely, the correlation coefficient in the case of data with weekly frequency shows that, overall, there is a negative correlation between spread and size with an average value of (-0.32), which is close to 0, a fact that leads us to the conclusion that it is a negative, but rather weak correlation between the two variables. In the same way, in the case of data with weekly frequency, the average value of the correlation coefficient, at the entire level of observations, was closer to 0 than the correlation coefficient found in the case of data with daily frequency, leading to the conclusion that there is a weak negative correlation between the analyzed variables. The table shows that the strongest negative correlations are found in 2019 and 2021, with values of (-0.68) and (-0.67) respectively, in the case of data with daily frequency, and 2020 and 2021 respectively, with values of (-0.63) and (-0.61) in the case of data with a weekly frequency. The obtained results illustrate the existence of a negative relationship between spread and size.

Conclusions

Disturbances due to political events and economic shocks have a significant impact on stock market spreads and investor sentiment, leading to uncertainty and volatility, as well as a decrease in investor confidence and an increase in risk perception. That's why risk management strategies can help investors make informed decisions about their portfolios

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and manage their risk exposure, and also minimize the impact of these shocks on these portfolios.

The use of data from the American stock market, using the model proposed by Roll, does not have an increased significance from an econometric point of view, having a low level of difficulty, but both the results obtained from the daily and weekly data series illustrated the existence of a negative relationship between spread and size, in accordance with existing studies in the specialized literature, being a correct statement from an economic point of view. At the same time, the obtained results validated that the stock market was influenced by the newer negative events in the last period analyzed in the paper.

The results obtained showed the strongest negative correlations in 2019 and 2021 in the case of data with daily frequency and 2020 and 2021 in the case of data with weekly frequency, for an informationally efficient market, where transaction costs are zero and the market price contains all relevant information. Special elements were also observed, where the data with weekly frequency had the correlation coefficient at the entire level of observations closer to 0 than the correlation coefficient encountered in the case of data with daily frequency, showcasing the existence of a weak negative correlation between the analyzed variables and vice versa for data with daily frequency.

After the analysis, we concluded that the 10 analyzed companies on the American stock market represent the best economic barometer. The relationship between supply and demand is vulnerable to sudden events with positive or negative effects coming from different areas of the world, a fact that is reflected in the stock market, which is in turn very sensitive to any news appearing at any time and with a strong effect on investors' decision. It is known that negative news can put pressure on the sale and decrease in share prices, and that is why investors try to anticipate them. Given that the stock market is very responsive to all the events that take place in the market, events that can bring negative effects that affect all market participants, there are certain investors who foresee the events and respond to them through decisions that can help reduce the impact before it occurs. However, the media coverage of the spread of the virus that caused the pandemic and panic led to the closure for an indefinite period of several branches of the industry such as the tourism industry, the hotel industry, the aeronautical industry, etc., a fact that can also be seen in the drop in prices on the market scholarship as it appeared in the results obtained for the years 2019, 2020 and 2021.

We could not decide on the causes that led to the results obtained not showing a strong negative correlation for the year 2022, as in the case above, however, our main explanation is that the analyzed data only contained the period until the middle of this year. The armed conflict between Russia and Ukraine was an unpredictable event that joined the negative effects produced by the pandemic and of course, it was felt quite acutely on the analyzed stock market.

The period chosen for our analysis highlights strong negative relationships between the spread and the size ("size"), relationships based on the news that appeared in the press regarding the spread of the pandemic, the number of deaths, the number of lost jobs, etc., news that had a negative impact on the stock market and on investors' decisions, a fact that led to a decrease in liquidity, especially in 2020 and 2021 and a higher BID-ASK spread. Events, such as the pandemic generated by the Coronavirus infections, the past historical conflicts, which resulted in the increase of the territories of the countries, which are now returning to the surface together with the new military conflicts, are seriously affecting the economic and financial situation not only of the countries directly involved, but especially of the countries in the region and, implicitly, of all European countries, even the USA as a member of NATO. The problems arising because of the influence of

disturbances at the level of large stock markets, such as the ones analyzed, have an important role especially on shares because they cause investors to become more and more cautious towards the stock market and with low investor sentiment when it comes to the risk of investing.

Events such as the Covid-19 pandemic, and the war between Russia and Ukraine, are unforeseen events, whose strongly negative effects affect not only stock markets but the entire economy. The war in the two countries has further amplified the problems created by the health crisis that began at the end of 2019 and has slowed down the supply and production circuit, leading to an increase in the prices of food, goods, etc. The military conflict between Russia and Ukraine was something unexpected with a strong impact on all stock markets as well as the energy and food markets, which led to radical decisions regarding the ability of investors to cover their investments. Taking into account the various economic phenomena such as inflation, slow economy, excessive debts on the rise, and climate changes, in the future, the task of political decision-makers will become more difficult regarding the identification and prevention of events affecting the financial market as well as the improvement of the economy in the future. The decision-makers will have to fight against economic and financial instability, to maintain a stable balance in which they negotiate so that there are no more armed conflicts and in which they lead prudent and balanced financial regulation and supervision towards stability.

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