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Analysis of Dependencies Occurring Between Volatility of Currency Pairs with Euro and Their Tick Volume

Abstract

The presented article fits in with the subject of the currency market. Price volatility and volume seem to allow to accurately assess the situation on the market, therefore the analysis of the type and strength of dependence, occurring between them is important from the point of view of all participants of the forex market transactions. The aim of the study is to verify the hypothesis that there is a strong monotone dependence between the level of exchange rate volatility and the tick volume of a given currency pair, in which euro is the base or quoted currency. Due to the fact that not all time series accepted for the study have a normal distribution, the Spearman rank correlation coefficient was applied to determine the strength of the compound. The research was carried out on the basis of data from EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD currency pairs at intervals of one hour, four hours, daily, weekly and monthly in the years 2016-2018. Based on the research, its hypothesis was rejected. At the same time, it was found that the relationship between volatility and tick volume exists in most cases (88% of all) and in more than half of the cases (60% of all) is at least moderate. The value of the correlation coefficient turned out to be positive in 96% of all examined cases

Key words: currency market, volatility, volume, dependency analysis, euro, US dollar, Japanese yen, Swiss franc, British pound, Australian dollar.

JEL Classification: F31, F36, G12, G15.

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Introduction

The foreign exchange market is the largest in terms of the level of turnover in the world market. Through the use of high financial leverage, it allows its participants to generate above-average rates of return, at the same time, with a very high risk of capital loss. The reference to the concepts of exchange rate volatility and trading volume is helpful in understanding the mechanism of its functioning. The first of these issues is taken up in many publications, mainly as a subject of forecasting. The issue of the currency market volume is less often the subject of analysis and is examined mainly in the context of changes in value over a long period of time.

Volatility and volume are a source of profit for an investor in the currency market, so it is worth to examine the type and the degree of connection between these parameters. The obtained results and conclusions may be used in the future, *inter alia*, in the process of making investment decisions. The aim of the article is to verify the hypothesis that there is a strong monotone dependence between the level of exchange rate volatility, in which the euro is the base or quoted currency, and the tick volume of a given currency pair.

The publication consists of three theoretical and one practical chapter. The first part of the article defines the concepts of volatility and volume in relation to the currency market. The most important characteristics of both issues are also presented, among others: temporal differentiation, types, functions that they perform on the market, as well as determinants and measurement methods. The second chapter of the article presents the euro as one of the most important international currencies. This part of the publication also argues that currency pairs, in which the euro is a base or quoted currency, even though they are not as popular with investors as currency pairs with the US dollar, deserve a deeper analysis. The third chapter is a review of the literature on the subject of volatility and volume in the currency market. The last chapter, which is empirical, presents the results of studies on the relationships between volatility and tick volume for EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD exchange rates at hourly, four-hour, daily, weekly and monthly intervals in 2016–2018.

The Essence of Volatility and Volume in Relation to the Currency Market

Two basic pieces of information to accurately assess the situation on the market are price volatility and turnover (Arms 1997: 1). Before making a practical attempt to assess the relationship between these parameters, it is worth looking at the essence of both concepts in relation to the currency market.

Currency market volatility is a parameter that informs how currency exchange rates change in a given unit of time. It is an inherent element of the currency market and at the same time it is the reason for the occurrence of exchange rate risk (Czekala, Szpara 2013: 87–102). There are two types of price changes: proportional and absolute. Proportional changes are most often used in comparisons. When analysing individual currency pairs, it is worth using absolute measures, i.e. changes expressed in pips at a specific time interval. The volatility assessment is important from the point of view of the currency market participants because the forecasts of the future exchange rate volatility are made on the basis of historical data. From the investor's point of view, volatility analysis: facilitates the decision to select a particular currency pair on which transactions will be made, helps in making decisions regarding the time of concluding the transaction and determining the size of the transaction as well as supports the course risk management process (Admiral Markets 2019).

Trading on the currency market takes place 24 hours a day, 5 days a week, between 23:00 on Sunday and 22:00 on Friday of Central European Time (CET). At the same time, the volatility of the forex market varies over time. Most often, it is the largest between 8:00 and 10:30 and also between 14:00 and 17:00. At 8:00, the Frankfurt Stock Exchange is marked by the beginning of the so-called "European session" and then more markets in Europe are opened. Volatility decreases around 10:30 because then no significant macroeconomic data are published. The second phase of volatility growth on the currency market starts at 14:00 CET, when the stock market opens in the United States and ends at 17:00 with the closing of the London Stock Exchange (Korsak, Piekutko 2014: 356–357). The period of the European session lasting from 8:00 to 17:00 is characterized by greater volatility of currency pairs in which the euro is the base currency or quoted (Comparic 2019).

The determinants that can be divided into two groups: fundamental factors and technical factors determine the volatility of the currency market. The fundamental

factors include: reports on economic data as well as data on the investment profitability level, monetary policy, international commodity exchange as well as the level of foreign investments. Fundamental factors also include political and geopolitical information. The second group of determinants of currency market volatility is the result of technical analyses made by market participants (Galant, Dolan 2010: 28–29).

In order to identify the level of volatility of individual currency pairs, market participants use various types of tools, among which the most popular include ATR and heat map. The ATR indicator measures the average volatility of price movements in the analysed period. Low values of the indicator point out a consolidation and high values a large volatility of the analysed pair (Trading Academy 2019). Heat maps are visual tables that allow real-time monitoring of the volatility of many currency pairs simultaneously (Forex Early Warning 2019). An example of a heat map is shown in Figure 1.

Figure 1: Example 9

	EUR	USD	AUD	GBP	NZD	CAD	CHF	JPY	HKD	SGD
EUR		0.27%	-0.26%	-1.38%	-0.04%	-0.4%	0.25%	0.72%	0.32%	0.15%
USD	-0.32%		-0.47%	-1.59%	-0.28%	-0.7%	-0.03%	0.45%	0.03%	-0.15%
AUD	0.18%	0.44%		-1.15%	0.15%	-0.22%	0.42%	0.91%	0.49%	0.32%
GBP	1.38%	1.71%	1.18%		1.35%	0.94%	1.7%	2.14%	1.69%	1.51%
NZD	0%	0.25%	-0.15%	-1.29%		-0.45%	0.21%	0.71%	0.29%	0.12%
CAD	0.4%	0.71%	0.28%	-0.96%	0.4%		0.7%	1.21%	0.69%	0.52%
CHF	-0.3%	0.01%	-0.46%	-1.66%	-0.32%	0%		0.43%	0.01%	-0.16%
JPY	-0.78%	-0.47%	-0.91%	-2.15%	-0.8%	-1.19%	-0.48%		-0.5%	-0.63%
HKD	-0.28%	0%	-0.43%	-1.65%	-0.31%	0%	0%	0.42%		0%
SGD	-0.11%	0%	-0.24%	-1.48%	-0.12%	1.02%	0.17%	0.59%	0.18%	

Source: Trading View.

The second important issue related to the functioning of each market is the volume. In contrast to volatility, the concept of turnover is often overlooked because most of the tools used to assess the market situation have been designed to analyse exchange rate volatilities rather than the accompanying turnover. The reason for this

is the fact that the price volatility ultimately determines the investor's profits or losses. However, it is worth remembering that the analysis of both factors is important for a reliable and comprehensive assessment of the situation on the market (Arms 1997: 1).

The volume can be defined as the quantity of a given asset that has been exchanged between sellers and buyers. It performs a number of functions on the market: it is an element of market analysis and a liquidity determinant, it weighs information held by market participants, verifies prices, reveals the beliefs and diversity of opinions of market participants, expresses interest and enthusiasm of market participants, drives the market itself, reveals the secret of the market, provides the reason for change and also gives rise to price dynamics (Dormeier 2012: 52–56).

Three types of volume can be distinguished on the currency market: real, transactional and a tick volume. The real volume represents the number of futures contracts that have been exchanged in a given time interval, e.g. on the CME market (Chicago Mercantile Exchange) (FX Mag 2019). The tick volume illustrates the number of price changes that occurred in a given time unit. Its name comes from the concept of tick, the smallest possible change in the price of a given asset. The disadvantage of this type of volume is the fact that it does not reflect the exchange taking place on the market and only allows to assess the activity of its participants. The tick volume, however, is most often used due to its availability, which is its main advantage. The last type of volume, referred to as transactional, is the number of transactions made by market participants. However, it has a fundamental disadvantage as it does not take into account the volume of transactions that have been made (Smart Trader 2019).

The volume finds many uses in the analysis of the currency market, but above all it is a source of confirmation of signals from other types of analyses. The higher the volume, the more valuable and reliable are the signals flowing in the analysis of charts or macroeconomic data (Traders Area 2019).

Euro as the Base and Quoted Currency on the Currency Market

The currencies whose share in transactions on the forex market is the largest based on the report of the Bank for International Settlements from 2016 include: the US dollar, the euro, the Japanese yen, and the pound sterling. The share of each of these currencies in the market turnover exceeds 10%. In 2016, the US dollar accounted

for 87.6% of all foreign exchange transactions, while the euro was subject to 31.4% of transactions (Bis 2016). Both currencies simultaneously make up the most popular EUR/USD currency pair among investors, which in 2016 was subject to almost a quarter of exchange transactions (23.1%) and at the beginning of 2019, every fifth transaction (20.03%) (FXSSI 2019).

In order to characterize the function that the US dollar and the euro have in the global economy, reference should be made to the concept of international currency. An international currency is a currency whose use as the value of money, the means of payment and the means of accumulation, extends beyond its territory (Oręziak 2008: 4). The fact that the currency can be considered international is determined by structural factors as well as macroeconomic stability of the country. The structural factors include: volume of production and trade, stability of purchasing power as well as the degree of development of the financial market (Bergsten 1997: 17–48).

The value of US GDP in 2018 was USD 20.44 trillion (Trading Economics United States 2019), while euro zone GDP for 2018 amounted to USD 13.669 trillion (Trading Economics Eurozone 2019). The volume of exports of the euro area countries in 2016 amounted to USD 1.929 trillion, while the US export volume in 2017 amounted to USD 1.576 trillion (Cia 2019). The value of shares and bonds outstanding in the euro area in recent years was significantly lower than the corresponding values in the United States (Kuziemska 2014: 144).

Taking into account the above-mentioned facts, it should be stated that the US dollar is at present unquestionably the dominant international currency. It is worth noting, however, that the participation of the euro zone in the global economy places it second only after the United States. In spite of this, most of the studies devoted to the currency market in the part concerning the analysis of particular parameters of foreign exchange investments are focused mainly on currency pairs connected with the US dollar. To a lesser extent, they refer to the problem of currency pairs in which there is no US dollar and the euro is the base or quoted currency.

Review of Literature on the Volatility and Volume of the Currency Market

Literature referring to the problem of volatility in the currency market is very broad. Articles matching the exchange rate change on the forex market largely focus

on forecasting methods, which is understandable because it is the volatility that is the source of profits and losses of entities on both sides of the transaction.

The article from 2006 by S. Kumar focuses on the assessment of ten statistical and econometric volatility models for the foreign exchange market and the Indian stock market. The models were compared using symmetric and asymmetric error statistics. After the surveys, it turned out that the most accurate forecast for the currency market was the GARCH model (5.1). More accurate results have been achieved for asymmetric error statistics (Kumar 2006). An example of a publication that is part of the subject of volatility forecasting is the article by R. Mohnot from 2011. The author attempted to assess the predictability of currency exchange rates in thirteen countries. In his research, carried out on data from 2005–2009, he also used the GARCH model. Comparing the volatility from the crisis periods and the relative stability before the crisis, he obtained results indicating that in the three years before the crisis the currencies of all the studied countries except Thailand, were at least once characterized by a low level of volatility. During the crisis, each of the currency pairs was characterized by a high level of volatility. Based on the research, the author stated that exchange rates tend to maintain conditional heteroscedasticity and, therefore, can be predicted with one date of delay (Mohnot 2011: 27–38). Y. Kamal, G. Usman and M. Muhammad, authors of the article published in 2012, emphasized in their publication that today the role of the exchange rate in corporate decision-making becomes more and more important. The authors undertook to examine exchange rate fluctuations using models from the GARCH group. The study was carried out using data from 2001–2009 and their results confirmed that models from this group may, to a greater or lesser extent, be used in accurate forecasting of exchange rates (Kamal, Usman, Muhammad 2012: 2830–2838).

The issue of volatility on the currency market, apart from the most extensive subject of research, which is the subject of forecasting rates, was also discussed in publications pertaining to the issue of linking volatility between individual currency pairs and markets, and as an element of constructing investment strategies.

In an article from 2011, V. Bubak, K. Evzen and F. Zikes analysed the relationships between the volatility of the currency pairs of the Central European countries and the EUR/USD currency pair. The authors created a parametric model in which the daily volatility of a given exchange rate was dependent on the historical values of the analysed pair and the other currency pairs. Based on the conducted research, the authors found dependencies between the volatility levels of currency pairs of Central European countries. However, they did not find any relationship between

the currency pairs of the Central European countries and the EUR/USD pair, with the exception of those with currencies of Poland and the Czech Republic (Bubák, Kočenda, Žikeš 2011: 2829–2841). The publication from 2012 by L. Menkhoff is part of the subject of volatility understood as risk. The author in his publication focused on the analysis of *carry trade* investment strategies. Based on the research conducted, L. Menkhoff concluded that high interest rates ensure low profits in times of high volatility, while low interest currencies generate positive returns (Menkhoff 2012: 681–718). An article from 2017 prepared by J. Barunika, K. Evzen, and L. Vach refers to the problem of factors affecting the volatility of the currency market. Based on the research carried out on data from 2007–2015, the authors found that positive asymmetries of fluctuations in volatility result mainly from monetary policy and events taking place in the real sphere. Negative asymmetries, on the other hand, are mainly the result of fiscal factors (Baruník, Kočenda, Vácha 2017: 39–56).

In contrast to the issue of volatility, the subject matter of the currency market volume has not been thoroughly researched in the literature. Publications in this field relate mainly to the question of changing the value of the volume and its informational significance. The issue of dependencies between volume and volatility was also the subject of research.

One of the two articles from 1996 by P. Jorion refers to the issues of risk and the volume of the currency market. The author in his publication showed, among others, that many aspects of the forex market depend on the perception of risk. P. Jorion also studied the type of connection between risk and volatility, showing that both variables are positively correlated with each other (Jorion 1996: 19–40). The second publication, released in 1996 by R. Lyons, is part of the subject of the informational meaning of the volume. The author examined the information value of transaction signals, generated at low and high turnover levels. The results of the research confirmed the hypothesis that signals generated in the case of a low volume value, at the same time have a high information value (Lyons 1996: 183–208). However, the publication by G. Galati from 2001 refers to the issue of a sharp drop in the value of the currency market volume in the years 1998–2001. In the article, the author states that the decrease in turnover over the three years studied, contrasts with the results of previous surveys, in which the volume value increase was systematically recorded (Galati 2001: 39–47).

On the basis of the presented literature review, it should be pointed out that issues of volatility and volume on the currency market have so far been mainly examined separately. Only the publication of P. Jorion from 1996 analyses both issues together (Jorion 1996: 19–40). Publications that are part of the subject of volatility, relate

mainly to the issues of forecasting courses as well as their relation to other markets. Articles devoted to the issue of volume, mostly focus on the issues of changes in its value and the informational significance of changes in the volume of turnover. In this article, an attempt was made to assess the level of dependence occurring between the volatility and volume of the currency market.

Research on the Level of Dependence between the Volatility and Volume of Selected Currency Pairs with the Euro in 2016–2018

The survey was conducted on the basis of data for currency pairs of the euro such as EUR/USD (euro to US dollar), EUR/JPY (euro to Japanese yen), EUR/GBP (euro to British pound), EUR/CHF (euro to Swiss franc) and EUR/AUD (Euros to the Australian dollar). The most liquid currency pairs were chosen, in which the euro was also the base currency or the quoted currency (FXSSI 2019). The data from the period from January 1, 2016 to December 31, 2018 were used for calculations. Data were aggregated in five time intervals: one-hour, four-hour, daily, weekly and monthly. The study analysed two factors: volatility and volume. Volatility was understood as the difference between the maximum and minimum value of the exchange rate at each of the time intervals. As the volume, a tick volume was available on the MetaTrader 4 platform, provided by the Fresh Forex brokerage firm. Due to the limited availability of data, the transaction volume was not used (Smart Trader 2019).

To determine the level of relationships between volatility and the tick volume of selected currency pairs, a correlation coefficient analysis method was used. The chosen method belongs to the set of quantitative methods. Due to the rejection of the hypothesis about the normality of distributions of all of the analysed variables based on the tests of normality of Kolmogorov-Smirnov distribution, the Spearman rank correlation coefficient was chosen to measure the degree of dependence.

The research procedure consisted of four stages. In the first stage, data from the years 2016–2018 were collected regarding the rates and value of the tick volume for five selected currency pairs, in which the euro was the base or quoted currency. In the second stage, the average volatility levels for individual currency pairs were calculated at five time intervals during the researched period. Next, the Kolmogorov-Smirnov test was used to measure the normality of distributions of all extracted

variables in order to select the correlation coefficient. Since not all variables adopted the normal distribution for the fourth stage, which was the calculation of the level of dependence between volatility and volume, the Spearman rank correlation coefficient was selected.

Table 1 presents the average values of tick volume of currency pairs EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD at intervals: hourly, four-hour, daily weekly and monthly in the years 2016–2018.

Table 1: Average values of tick volume of currency pairs in which the euro is the base currency or quoted at selected time intervals in 2016–2018

Currency pair	1 hour	4 hours	1 day	1 week	1 month
EUR/USD	4 723	18 868	113 133	562 374	2 444 939
EUR/JPY	7 960	31 809	190 729	948 986	3 828 432
EUR/GBP	5 009	20 014	120 009	596 660	2 419 527
EUR/CHF	4 374	17 476	104 790	520 742	2 135 683
EUR/AUD	6 128	25 623	153 640	764 221	3 068 509

Source: own elaboration.

For each analysed time interval, the average values of the tick volume were the highest for the EUR/JPY currency pair, while the lowest for the EUR/CHF pair.

Table 2 presents the average volatility values of currency exchange rates EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD at intervals: hourly, four-hour, daily weekly and monthly in the years 2016–2018.

Table 2: Average volatility values of exchange rate pairs in which the euro is the base or quoted currency at selected time intervals in 2016–2018

Currency pair	1 hour	4 hours	1 day	1 week	1 month
EUR/USD	0.0015	0.0032	0.0085	0.0193	0.0396
EUR/JPY	0.0021	0.0043	0.011	0.0255	0.0515
EUR/GBP	0.0013	0.0027	0.007	0.0157	0.0325
EUR/CHF	0.0011	0.0022	0.0056	0.0118	0.0244
EUR/AUD	0.0024	0.0051	0.0129	0.0295	0.0608

Source: own elaboration.

For each of the five time intervals, the EUR/AUD exchange rate was characterized by the highest volatility, while the EUR/CHF pair showed the lowest volatility.

Table 3 presents the results of the normality study of volume distributions of currency pairs EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD at intervals of one hour, four hours, daily and weekly in 2016–2018. The measurements were made using the normality test of the Kolmogorov–Smirnov distribution. Time series that have a normal distribution are marked by the word „YES”, while the one without the normal distribution are marked by the word „NO”.

Table 3: Results of assessing the normality of tick volume distributions of currency pairs in which the euro is the base currency or quoted at selected time intervals in 2016–2018

Currency pair	1 hour	4 hours	1 day	1 week	1 month
EUR/USD	NO	NO	NO	YES	YES
EUR/JPY	NO	NO	NO	YES	YES
EUR/GBP	NO	NO	YES	YES	YES
EUR/CHF	NO	NO	NO	YES	YES
EUR/AUD	NO	NO	NO	NO	YES

Source: own elaboration.

Of the 25 analysed time series, in 10 cases (40% of all), the distribution proved to be normal. For intervals: one hour and four hours, all time series were characterized by an asymmetrical distribution. For the daily interval in one of five cases (20%) a normal distribution was recorded. Only the tick volume distribution of the EUR/GBP currency pair was characterized by normality for the daily interval. In the case of the next of the analysed intervals, i.e. the weekly period, the situation turned out to be reversed because distributions of the tick volume for four currency pairs: EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF (80%) proved to have a normal distribution. The distribution of the tick volume of each of the five currency pairs turned out to be normal for the monthly time interval. Based on the results of normality tests of volume distributions of currency pairs in which the euro is a base or quoted currency, it should be noted that the number of time series with a normal distribution increases with the growth of the assumed interval. At the same time, it is worth pointing out that the most common distribution was the tick volume of the EUR/GBP pair in as many as three out of five cases, and the least frequent in only one case was the distribution of the tick volume of the EUR/AUD pair.

Table 4 presents the results of the study of the normality of volatility distributions of currency pairs EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD at intervals: hourly, four-hour, daily and weekly in 2016–2018. In this case, the measurements were also made using the normality test of the Kolmogorov–Smirnov

distribution. Time series that have a normal distribution are marked by the word „YES”, but without the normal distribution by the word „NO”.

Table 4: Results of assessing the normality of volatility distributions of currency pairs in which the euro is the base currency or quoted at selected time intervals in 2016–2018

Currency pair	1 hour	4 hours	1 day	1 week	1 month
EUR/USD	NO	NO	NO	NO	YES
EUR/JPY	NO	NO	NO	NO	YES
EUR/GBP	NO	NO	NO	NO	YES
EUR/CHF	NO	NO	NO	NO	NO
EUR/AUD	NO	NO	NO	NO	YES

Source: own elaboration.

Of the 25 time series of exchange rate volatilities in which the euro is the base currency or quoted only four, they have a normal distribution (16% of all). The normal distribution has four out of five time series in the monthly interval for currency pairs EUR/USD, EUR/JPY, EUR/GBP and EUR/AUD. Only in the case of the EUR/CHF currency pair, in any of the analysed intervals, the volatility is not characterized by normal distribution.

Table 5 presents the values of Spearman's rank correlation coefficients between volatility and tick volume of currency pairs: EUR/USD, EUR/JPY, EUR/GBP, EUR/CHF and EUR/AUD at intervals: hourly, four-hour, daily, weekly and monthly in the years 2016–2018.

Table 5: Spearman's rank correlation coefficients between volatility and volume of currency pairs in which the euro is the base currency or quoted at selected time intervals in 2016–2018

Currency pair	1 hour	4 hours	1 day	1 week	1 month	Minimum	Maximum	Average
EUR/USD	0.77	0.77	0.45	0.33	0.41	0.33	0.77	0.55
EUR/JPY	0.61	0.54	0.34	0.31	0.25	0.25	0.61	0.41
EUR/GBP	0.73	0.74	0.5	0.46	0.61	0.46	0.74	0.61
EUR/CHF	0.55	0.53	0.18	-0.02	0.07	-0.02	0.55	0.26
EUR/AUD	0.58	0.51	0.35	0.23	0.32	0.23	0.58	0.4
Minimum	0.55	0.51	0.18	-0.02	0.07	-0.02	0.55	0.26
Maximum	0.77	0.77	0.5	0.46	0.61	0.46	0.77	0.62
Average	0.65	0.62	0.37	0.26	0.33	0.26	0.65	0.45

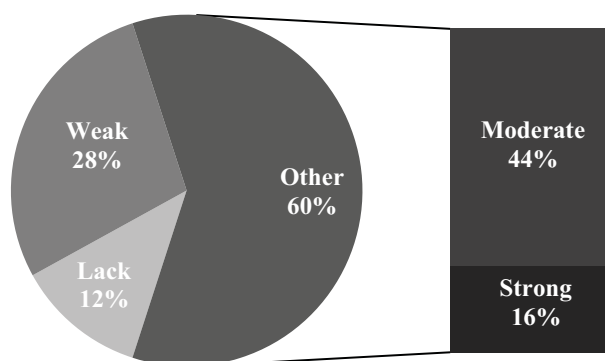
Source: own elaboration.

In the case of values calculated for an hour and a four-hour time interval, volatility was linked with tick volume to the highest degree in the case of the exchange rate of the EUR/USD currency pair (0.77 in both cases). The lowest level of connection for the hourly interval occurred for the EUR/CHF currency pair (0.55) and for the four-hour interval for EUR/AUD (0.51). Analysing the daily interval, the values of the correlation coefficient for EUR/GBP pair (0.50) turned out to be the highest, while the smallest correlation, with the Spearman rank correlation coefficient of 0.18, characterized the EUR/CHF pair parameters. In the case of weekly and monthly intervals, the highest level of correlation was recorded for the EUR/GBP currency pair (0.46 and 0.61 successively) and the lowest correlation, close to zero, was determined by time series of the EUR/CHF currency pair (consecutively -0.02 and 0.07).

The highest correlation value of all the currency pairs selected for the study at all time intervals was recorded for the EUR/USD pair for data aggregated in one-hour and four-hour periods (0.77 each). The lowest and the only negative value of -0.02 was recorded for the EUR/CHF currency pair in the weekly interval.

Figure 2 presents the percentage distribution of Spearman's rank correlation coefficients, calculated between volatility and tick volume for selected currency pairs with the euro in the analysed time intervals in terms of dependence strength.

Figure 2: Percentage distribution of Spearman's rank correlation coefficients calculated between volatility and tick volume for currency pairs where the euro is the base or quoted currency at selected time intervals in 2016–2018



Source: own elaboration.

Only in four of the 25 cases analysed (16% of all) the degree of association between variation and tick volume turned out to be greater than 0.7, i.e. quite strong monotonic correlation, in 11 cases (44%) the relationship turned out to be moderate, in seven cases it was weak (28%) and in three (12%) it did not occur. However, the average degree of correlation determined by the correlation coefficient was 0.45 and can be described as moderate (Task Statistics 2019).

Conclusions

During the research, Spearman's rank correlation coefficients were calculated between exchange rate volatility and tick volume of five currency pairs, at five time intervals. Of the 25 observations, a strong monotone dependence occurred only in 16% of cases, while most frequently, in 44% of cases, the relationship turned out to be moderate. In the remaining 40% of cases, the relationship turned out to be weak or statistically insignificant. On the basis of the conducted research, one should therefore reject the hypothesis that there is a strong monotone dependence between the level of exchange rate volatility, in which the euro is the base or quoted currency, and the tick volume of a given currency pair. The conducted research shows that between the analysed parameters, as much as in 88% exists at least a weak dependence, while in 60% of cases it is at least moderate.

The results of the conducted research confirm the thesis put forward by P. Jorion in the article from 1996 titled "Risk and turnover in the foreign exchange market", in which the author claimed that the relationship between the size of volatility and the volume is true (Jorion 1996: 19–40). In 24 cases analysed (96% of all) the tested relationship turned out to be positive, only the examined parameters of the EUR/CHF currency pair in the weekly time interval turned out to be negative.

Confirmation of the existence of dependence between volatility and tick volume may be used in forecasting of the exchange rates. The limitation of the test results presented in the article is the lack of access to data about the size of the real volume. In exchange, the tick volume available for the researcher was used. Further research using the real volume could allow for more accurate results. At the same time, from the point of view of a strategy building individual investor, who in most cases also does not have access to real-volume data, the research results obtained using the tick volume may be more useful.

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