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Financial Internet Quarterly 2023, vol. 19 / no. 1, p. 1-7

10.2478/fiqf-2023-0001

Financial Internet Quarterly

REACTION OF THE USD/PLN CURRENCY PAIR EXCHANGE RATE TO THE PUBLISHED MACROECONOMIC DATA

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Abstract

The results of the research presented in the article regard the importance of publication of macroeconomic data from the United States for the short-term USD/PLN currency pair exchange rate volatility. The main purpose of the research was to indicate what macroeconomic data is important for the short-term USD/PLN exchange rate volatility. The following research questions have been posed does the USD/PLN exchange rate react to the published macroeconomic data from the American economy and second could greater USD/PLN exchange rate volatility be observed during the COVID pandemic and has the war in Ukraine impacted the USD/PLN exchange rate volatility. International Foreign Exchange Market is the largest and most dynamically developing financial market in the world. In the globalized world the exchange rates are mainly influenced by economic factors. The most significant economic factors that impact short-term exchange rate volatility are primarily macroeconomic data from the American economy. Therefore in this article the author attempts to analyze macroeconomic data and their impact on short-term USD/PLN exchange rate volatility. Data based on which the research was made is as follows: Consumer Price Index, Non-Farm Payrolls (NFP), Services PMI, Manufacturing PMI, Empire State Manufacturing Index or Retail Sales. The analysis of connections between the publication of macroeconomic data and the reaction of exchange rates was carried out using the linear regression model with GARCH process for the random parameter. Conclusions of this research is exchange rate volatility USD/PLN was higher after publications of the macroeconomic data from Americans economy. The strongest exchange rate reaction was after publication of data regarding inflation, Manufacturing PMI and Retail Sales. In the COVID (1.03.20—14.02.22) period we observed increased USD/PLN exchange rate volatility. Exchange rate volatility was expressly larger in the period of war in Ukraine (15.02.22 – end of experiment).

JEL classification: C51, E44, F31

Keywords: Foreign Exchange Markets, currency exchange rates, GARCH model

Received: 22.11.2022 Accepted: 22.01.2023

Cite this:

Pasionek J. (2023) Reaction of the USD/PLN currency pair exchange rate to the published macroeconomic data. Financial Internet Quarterly 19 (1), pp. 1-7.

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Introduction

The Foreign Exchange Market, colloquially called Forex, is one of the largest and most dynamically developing financial markets in the world. It is a decentralized market in the economic, geographic and technical sense. The advantage of this market is undoubtedly the fact that anyone can become an investor on this market, thus there are no market entry or exit barriers.

The market is characterized by the largest liquidity, dynamics and turnover (Zembura, 2011, p. 114 a). Data from the report of the International Settlement Bank indicate the ever-growing importance of this segment on the international arena. The average daily transaction value increased from USD 5.5 trillion to USD 6.59 trillion in 2019.

Forex is characterized by certain features, where the most significant are the following:

a) global extent – transactions possible in various regions of the world, it is not a geographically located market;
b) possibility to close transactions 24h/day;
c) no central supervision – domestic supervision authority in every country. In Poland the authority supervising the functioning of Forex is the Polish Financial Supervision Authority (Oziewicz, 2006; Rubaszek & Serwa, 2009; Świerkocki, 2011; Zembura, 2011b; Bieliński, 2013).

In the globalized world the exchange rates are mainly impacted by economic factors. In the transactions on Forex the exchange rate of the given currency pair is expressed as one figure that constitutes a relation of the quoted currency to the notional amount. The demand and supply for the given currency pair depends on many factors. The most significant economic factors that influence the short-term exchange rate volatility are macroeconomic data from the American economy. This data is usually published in the form of monthly reports.

The macroeconomic variables can be divided into:

a) structural indices, e.g. inflation indices, Gross Domestic Product (GDP) or Balance of Trade;
b) labor market indices, e.g. Non-Farm Payrolls, unemployment rate or the number of unemployment benefit claims;
c) real estate sector indices, e.g. primary market house sales index, building permit index or secondary house sales index;
d) producers' orders indices, e.g. orders in industry, orders for durable goods or orders for goods without means of transport;
e) enterprises' decisions indices, e.g. Supply Management Institute's Index for Industry or Supply Management Institute's Index for Services;
f) consumers' decision and sentiment indices, e.g. Retail Sales, Consumer Confidence Index or University of Michigan Consumer Sentiment Index.

The main purpose of the research was to indicate what macroeconomic data is important for short-term USD/PLN exchange rate volatility. The analysis uses half-hourly data on the exchange rate of the Polish zloty against the US dollar. To date, there had been no attempts to study the impact of US macroeconomic data of the USD/PLN currency pair within the M30 interval.

The study results have a cognitive as well as an application dimension. As regards the cognitive dimension, the article may be a source of knowledge on the Forex market and on the determinants of the shaping of the USD/PLN exchange rate. As for the application dimension, the study results may be useful for currency market players. The study may be addressed to investors who conduct transactions involving the USD/PLN currency pair. The proper identification of the currency exchange response translates into investment success.

Literature review

The empirical research and economic practice prove that exchange rates react to information regarding macroeconomic data. Data from the United States economy is of particular importance. Exchange rate volatility under the influence of macroeconomic data from the United States was confirmed among others in the research of Devereux and Lane (2003), Moran (2009), Insah (2013) or Mirchandani (2013) Andersen and Bollerslev (2013). Thus, it is macroeconomic data from the American economy that is subject to analysis in this research.

Empirical research has confirmed that foreign currency investors focus on different macroeconomic data. Therefore, the impact of particular macroeconomic data on exchange rates can be of large, medium or small significance. Such classification is commonly used both in the subject literature and in market analyses. One should remember that the significance attributed to particular macroeconomic indices is not permanent and may change, e.g. due to the change of market environment. It has been confirmed in a plethora of scientific research.

In multiple publications it is emphasized that the selection of the 1-hour time range gives the most authoritative results, also because of the fact that in longer periods of time the exchange rate reaction may be polluted by the influence of other determinants. Such conclusions have been drawn among others in the research of Almeida et al. (1998). Goodhart has demonstrated strong influence of US macroeconomic data on

the exchange rate volatility emphasizing that the strength of the influence decreases with time. Similar conclusions have been formulated by Andersen et al. (2007) who have demonstrated that the influence of data from USA on the exchange rate volatility was significant but momentaneous. Neely has proved that macroeconomic announcements attribute to the exchange rate volatility and that the planned and unplanned news usually increase the exchange rate volatility for about one hour, frequently causing price jumps. Thus, the time of analysis for the analysis of macroeconomic data has been narrowed to one hour.

Moreover Omrane and Savaser (2016) have pointed to the large impact of the chronology of publications during a month demonstrating that in one variables category it is data published first that is most significant. Harris and Żabka's (1995) and Edison's (1997) research have proved that data on the change of employment in the USA is of expressly positive and statistically significant impact on the dollar exchange rate. Whereas Simpson et al. (2005) did a study in which the influence of 23 macroeconomic announcements on exchange rates were analysed, which proved that the exchange rates reacted to the announcements on inflation, customer demand and interest rates.

Data and methodology

The results of research of short-term reaction of the USD/PLN exchange rate to the publication of macroeconomic data are presented. The research comprises data from June 2017 to September 2022. Macroeconomic data used in the analysis come from the American economy. The analysis uses half-hourly data on the exchange rate of the Polish zloty against the US dollar. The purpose of the research was to indicate what macroeconomic data is important for the short-term USD/PLN exchange rate volatility. The following research question has been posed: Does the USD/PLN exchange rate react to the published macroeconomic data from the American economy?

In this research short-term reaction is understood as a reaction to the publication of macroeconomic data within the range of one hour. The choice of the one-hour reaction as the subject of analysis is a typical solution discussed in the subject literature. Numerous publications emphasize that choosing the one-hour time range allows one to eliminate the risk of influence of other data published on the same day but at different time. Therefore, the analysis of the one-hour reaction gives the most authoritative results.

In accordance with the schedule of publications, there is only one new piece information published in the analysed time ranges. At the moment of data publishing, e.g. regarding inflation (CPI), no other macroeconomic data from the American economy is published. The risk of impact of other macroeconomic data has been thus significantly eliminated. However, it does not exclude the inflow of unexpected information unforeseen in the macroeconomic calendar (such as war, cataclysms, unexpected announcements by authorities, etc.).

The analysis of the short-term exchange rate reaction to the publication of macroeconomic data demands taking into consideration the expectations prior to the publication of data. The exchange rate does not react to the value of the published macroeconomic variable, but rather to how much this variable differs from the expected, i.e. how much it has surprised market participants. Therefore, the subject of the research is the surprise. In order to be able to calculate the surprise connected with the published macroeconomic data one uses the median of questions asked in the research performed by Money Market Services (MMS). Such research is carried out once a week. MMS addresses a survey of up to 40 managers. The results allow collection of data in the scope of specialists' expectations with regard to the coming economic information (Neely, 2011, pp. 361-407). Thus, the macroeconomic surprise constitutes the difference between the expected value (prognosis) of the published macroeconomic data and the actually published value (Caruso, 2016, p. 28; Andersen et al., 2013, p. 38; Andersen et al., 2007, p. 258).

In Table 1 a sample macroeconomic calendar is presented. It comprises one calendar year with monthly publications for the sample American macroeconomic variable: inflation.

Table 1: United States of America – consumer price index m/m

Year	Month	Day	Hour	Consumer price index (m/m in %)		
				Present value	Projected value	Previous value
2021	January	13	15:30	0.4	0.4	0.2
	February	10	15:30	0.3	0.3	0.2
	March	10	15:30	0.4	0.4	0.3
	April	13	14:30	0.6	0.5	0.4
	May	12	14:30	0.8	0.2	0.6
	June	10	14:30	0.6	0.4	0.8
	July	13	14:30	0.9	0.5	0.6

Year	Month	Day	Hour	Consumer price index (m/m in %)		
				Present value	Projected value	Previous value
2021	August	11	14:30	0.5	0.5	0.9
	September	14	14:30	0.3	0.4	0.5
	October	13	14:30	0.4	0.3	0.3
	November	10	15:30	0.9	0.6	0.4
	December	10	15:30	0.8	0.7	0.9

Source: Own study based on: https://pl.investing.com/economic-calendar/cpi-69 (Accessed: 24.09.2022).

The green colour means that the present value of the index is much higher from prognoses, which can lead to dollar weakening. Whereas the red colour of the current value means that the actually published value of this index is less than the expected value. Such a value means better news for the investors as it can herald currency appreciation. An announcement is deemed surprising if it departs from the market expectations. Therefore, it is the surprise value that is analysed and not the published value.

The selection of macroeconomic data from the United States raises no doubts as it has been confirmed by a plethora of research. Moreover, the USA is still the most important economy in the world and therefore investors pay most attention to the publications from this economy. In the article it is the USD/PLN currency pair that has been analysed. The basic criterion of macroeconomic variable selection for the research was the importance of the given variable for the shaping of the currency rates in accordance with the most important currency rate theories and their practical meaning from the investors' point of view.

The analysis of the change of exchange rate reactions to the publication of data from the American economy was performed with reference to five macroeconomic data points. The reaction was tested based on the following variables: CPI, Non-Farm Payroll, ISM Services PMI, ISM Manufacturing PMI, ESMI or Retail Sales. The study uses the macroeconomic calendar of the Investing.com platform recognized by investors around the world. The platform updates data regarding the expected, real and past value in the macroeconomic calendar. It also publishes data from previous years. The analysis of connections between the publication of macroeconomic data and the reaction of exchange rates was carried out using the linear regression model with the GARCH process for the random parameter.

Empirical results

The analysis of connections between the publication of macroeconomic data and the reaction of exchange rates was carried out using the linear regression model with the GARCH process for the random parameter. The model presents itself as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \sum_{i=2}^{k_c+1} \alpha_i C_{it} + \sum_{j=1}^{k_x} \beta_j X_{jt} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = \gamma_0 + \gamma_1 (\Delta Y_t)^2 + \gamma_2 \varepsilon_{t-1} + \sum_{i=3}^{4} \gamma_i C_{it}^g + \sum_{j=1}^{k_x} \delta_j X_{jt} \quad (2)$$

ΔY_t – change of exchange rate within half an hour expressed in pips calculated as follows:

$$\Delta Y_t = Y_t^z - Y_t^o \quad (3)$$

Whereas Y^0 and Y^z refer adequately to the exchange rate at the opening and at the closure of the given half-hour time range;

C_{it}, i = 1, 2, … , k_c – the values of the Boolean control variables representing particular hours or time ranges within the day; the variables assumed value 1 for the given time range or hour and 0 in other cases; the following time ranges and hours were taken into account: 6:00-8:30, 9:00, 9:30, 10:00, 10:30, 11:00, 11:30, 12:00-14:00, 14:30, 15:00, 15:30, 16:00, 16:30, 17:00, 17:30, 18:00-21:30;

X_{jt}, j = 1, 2, … , k_x – the values of standardized macroeconomic surprises for data from the United States;

ε_t – the value of the random parameter;

C_t^g - the value of the Boolean control variable representing the periods of the increased exchange rate volatility; COVID – 1.03.2020—14.02.2022; war in Ukraine – 15.02.2022—23.09.2022;

α, β, γ, δ - model parameters; describe average exchange rate changes in particular parts of the day; parameters depict exchange rate changes after the occurrence of the particular surprise of one standard deviation; parameters characterize the level of volatility of the analyzed exchange rates, whereas parameters describe volatility fluctuations that occur after the occurrence of the surprises.

These type of models are commonly used for modelling phenomena on the financial markets, especially for modelling exchange rates. Similar research approach was applied in other research referring to exchange rates on Forex, e.g. Egert et al. (2014).

The model parameters were calculated on the basis of half-hour data on the exchange rates in the years 2017-2020. One series counted 65,000 observations. Data regarding surprises was standardized so that the standard deviation of particular surprises always equals 1 and their average value is 0. If no macroeconomic data was published in the given moment, the value of variables describing the surprises was equal 0. The estimation of models was carried out using the standard largest method. The calculation of parameters was performed in the Stata 15 program.

Results for USD/PLN

Table 2 lists calculations of parameters of model (1-2) for the USD/PLN currency pair.

Table 2: Calculations of parameters of model (1-2)

Parameter α		Parameter β		Parameter δ		Parameter γ	
α_0	-8.344***	CPI	433.4***	CPI	2.103***	γ_0	9.105***
	(2.258)		(19.50)		(0.0336)		(0.0110)
α_1	0.00013**	ESMI	-3.762	ESMI	-1.237***	γ_1	0.311***
	(0.00005)		(25.16)		(0.131)		(0.00288)
id_0600_0830	7.999**	ISM Servces PMI	15.80	ISM Servces PMI	1.465***	γ_2	0.634***
	(3.158)		(29.62)		(0.234)		(0.00223)
id_0900	46.55***	ISM Manufacturing PMI	189.9***	ISM Manufacturing PMI	1.476***	γ_3 (id_covid)	0.549***
	(3.503)		(28.00)		(0.214)		(0.0112)
id_0930	14.55***	NFP	105.7	NFP	-8.631***	γ_4 (id_war)	1.704***
	(3.826)		(96.57)		(0.424)		(0.0150)
id_1000	-9.841**	Retail Sales	116.6***	Retail Sales	-1.407***	-	-
	(3.893)		(26.49)		(0.324)		-
id_1030	-18.65***	-	-	-	-	-	-
	(5.181)		-		-		-
id_1100	42.97***	-	-	-	-	-	-
	(6.317)		-		-		-
id_1130	71.04***	-	-	-	-	-	-
	(7.428)		-		-		-
id_1200-id_1400	1.293	-	-	-	-	-	-
	(3.688)		-		-		-
id_1430	-2.961	-	-	-	-	-	-
	(5.480)		-		-		-
id_1500	-37.87***	-	-	-	-	-	-
	(4.414)		-		-		-
id_1530	41.30***	-	-	-	-	-	-
	(5.006)		-		-		-
id_1600	33.93***	-	-	-	-	-	-
	(5.182)		-		-		-
id_1630	-34.74***	-	-	-	-	-	-
	(5.516)		-		-		-
id_1700	6.161	-	-	-	-	-	-
	(5.942)		-		-		-
id_1730	24.15***	-	-	-	-	-	-
	(6.683)		-		-		-
id_1800_2130	4.271*	-	-		-	-	-
	(2.373)		-		-		-

Source: Own elaboration.

On the basis of the analysis of the results for parameters one can see that between 11:30-12:00 the USD/PLN exchange rate increased on average by 71 pips above the trend and it was the largest average change during the day. Between 9:00-9:30 the exchange rate increased by app. 47 pips. Similar changes occurred between 11:00-11:30 (increase by 43 pips) and 15:30-16:00 (increase by 41 pips). The smallest USD/PLN exchange rate change took place between 12:00-14:00 (increase by slightly more than 1 pip). Similar small changes of the exchange rate were observed between 14:30-15:00 (decrease by app. 3 pips) and 18:00-21:00 (increase by slightly more than 4 pips).

The analysis of the results for parameter allows one to see that the positive surprise in the scope of data regarding inflation, Manufacturing PMI and Retail Sales definitely caused the strongest reaction of the USD/PLN exchange rate. The occurrence of the positive surprise in the scope of data regarding inflation of 1 standard variation resulted in the increase of USD/PLN exchange rate by 433 pips on average. Whereas after publication of data on Manufacturing PMI the USD/PLN exchange rate changed by approximately 190 pips within one hour from the moment of data publication. Then the positive surprise in the scope of retail sales data – one standard deviation – resulted in the average USD/PLN exchange rate change of approximately 117 pips within one hour from the moment of data publication.

The analysis of parameter allows one to see that in the COVID period (1.03.20—14.02.22) we observed increased USD/PLN exchange rate volatility. Such big increased volatility was also observed during the war in Ukraine (15.02.22 – end of experiment).

On the basis of the analysis of the results of parameter one can see that the positive surprise in the scope of data regarding inflation, Manufacturing PMI and Services PMI increased the USD/PLN exchange rate volatility. Whereas positive surprises in the scope of data regarding NFP and ESMI expressly decreased the USD/PLN exchange rate fluctuations.

Conclusion

The performed research was to distinguish the role of the selected macroeconomic data from the American economy as the determinants influencing short-term reaction of the USD/PLN currency pair exchange rate. The following research questions were posed: Does the USD/PLN exchange rate react to the published macroeconomic data from the American economy? Could larger USD/PLN exchange rate volatility be observed during the COVID pandemic and has the war in Ukraine impacted USD/PLN exchange rate volatility? The above research allowed us to formulate conclusions that constitute replies to the posed research questions.

The most important conclusions from the performed research were presented below.

a) Exchange rate volatility was higher after publications of the macroeconomic data. Between 11:30-12:00 the USD/PLN exchange rate increased on average by 71 pips above the trend and it was the largest average change during the day. Whereas after publication of data on Inflation the USD/PLN exchange rate changed by approximately 433 pips within one hour from the moment of data publication.
b) The strongest exchange rate reaction was after publication of data regarding Inflation, Manufacturing PMI and Retail Sales. The occurrence of the positive surprise in the scope of data regarding inflation resulted in the increase of the USD/PLN exchange rate by 433 pips on average. Whereas after publication of data on Manufacturing PMI the USD/PLN exchange rate changed by approximately 190 pips within one hour from the moment of data publication. Then the positive surprise in the scope of retail sales data resulted in the average USD/PLN exchange rate change of approximately 117 pips within one hour from the moment of data publication.
c) In the COVID (1.03.20—14.02.22) period we observed increased USD/PLN exchange rate volatility.
d) Exchange rate volatility was expressly larger in the period of war in Ukraine (15.02.22 – end of experiment).
e) The positive surprise in the scope of data regarding Inflation, Manufacturing PMI and Services PMI increased the USD/PLN exchange rate volatility, whereas positive surprises in the scope of data regarding NFP and ESMI expressly decreased the USD/PLN exchange rate fluctuations.

The author believes that the conducted study will assist in the making of decisions by Forex market investors involved in USD/PLN currency pair investing.

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