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Changes in the impact of US macroeconomic news on financial markets the example of the Warsaw Stock Exchange

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ABSTRACT

Due to the high importance of the American economy, in the past, announcements of US macroeconomic data were shown to have a significant impact on financial markets in general, and on European stock markets in particular. However, as this effect may vary in time, this paper examines the changes in the impact of US macroeconomic news on the WIG20, the main index of the Warsaw Stock Exchange. Based on intraday data from 2004-2019 we study the changes in significance and in the strength of the reaction of WIG20 to announcements of unexpected values of 13 indicators describing the American economy. On the basis of the event study analysis, we describe the reaction of the WIG20 index in the first few minutes after these kinds of announcements.

Key words: event study, macroeconomic announcements, intraday data, Warsaw Stock Exchange.

1. Introduction

Information on the state of an economy is important for investors in financial markets, and it affects both the foreign exchange markets as well as the stock markets. Due to globalisation and the dominant role of the US economy, American macroeconomic news is very important in this context. This has been shown in various scientific papers dealing with this issue. In the beginning, these studies mainly examined the impact of US macroeconomic data on the USA, and on markets in other developed countries (e.g. Schwert, 1981; Pearce and Roley, 1985; Li and Hu, 1998; Nikkinen and Sahlström, 2004; Boyd et al., 2005; Andersen et al., 2007; Harju and

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Hussain, 2011). Over time, this analysis was extended to investigate the impact of US macroeconomic data on emerging markets, including markets in Central and Eastern Europe (e.g. Hanousek et al., 2009; Gurgul and Wójtowicz, 2013, 2014, 2015). However, the number of papers concerning the reaction of European emerging markets to macroeconomic news from the USA is still very limited.

Previously mentioned studies of stock market reactions to information about the US economy were carried out by various authors who applied various methods and used different data covering the periods of different economic conditions. Taking that into account, it is difficult to compare the results of these studies, and to draw conclusions from the changes in the impact of news from the United States. For this reason, in this paper we examine the reactions of the WIG20 (the main index of the Warsaw Stock Exchange) to announcements of 13 macroeconomic indicators containing current information about the state of the US economy over time. The WSE is the largest stock market among post communist countries in Central and Eastern Europe. Hence, the results of this paper can be seen as a reflection of changes observed on other emerging markets in the CEE region. Additionally, previous research from Gurgul and Wójtowicz (2014; 2015) suggests that the reaction of investors on the WSE is similar to that on the Vienna Stock Exchange. Therefore, the results of the study can be at least partially transferred to the VSE.

To describe the reaction of the WSE to US data in detail, we consider 5-minute WIG20 returns from January 2004 until the end of July 2019. Application of this data allows us to comprehensively investigate the changes in strength and significance of the impact of US macroeconomic news over time. It is also important to mention that the period considered includes both the time of bull market before the global financial crisis, the time of the crisis itself, as well as the period of changes following the crisis. Additionally, it also covers periods of other crises in the world including the government-debt crisis in Greece or the financial crisis in Spain (2008–2014).

By applying intraday data this paper is an extension of previous research about the event study methodology. To verify the significance and the strength of the impact of announcements of US macroeconomic data on the WIG20, we apply a nonparametric rank test proposed by Kolari and Pynnönen (2011). It is a generalization of the widely applied test of Corrado and Zivney (1992). The application of this methodology, instead of the commonly used GARCH models or regressions with dummy variables, allows us to analyse the significance of the reaction of index returns to American macroeconomic news more precisely.

The remainder of the paper is organised as follows. In the next section we provide an overview of the existing literature focussing on the impact of macroeconomic announcements on financial markets. In Section 3 we present the US macroeconomic indicators and the returns used in this study. We also briefly describe the methodology

applied. Afterwards the empirical analysis and the discussion of its results are presented. The final section critically concludes the paper.

2. Literature review

Early studies on the impact of US macroeconomic data announcements were focused on the US stock market (Geske and Roll, 1983; McQueen and Roley, 1993). These studies have been subsequently extended to other developed markets showing the importance of information about the US economy. For example, Nikkinen and Sahlström (2004) examined the impact of US and domestic macroeconomic news on the German and Finnish equity markets. Their study shows a dominant role of information from the US as the volatility on both markets is significantly impacted by US announcements, particularly by information about the unemployment rate and PPI. A wider group of stock markets was considered by Nikkinen et al. (2006), who analysed the impact of US macroeconomic news announcements on 35 stock markets around the world. Among these markets, there were some developed and emerging markets in Europe. Based on data from July 1995 to March 2002, Nikkinen et al. (2006) stated, on the one hand, that unexpected macroeconomic information from the USA affects the volatility on developed stock markets in Europe and Asia. On the other hand, the volatility on emerging CEE markets (including the Czech Republic, Hungary, Poland, Russia and Slovakia) was not significantly impacted by announcements of US macroeconomic indicators. This showed that developed and emerging markets in Europe reacted differently to US macroeconomic news announcements. However, this observation may have been caused by the application of data from the early period of the development of equity markets in the CEE region. This observation is supported by opposite results shown by Gurgul et al. (2012). Based on data from January 2004 to December 2011, Gurgul et al. (2012) pointed out a significant reaction of daily returns of the WIG20 to unexpected news about inflation and industrial production in the United States.

More precise results on the impact of US macroeconomic news on European markets were obtained by applying intraday data. For example, based on the five-minute returns Andersen et al. (2007) analysed the impact of US macroeconomic news on US, German and British stock, bond and foreign exchange markets. High-frequency data was also applied by Harju and Hussain (2011), who investigated the impact of scheduled US macroeconomic announcements on British, French, German, and Swiss stock markets. They proved that announcements of CPI, PPI, retail sales, durable goods orders, unemployment rate and industrial production lead to significant and immediate changes of the volatility and the 5-minute returns of the CAC40, the DAX30, the FTSE100, and the SMI. Similar results, significant and immediate reaction,

were presented by Dimpfl (2011), who analysed the 1-minute returns of the DAX from July 2003 to December 2006. Dimpfl (2011) showed that investors on the Frankfurt Stock Exchange react right after a news release and the significant reaction takes place in the first ten minutes.

Gurgul and Wójtowicz (2015) analysed the reaction of the Austrian stock exchange. Applying 1-minute returns of the ATX (= the main index of Vienna Stock Exchange) from 2 January 2007 to 31 December 2013 they proved a significant impact of announcements of 10 US macroeconomic indicators on the returns and the volatility. The strongest reaction was induced by news from the US labour market included in nonfarm payrolls announcements. Gurgul and Wójtowicz (2015) also examined the changes in the strength of the reaction of the ATX to US macroeconomic announcements in subsequent years of the period under consideration. This analysis led to the conclusion that the strongest reaction of investors in Vienna took place during the global financial crisis in 2007-2009. After this period, the reaction of the ATX to news from the US economy was weaker.

Empirical analysis based on intraday data has also been conducted for European emerging markets. Hanousek et al. (2009) investigated the reaction of stock prices in the Czech Republic, Hungary and Poland to US and EU macroeconomic news. On the basis of the five-minute returns from the period June 2, 2003 – December 29, 2006, Hanousek et al. (2009) showed that the Czech and the Hungarian stock markets reacted significantly to macroeconomic news from both the US and EU, while the stock market in Poland was only affected by announcements from the Eurozone. This line of research was continued by Hanousek and Kočenda (2011). Using 5-minute returns of the WIG20, the PX50 and the BUX from the period 2004–2007 they proved that stock markets in the Czech Republic, in Hungary and in Poland mainly reacted to macroeconomic information from the EU, and that macroeconomic data from the United States was not so important.

Opposite conclusions follow from Gurgul and Wójtowicz (2014), who studied the reaction of the Polish stock market to US announcements. Based on the 1-minute returns from 1 April 2007 and 30 August 2013, they showed that the WIG20 reacted immediately and significantly to unexpected news from the US economy. A significant reaction was observed in the first minute after announcements about industrial production, durable goods orders, retail sales and nonfarm payrolls. Additional analysis performed by Gurgul and Wójtowicz (2014) indicated that US macroeconomic announcements did also influence medium and small stock indices of the stock exchange in Warsaw significantly.

In addition to the impact on the stock markets, the impact of macroeconomic news on foreign exchange markets in the CEE countries has been examined. Égert and Kočenda (2014) showed that the Czech, the Hungarian and the Polish currencies

significantly react to American macroeconomic information. However, this reaction is different in the pre-crisis (2004-2007) than in the crisis period (2008-2009). The reaction of the foreign exchange markets in these countries to macroeconomic news from the Eurozone and the US was analysed also by Kočenda and Moravcova (2018), who applied intraday data from 2011-2015.

3. Data and methodology

3.1. Announcements

In this paper, we investigate the impact of the announcements of 13 macroeconomic indicators describing various aspects of the US economy. These include: the Consumer Confidence Index (CCI), the Consumer Price Index (CPI), the Durable Goods Orders (DGO), the Existing Home Sales (EHS), the Housing Starts (HS), the Industrial Production (IP), the ISM Manufacturing Index (ISM), the Initial Jobless Claims (IJC), the Nonfarm Payrolls (NFP), the New Home Sales (NHS), the Producer Price Index (PPI), the Real GDP (GDP), and the Retail Sales (RS). In most papers the unemployment situation in the USA is described by the Unemployment Rate. However, as Andersen et al. (2007) show, Nonfarm Payrolls is one of the most significant macroeconomic indicators to describe the US unemployment situation. Similar conclusions follow from the research of Suliga and Wójtowicz (2013).

We chose these indicators because they contain the most current and the most important information for investors. Almost all of these indicators are released on a monthly basis and they describe the economic situation in the USA in the previous (or even in the current) month. The only exception is IJC, which is announced weekly. It contains information from the previous week. Taking into account monthly data ensures a sufficient number of announcements to conduct this study. The second advantage of these indicators is that they have been widely studied in literature. Thus, we can compare the results of this analysis with previous research.

All the indicators under study are released during trading hours on the WSE. Most of them (CPI, DGO, HS, IJC, NFP, PPI, GDP, and RS) are published at 8:30 EST (14:30 CET), CCI, EHS, ISM, and NHS are released at 10:00 EST (16:00 CET) and only values of IP are announced at 9:15 EST (15:15 CET), where EST means Eastern Standard Time and CET means Central European Time.

The announcements are released on different days of the month and different days of the week. The sequence in which US macroeconomic indicator announcements are released may play an important role on how they are perceived by investors. The earlier the indicator is released, the more important it is for investors because it is more probable that it contains new, unexpected information. The value of indicators released later in a month can be forecasted based on the value of earlier indicators. The earliest

published indicator is ISM, which is announced in the first few days of a month. Then, it is followed by NFP, which is a part of the Employment Report published by the Bureau of Labour Statistics usually on the first Friday of each month. The majority of the other indicators (CPI, EHS, HS, IP, PPI, and RS) is released mainly in the middle of a month. The rest of them (CCI, DGO, NHS, and GDP) is released in the last few days of a month. However, it should be noted here that values of CCI describe consumers' perception of the economic conditions in the current month.

In this paper, we study the impact of unexpected news related to these US macroeconomic announcements. Thus, for each macroeconomic news release the actual value of the announced indicator is compared with its consensus forecast. All comparisons are performed on the basis of the consensus published by Bloomberg a few days before announcements. It allows us to classify all releases into three clusters: 'above consensus', 'below consensus' and 'in line with consensus'. Because the news in the last cluster is in line with previous investor expectations, our analysis focuses only the first two clusters, which contain unexpected news.

In order to interpret the results of the analysis correctly we divide the announcements according to their meaning rather than simply compare them with the consensus. For most of the indicators, the announcement above the consensus is good news because it is expected to have a positive impact on the stock market. The only exception is publication of CPI, PPI and IJC, where values greater than the forecast are expected to have a negative impact on the stock prices and thus are seen by investors as bad news. Analogously, if the values of CPI, PPI and IJC are lower than the forecast, it is considered good news for the stock market. Based on this consideration we divide all the announcements into two categories of unexpected news: good news and bad news. For these two sets of data, we will perform the empirical analysis.

In addition to analysing the impact of announcements of an individual indicator, we also examine the impact of all good and all bad news. In the set of all good (bad) news, we take into account only monthly announcements, i.e. without IJC announcements released weekly. Additionally, when two or more indicators are announced on the same day, we consider only the first indicator. Subsequent announcements on the same day are excluded from the sample because expectations about their value could be heavily influenced by earlier news, and thus, they might be different from consensus. When two or more announcements are made at the same hour, we consider them only if they do not contain contradictory information, i.e. when each of them is good news or each of them is bad news. The final numbers of the different types of events under study that take place during trading days on the WSE are reported in the second column of Table 1.

3.2. Returns

To describe the impact of US macroeconomic announcements on investors operating on the Warsaw Stock Exchange correctly we study the 5-minute percentage log-returns $R_{i,t}$ of the WIG20 from 2 January 2004 to 31 July 2019:

$$R_{i,t} = 100\big(ln\, P_{i,t} - ln\, P_{i,t-1}\big), \tag{1}$$

where $P_{i,t}$ is the value of the WIG20 at the end of the t-th 5-minute period on day i. The application of the 5-minute intraday returns is a common compromise between accuracy and the negative effects of market microstructure (e.g. Jones et al., 2005; Andersen et al., 2007; Harju and Hussain, 2011). The value of the WIG20 obtained from the WSE is calculated on the basis of stock prices of 20 largest and most liquid companies listed on the WSE. The behaviour of the share prices of WIG20 companies, as well as the perspectives of the companies themselves, are subject to deep analysis by investors. This is why we expect new important information to be included in the WIG20 very quickly. These expectations are also supported by the results of previous studies, for example Gurgul and Wójtowicz (2014).

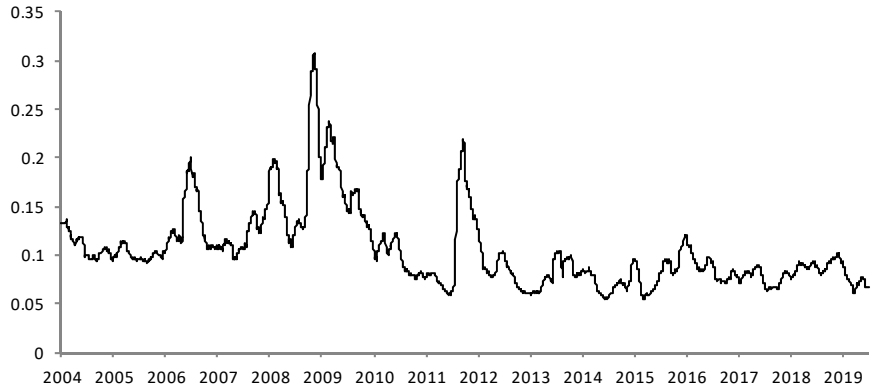

Figure 1. Standard deviation of 5-min percentage WIG20 log-returns in the period 2004-2019
Source: Own elaboration.

The regarded period covers about 15 years characterised by changes in the economic situation in the United States and in the whole world. These changes include various crises that took place in these years. It is well known that the volatility on stock markets increases during such turbulent periods. This phenomenon has also been observed on the WSE. It is also visible on Figure 1, where we present values of the standard deviation S_i computed for each day i based on the 5-min log-returns of the WIG20 from the continuous trading phase of a session from days $i-20, \ldots, i+20$. Due to these changes in volatility, to compare the strength of the reaction of the WIG20

returns to publications of US macroeconomic indicators in various sub-periods of the main period 2004-2019 we will also consider standardised 5-min returns $SR_{i,t}$ defined as 5-min log-returns $R_{i,t}$ divided by the corresponding standard deviation S_i defined as above for day i. In that case, standardised returns are expressed in terms of return standard deviation.

3.3. Event study

To investigate the impact of US macroeconomic news on the intraday returns of the WIG20 we use the event study methodology. In brief, it includes the analysis of the significance of the abnormal behaviour of returns (abnormal returns) around the event (in the so-called event window). In this paper, the events are defined as the announcements of unexpected macroeconomic news described previously. An event window contains two 5-minute WIG20 returns before the announcement and three returns after the announcement was made.

Abnormal returns are defined as the difference between actual returns and their expected values computed based on data prior to the event window (form the pre-event window). For the i-th event and time t abnormal return AR_{it} is defined as:

$$AR_{it} = R_{it} - E(R_{it}|\Omega), \tag{2}$$

where R_{it} is the 5-minute return and $E(R_{it}|\Omega)$ is the expectation of R_{it} conditional on information set Ω form the pre-event window. In this paper we consider the pre-event window containing 36 values of 5-minute WIG20 returns just before the event window. This choice of the length of event and pre-event window ensures that the pre-event window does not start earlier than 10:25CET (when macroeconomic indicator in announced at 13:30CET) and even for data from before October 2005 (when trading sessions on the WSE started at 10:00CET) it does not contain intraday returns from the initial part of a trading session with increased volatility. To set up notation let us denote the moment of a news release by $t = 0$. Then, the event window includes the 5-minute returns for $t = -1, \dots, 3$, while the pre-event window includes returns for $t = -37, \dots, -2$. It should be noted here that the impact of the i-th news announcement can be observed only for $t \geq 1$.

There are various methods of computing expected values of R_{it}. In this paper, however, we apply the constant mean model where $E(R_{it}|\Omega)$ is equal to the average of returns in the pre-event window. It is a simple but very useful and robust model.

To test the significance of mean abnormal returns in the event window, we apply the nonparametric generalized rank test of Kolari and Pynnonen (2011) with a correction for event-implied volatility. The great advantage of this nonparametric test is that it does not need any assumption about the normality of abnormal returns. The test statistics is constructed as follows.

In the first step of the test procedure, we group events into a cluster. The events are a specific type of announcements, for example the announcements of a given macroeconomic indicator that are good (or bad) news for investors. For each i-th event in the cluster, for $t = -37, \dots, 3$ we compute abnormal returns AR_{it} from (2) with $E(R_{it}|\Omega)$ computed earlier as the average of returns in the pre-event window $(t = -37, \dots, -2)$. Then, for each event, all abnormal returns in the event and pre-event windows are standardised:

$$SAR_{it} = AR_{it}/S_{AR_i}, \tag{3}$$

where S_{AR_i} is the standard deviation of abnormal returns in the pre-event window. Thisprocedure ensures the comparability of abnormal returns computed based on data from days with high or low volatility.

In order to account for any event-induced increase in volatility observed in the event window (Corrado, 2011; Corrado and Truong, 2008; Kolari, Pynnonen, 2011) we re-standardise the SAR_{it}s in the event window for $t > 0$ by dividing them by the cross-sectional standard deviation:

$$SAR'_{it} = \begin{cases} SAR_{it} & t = -37, \dots, 0 \\ SAR_{it}/S_{SAR_t} & t = 1, \dots, 3, \end{cases} \tag{4}$$

where

$$S_{SAR_t} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(SAR_{it} - \overline{SAR_{it}})^2} \tag{5}$$

is the cross-sectional standard deviation of the standardised abnormal returns, and N is the number of events in the cluster. Under the null hypothesis of no news effect, SAR'_{it}s are zero mean and unit variance random variables.

To study the impact of a news release we test the significance of abnormal returns for each t_0 in the event window separately. Thus, for each $t_0 = -1, \dots, 3$ the demeaned standardised abnormal ranks of SAR'_{it}s are given by the formula:

$$U_{it} = \frac{rank(SAR'_{it})}{T+1} - 1/2 \tag{6}$$

for $i = 1, \dots, N$, where $t \in \Theta = \{-37, \dots, -2, t_0\}$, $T-1$ is the length of the pre-event window and $rank(SAR'_{it})$ denotes the rank of SAR'_{it} within the vector consisting of standardised abnormal returns from the pre-event window and SAR'_{it_0}. With this notation U_{it_0} denotes the demeaned standardised abnormal rank of SAR'_{it_0} and the null hypothesis of no news effect is equivalent to

$$E\left(U_{it_0}\right) = 0. \tag{7}$$

To test this hypothesis we apply the generalised rank t_{grank} test statistic of Kolari-Pynnönen (2011) defined as:

$$t_{grank} = Z\sqrt{\frac{T-2}{T-1-Z^2}}, \tag{8}$$

where $Z = \overline{U}_{t_0}/S_{\overline{U}}$, $S_{\overline{U}} = \sqrt{\frac{1}{T}\sum_{t\in\Theta}\overline{U}_t^2}$ and $\overline{U}_t = \frac{1}{N}\sum_{i=1}^{N} U_{it}$.

Under the null hypothesis of no news effect, the distribution of t_{grank} statistic converges to Student t distribution with $T-2$ degrees of freedom when the number of events N in the cluster increases.

It is worth noting here that the above procedure can be applied to standardised returns $SR_{i,t}$ defined in Section 3.2 instead of returns $R_{i,t}$. Then, due to standardisation (3) and application of constant mean model abnormal standardised returns ASR_{it} computed similarly to (2) are equal to standardised returns AR_{it} divided by corresponding standard deviation of 5-minute returns:

$$ASR_{it} = \frac{AR_{it}}{S_i}, \tag{9}$$

where S_i is the standard deviation of 5-minute log returns of the WIG20 from the continuous trading phase of a session from 40-day window around the day of i-th announcement. Additionally, application of standardised returns instead of returns in the Kolari-Pynnönen test gives the same value of test statistic t_{grank}. The more specific applications of described methodology are also given in Gurgul and Suliga (2019).

In the analysis presented in the following section we use event study to test the significance of the announcements. However, the strength of the impact is described by average of abnormal returns $\overline{AR}_t$ or the average of abnormal standardised returns $\overline{ASR}_t$ computed for given time t.

4. Empirical results

4.1. Reaction in the whole period

In the first step of the analysis, we study the reaction of the WIG20 5-minute returns in the whole period 2004-2019. This will provide a background for further, more detailed analysis and comparisons.

Table 1 presents the values of mean abnormal returns $\overline{AR}_t$ computed in the event window for bad (Panel A) or good (Panel B) unexpected news included in announcements of the US macroeconomic indicators described previously. Together with the values of $\overline{AR}_t$ we report results of the Kolari-Pynnönen generalised rank test.

In addition to the means for single indicators in Table 1, we also present the results of the event study analysis for all the bad and all the good news (rows "ALL").

Most of the significant means of abnormal returns are observed in the first five minutes just after a news release ($t = 1$). It indicates that there is an immediate reaction of investors on the WSE to publication of US macroeconomic data. This significant change in the WIG20 is implied by most of the announcements. Only bad news included in announced values of the EHS and the PPI and good news about the DGO, the NHS, the PPI do not induce significant changes in the WIG20 at least at the 10% level.

The strongest reaction, measured by values of the mean $\overline{AR}_1$, is observed particularly after bad news regarding the DGO, the NFP and the GDP were released. In this case, the value of the WIG20 fell in the first five minutes after the announcement by about -0.12% additionally. In the case of good news the announcements of the NPF implied the strongest changes of the WIG20 ($\overline{AR}_1 \approx 0.166\%$). The analysis of the Kolari-Pynnönen test results indicates that the significant changes in the WIG20 are mainly limited to first five minutes after a news release. It confirms that the reaction of investors on the WSE is immediate and only lasts for a very short time.

When we compare the values of $\overline{AR}_1$ after good news and the values of $-\overline{AR}_1$ after bad news it turns out that for most of the indicators they are very close. An additional comparison of the strength of the changes of the WIG20 after different kinds of news shows no reaction asymmetry. To be more precise, for each of the indicators the Mann-Whitney test confirms that there is no significant difference between distributions of AR_1 after good news and the distribution of $-AR_1$ after bad news. These observations do confirm previous results of Gurgul and Wójtowicz (2014).

Table 1. Mean abnormal returns (in %) of the WIG20 in the event window for bad and good news from the US economy

Indicator	Number of events	$t = -1$	$t = 0$	$t = 1$	$t = 2$	$t = 3$
Panel A: bad news						
CCI	50	-0.028	-0.004	-0.086**	-0.011	0.011
CPI	49	-0.007	-0.012	-0.102*	-0.005	-0.003
DGO	91	-0.010	0.000	-0.123***	0.008	-0.003
EHS	54	-0.014	-0.012	-0.041	0.014	0.015
HS	98	0.009*	0.001	-0.024*	-0.004	0.032
IP	90	0.009	0.005	-0.053***	-0.002	0.010
ISM	35	-0.008	-0.003	-0.078**	0.044**	0.036
IJC	360	0.005	0.002	-0.051***	0.004	0.004
NFP	97	-0.009	0.005	-0.123**	-0.002	0.016
NHS	51	-0.017	0.025**	-0.016**	-0.019	0.002
PPI	83	0.012	-0.017	-0.004	0.008	0.017
GDP	80	0.022**	0.015*	-0.124***	-0.031	0.010
RS	92	0.001	-0.010	-0.079**	0.018	0.003
ALL	859	-0.002	0.000	-0.068***	0.000	0.013**

Table 1. Mean abnormal returns (in %) of the WIG20 in the event window for bad and good news from the US economy (cont.)

Indicator	Number of events	$t=-1$	$t=0$	$t=1$	$t=2$	$t=3$
Panel B: good news						
CCI	52	0.017*	-0.007	0.037**	0.000	-0.009
CPI	60	0.010	-0.003	0.060*	0.014	0.022
DGO	85	-0.004	0.006	0.063	-0.005	-0.013*
EHS	47	-0.002	0.007	0.035**	-0.015	0.001
HS	85	0.009	0.004	0.059***	0.019	-0.009
IP	73	0.018	0.027***	0.053**	0.021	-0.015
ISM	51	-0.022	-0.012	0.084**	-0.012	-0.013
IJC	391	-0.004	-0.007	0.048***	0.009	-0.007
NFP	78	0.006	0.013	0.166***	-0.007	0.005
NHS	50	-0.008	0.019	0.046	0.011	-0.029
PPI	78	0.007	0.000	0.008	0.021	-0.001
GDP	67	0.000	0.005	0.096**	-0.002	-0.026
RS	76	0.002	0.014*	0.144***	-0.002	0.002
ALL	806	0.002	0.005***	0.071***	0.003	-0.007*

*, **, *** indicate significance of a mean at 10%, 5% and 1%, respectively, resulting from the Kolari-Pynnönen rank test.

Source: Own work.

4.2. Changes in reaction strength

The main part of the empirical study in this paper is dealing with changes in the strength of investors' reaction to US macroeconomic news in the last 15 years. To do this we compare the results of event study analysis carried out in various sub-periods. These sub-periods should be long enough to include a suitable number of macroeconomic announcements. On the other hand, these sub-periods should be as short as possible to give more accurate results. Finally, as a compromise, we perform an event study analysis in 5-year windows that are shifted every quarter. The first of these windows starts in January 2004 and ends in December 2008, while the last window is a little shorter and begins in October 2014 and ends in July 2019.

As previously mentioned, a correct comparison of the strength of the WIG20 changes after news announcements in various sub-periods may be biased by changes in the volatility. To overcome this problem we will also consider the standardised 5-minute returns $SR_{i,t}$ defined in Section 3.2. We note once again that the application of $SR_{i,t}$ instead of the returns does not change the results of the Kolari-Pynnönen test.

The procedure described above is flexible enough to provide us with an appropriate description of changes in the reaction to US macroeconomic news announcements. In addition to that, due to the symmetry of the reaction of the WIG20 and to increase the number of events in each window we consider both types of unexpected news

(good and bad news) together. To do this, we multiply the abnormal returns (and abnormal standardised returns) corresponding to bad news by -1. As a result, all the abnormal results should move in the same direction after news announcements.

Table 2. Means of abnormal standardised returns of the WIG20 in the event window

	2004-2019		2004-2008		2009-2013		2014-2019		End of significant impact
	N	$\overline{ASR}_1$	N	$\overline{ASR}_1$	N	$\overline{ASR}_1$	N	$\overline{ASR}_1$	
CCI	102	0.574***	-	-	35	0.917***	60	0.315	Dec 2017
CPI	109	0.663***	42	1.016***	33	0.132	31	0.599	Sep 2012
DGO	176	0.747***	58	1.076***	57	1.064***	56	0.144	Jun 2016
EHS	101	0.377*	-	-	37	0.816**	59	0.097	Dec 2015
HS	183	0.373***	60	0.372*	58	0.637***	59	0.096*	Mar 2018
IP	163	0.403***	51	0.280*	53	0.968***	53	-0.140	Mar 2017
ISM	86	0.794***	-	-	29	1.668***	52	0.318	Jun 2017
IJC	751	0.416***	243	0.379***	243	0.765***	242	0.171**	Jul 2019
NFP	175	1.364***	57	1.095*	54	2.937***	57	0.260	Jun 2017
NHS	101	0.335***	-	-	35	0.636***	60	0.035	Jun 2016
PPI	161	0.033	53	0.451	55	0.013	49	-0.343	Insignif. t
GDP	147	1.030***	45	1.335***	52	1.339**	45	0.368*	Sep 2017
RS	168	0.916***	59	0.612***	53	1.506***	49	0.657	Dec 2017
ALL	1665	0.620***	418	0.780***	543	1.054***	640	0.160**	-

*, **, *** indicate significance of a mean at 10%, 5% and 1%, respectively, resulting from the Kolari-Pynnönen rank test.

Source: Own work.

Due to the large number of the results of the analysis in the sub-periods, we do not report here all of them. In Table 2, we present the results of the empirical study for three disjoint windows: January 2004–December 2008, January 2009–December 2013, and October 2014–July 2019. More precisely, we report only the values of means of abnormal standardised returns $\overline{ASR}_1$ in the first five minutes after macroeconomic news announcements are made. As a background, we also present the values of $\overline{ASR}_1$ computed for the whole period considered.

The comparison of the results in Table 2 clearly shows that the strongest reaction to macroeconomic news from the United States was observed in first two presented windows that include data from the period of the global financial crisis or from the period just after the crisis. However, for most of the indicators higher values of $\overline{ASR}_1$ are in the post-crisis period (2009-2013). In the case of NPF, $\overline{ASR}_1$ is close to 3 indicating that the average of abnormal returns in the first five minutes after NFP announcements was three times the standard deviation of usual 5-minute returns.

In addition, the results of the Kolari-Pynnönen test indicate a very strong and highly significant impact of US macroeconomic news in this post-crisis period.

The comparison of the last column of Table 2 with the rest of the results indicates a very strong decrease in the strength of impact of US macroeconomic data announcements on investors on the WSE in recent years. Only in a few cases, changes in the WIG20 implied by news under study are significant. Moreover, they are significant at most at the 5% level. Such a situation can also be observed when all the announcements are joined together. The insignificance of the reaction is accompanied by very low values of $\overline{ASR}_1$. For example, in the case of the NPF the average falls from 2.94 in 2009-2013 to insignificant value of 0.26 in 2014-2019.

To describe the changes in the reaction of the WIG20 to publications of US data during the whole period 2004-2019 more precisely we present the values of $\overline{ASR}_1$ computed for all events in each of the 5-year windows in Figure 2. As a comparison, we do also present the values of $\overline{ASR}_1$ from 2-year windows shifted also by one quarter. The results of the analysis in the 2-year window are more flexible and better describe the changes in the strength of the impact. However, it can be applied only to study the impact of announcements of all indicators together. In the case of a single indicator a 2-year window does not contain enough data to provide reliable results.

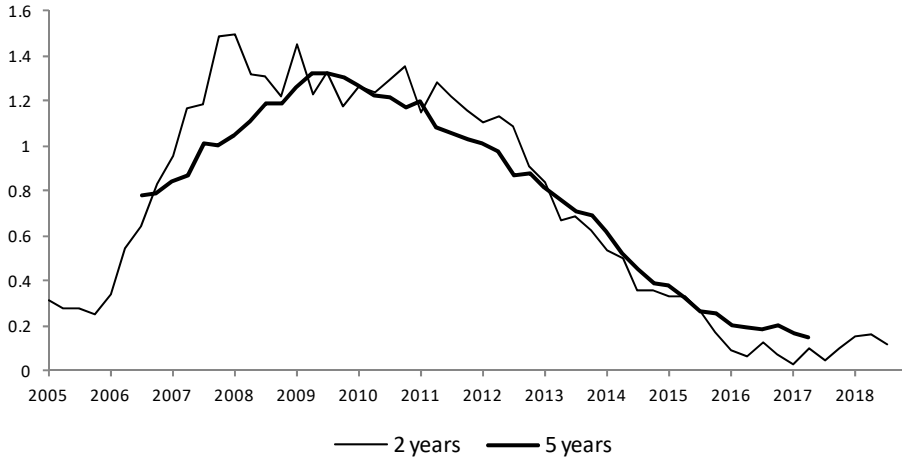

Figure 2. Averages of the abnormal standardised returns of the WIG20 over 2-year and 5-year windows

Source: Own work.

The results presented in Figure 2 confirm the conclusion already drawn based on Table 2. They clearly indicate a very strong impact of US macroeconomic news announcements on investors on the Warsaw Stock Exchange during the global financial

crisis. In the pre-crisis periods, the values of $\overline{ASR}_1$ in a 2-year period are on the level of 0.3. However, when the crisis begins and the windows begin to include data from it, the average $\overline{ASR}_1$ begins to grow rapidly up to about 1.4. The strong impact of news from the United States lasts until late 2012 when the averages slowly begin to decrease. From 2015-2016 we may observe a stabilisation of $\overline{ASR}_1$ about 0.1. A similar behaviour of $\overline{ASR}_1$ may be observed in the case of 5-year window. However, in this case the changes are slower and much smoother.

Despite this observed decreasing tendency in $\overline{ASR}_1$ it should be pointed out that according to the results of the Kolari-Pynnönen test even in the last window the changes in the WIG20 induced by US macroeconomic news are significant. In fact, they are significant in every 5-year window. However, in some cases it is probably due to the large number of events in the cluster increasing the power of the test.

The last column of Table 2 shows that changes of the WIG20 only after IJC announcements remain significant during the whole period. The rest of indicators become insignificant earlier. For example, the NFP announcements, which showed the strongest impact, are significant until July 2012–June 2017.

5. Conclusions

In this paper, we analyse the changes in the impact of US macroeconomic news on investors on the Warsaw Stock Exchange. We examine the behaviour of 5-minute returns of the WIG20 in a short period after the announcements of 13 macroeconomic indicators describing the US economy were made. These indicators characterise inflation, industrial production, retail sales, the housing market, the labour market, and the GDP, among other things. Based on intraday returns from a 15-year period from January 2004 to July 2019 we are able to compare the strength of the impact of US macroeconomic news on the WIG20.

When the whole period is taken into account, the WIG20 reacts significantly to announcements of most of the indicators considered. This reaction is immediate and it is usually limited to the first 5-minute returns. The strongest impact is observed after NFP announcements.

The analysis in sub-periods leads to the conclusion that, in general, US macroeconomic news announcements induced the highest averages of abnormal returns during the global financial crisis (2007-2009) and in the first few years after the crisis. In later years, the impact of information from the United States was notably weaker. This change in the impact of US macroeconomic data was probably caused by the end of the crisis and by stabilising the economic situation in the United States. Additionally, new crises in various parts of the world attracted the attention of investors.

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