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INTRADAY EVENT STUDY. THE IMPACT OF US MACROECONOMIC NEWS ON WIG20*

Summary: In this paper we examine the impact of unexpected news about the US economy on stock prices on the Warsaw Stock Exchange. Previous studies from developed markets indicate, that macroeconomic news announcements are quickly reflected in stock prices. Hence, we study the reaction of 1 minute returns of WIG20, which describes prices of the largest and the most liquid stocks on WSE. Empirical analysis performed by means of event study shows the significant response of WIG20 just after news announcements. Additionally, this response remains visible up to three minutes after news release. However, the strength and duration of the news impact depends on the announced macroeconomic indicator..

Keywords: event study, news announcements, WSE, intraday data.

Introduction

Investors on stock markets are influenced by variety of domestic and foreign information. Some of them are firm or sector-specific, while the others concern whole economies. Such macroeconomic news is particularly important, because it carries information about condition of an economy and possible future government actions. Thus, it could impact future perspectives of a stock market.

The impact of macroeconomic news on a stock market, in particular on the US stock market has been studied for years [e.g. Boyd et al., 2005; Li, Hu, 1998]. The US economy is the largest and the most important economy in the

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world, thus the US macroeconomic news is of great importance, not only to US stock market, but also to other developed markets as it is shown, e.g. by T. Andersen and other experts [2007], K. Harju and S. Hussain [2011], J. Nikkinen and P. Sahlström [2004].

J. Nikkinen and P. Sahlström [2004] examine the impact of monthly reports from Germany, Finland and US on German and Finnish stock markets. On the basis of daily returns from January 1996 to December 1999 the authors show, that domestic macroeconomic data do not affect neither the German, nor the Finnish market. Only announcements about inflation and unemployment in the US have significant impact.

T. Andersen and other experts [2007] investigate the impact of releases of 22 US macroeconomic indicators on 5-minute returns on stock, bond and exchange markets in the US, UK and Germany. On the basis of data from July 1998 to December 2002. T. Andersen and others confirm the significant impact of US announcements on conditional means on European stock markets. They also show, that the strength and direction of a stock market response to macroeconomic news depends on the state of the economy, i.e. its meaning is different during contractions and expansions.

K. Harju and S. Hussain [2011] also study the importance of information from the US economy to investors on Eastern European stock markets. On the basis of data from September 2000 to March 2006 they examine the impact of releases of 13 US macroeconomic indicators on 5-minute returns of four European indices: CAC40, DAX30, FTSE100 and SMI. As a result, the authors show, that both intraday returns and volatility are sensitive to US macroeconomic data announcements. However, the strongest reaction is observed in the case of Unemployment Rate and Durable Goods Orders announcements.

The number of papers concerning the impact of US macroeconomic data on emerging markets in the Central and Eastern Europe is very limited. The reaction of Polish, Czech and Hungarian stock markets to US, EU and domestic macroeconomic data is studied by J. Hanousek and others [2009]. Their paper indicates, that 5-minute returns of WIG20 are generally unaffected by EU-wide announcements, while US data have significant impact on WIG20 returns and volatility.

H. Gurgul and others [2012] examine responses of WIG20 to US macroeconomic data announcement, including information about inflation, production and unemployment. On the basis of data from February 2004 to December 2011 they show, that CPI and Industrial Production announcements significantly affect daily returns of WIG20, whereas Unemployment Rate announcements have no impact.

The issue whether stock markets in new EU member countries react to foreign macroeconomic data still needs detailed study. It is natural to concentrate on the Warsaw Stock Exchange, which is the largest and the most important stock market in this part of Europe. In this paper we extend the work of H. Gurgul and others [2012] and examine the response of 1-minute returns of WIG20 to announcements of six US macroeconomic indicators. To test the significance of the impact of US data, we apply the event study methodology. It allows us to describe not only the strength of the impact, but also its duration. Additionally, on the basis of Kruskal-Wallis tests we compare the reaction of WIG20 to different indicators announcements.

The structure of the paper is as follows. Data applied in the study are described in the next Section. Event study methodology is shortly presented in Section 3, while Section 4 contains empirical results. Short summary concludes the paper.

1. Data

In this paper we analyze the impact US macroeconomic data announcements on intraday WIG20 returns in the period from 3 January 2004 to 31 August 2013. We study six macroeconomic indicators describing inflation, production, sales and employment in US: Consumer Price Index (CPI), Producer Price Index (PPI), Industrial Production (IP), Retail Sales (RS), Durable Goods Orders (DGO) and Nonfarm Payrolls (NFP). All these indicators are released monthly. However, some of them are announced at the beginning of the month (NFP), whereas some of them are released in the middle of the month (CPI, IP) or at the end of the month (DGO). In general, macroeconomic indicators under study are released at 8.30 EST (Eastern Standard Time), i.e. at 14.30 CET (Central European Time). The only exception is IP, which is released at 9.15 EST (15.15 CET). However, when time of announcements is considered, the differences in the introduction of the Daylight Saving Time in US and EU must be taken into account. Hence, some of the announcements under study reach the WSE at 13.30 CET or 14.15 CET respectively.

To study the impact of unexpected news about US economy the value of each announced macroeconomic indicator is compared with its consensus forecast published in advance by Bloomberg. On the basis of these comparisons, all announcements of each indicator are divided into three clusters: “above consensus”, “below consensus” and “in line with consensus”. Obviously, unexpected news is in first two clusters and thus only these clusters will be further analyzed in this paper. Previous studies [Andersen et al., 2007; Harju, Hussain, 2008] indicate, that announcements of IP, RS, DGO and NFP above consensus and CPI, PPI below

consensus are good news whereas IP, RS, DGO, and NFP below consensus and CPI, PPI above it are bad news. Good news implies positive reaction of stock market (i.e. positive abnormal returns after the announcement), while bad news implies negative investors' reaction and is followed by negative abnormal returns.

In this paper, we study only US data announcements released on trading days on the WSE. Additionally, to reduce the problem of confounding events, we study the impact of the first announcement in a day, i.e. when more than one indicator is announced in a day only first of them is included into the dataset. When two announcements are released at the same time, we study their impact, only if they do not contain contradictory information (i.e. when both of them are seen as good news or both of them are bad news) or one of them is in line with consensus. Finally, the dataset examined in this paper contains 272 good news announcements and 229 bad news announcements between 3 January 2004 and 31 August 2013. Detailed numbers of announcements in each cluster are reported in Tables 1 and 2.

The intraday behavior of the WSE is described by 1-minute returns of WIG20. We study WIG20, because its values are based on prices of the largest and the most liquid companies listed on the WSE. Thus, it ensures adequate response to unexpected news.

2. Methodology

To test whether US macroeconomic news influences intraday returns of WIG20, we examine the abnormal behavior of WIG20 returns around news announcements by means of event study. To apply the event study methodology, we consider the pre-event window of length 130 minutes and the event window of length 12 minutes. The event window contains five 1-minute returns before the announcement, the return when news is released and six returns after the announcement. US macroeconomic data are announced mainly at 14.30 CET, thus for each announcement we consider less than three-hour period of time in the middle of a trading session on WSE and there is no need to take into account intraday seasonality of returns volatility associated particularly with highly volatile returns at the end and at the beginning of a trading session.

For definition purposes we denote the time of the announcement as $t = 0$. Then $t = -5, \dots, 6$ are the event window while $t = -135, \dots, -6$ are the pre-event window. New information can be reflected in WIG20 returns only for $t > 0$, i.e. R_1 which describes the change of WIG20 from $t = 0$ to $t = 1$ is the first return, where new information can be incorporated.

To test the significance of the impact of US macroeconomic news on WIG20 in each cluster we apply nonparametric rang test of C.J. Corrado and T.L. Zivney [1992] with correction for event-implied volatility. The advantage of this test is its robustness for heterogeneity of returns variance. Moreover, the assumption about normality of abnormal returns is not necessary. The test procedure is as follows. For each event in a cluster, we fit an ARMA (p, q) model ($p, q = 1, \dots, 5$) to returns in the pre-event window. Then, for i -th event and for each t in the event and the pre-event window we compute abnormal returns AR_{it} as the difference between WIG20 return R_{it} and the one-step forecast of ARMA model. Next, for each event the abnormal returns are standardized:

$$SAR_{it} = AR_{it} / S(AR_i)$$

where:

$$S(AR_i) = \sqrt{\frac{1}{129} \sum_{t=-135}^{-6} AR_{it}^2}$$

is the standard deviation of abnormal returns in the pre-event window. To take into account observed increased volatility of abnormal returns after the event [Corrado, 2011] standardized abnormal returns are additionally adjusted according to the formula:

$$SAR'_{it} = \begin{cases} SAR_{it} & t = -135, \dots, 0 \\ SAR_{it} / S(AR_t) & t = 1, \dots, 6 \end{cases}$$

where:

$$S(SAR_t) = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (SAR_{it} - \overline{SAR}_{it})^2}$$

is the cross-sectional standard deviation of SAR_{it} and N is the number of events in the cluster. Finally, Corrado-Zivney statistics is defined for each $t_0 = -5, \dots, 6$ separately as [Corrado, 2011]:

$$T_{CZ}(t_0) = \frac{1}{\sqrt{N}} \sum_{i=1}^N \frac{\left(rank(SAR'_{it_0}) - \frac{131}{2} \right)}{\sqrt{130 \cdot 131 / 12}}$$

where $rank(SAR'_{it_0})$ denotes the rank of SAR'_{it_0} within the vector of SAR'_{it} from the pre-event window with attached SAR'_{it_0} . Distribution of T_{CZ} statistics rapidly converges to the standard normal distribution, when the number of events N in the cluster increases.

In addition to the abovementioned event study analysis for each t in the event window, we compare the reaction of WIG20 returns to announcements of different US macroeconomic indicators. It means, that for each t we compare mean abnormal returns \overline{AR}_t in different clusters of bad or good news. The most common way to test the significance of such comparison is to apply Analysis of Variance. However, it requires normality of dependent variable, but it is well-known, that intraday returns are highly skewed and leptokurtic. Thus, to compare the reaction of WIG20 to different macroeconomic indicators we apply Kruskal-Wallis test, which does not require such strong assumptions like ANOVA.

3. Empirical results

We examine the impact of each kind of news separately. However, to describe them we divide all events into two groups: those which are seen as bad news and those which are seen as good news. Results of event study in each of the group are reported in Tables 1 and 2. Each column in these tables contains means of abnormal returns induced by specific indicator announcements. Means are computed for each t in the event window. Together with \overline{AR}_t we present its significance indicated by Corrado-Zivney test.

Table 1. Mean abnormal returns of WIG20 (in %) in the reaction to bad news from the US economy in the period from January 2004 to August 2013

	CPI (35 events)	IP (27 events)	PPI (50 events)	DGO (58 events)	RS (39 events)	NFP (63 events)
-3	-0.0102	-0.0007	-0.0051	-0.0068	-0.0007	0.0007
-2	0.0017	-0.0031	-0.0043	0.0021	-0.0118	0.0144**
-1	0.0047	-0.0072	-0.0084	-0.0082	-0.0112*	0.0084*
0	-0.0090	0.0127	-0.0030	0.0075	-0.0020	-0.0032
1	-0.0603	-0.0210	-0.0632**	-0.1164***	-0.0782**	-0.1531***
2	-0.0326	-0.0201	0.0154	-0.0159	-0.0238	-0.0338**
3	0.0095	-0.0095	0.0228	-0.0129	0.0129	-0.0177
4	-0.0074	-0.0079	-0.0126	-0.0095	0.0062	0.0229
5	-0.0148	-0.0059	-0.0120	-0.0066	-0.0242	0.0088
6	0.0036	-0.0005	0.0241	-0.0116	0.0033	0.0061

*, **, *** – significance at 10%, 5% and 1% respectively

Results in Table 1 confirm, that all events in “bad news” clusters imply negative reaction of WIG20. All mean abnormal returns in the first minute after announcements are negative. However, two of them (for CPI and IP) are insig-

nificant. In other cases, \overline{AR}_1 is significant at least at 5% level. The strongest reaction ($\overline{AR}_1 \approx -0.15\%$) can be observed, when the announced value of NFP is below consensus. In general, significant reaction of WIG20 is limited to the first minute after announcements. Only when NFP is announced, mean of abnormal returns for $t = 2$ is also significantly negative. All later mean abnormal returns in the event window are insignificant. On the other hand, significant means of abnormal returns are observed within two minutes before RS and NFP announcements. However, the differences between their signs, together with (not presented here) low cross-sectional variances of abnormal returns before the event, suggest that these significant means are the results of some nervous reaction before the announcements. Hence, results in Table 1 mean the largest stocks listed on WSE react to US macroeconomic data releases only just after the announcement and the response quickly diminishes. This is also one of the arguments for high efficiency of WSE.

Table 2. Mean abnormal returns of WIG20 (in %) in the reaction to bad news from the US economy in the period from January 2004 to August 2013

	CPI (38 events)	IP (13 events)	PPI (40 events)	DGO (54 events)	RS (37 events)	NFP (47 events)
-3	-0.0156	-0.0238**	0.0067	0.0002	0.0073	0.0002
-2	-0.0051	0.0046	-0.0009	0.0093	0.0113*	0.0006
-1	-0.0054	-0.0131	0.0076	-0.0050	0.0019	0.0098
0	-0.0081	0.0007	-0.0044	0.0011	-0.0032	-0.0135***
1	0.0519	0.0611	0.0098	0.0773***	0.0894***	0.1431***
2	0.0434**	0.0119	0.0388*	0.0052	0.0233	0.0457**
3	0.0018	0.0481	0.0211	0.0218	0.0204**	0.0049
4	-0.0144	0.0357	-0.0001	0.0029	0.0022	0.0018
5	0.0239	0.0032	0.0007	0.0016	0.0021	-0.0035
6	0.0170	-0.0379**	-0.0107	0.0043	0.0024	-0.0053

*, **, *** – significance at 10%, 5% and 1% respectively

Results in Table 2 confirm, that the announcements of good news are followed by positive means of abnormal returns. The reaction of WIG20 returns is highly significant when DGO, RS and NFP are announced. On the other hand, the response to inflation announcements (CPI as well as PPI) is significant only in the second minute after news release. It is probably due to general problems with the interpretation of inflation and unemployment news [e.g. Andersen et al., 2007]. Similarly to bad news, the strongest reaction of WIG20 returns is implied by NFP announcements ($\overline{AR}_1 \approx 0.14\%$). In the case of NFP there is also visible

significant \overline{AR}_0 . However, its sign is opposite to the notion of the announced news, what is probably due to investors anticipations or speculations about the announced value of NFP. The comparison between results in Table 1 and 2 indicate, that good news affects stock prices of the largest firms on the WSE a little longer than bad news.

Table 3. Values of Kruskal-Wallis K statistics in “bad news” and “good news” clusters computed for $t = 0, \dots, 6$ after US macroeconomic news release

	$t = 0$	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
	Bad news						
K statistics	4.914	13.67	7.049	9.288	3.203	6.644	5.486
p-value	0.426	0.018	0.217	0.098	0.669	0.248	0.360
	Good news						
K statistics	5.527	14.07	3.670	2.147	2.941	1.932	5.450
p-value	0.355	0.015	0.598	0.829	0.709	0.858	0.363

The reaction of WIG20 seems to depend on the announced indicator. For example, means of abnormal returns in the first minute after bad news vary from -0.153 (NFP) to -0.021 (IP) and some of them are significant, while other not. Additionally, for other t means have different signs. Responses to good news are even more heterogeneous. To verify, whether the response of WIG20 to bad news transmitted in macroeconomic indicators announcements is similar for each time t we perform Kruskal-Wallis tests. For each $t = 0, \dots, 6$ we test, whether abnormal returns AR_{it} in each of the clusters of bad news presented in Table 1 have the same medians. Similar test is performed for all clusters of good news. Results of these tests for bad and good news clusters are reported in Table 3. Each column of Table 3 presents the value of Kruskal-Wallis statistics K together with its p-value.

In the case of bad news announcements, the significant difference in the distribution of abnormal returns is observed in the first minute after news release¹. It indicates difference in the reaction of WIG20 to different US indicators. However, from Table 1 it follows, that the reaction of WIG20 to CPI and PPI announcements is insignificant. Thus, to more adequately verify heterogeneity of WIG20 reactions we restrict Kruskal-Wallis test to indicators, that induced significant \overline{AR}_1 in Table 1, i.e. to PPI, DGO, RS and NFP. In this case, K statistics equals 7.576 (with p-value 0.055), what also indicates significant difference

¹ K statistics is also significant (at 10% level) for $t = 3$. However, this is the first moment, when mean abnormal returns induced by three indicators (CPI, PPI and RS) change sign.

between distributions of abnormal returns in the clusters. Pairwise Wilcoxon tests for AR_{1t} indicate, that the most significant is the difference in response of WIG20 to PPI and NFP announcements. Kruskal-Wallis tests performed for other t do not reject the null hypothesis except $t = 3$. Hence, it can be concluded, that the strength of the reaction of WIG20 returns depends on the announced indicator only in the first minute after news release and then after next two minutes, when the impact of unexpected news vanishes and some counterreactions start.

Similarly to bad news, Kruskal-Wallis test indicates, that the reaction of WIG20 returns in the first minute after good news from the US economy depends significantly on the announced indicator. This result is also true, when the test is restricted to DGO, RS and NFP ($K = 5.984$ with p -value = 0.05). The most significant difference between distributions of abnormal returns for $t = 1$ (and thus between investors' reaction) is observed when PPI and NFP are announced (p -value in Wilcoxon test equals about 0.0017). For other t the investors' reaction does not differ significantly.

Conclusions

In this paper we study the impact of six US macroeconomic indicators on 1-minute returns of WIG20 in the period from January 2004 to August 2013. We examine the impact of: Consumer Price Index, Producer Price Index, Industrial Production, Retail Sales, Durable Goods Orders and Nonfarm Payrolls. By means of event study analysis we show, that intraday WIG20 returns react significantly to unexpected good and bad news about DGO, RS and NFP in the first minute after news release. Such fast and significant reaction of stock prices on the WSE is also observed, when announced value of PPI is greater than expected. In general, significant reaction of WIG20 is observed within three minutes after news release. The comparison of abnormal returns distributions indicates significant differences between reaction of WIG20 to unexpected news announcements in the first minute after the announcement. The most significant difference is observed, when PPI and NFP are announced. On the other hand, the impact of US macroeconomic indicators under study for $t > 1$ does not differ significantly.

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ANALIZA ZDARZEŃ DLA DANYCH ŚRÓDDZIENNYCH. WPLYW OGŁOSZEŃ AMERYKAŃSKICH DANYCH MAKROEKONOMICZNYCH NA WIG20

Streszczenie: W pracy zaprezentowano badanie wpływu niespodziewanych informacji, dotyczących gospodarki USA, na ceny akcji spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie. Wcześniejsze badania dotyczące reakcji rynków rozwiniętych wskazują, że ceny akcji bardzo szybko reagują na ogłoszenia amerykańskich danych makroekonomicznych. Dlatego, zbadana została reakcja 1-minutowych stóp zwrotu indeksu WIG20, który opisuje zachowanie się cen akcji najbardziej płynnych i największych spółek. Badanie przeprowadzone z wykorzystaniem analizy zdarzeń potwierdza, że istotna reakcja WIG20 występuje tuż po ogłoszeniu danych makroekonomicznych. Ponadto, pozostaje ona widoczna, aż do trzech minut po ogłoszeniu. Siła oraz czas trwania reakcji zależą od tego, którego ze wskaźników dotyczy ogłoszenie.

Słowa kluczowe: analiza zdarzeń, ogłoszenia danych, GPW, dane śróddzienne.