THE REACTION OF INTRADAY WIG RETURNS
TO THE U.S. MACROECONOMIC NEWS ANNOUNCEMENTS

Henryk Gurgul[1], Milena Suliga, Tomasz Wójtowicz[1]
Department of Applications of Mathematics in Economics
AGH University of Science and Technology in Cracow
e-mail: henryk.gurgul@gmail.com, milena.suliga@gmail.com,
twojtow@agh.edu.pl

Abstract: This paper analyses the reaction of stock returns on the Warsaw Stock Exchange to U.S. macroeconomic news announcements. The study is conducted on the basis of five-minute returns of WIG from January 2004 to December 2012. This nine-year period includes different stages of economic cycle and additionally the global financial crisis. Hence results of our analysis are not limited only to contraction or expansion and can be applied to bull and bear market. The application of event study analysis allows us to measure not only the strength of the impact of information release but also its duration.

Keywords: event study, macroeconomic announcements, intraday data

INTRODUCTION

The reaction of stock prices to various domestic and foreign announcements is an issue that still attracts the attention of many researchers. According to the Efficient Market Hypothesis "stock prices always fully reflect available information" [Fama 1970] and important, unanticipated events should lead to instantaneous market response. It is widely known that macroeconomic news announcements can affect the price formation process but there is still insufficient research about the speed and strength of the reaction of different equity markets and the duration of the reaction's impact. It is especially visible for Warsaw Stock Exchange (WSE) and other emerging markets in Eastern and Central Europe.

Stock markets are affected by domestics as well as foreign macroeconomic news. Taking into account time zones, trading on WSE is mainly influenced by European and U.S. macroeconomic news. However, most of the European macroeconomic news announcements are released before the opening of WSE, which precludes researchers from precise evaluating their impact. On the other hand, U.S. macroeconomic news is released mainly during trading hours on European stock markets. This fact, together with the importance of the U.S. economy is the reason why U.S. macroeconomic news should be taken into account while investigating investors reaction on WSE.

The issue of European markets reaction to American macroeconomic news has been, so far, the subject of few researches based on daily or intraday data. Using daily data from January 1996 to December 1999 Nikkinen and Sahlström [Nikkinen and Sahlström 2004] show that German and Finnish stock markets react strongly to PPI and Unemployment Rate announcements. While CPI has an impact only on German stock market.

Gurgul et al. [Gurgul et al. 2012] examine the effect of U.S. macroeconomic data announcement on daily WIG20 returns from February 2004 to December 2011. Their research shows, that information about CPI and Industrial Production significantly affects investor reactions, whereas Unemployment Rate announcements have no impact on WSE in the period under study.

In recent years intraday data has been widely used in studies of investors reaction. Andersen et al. [Andersen et al. 2007] take into account the set of 22 U.S. macroeconomic fundamentals released at different intervals (from weekly to quarterly) in the period from July 1998 to December 2002. Their study proves significant impact of unexpected news on high-frequency stock, bond and exchange rate conditional mean in U.S., Germany and UK. However, the reaction of equity markets depends mainly on the state of market.

Using five-minute returns of CAC 40, DAX 30, SMI and FTSE 100 Harju and Hussain [Harju and Hussain 2008] show that intraday seasonality on the European equity markets is affected by U.S. macroeconomic news announcements at 14:30 CET. They also find that the strongest impact is observed in the case of Unemployment Rate and Durable Goods Orders announcements. Moreover, investors reaction to U.S. macroeconomic news is immediate and quickly disappears.

Both abovementioned papers concerning intraday returns behavior focus on developed capital markets. There is little evidence concerning the reaction to U.S. macroeconomic news on emerging markets, such as WSE. This subject is studied by Hanousek et al. [Hanousek at al, 2008], who examine Polish, Czech and Hungarian stock markets. On the basis of intraday data they detect the significant impact of American and E.U. macroeconomic news announcements on returns and volatility of WIG20, BUX and PX50.

Multivariate GARCH models are applied by Będowska-Sójka [Będowska-Sójka 2009], who examines common reaction of German, French and Polish stock

markets from November 2007 to April 2009. She confirms results of [Harju and Huissain 2008] that U.S. data announcements explain high volatility of intraday returns about 14.30 CET and have an immediate impact on both returns and volatility.

In this paper we extend research on the impact of U.S. macroeconomic news announcements to intraday stock prices on the Warsaw Stock Exchange. We examine the strength, direction and duration of investors reaction to macroeconomic news. By the event study analysis we are able to describe the behavior of stock prices before as well as after the announcement. Application of the intraday data from January 2004 to November 2012 allows us to examine investor reaction in different phases of business cycle including financial crisis.

The structure of this paper is as follows. Next section presents data and methodology applied in the study. Empirical results are presented and discussed in third section. Short summary concludes the paper.

DATA AND METHODOLOGY

To study the impact of U.S. macroeconomic news announcements on stock prices on the Warsaw Stock Exchange, we choose six important, monthly published macroeconomic indices that appear in literature [Andersen and Bollerslev 1998; Engle and Li 1998; Będowska-Sójka 2010; Harju and Hussain 2008]. These are: Consumer Price Index (CPI), Producer Price Index (PPI), Nonfarm Payrolls (NFP), Industrial Production (IP), Durable Goods Orders (DGO) and Retail Sales (RS). We examine their impact on five-minute log-returns of WIG from January 2004 to December 2012. Five-minute returns are the kind of intraday data that are commonly used in the literature (e.g. Andersen et al. 2007). News release time together with announced values and their forecasts come from www.deltastock.com and www.yahoo.com. We consider only announcements released on trading days on WSE. Most of announcements under study are released at 8.30 EST (14.30 CET). Only Industrial Production is released at 9.15 EST (15.15 CET). Due to differences in introduction of the Daylight Saving Time in the U.S. and Europe in some cases the announcements reach the WSE one hour earlier i.e. at 13.30 CET and 14.15 CET respectively.

For each news release we compare the announced value with its previous market forecasts and thus divide announcements into three clusters: "below consensus", "in line with consensus" and "above consensus". In the case of NFP, IP, DGO and RS, the announcement above consensus is expected to have positive impact on stock market, whereas CPI and PPI higher than consensus is expected to have negative impact. Announcement that is in line with consensus is classified as neutral. We focus our attention on unexpected news i.e. news in clusters "below consensus" and "above consensus". Macroeconomic announcements are released on different days of month, thus there are days when more than one announcement under study is released. To examine the impact of new unexpected information we

take into account only first news in such a day. Later announcements are excluded from the sample. When two announcements were published at the same time we take them into account only if they contain the same information, i.e. when they are both positive or both negative. This allows us to avoid or at least to reduce the problem of confounding events.

To investigate the impact of U.S. macroeconomic news on intraday returns on the WSE we use event study methodology. The key issue in the event study is appropriate choice of the lengths of pre-event window (i.e. estimation window) and event window. In this paper we consider four-hour pre-event window (i.e. 48 five-minute returns) and 45-minutes event window. The event window consists of nine returns: three before the event (15 minutes), the return from the time of announcement release and five returns (25 minutes) after the announcement time. Such event and pre-event windows do not contain highly volatile returns from the beginning and the end of trading session.

In this paper we apply the event study test proposed by Brown and Warner [Brown and Warner 1985]. Its advantages are rather mild assumptions. It requires only normality of mean abnormal returns. For each event i in the cluster ("below consensus" or "above consensus") abnormal returns (AR_t) are computed as difference between actual returns and their average in the pre-event window. Then, for each t the cross-sectional average abnormal return ($\overline{AR_t}$) is computed as:

$$\overline{AR_t} = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t},$$

where N denotes the number of events in the cluster. To test the significance of mean abnormal returns at time t i.e. to test hypothesis:

$$H_0: E(\overline{AR_t}) = 0$$
$$H_1: E(\overline{AR_t}) \neq 0$$

we apply test statistic defined as:

$$t_{stat} = \frac{\overline{AR_t}}{\hat{\sigma}_{\overline{AR}}},$$

Where $\hat{\sigma}_{\overline{AR}}$ is the sample cross-sectional standard deviation of $\overline{AR_t}$ for the pre-event window. Under the assumption that mean abnormal returns $\overline{AR_t}$ are normally distributed, t_{stat} has t-Student distribution with N-1 degrees of freedom. Five-minute returns are in general non-normal but by the Central Limit Theorem the cross sectional mean abnormal returns converges to normality when the number of events in the cluster increases. To study the significance of returns reaction we perform two-sided test because rejection of null hypothesis by two-sided test implies its rejection also by one-sided test if the sign of $\overline{AR_t}$ is appropriate.

Additionally to abovementioned parametric test we apply nonparametric rank test proposed by Corrado and Zivney [Corrado and Zivney 1992] with correction for increased abnormal returns volatility after news release. Its construction and properties are described in details in [Corrado 2011].

If we denote the moment of the news release by $t = 0$ then the pre-event window are $t = -51, \dots, -4$ while $t = -3, \dots, 5$ are event window. For each event abnormal returns are first standardized:

$$SAR_{it} = AR_{it}/SD(AR_i),$$

Where $SD(AR_i)$ is abnormal returns standard deviation in the pre-event window. In the event window, however, increased volatility of abnormal returns is frequently observed [Corrado 2011]. To control for this event-induced shift in the cross-sectional variance we adjust standardized abnormal returns:

$$SAR'_{it} = \begin{cases} SAR_{it} & t = -51, \dots, -1 \\ SAR_{it}/SD(SAR_t) & t = 0, \dots, 5, \end{cases}$$

where $SD(SAR_t)$ is cross-sectional standard deviation and N is the number of events in the cluster. For each t in the event window the significance of abnormal returns can be tested separately. For each t from the event window Corrado–Zivney T_{CZ} statistics is defined as:

$$T_{CZ}(t) = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{rank(SAR'_{it}) - \frac{n+1}{2}}{\sqrt{n(n+1)/12}},$$

where n is the length of the pre-event window and $rank(SAR'_{it})$ denotes the rank of SAR'_{it} within the vector consisting of standardized abnormal returns from the pre-event window and SAR'_{it}. T_{CZ} statistics is asymptotically normally distributed. The advantage of nonparametric Corrado–Zivney test is that is does not need any assumption of abnormal returns normality.

EMPIRICAL RESULTS

To verify normality of mean abnormal returns we apply Shapiro–Wilk and Jarque–Berra tests for each cluster of events. The null hypothesis is rejected at 5% significance level in two cases: when announced value of DGO is above consensus and when value of RS is greater than expected. In other cases normality cannot be rejected. Detailed results of event study i.e. mean abnormal returns in the event window together with corresponding test statistics are presented in Table 1 and 2. For each macroeconomic indicator results for two kinds of events are reported: when the announced value of the macroeconomic indicator is below or above market expectations. For each indicator the number of events in each such cluster is also reported.

Results in Table 1 and 2 indicate significant and immediate investor reaction on WSE to U.S. macroeconomic news announcements. In almost all cases mean abnormal returns for the event time ($t = 0$) are significant at 1% level. The exceptions are announcements about PPI (when PPI is below consensus the mean abnormal return is insignificant and when PPI is above forecasts then the mean is significant at 5% level) and about IP lower than forecasts when mean abnormal return is significant at 5%.

Table 1. The reaction of WIG 5-minute returns to CPI, PPI and NFP announcements
        in the U.S. in the period 2004-2012

t	Below consensus			Above consensus		
	$\overline{AR}$	t-stat	T_{CZ}	$\overline{AR}$	t-stat	T_{CZ}
CPI (31 and 32 events)						
-3	-0.015	-0.87	-1.11	-0.003	-0.14	0.34
-2	0.024	1.39	1.60	-0.016	-0.82	-1.14
-1	-0.018	-1.05	-0.39	-0.007	-0.35	-0.56
0	0.053	3.13*	1.84***	-0.071	-3.61*	-1.54
1	0.040	2.32**	1.96***	-0.013	-0.68	0.33
2	0.020	1.15	0.20	-0.008	-0.40	0.37
3	0.011	0.66	0.92	-0.011	-0.54	0.29
4	-0.003	-0.18	0.62	-0.002	-0.11	0.43
5	0.023	1.36	1.44	0.004	0.23	-0.03
PPI (30 and 41 events)						
-3	0.000	0.01	0.09	0.001	0.10	-0.35
-2	0.015	1.01	2.00**	0.019	1.74	1.20
-1	-0.003	-0.20	-0.08	-0.017	-1.54	-1.12
0	0.006	0.36	0.60	-0.023	-2.11**	-0.31
1	-0.008	-0.52	-0.57	0.004	0.34	-0.12
2	0.003	0.17	-0.50	0.015	1.41	0.13
3	-0.013	-0.87	-0.90	0.023	2.09**	1.40
4	-0.008	-0.52	-0.85	0.020	1.89	1.01
5	-0.005	-0.35	0.05	-0.006	-0.52	0.15
NFP (59 and 42 events)						
-3	0.006	0.61	0.66	0.000	-0.04	0.17
-2	-0.006	-0.62	-0.02	0.001	0.09	0.34
-1	0.010	0.98	1.57	0.018	1.73	1.85***
0	-0.107	-10.5*	-2.82*	0.103	10.1*	2.47**
1	-0.002	-0.24	-0.30	-0.017	-1.68	-0.17
2	0.018	1.75	0.78	0.023	2.27**	2.24**
3	-0.015	-1.45	-0.30	-0.001	-0.12	0.04
4	-0.003	-0.29	1.04	-0.023	-2.31**	-1.54
5	0.023	2.23**	1.66	-0.025	-2.41**	-1.34

Source: own calculation
        *, **, *** - significant at 1%, 5% and 10% level respectively

Table 2. The reaction of WIG 5-minute returns to IP, DGO and RS announcements
in the U.S. in the period 2004-2012

	Below consensus			Above consensus		
t	$\overline{AR}$	t-stat	T_{CZ}	$\overline{AR}$	t-stat	T_{CZ}
IP (29 and 13 events)						
-3	-0.022	-1.31	-1.37	0.014	0.66	0.45
-2	0.031	1.81***	1.57	0.030	1.41	1.81***
-1	-0.001	-0.03	1.00	-0.025	-1.18	-0.37
0	-0.036	-2.14**	-1.84***	0.106	5.02*	2.19**
1	-0.003	-0.16	0.19	0.015	0.70	-0.13
2	-0.016	-0.94	-1.21	-0.018	-0.85	-0.58
3	0.006	0.37	1.68***	0.012	0.57	0.35
4	-0.014	-0.83	0.70	0.038	1.79***	1.02
5	-0.029	-1.69***	-0.80	0.033	1.59	1.38
DGO (53 and 47 events)						
-3	-0.002	-0.15	0.49	-0.012	-1.12	-0.69
-2	-0.004	-0.33	-0.21	0.005	0.53	1.60
-1	-0.004	-0.38	-0.71	0.005	0.51	0.80
0	-0.107	-9.53*	-4.52*	0.074	7.11*	2.63*
1	-0.014	-1.24	-0.53	0.007	0.66	1.70***
2	-0.002	-0.19	-0.20	-0.001	-0.09	-0.61
3	-0.007	-0.65	-0.30	-0.009	-0.85	-0.64
4	-0.007	-0.60	-0.38	0.023	2.16**	1.60
5	-0.008	-0.70	-0.07	0.021	2.01***	1.41
RS (38 and 32 events)						
-3	-0.030	-2.27**	-1.45	0.013	1.07	0.29
-2	0.021	1.58	1.75***	0.005	0.40	0.35
-1	-0.011	-0.80	-0.49	0.015	1.19	2.11**
0	-0.050	-3.76*	-1.08	0.073	5.97*	2.63*
1	0.008	0.57	0.85	-0.014	-1.14	-0.80
2	0.021	1.63	1.41	0.004	0.35	-0.27
3	-0.034	-2.60**	-0.97	0.008	0.69	0.69
4	0.010	0.79	0.92	-0.024	-1.99***	-0.11
5	0.005	0.42	0.32	-0.004	-0.36	-0.27

Source: own calculation
*, **, *** - significant at 1%, 5% and 10% level respectively

Investor reaction to CPI announcements is in line with earlier results of [Gurgul et. al, 2012] obtained for daily data. CPI below forecast is seen by investors as positive news. It leads to positive mean abnormal returns up to 20 minutes after release and is significant for the first 10 minutes. Similarly, CPI greater than expected is seen as negative information and leads to negative five-minute returns up to 25 minutes after the release. However, only first mean abnormal return is significant. It indicates that investor reaction to CPI is homogeneous across the market and new information about inflation in the U.S. is immediately incorporated into stock prices. However, there are also some its echoes that slowly vanish. Corrado–Zivney test confirms significant reaction to CPI below forecast.

PPI announcements have similar meaning to CPI. Announcement below forecast is good news while PPI greater than expectations is bad news. In the case of PPI, however, changes in abnormal returns are weaker than for CPI. To understand this phenomenon it should be noted that PPI announcements are frequently secondary to CPI and thus investors can update their expectations about true value of PPI.

One of the most complex patterns in average abnormal returns can be seen when Nonfarm Payrolls is announced. NFP below consensus is seen as bad news while NFP above forecast is good news. However, abnormal returns change significantly for $t = 0$ despite the value of unexpected news about NFP. After this immediate and very strong reaction there are observed several significant mean abnormal returns of different signs. This heterogeneous investors reaction is probably due to the fact that Nonfarm Payrolls is only one of a few macroeconomic indicators that are published by the Bureau of Labor Statistics in the Employment Report. The other important indicators are e.g. Unemployment Rate, Average Workweek and Hourly Earnings. Each of them can convey quite different information about employment in U.S. Thus, the changes in stock prices after the event are the reflection of updating investor expectations in the relation to reaction on other financial markets.

The investors reaction to Industrial Production announcements is more straightforward. IP below consensus is seen as bad news and leads to mainly negative abnormal returns in the event window. Differences between test statistics are due to high returns volatility in the event window. IP above consensus is certainly good news for stock market. Investors immediately react homogeneously on it and average stock prices increase about 0.1% in first five minutes after the release. This is the strongest positive reaction to macroeconomic news announcements under study.

The reaction to DGO smaller than expected is clearly negative and very strong just after the event with the highly significant negative mean abnormal return in first five minutes (about -0.11%). All other averages in the event window are also lower than zero. On the other hand, the DGO announcement above forecasts is good news to the market. Averages in the event window are mainly

positive with mean for $t = 0$ significant at 1% level. Significance of mean abnormal returns in each cluster is also confirmed by T_{CZ} statistics. In this case it is important due to the non–normality of average abnormal returns in the pre-event window.

Retail Sales below consensus is interpreted by investors as bad news. However, significance of investors reaction cannot be clearly confirmed due to differences between test statistics. In the case of RS above consensus both tests confirm significant changes in stock prices just after the announcement.

CONCLUSIONS

This paper analyses the reaction of intraday stock prices on the Warsaw Stock Exchange to U.S. macroeconomic news announcements. We examine the impact of six macroeconomic indicators: Consumer Price Index, Producer Price Index, Nonfarm Payrolls, Industrial Production, Durable Goods Orders and Retail Sales. All computations are performed on the basis of five-minute WIG returns from January 2004 to November 2012. This period includes different stages of economic cycle and the global financial crisis. Hence results of our analysis are overall and can be applied to bull and bear market. We apply event study analysis do characterize the information content and duration of unexpected news when the announced value is above or below expectations. Results of the performed study confirm that CPI, PPI lower than consensus and NFP, IP, DGO and RS greater than expectations are good news while CPI, PPI greater than expected and NFP, IP, DGO and RS smaller than forecasts are bad news. In each case except for PPI below consensus stock prices react significantly and immediately to news release. The strongest reaction (about 0.1%) in both directions is observed when Nonfarm Payrolls is announced. Strong negative change in abnormal returns is visible when Durable Goods Orders is below forecasts while the highest increase in abnormal returns is caused when Industrial Production is greater than expected. Investors reaction on WSE is not limited to first five minutes after the announcement. Stock prices react significantly not only when U.S. macroeconomic news is announced but also after it.

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