Intraday CAC40, DAX and WIG20 returns when the American macro news is announced

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Abstract

We examine the reaction of the returns of CAC40, DAX and WIG20 to the periodically scheduled prominent American macroeconomic data announcements. We investigate returns and volatility dynamics at the time of news arrival as well as interdependence between series within the time of the announcements. The results suggest that the macro announcements from the U.S. market not only explain seasonality observed in these equity markets but also have a significant impact on both returns and volatility. However, the reactions to announcements are different with respect to the type of announcement. Application of dynamic conditional correlation models allows us to decompose the total impact of announcements into the reaction on the domestic market and conditional correlation between the markets.

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1. Introduction

One of the most puzzling issues in market microstructure is the question how information determines asset prices. The empirical literature on the effect of public information arrival concentrates on macroeconomic announcements as a source of public information. The importance of the American economy as well as the timing of US macroeconomic releases encourages the use of American announcements in research. They are very frequently characterized by specific features that make them useful: they are published periodically with timing of announcements being strictly predetermined as to the date and the hour. Additionally, the releases are widely expected and preceded by expectations which represent a consensus between different financial analysts (Li, Engle 1998).

The literature on the effect of macro news on returns and volatility is huge and includes surveys concerning the bond market (Ederington, Lee 1993), the foreign exchange market (Bauwens, Omrane, Giot 2003) and the equity market (Hanousek, Kocenda, Kutan 2008). Different approaches to examining the impact of macroeconomic news on asset prices are taken: studies focus on changes in returns (Andersen et al. 2007), impact on volatility (Andersen, Bollerslev 1998) and both, returns and volatility (Harju, Hussein 2006)**.** When examining reaction to announcements, both daily and high-frequency data are used with a growing importance of the latter. Intraday data shows seasonality patterns, therefore discovering the price formation process when high frequency data are used is quite complex. Andersen and Bollerslev (1998) emphasized that the scheduled macroeconomic news plays an important role when modeling high-frequency data.

The literature considering high frequency returns in the context of US macroeconomic announcements in European stock market is limited. Harju and Hussein (2006) examine four major European equity markets in the context of US announcements (CAC40, DAX, DMI and FTSE100). They find that US fundamentals have an impact on European investors' behaviour. Both equity returns and volatilities are sensitive to American macro releases. Moreover, indices show similar strong intraday seasonality pattern and react in the same way to macroeconomic information. Hanousek, Kocenda and Kutan (2008) estimate the impact of different macroeconomic news (US macro announcements among them) on composite stock returns of three markets, Czech, Polish and Hungarian. They found that the impact of foreign macroeconomic announcements goes beyond the impact of foreign stock markets. Those emerging markets seem to react similarly to foreign news and this reaction is in line with the reaction of more advanced western European markets. However, none of these two cited papers takes into account multivariate modelling.

In the current paper we model high frequency returns of CAC40, DAX and WIG20 indices with respect to US macroeconomic announcements. CAC40 (Continuous Assisted Quotation) is a benchmark French stock market index and represents a capitalization-weighted measure of the 40 most significant values on the Euronext Paris. DAX (Deutsche Aktienindex) is the index for the largest 30 German companies quoted on the Frankfurt Stock Exchange. WIG20 (Warszawski Indeks Giełdowy) is a Polish capitalization-weighted index quoted on the Warsaw Stock Exchange which represents 20 most liquid and biggest companies. Our data set consists of 5 minute intraday price data from the period 02.11.2007–30.04.2009 and release dates of eight macroeconomic announcements. We are interested whether the news about American macro fundamentals has an impact on both stock returns and volatility.

This paper contributes to the existing literature in several aspects. First, the analysis of the intraday dynamics of three different equity market returns, the French, the German and the Polish, is provided, emphasizing the strong seasonal pattern observed in high frequency series. The systematic features of high frequency data are described in numerous works (Dacorogna et al. 2001). When considering equity markets the empirical evidence of the properties of intraday stock returns series dates back at least to Wood et al. (1985). They described the existence of a U-shaped pattern in trading day volatility measured as averages of absolute returns. This pattern shows that volatility is higher both at the beginning and at the end of the trading day. However, we show that for European markets this pattern is slightly changed by a significant spike at 14:30, which is common for all three examined markets and is caused by macro announcements which are released at that time. A method of seasonality removal suitable for our data sample is proposed.

Second, we estimate multivariate GARCH (MGARCH) models for three examined series. Due to the different number of intraday returns for CAC40 (or DAX) and WIG20, we synchronize the daily length of the series (the number of 5 minute returns). In modelling we control for the impact of different types of macroeconomic announcements as well as for good and bad announcements on returns and volatility. We also provide evidence of influence of macroeconomic releases by comparison of models with and without macro announcements. The announcement surprises produce conditional mean and volatility changes; hence all three high frequency indices are linked to fundamentals from the US economy. However, the reactions to announcements among the markets differ both when the returns and volatility are considered. Third, introducing synchronized series into dynamic conditional correlation (DCC) framework with dummy variables standing for announcements allow us to examine the interdependence between series in the presence of macroeconomic announcements. The conditional correlations of three pairs of indices are estimated.

The remainder of the paper is organized as follows. Section 2 describes our data. The intraday volatility pattern for days with macro releases and without them is compared and seasonality removal is discussed in Section 3. Section 4 presents the methodology. The results are shown in Section 5. Section 6 concludes.

2. Data

2.1. Returns

The primary data set consists of five minute price quotes of three European markets: CAC40, DAX and WIG20 from 1.11.2007 to 30.04.2009 (18 months). Returns are calculated as percentage logarithmic returns, $r_t = \ln(p_t/p_{t-1})*100\%$, where p_t is a price at time t. The price quotes are from www.stooq.pl.

Time schedule for the opening and closing of the markets is the same for French and German stock exchanges, starting at 9:00 CET and closing at 17:30 (which makes 102 returns per day). For the Polish index till the end of August 2008, the stock market was open from 9:30 to 16:10 (80 returns per day), and since September the quotes have been from 9:00 to 16:10 (86 returns per day). Multivariate modeling requires the same length of the series. Because of the differences in the time

of quotations, the series had to be synchronized: the observations after 16:10 and before 9:30 in the first period (1.11.2007–31.08.2008) and after 16:10 in the second period (1.09.2008–30.04.2009) were removed from the sample. In estimation and graphics presented further in the paper we use G@RCH 5.1 software, the OxMetrics module (Laurent 2007). In Table 1 data description for whole and synchronized series.

Table 1

Descriptive statistics of raw, synchronized and seasonally filtered CAC40, DAX and WIG20 returns

	Raw series			**Synchronized series**			**Seasonally filtered series**		
	CAC40	**DAX**	**WIG20**	**CAC40**	**DAX**	**CAC40**	**DAX**	**WIG20**
No. of observations	36 006	36 006	30 344	30 344	30 344	30 344	30 344	30 344
Minimum	-7.8	-9.4	-6.6	-7.8	-9.4	-15.5	-14.4	-11.1
Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	6.8	6.1	5.3	6.8	6.1	23.6	22.7	17.2
Standard deviation	0.2	0.2	0.3	0.2	0.2	1.5	1.5	1.4
Skewness	0.2	-1.8	-1.4	0.2	-2.1	0.2	0.2	0.1
Excess kurtosis	140.6	160.4	72.6	182.1	203.8	9.3	10.5	4.8

The sample mean of 5 minute returns for all three indices is indistinguishably different from zero at standard significance level given the sample standard deviation. Not surprisingly, the returns are not normally distributed. The sample skewness and the sample excess kurtosis are highly statistically significant (for series after synchronization excess kurtosis is even higher). In addition, twelfth-order (one hour) autocorrelation is statistically different from zero for every series and all three are characterized by the ARCH effect in 12 lags.

2.2. Macroeconomic announcements

The data and timing of American announcements are from www.deltastock.com. In the case of American announcements the expectations of indices (so called *consensus*) are known in advance, therefore we consider only those releases where the value of the macroeconomic indicator is different from earlier published consensus value. The sample of US announcements consists of macro indices commonly used in the literature (Harju, Hussein 2006; Li, Engle 1998; Andersen, Bollerslev 1998). The announcements are released on a monthly basis and at varying time (14:30, 15:15 and 16:00 CET). These are: Consumer Price Index, Producer Price Index, Unemployment Rate, Industrial Production, Retail Sales, Durable Goods Order ex Transportation, New Home Sales and Conference Board Consumer Confidence. The type of announcements and number of observations where the realized value was different from consensus and timing of releases (CET) are presented in Table 2.

Table 2

American macroeconomic announcements considered in the study

Announcement type	Number of observations	Time of announcement (CET)
Conference Board Consumer Confidence CC	17	16:00
Consumer Price Index CPI	14	14:30
Durable Goods Order ex Transportation DGO	16	14:30
Industrial Production IP	16	15:15
New Home Sales NH	18	16:00
Producer Price Index PPI	16	14:30
Retail Sales RS	16	14:30
Unemployment Rate UR	16	14:30

These announcements are reported on a monthly basis, which should give altogether 18 observations in each case. However, for some releases the real value of indicators were identical with expectations. In a few other cases the announcement was done on the day when European exchanges were closed. As far as the day of the week is concerned, from the list above the Producer Price Index is reported mainly on Tuesdays, Unemployment Rate mainly on Fridays, Conference Board Consumer Confidence only on Tuesdays and the rest of announcements is released on changing week-days. Regarding the day of the news releases, out of 132 announcements only 6 were disclosed on Monday, 38 on Tuesdays, 30 on Wednesdays, 23 on Thursdays and 32 on Fridays.

We also defined good and bad news depending on whether the released value of the macroeconomic indicator was higher (good news in the case of Industrial Production, Retail Sales, New Home Sales, Durable Goods Order and Conference Board Consumer Confidence) or lower (good news in the case of Consumer Price Index, Producer Price Index and Unemployment Rate) than the earlier published consensus. It gives altogether 53 good news and 76 bad.

3. Intraday volatility pattern

In this section absolute returns are a proxy for volatility. Intraday returns are said to show periodicity, which is easily visible when looking at absolute returns. The averages of five-minute absolute returns are calculated for all three indices. In the case of WIG20 the calculations are done in two periods, taking into account 2 different time schedules of the stock exchange. The averages of absolute returns are shown in Figure 1.

Averages of absolute returns of 3 indices: CAC40, DAX and WIG20 from 9:00 to 17:30 CET. WIG20_1 stands for averages from the period 1.11.2007–30.08.2008, whereas WIG20_2 from 1.09.2008–30.04.2009.

When describing intraday volatility pattern for indexes, volatilities of CAC40 and DAX are almost identical, whereas volatility of WIG20 is quite different. Absolute returns are higher at the beginning of the trading day, which is usually explained by the inflow of information within

Figure 1

Averages of absolute returns for CAC40, DAX and WIG20 in two separate periods
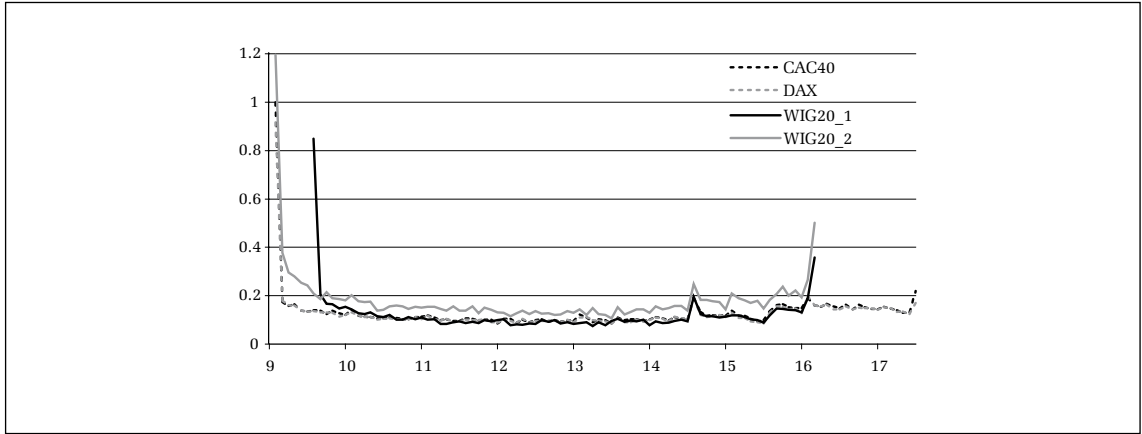
Note: WIG20_1 presents the averages from the period 1.11.2007–30.08.2008, whereas WIG20_2 from 1.09.2008–30.04.2009.

the time when the stock exchange was closed (afternoon and night). At the end of the day the volatility for WIG20 is by half lower than at the opening time, while in the case of CAC40 and DAX volatility does not increase (inversed J-shape). The figure of indexes' volatility shows two spikes at 14:30 and 16:00 CET, which may be explained with the opening of the futures market on NYSE (14:30) or US macroeconomic announcements releases (14:30 and 16:00) (Harju, Hussein 2006). The comparison of the average absolute returns for DAX, CAC40 and WIG20 on days with and without macro releases are shown in Figure 2.

In our study five of eight indicators are released at 14:30. As shown in Figure 2 volatility is much lower on days without macro announcements than on days with them at 14:30 CET which suggests that macro releases have an important impact on price changes for all three indices.

The observed volatility pattern suggests the existence of periodicity in the data. The use of raw data may be misleading, showing only that the volatility is higher at the opening (and closing in the case of WIG20) of the quotation. However, the periodicity can be removed from the data and there exists a number of methods of seasonality removal in the literature (Dacorogna et al.). For example, Andersen and Bollerslev (1998) used flexible Fourier form (FFF regression) to detect cyclical factors, Melvin and Yin (2000) divided returns by their cross-sectional averages and Bauwens, Omarane and Giot (2006) divided returns by averages of absolute returns, taking into account the day-of-the week effect. We use the method applied by Bauwens et al. (2006), having in mind that the announcements are also differently dispersed between the days of the week. Although not sophisticated, this method is well tailored to the changing number of returns within the day in our sample. Every 5-minute return is divided by earlier calculated mean of absolute returns from the whole sample at the same time. The seasonally filtered returns are presented together with raw and synchronized series in Table 1.

Figure 2

Intraday average absolute returns over time on days with American announcements (_A) and without announcements (_NA) from the sample
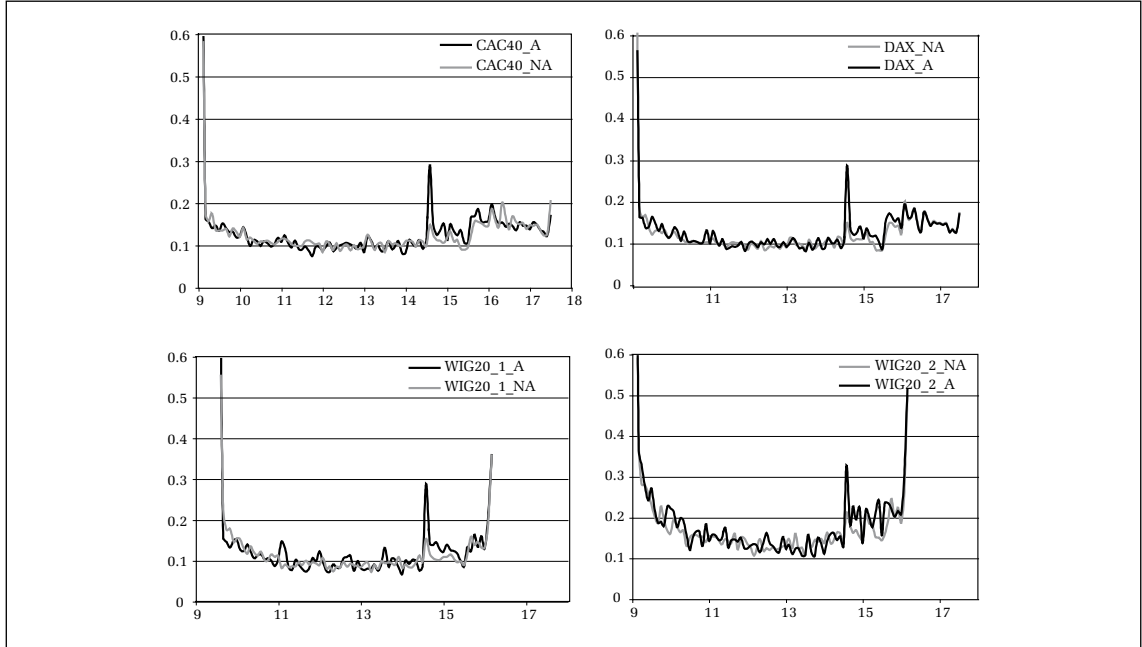
Note: WIG20_1 stands for averages from the period 1.11.2007–30.08.2008, whereas WIG20_2 from 1.09.2008–30.04.2009.

4. Methodology

The problem of interdependence between the markets is very important for the practitioners as well as for researchers. We examine if the American announcements have an impact on returns and volatilities of three indices, CAC40, DAX and WIG20. There is evidence of similar reaction to this type of information in works of Harju, Hussein (2006), Hanousek et al. (2008), but none of these works use multidimensional models. By applying the dynamic conditional correlation model we are able to observe how the American announcements influence the volatilities of the examined series. All results are generated using Ox version 5.10, with the Arfima (Doornik, Ooms 2003; Doornik 2002) and GARCH package (Laurent, Peters 2004).

We model return series filtered from seasonality, r_t, with an AR(2) process with additional dummy variables M_i standing for announcement releases in the following way:

$$r_t = \mu_t + \phi_1 r_{t-1} + \phi_2 r_{t-2} + \sum_{i=1}^{n} \gamma_i M_i + a_t \tag{1}$$

The dummy variables are introduced to capture the effect of announcements. The dummy variable M_i has a value of one for the first return after the announcements and zero otherwise. The

coefficient γ_i measures if there is a reaction in return to examined announcement. Then residuals from linear model, a_t are introduced into the dynamic conditional correlation (DCC) model in the following way (Engle 2002):

$$\mathbf{a}_t = \mathbf{H}_t^{1/2}\varepsilon_t \tag{2}$$

$$\mathbf{a}_t|\Omega_{t-1} \sim EC_k(\mathbf{O},\mathbf{H}_t,g) \tag{3}$$

where EC_k stands for elliptical (here Student-t) distribution and g is a scalar function, referred to as density generator (Pelagatti, Rondena 2004).

The multivariate Student-t distribution is used due to high excess kurtosis in the series.

$$\mathbf{H}_t = \mathbf{D}_t\mathbf{R}_t\mathbf{D}_t \tag{4}$$

$$\mathbf{D}_t = diag(\sqrt{h_{11,t}}, \dots, \sqrt{h_{kk,t}}) \tag{5}$$

where conditional volatilities $h_{ii,t}$ are modeled with FIGARCH (1, d, 1) process with specification given by Chung (1999). The FIGARCH model was chosen from the GARCH family models – the choice was based on information criteria and the value of logarithm of likelihood function. We introduce into conditional variance equations dummy variables M, which have a value of 1 only for the first return after the announcements and zero otherwise.

$$\alpha(L)(1-L)^d(a_t^2 - h_{ii}) = [1-\beta(L)](a_t^2 - h_{ii,t}) + \sum_{i=1}^{n}\gamma_i M_i \tag{6}$$

where:

$h_{ii,t}$ – conditional variance,
h_{ii} – unconditional variance of a_t.

In the DCC model the R matrix is given by:

$$\mathbf{R}_t = (diag(\mathbf{Q}_t))^{-1/2}\mathbf{Q}_t(diag(\mathbf{Q}_t))^{-1/2} \tag{7}$$

The dynamics of symmetric and positively defined matrix $\mathbf{Q}$ is given by the following equation:

$$\mathbf{Q}_t = (1 - \sum_{m=1}^{M}\alpha_m - \sum_{n=1}^{N}\beta_n)\overline{\mathbf{Q}} + \sum_{m=1}^{M}\alpha_m\mathbf{u}_{t-m}\mathbf{u}'_{t-m} + \sum_{n=1}^{N}\beta_n\mathbf{Q}_{t-n} \tag{8}$$

where vectors $\mathbf{u}$ are standardized residuals from univariate FIGARCH models:

$$\mathbf{u}_t = \mathbf{D}_t^{-1}\mathbf{a}_t \tag{9}$$

We assume Student-t distributed errors in the estimation, and therefore we use the following quasi-maximum likelihood function:

$$L(\psi|\varphi) = \sum_{t=1}^{T} (\ln c - \frac{1}{2} \ln|\mathbf{R}_t| + \ln g(\mathbf{u}_t' \mathbf{R}_t^{-1} \mathbf{u}_t)) \qquad (10)$$

The log-likelihood function is non-linear in this case and therefore we use the MaxSQPF algorithm which implements a sequential quadratic programming technique to maximize the log-likelihood function (Laurent 2009). The covariance matrix of the estimates is computed with the Quasi-Maximum Likelihood method.

5. Empirical results

We present results of conditional dynamic correlation estimation with additional dummy variables standing for macroeconomic announcements both in the conditional mean and conditional variance equations and models without these variables. Then, the values of the logarithms of likelihood functions of both types of models are compared. If the value of logarithm of likelihood function for the model with announcement dummies is higher than without them, then the announcement releases are important in explaining the behaviour of returns and volatility. We estimate the DCC model for three synchronized series, CAC40, DAX and WIG20 (the models for two whole series CAC40 and DAX were estimated but are not presented here – the results were very similar to these presented for the synchronized series).

5.1. Reaction to announcements in returns: separate announcements and bad or good news

When examining the reaction to American announcements in returns, there are two estimated models in which bad or good information dummies are included or dummies standing for separate announcements – in both cases the dummy variables are equal to one only for one return just after the announcement (e.g. at 14:35 if the announcement was released at 14:30). The results of estimation are given in Table 3. The first three columns of estimated parameters are for the model without any announcement dummies, the second three are for estimation with 8 dummy variables (one for each announcement type) and last three columns are for models with 2 dummy variables (bad and good news releases).

As shown in Table 3, all autoregressive parameters are negative and ϕ_2 is significant for all three series. When a model with different announcements is considered, only in the case of DAX we observe statistically significant parameters: Durable Goods Order announcements on the average increase returns and Unemployment Rate announcements decrease returns. However, when the good or bad news announcements are considered, for all three series we observe that after good news the reaction is positive and returns are increasing, and after bad news the returns are decreasing. Interestingly, for the CAC40 the increase after good news is bigger than the decrease after bad news, while for the WIG20 oppositely. The highest increase and decrease in returns is observed in the CAC40 series.

Table 3

Reaction to announcements in returns: conditional mean equation AR(2)

$$r_t = \phi_0 + \phi_1 r_{t-1} + \phi_2 r_{t-2} + \sum_{i=1}^{n} \gamma_i M_i + a_t$$

Parameters	No announcements			Different announcements			Good and bad news		
	Series								
	CAC40	DAX	WIG20	CAC40	DAX	WIG20	CAC40	DAX	WIG20
ϕ_0	-0.0035	0.0009	-0.0108	-0.0035	0.0015	-0.0098	-0.0033	0.0015	-0.0100
	(0.0057)	(0.0053)	(0.0064)	(0.0057)	(0.0053)	(0.0064)	(0.0057)	(0.0053)	(0.0064)
ϕ_1	-0.0107	-0.0120	-0.0110	-0.0106	-0.0116	-0.0117	-0.0102	-0.0119	-0.0118
	(0.0063)	(0.0063)	(0.0064)	(0.0063)	(0.0063)	(0.0064)	(0.0063)	(0.0063)	(0.0064)
ϕ_2	**-0.0271**	**-0.0187**	**-0.0270**	**-0.0269**	**-0.0180**	**-0.0270**	**-0.0272**	**-0.0179**	**-0.0276**
	(0.0063)	(0.0064)	(0.0063)	(0.0063)	(0.0061)	(0.0062)	(0.0063)	(0.0061)	(0.0062)
good news							**1.0216**	**0.8927**	**0.7868**
							(0.2538)	(0.2608)	(0.2923)
bad news							**-0.9088**	**-0.8067**	**-0.8927**
							(0.2523)	(0.2659)	(0.2629)
CC				0.4285	0.1455	-0.8338			
				(0.3375)	(0.2909)	(0.6116)			
CPI				-0.2039	0.2068	0.0926			
				(0.4709)	(0.5305)	(0.6740)			
DGO				0.2791	**0.9353**	0.0421			
				(0.3103)	(0.3500)	(0.5675)			
HS				0.0590	-0.0666	0.2125			
				(0.4205)	(0.2806)	(0.5651)			
IP				-1.0883	-0.5164	-0.1761			
				(0.6706)	(0.8154)	(0.4857)			
PPI				-0.4867	-0.2061	-0.1843			
				(0.5831)	(0.5781)	(1.0253)			
RS				0.2871	0.0217	0.4367			
				(0.8091)	(0.6891)	(0.8153)			
UR				-0.7400	**-1.4418**	-1.0946			
				(0.6405)	(0.5047)	(0.6161)			

Notes: The figures in the parentheses correspond to standard error. Significant coefficients at 5% significance level are bolded. The abbreviations for announcements are: CC – Conference Board Consumer Confidence, CPI – Consumer Price Index, DGO – Durable Goods Order ex Transportation, HS – New Home Sales, IP – Industrial Production, PPI – Producer Price Index, RS – Retail Sales, UR – Unemployment Rate.

5.2. Reaction to announcements in volatility: separate announcements and bad or good news

In Table 4 the results of estimated conditional variance equations are presented: without announcement dummies, with separate announcements and with good-bad news dummy variables.

As shown in Table 4, the estimates of models with and without announcement dummies are quite similar. The introduction into the model of announcement dummies results in increasing the

Table 4

Reaction to announcements in volatility: The 3-variable FIGARCH(1, *d*, 1) model with multivariate Student-*t* distribution

Parameters	No announcements			Different announcements			Good and bad news		
	Series								
	CAC40	DAX	WIG20	CAC40	DAX	WIG20	CAC40	DAX	WIG20
α_0	**0.9742**	**0.6853**	**1.8057**	**0.9828**	**0.6992**	**1.7756**	**0.9782**	**0.6960**	**1.7896**
	(0.2109)	(0.1160)	(0.2722)	(0.2257)	(0.1202)	(0.2703)	(0.2233)	(0.1184)	(0.2730)
α_1	**0.2935**	**0.3046**	**0.3460**	**0.2869**	**0.2990**	**0.3346**	**0.2879**	**0.2992**	**0.3384**
	(0.0360)	(0.0300)	(0.0520)	(0.0351)	(0.0294)	(0.0518)	(0.0348)	(0.0289)	(0.0515
β_1	**0.5427**	**0.5528**	**0.5405**	**0.5451**	**0.5513**	**0.5321**	**0.5459**	**0.5510**	**0.5350**
	(0.0459)	(0.0332)	(0.0550)	(0.0459)	(0.0330)	(0.0551)	(0.0458)	(0.0324)	(0.0547)
d(FIGARCH)	**0.3138**	**0.3134**	**0.2948**	**0.3222**	**0.3174**	**0.2950**	**0.3217**	**0.3157**	**0.2956**
	(0.0196)	(0.0154)	(0.0168)	(0.0204)	(0.0159)	(0.0167)	(0.0205)	(0.0156)	(0.0168)
good news							**1.1770**	**1.4052**	**1.7932**
							(0.4310)	(0.5517)	(0.7255)
bad news							**1.7472**	**1.3657**	**1.6069**
							(0.4203)	(0.3238)	(0.4058)
CC				0.8772	0.3426	1.0328			
				(0.4813)	(0.3460)	(0.8534)			
CPI				**3.4981**	**3.1555**	3.4046			
				(1.2487)	(1.2216)	(2.4016)			
DGO				**4.2857**	**2.5201**	**4.5200**			
				(1.3409)	(0.9583)	(1.2350)			
HS				0.1067	0.4856	0.3549			
				(0.3371)	(0.5502)	(0.8223)			
IP				**2.2394**	1.4877	2.5038			
				(1.0568)	(1.0156)	(1.5810)			
PPI				**1.2158**	1.0355	1.4763			
				(0.6164)	(0.6321)	(0.9099)			
RS				**1.6188**	1.3958	**2.1721**			
				(0.8324)	(0.8375)	(0.8589)			
UR				**2.3911**	**2.7239**	**1.9282**			
				(0.7207)	(0.8211)	(0.6461)			
Dynamic conditional correlation estimates									
α(DCC)	**0.0109**	(0.0014)		**0.0111**	(0.0014)		**0.0112**	(0.0014)	
β(DCC)	**0.9769**	(0.0041)		**0.9768**	(0.0040)		**0.9765**	(0.0041)	
LL	-127166			-127140			-127128		
df Student-*t*	6.90507			6.9828			6.9607		

Notes: The figures in the parentheses correspond to standard error. Significant coefficients at 5% significance level are bolded. The abbreviations for announcements are: CC – Conference Board Consumer Confidence, CPI – Consumer Price Index, DGO – Durable Goods Order ex Transportation, HS – New Home Sales, IP – Industrial Production, PPI – Producer Price Index, RS – Retail Sales, UR – Unemployment Rate. LL stands for logarithm of likelihood function. Df Student-*t* are degrees of freedom in Student distribution.

value of logarithm of likelihood function, both in the case of different announcements and good-bad news, which suggests that macro releases give additional information when modeling intraday time series.

The volatility responses to American announcements are quite similar across markets. The conditional volatility equation shows significant coefficients common for all indices in the case of two macro variables: Durable Goods Order and Unemployment Rate. In the case of CAC40, 6 out of 8 announcements are statistically significant (additionally to DGO and UR these are: Consumer Price Index, Industrial Production, Producer Price Index and Retail Sales), for DAX 3 of 8 (Consumer Price Index) and for WIG20 3 of 8 are statistically significant (Retail Sales). It is also worth noting that the coefficients in the case of Durable Goods Order for both French and Polish market and Consumer Price Index for French and German market are quite large, which suggests significant economic importance of those releases.

When a model with good and bad news is considered, in all cases parameters standing at both good and bad news are significant and contradictory to leverage effect (Black 1976), in the case of WIG20 good news increases volatility more than bad news. This might be caused by the sample period coinciding with the financial crisis when bad news is in majority. The stronger reaction to good news may be a result of overreaction to good news in difficult times. However in the case of CAC40 we observe that bad news increases volatility more than good news and for DAX the difference is rather small.

Figure 3

Estimation of conditional variance (CVar) of CAC40, DAX and WIG20 and conditional correlation (CCor) for the following pairs: CAC40-DAX, CAC40-WIG20 and DAX-WIG20
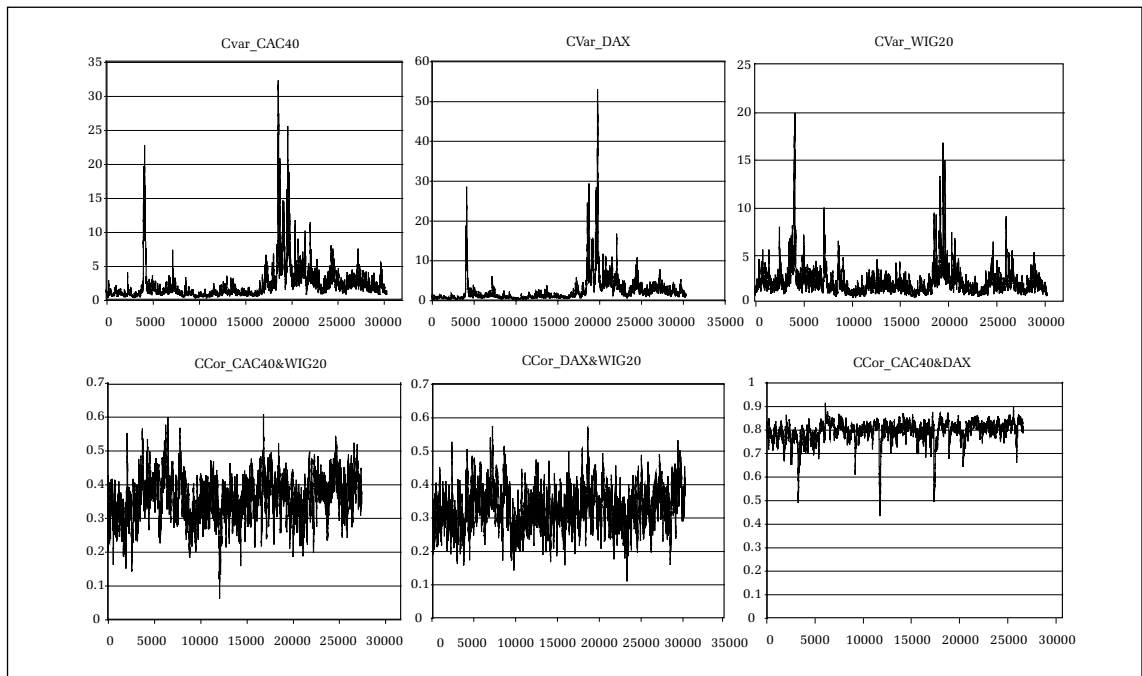
5.3. The estimates of dynamic conditional correlation

Both conditional variances and estimated conditional correlation for 3 pairs of indices are presented in Figure 3.

The dynamics of conditional variances are similar across the series. The highest values of estimated conditional variance are observed in the DAX series and the lowest in WIG20. The estimated dynamic correlations are in all cases positive and nontrivial. The strongest interdependence can be observed in the case of CAC40 and DAX, and the conditional correlation between CAC40 and WIG is very similar to that for DAX and WIG20. The unconditional correlation for CAC40 and WIG is 0.37, for CAC40 and DAX is 0.8 and for DAX and CAC40 is 0.34.

However, the short-term jumps in conditional correlation are not caused by examined macro announcements, while other information has an influence on correlation of indices.

6. Concluding remarks

This paper provides a characterization of returns of three main indices from the French, German and Polish market. Using high-frequency 5-minute data of CAC40, DAX and WIG20 from the period 01.11.2007–30.04.2009 combined with U.S. macroeconomic announcements, we examine the impact of the announcements on returns and volatility of these indices. We observe that for different markets the seasonal intraday pattern is analogous.

We confirm the observation presented in earlier works that French and German indices' volatility proxied by absolute returns increases at 14:30, which is the most frequent daytime when American macroeconomic news are released. Our finding is that the same rule applies to WIG20. It suggests that the American announcements might be treated as a significant risk factor in pricing assets both on the advanced and emerging markets.

Among macroeconomic announcements Durable Order Goods and Unemployment Rate increased volatility of all 3 indices, whereas for the conditional mean equation there is no single announcement which would have common significance. Surprisingly good news increased returns and volatility by more than bad news decreased returns and increased volatility.

The conditional correlations for examined series are very similar in the case of pairs CAC40-WIG20 and DAX-WIG20. Not surprisingly the highest correlation is observed for CAC40 and DAX. However, the short-term decreases of correlation are not connected with the release of macroeconomic indicators.

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