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The Impact of Monetary Policy Announcements on Stock Market Index in Poland

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ABSTRACT

Financial market participants are influenced by the news reaching them from all manner of sources, including the country's central bank. In this paper we model daily returns of WIG20 index with respect to announcements made by the National Bank of Poland (NBP) regarding the changes of the official interest rate of open market operations (the so-called reference rate) during the period of 2004-2016. The goal is to examine whether the NBP's announcements have an impact on either stock returns or volatility and whether the content of such communiqué (either interest rate cut or raise) matters. The FIGARCH model is found to be an appropriate specification for the data. Moreover, the results suggest that, in fact, interest rate changes do have a significant impact on both returns and volatility. However, the reactions to news are different with respect to the type of announcement.

Keywords: monetary policy, news effect, stock market.

1. Introduction

Ever since Fama [1970] published his findings on market efficiency, economists have started to research the topic of financial markets and the effects macroeconomic announcements have on them. Are the markets efficient? Do the prices of traded assets already reflect all previous, publicly available information? Do the prices instantly change to reflect new public information? Advances made on the field of quantitative methods, as well as rising availability of increasingly disaggregated data, have given rise to new opportunities in this field of research. This allows for creating new methods of testing how information determines asset prices.

While considering market fluctuations, one should take into account such factors as economic, political, legal, psychological, organizational or structural. The sources of public information that may influence financial markets are numerous and varying. Some of those may be: announcements of macroeconomic indicators (including the unemployment level, consumer and producer price indices, production and gross domestic product levels), statements made by politicians, heads of states, prominent figures among businessmen or economists in local or international circles, news about decisions made by state authorities or about technological advances and breakthroughs. The above list is by no means exhaustive.

This paper focuses on monetary policy announcements and their impact on the stock market. Changes in the official central bank rate of open market operations signify a more expansionary or contractionary policy which, by means of monetary transmission mechanisms, influences outcomes such as the inflation or economic output. They also help to manage the expectations of market participants through the so-called expectations channel. Market participants pay close attention to all central bank communication, especially interest rate changes, and try to anticipate those to stay ahead of the trends.

In this paper we model daily returns of WIG20 index with respect to announcements made by the National Bank of Poland (NBP) regarding the changes of the official interest rate of open market operations (the so-called reference rate). Our research covers the period from 2.1.2004 to 31.10.2016. The goal of the paper is to examine whether the NBP's announcements have an impact on either stock returns or volatility and whether the content of such communiqué (either interest rate cut or raise) matters. This paper contributes to the existing literature. We estimate univariate FIGARCH models for the examined data. In modeling, we introduce dummy variables to control for the impact of monetary policy decisions. Therefore, we apply existing methodology to explore the reaction of Polish stock index returns to interest rate changes, which – to the best of the author's knowledge – has not been the focus of previous efforts. Additionally, the research period used in the paper is longer and more current than the periods used in other similar works focusing on the impact of interest rate changes on the Polish financial market.

The remaining part of the paper is organized as follows. Section 2 reviews the literature related to the effect of news on financial markets. Section 3 presents the methodology used for evaluating the impact of monetary policy announcements. The results are shown in Section 4. Section 5 concludes the paper.

2. Literature review

When making investment decisions, investors may be surprised by an unexpected event and modify their behaviour accordingly. Surprises are shocks for financial markets, and investors process them as information signals. Therefore, errors in predicting asset prices may be explained as an influx of unexpected news on the market. Fama's market efficiency theory [Fama 1970] has become a framework for analysing the process of price adjustments of financial instruments on the capital market and testing how information determines asset prices. On the basis of the market efficiency theory it may be assumed that new information (especially unexpected) should be reflected in the level of asset prices immediately and directly. This leads, therefore, to the study of market reactions to macro news or central bank decisions. Quantitative methods used in this field of research include event analyses, impulse response analyses, multi-equation structural macroeconomic models or vector autoregression models.

Much focus has been put on exploring the reaction of currency and capital markets to macroeconomic announcements. In the literature the impact of announcements may be observed on both returns and volatility. Macroeconomic news has been found to have a short-lived but significant effect on financial returns on the forex market [Andersen and Bollerslev 1998]. However, the influence can be more easily detected within high frequency data, and recently researchers shifted their interest to modeling the reactions in intraday data which provide more precise information for the announcement times of macro indicators.

Some of the most important works in this field include surveys made on the foreign exchange market [Goodhart 1989; Almeida, Goodhart and Payne 1998] and on equity markets [Hanousek, Kocenda and Kutan 2008]. Some studies focused on examining the impact on returns [Goodhart 1989], on volatility [Andersen and Bollerslev 1998; Andersen, Bollerslev and Diebold 2004] or on both simultaneously [Harju and Hussein 2006; Han 2007; Ehrmann et al. 2013].

The paper by Almeida, Goodhart and Payne [1998] studies a high frequency reaction of the DEM/USD exchange rate to publicly announced macroeconomic information emanating from Germany and the US. They detect a strong, quick impact of macroeconomic news, with the exchange rate reflecting the anticipated policy reaction by the monetary authorities to the piece of news. Furthermore, the impact of German announcements on the exchange rate is on average smaller than the impact of US news. In addition, they detect influences of German monetary policy decisions on the reaction of the exchange rate. Harju and Hussein [2006] examine the impact of US macro announcements on four major European equity markets. They find that US fundamentals have an impact (in both returns and volatility) on equity markets – CAC40, DAX, DMI and FTSE100. The impact of EU-wide macroeconomic news on stock market indices from Central European countries (Czechia, Poland and Hungary) is the subject of the paper by Hanousek, Kocenda and Kutan [2008]. They conclude that the reaction of emerging markets is in line with more advanced western European markets. Han [2007] uses FIGARCH models with a linearly distributed lag dummy variable to examine how US and EMU macroeconomic shocks affect high frequency Dollar-Euro returns on an intraday basis. He finds that the effects of the shocks are generally statistically significant and that they appear to be asymmetric, depending on the regions and the signs of the shocks. A recent study by Ehrmann et al. [2013] examines the determinants of the euro exchange rate during the sovereign debt crisis. While they find that exchange rate developments are difficult to explain (with macroeconomic fundamentals having low explanatory power), actions at the EU level and by the ECB have affected the exchange rate and its volatility. In particular, the ECB actions have contributed to lowering the euro's volatility.

The research into the impact of changes made to the central bank discount rate on equity market returns was pioneered by Waud [1970], Smirlock and Yawitz [1985], Pearce and Roley [1985] and Hardouvelis [1987].

In the early 1970s, Waud [1970] presented evidence that interest rates and stock prices respond to announcements of discount rate changes in the US. Smirlock and Yawitz [1985] expanded on his work by introducing 'technical' and 'nontechnical' discount rate changes, the latter containing some information about the monetary policy. In the pre-1979 period they found no evidence of announcement effects, whereas in the post-1979 period they found negative announcement effects for 'nontechnical' announcements only. Pearce and Roley [1985] similarly discovered that changes in the discount rate had a negative effect on equity prices, but only in the post-1979 period. Their paper examines the daily response of stock prices to announcements about the money supply, inflation, real economic activity, and the discount rate. The empirical results indicate that surprises related to monetary policy significantly affect stock prices, but there is only weak evidence of stock price responses to surprises beyond the announcement day. Likewise, Hardouvelis [1987] found a negative effect of discount rate changes on equity prices during the 1979-82 period, but not after 1982. His paper analyses the response of stock prices to the announcements of 15 representative macroeconomic variables. The conclusion states that stock prices respond primarily to announcements of monetary variables. While analyzing increases and decreases separately, Jensen and Johnson [1993] found effects of both 'technical' and 'nontechnical' interest rate changes, with the latter being stronger. More recent work by Jensen and Johnson [1995] included examination of periods before, during and after a discount rate change occurred. There was a negative effect on stock returns in all three periods. Thorbecke [1997] used a number of different approaches (including VAR and event study) to the relationship between the monetary policy and equity prices. He established that monetary tightening has the strongest (negative) effect on equity prices of small companies. He also concluded that expansionary policy exerts a large and statistically significant positive effect on monthly stock returns. Furthermore, he found a significant negative effect on the percentage change in the Dow Jones Industrial Average index from policy-induced changes in the federal funds rate.

Locally, the reaction of USD/PLN exchange rate to changes of the NBP reference rate was studied by Serwa and Smolińska-Skarżyńska [2004]. Basing their research on data with daily frequency from the period of 16.03.2000-31.07.2002, they have concluded that decreases of the NBP interest rate coincided with the appreciation of the Polish zloty. Gurgul [2012] has also used an event study as a method of testing the impact of different types of announcements on the Polish stock market returns. The results suggested that the first change of the NBP rediscount rate (whether up or down), reversing the previously established direction of the monetary policy (the pattern of interest rate changes), had a positive effect on stock prices. The impact of macro news announcements on intraday returns on the European stock indices has been extensively studied by Będowska-Sójka [2010; 2011; 2013]. She has established that the macro announcements from the US market have a significant impact on both returns and volatility of CAC40, DAX and WIG20 indices. However, the reactions are different with respect to the type of announcement [Będowska-Sójka 2010]. Using DAX and WIG20 she has also concluded that the domestic and neighbour-country announcements are much less important than US releases.

3. Data

The raw data set consists of daily WIG20 price quotes in the period of 2.01.2004 - 31.10.2016. WIG20 (Warszawski Indeks Giełdowy) is a Polish capitalization-weighted index quoted on the Warsaw Stock Exchange which represents 20 most liquid and biggest companies. Since the raw data (WIG20 daily closing quotations) present a non-stationary process, we use percentage logarithmic returns, calculated with the formula: r_t=100%* ln(p_t/(p_(t-1))), where p_t is a price at time t. The source for the data is www.stooq.pl database. The estimation, graphics and charts are made with OxMetrics 7.0 G@RCH 7.0 software [Laurent 2009]. The return series for WIG20 are depicted in Figure 1. The descriptive statistics for the time series are presented in Table 1.

The sample mean of the time series is not distinguishably different from zero, given the sample standard deviation. The sample skewness and the sample excess kurtosis are statistically highly significant. The empirical distribution is skewed to the left. Hence the returns are not normally distributed which is confirmed by the Jarque-Bera test. The results of the unit root ADF test confirm that the time series is stationary. In addition, with the Box-Pierce statistic we have detected autocorrelation in WIG20 returns and squared returns, and the series is characterized by the ARCH effect.

The primary instrument of the monetary policy in Poland is a short-term interest rate. The NBP reference rate determines the yield on main open market operations, affecting at the same time the level of short-term market interest rates. The main operations currently conducted by the NBP take the form of regular issuance of the NBP money market bills, usually with a maturity of 7 days [NBP 2015]. Changes in the NBP reference rate stem from the course of the monetary policy pursued by the central bank, as determined by the Monetary Policy Council. The schedule of Council meetings is announced in advance. The source for the monetary policy announcements is the official NBP website (www.nbp.pl).

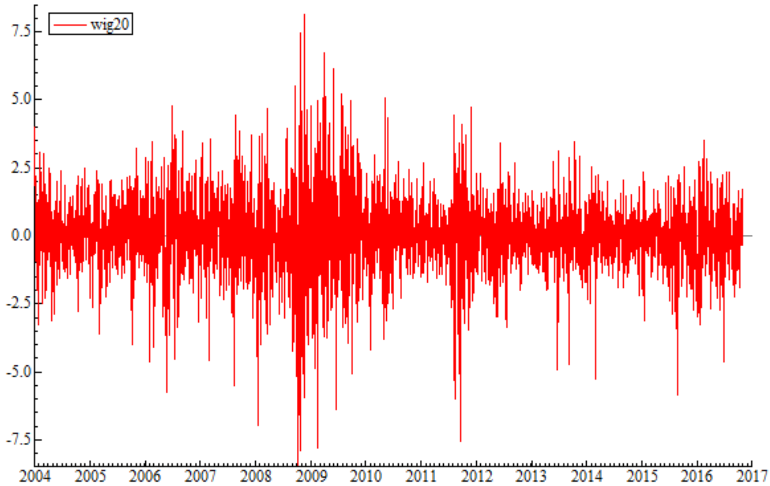

Figure 1: Daily WIG20 returns from 2.01.2004 to 31.10.2016

Table 1: Descriptive statistics of WIG20 returns in the period from 2.01.2004 to 31.10.2016

	No. of observations	Min	Mean	Max	Std. dev.	Skewness	Excess kurtosis
WIG20	3218	-8.4428	0.0036	8.1548	1.4595	-0.3012	3.2908

Between 2.01.2004 and 31.10.2016 there have been 39 changes in the official reference rate. Out of those, the Monetary Policy Council has made 16 decisions to raise the rate, and 23 decisions to cut the rate. Changes in the interest rate level tend to cluster into groups as to represent periods of expansionary and contractionary monetary policy.

The level of the reference rate and the changes made to it are depicted in Figure 2.

Out of 39 changes that were made, the interest rate was changed by 75 basis points twice, with 8 times by 50 basis points and 29 times – by 25 basis points.

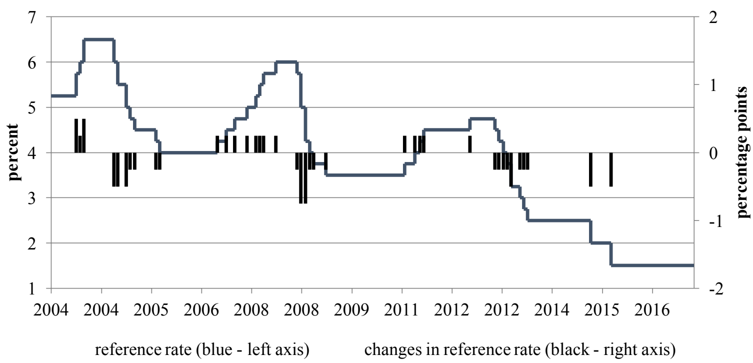

Figure 2: Reference rate level and changes from 2.01.2004 to 31.10.2016

4. Methodology

The methodology used here could be classified as following the broader meaning of an event study. Event study methodology has been introduced in the 1960s to use the financial market data to measure the impact of a specific event on the value of a company [MacKinlay 1997] by finding an abnormal return attributable to the event under analysis. It has since started to be used for examining the impact of news on prices, also implementing a variety of quantitative methods.

In the paper we use models from the ARMA and GARCH family with dummy variables added to represent monetary policy announcements taking place in the aforementioned time range. We examine if the news (of changes in the NBP reference rate) has an impact on the returns and volatilities of WIG20 index. By applying the GARCH model we are able to observe how the announcements influence the volatility of the examined series. Recently, a similar approach has been used by Będowska-Sójka [2010], Kołodziejczyk [2014], Filipowicz [2013]. All the results are generated using OxMetrics 7 with G@RCH package.

The research procedure is as follows. First, we consider the model (out of the ARMA-GARCH family) which best fits WIG20 returns. Tests are performed to confirm whether the model is well-suited to the data. Second, we create three dummy variables – one to represent information about all interest rate changes, one to account for interest rate cuts and one to account for rises. Third, the dummy variables are introduced consecutively into the conditional mean and conditional variance equations to capture the effect of the announcements on returns and volatility. The models are reestimated with the introduction of each dummy variable. The statistical significance of each estimated parameter is tested.

Some of the most important advances in modern econometrics involved modifications to the ARMA-GARCH models which allow for exploring both linear (autocorrelation in returns) and nonlinear (autocorrelation in squared returns) properties found in the data. ARMA is used to model a conditional average in the series. ARCH (autoregressive conditional heteroskedasticity) is a time series regression model of the volatility of a financial time series developed by Engle [1982]. A useful generalization of this model is the GARCH model introduced by Bollerslev [1986]. The conditional mean and conditional variance equations for ARMA(r,s)-GARCH(p,q) are:

$$r_t = \mu_t + y_t$$
$$\mu_t = a_0 + \sum_{i=1}^{r} a_i r_{t-i} - \sum_{j=1}^{s} b_j y_{t-j}$$
$$y_t = \sigma_t \varepsilon_t$$
$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i y_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2$$

where ε_t ~ iid(0,1), ω > 0, α_i ≥ 0 and β_j ≥ 0.

In the conditional variance equation alpha parameters account for shocks in squared returns, whereas the beta parameters represent a weighted average of past squared returns. Apart from a Gaussian distribution, εt may also be modeled with other distributions: Student's t, skewed Student or GED distribution to account for the fat tails of the high-frequency or skewed financial time-series. Additional variables can be added to the conditional mean and variance equations.

Due to the long memory in the series of absolute returns we chose the FIGARCH model out of the GARCH family of models – the choice was made on the basis of information criteria and the statistical significance of parameters. FIGARCH (p,d,q) specification was introduced by Baillie, Bollerslev and Mikkelsen [1996] and is known as the BBM's method. The conditional variance can be specified as:

$$(1-\beta(L))\sigma_t^2 = \omega + [1-\beta(L)\text{-}\phi(L)(1-L)^d]y_t^2$$

where lag polynomials are:

$$\beta(L) \equiv \beta_1 + \cdots + \beta_p L^p, \phi(L) \equiv 1 - \phi_1 L\text{-} \ldots \text{-}\phi_q L^q,$$

and 0≤d≤1 being the fractional differencing parameter. When d=0, then FIGARCH reduces to the standard GARCH model. When d=1, then FIGARCH becomes the IGARCH (integrated GARCH) model, implying the complete persistence of the conditional variance to a shock in squared returns.

The exact specification of an ARMA(1,1)-FIGARCH(1,d,1) conditional mean and variance equations used in this paper is as follows:

$$r_t\text{-}\mu = a_1(r_{t\text{-}1}\text{-}\mu) + (\text{-}b_1)y_{t\text{-}1} + y_t$$
$$y_t = \sigma_t \varepsilon_t$$
$$\sigma_t^2 = \omega + \beta_1 \sigma_{t\text{-}1}^2 + [1-\beta_1 L\text{-}\phi_1 L(1-L)^d]y_t^2$$

Subsequently, we introduce dummy variables x_(i,t) into both conditional mean and conditional variance equations:

$$r_t\text{-}(\mu + \sum_{i=1}^{k} c_i x_{i,t}) = a_1 \left(r_{t\text{-}1}\text{-}(\mu + \sum_{i=1}^{k} c_i x_{i,t\text{-}1}) \right) + (\text{-}b_1) y_{t\text{-}1} + y_t$$

$$y_t = \sigma_t \varepsilon_t$$

$$\sigma_t^2 = \omega + \beta_1 \sigma_{t\text{-}1}^2 + \sum_{i=1}^{k} \omega_i x_{i,t} + [1 - \beta_1 L\text{-}\phi_1 L(1-L)^d] y_t^2$$

These dummy variables are defined in the way that they take the value of 1 only at the time of the monetary announcement (for the return on the day of the interest rate change) and 0 otherwise. To facilitate the examination of the interest rate changes in general, as well as cuts and rises in the rate separately, three dummy variables are introduced:

- CHANGE – which takes the value of 1 each time the reference rate has been changed by the monetary policy committee of the NBP (39 decisions),
- UP – which takes the value of 1 each time the reference rate has been raised by the monetary policy committee (16 decisions),
- DOWN – which takes the value of 1 each time the reference rate has been cut by the monetary policy committee (23 decisions).

In the end, the statistical significance of each estimated parameter is examined in order to judge which factors have a significant influence over the returns on WIG20 and their volatility.

5. Results

Table 2 presents the estimation results of applying the model without any announcement dummies to the WIG20 returns in the first step of the procedure.

Table 2: The estimates of ARMA(1,1)-FIGARCH(1,d,1) without dummy variables

parameters	base model for WIG20
a_1	**-0.274802** (0.10829)
$-b_1$	**0.306071** (0.11835)
ω	**0.023129** (0.00906)
d	**0.608340** (0.07925)
ϕ_1	**0.185745** (0.04656)
β_1	**0.773117** (0.04463)
Asymmetry ln(ξ)	**-0.057797** (0.02194)
DF (ν)	**8.475866** (1.2262)
Log likelihood	-5350.607

Note: Estimated parameters together with standard errors (in parentheses) are reported. The bolded parameters are statistically significant at α=0.05. Skewed Student distribution was used with DF (degrees of freedom) and asymmetry coefficient reported.

As can be seen in Table 2, parameters in the conditional mean equation, both the autoregressive and moving average component, are statistically significant. In the conditional variance equation ω, ϕ, β and d are significant and the values are reasonable. It suggests that volatility is impacted by both persistence (represented by parameter β) and squares of previous shocks (represented by parameter ϕ). The long memory volatility parameter (d) is estimated to be 0,6 and appear to be statistically significant. Thus, the hypotheses that d=0 (stationary GARCH) and d=1 (integrated GARCH) can be rejected for the WIG20 returns. Furthermore, a series of diagnostic tests on the standardized residuals and squared standardized residuals failed to detect any need to further complicate the model . In that regard daily WIG20 returns seem to be similar to high frequency data, since related research suggests that high frequency (from 5 min to 30 min) data also have a long memory property in the volatility process [Han 2008, Będowska-Sójka 2011]. The estimated number of degrees of freedom in regards to Student's t-distribution is relatively high, meaning it is more similar to the normal distribution, and therefore contains less outliers (the tails are less heavy).

The estimated effects of monetary policy announcements on the conditional mean and conditional variance of the WIG20 returns are reported in Table 3 and 4. The estimation results show that the estimated parameters of models with dummy variables are generally quite similar to those of the base model reported in Table 2. In particular, the estimated value of long memory parameter of models (1), (2) and (3) is found to be almost the same as that estimated form the base model in Table 2. Apart from the dummy variable, all other parameters are still statistically significant. When examining the reaction to all NBP announcements of interest rate changes (represented in the dummy variable CHANGE) it seems that those announcements are not statistically significant to the model. The CHANGE variable was not significant, either added to the conditional mean equation (2), to the conditional variance equation (3), or to both of them (1). However, what is worth noting is that the value of the logarithm of the likelihood function for the model with announcement dummies (in both equations – model (1)) is noticeably higher than without them (base model). It suggests that the news of reference rate changes is important in explaining the behaviour of returns and volatility.

Table 3: The estimates of ARMA(1,1)-FIGARCH(1, *d*, 1) with dummy variable CHANGE

parameters	(1)	(2)	(3)
		conditional mean equation	
a_1	**-0.289365** (0.11072)	**-0.281402** (0.10884)	**-0.278681** (0.10961)
$-b_1$	**0.323130** (0.12039)	**0.314370** (0.11846)	**0.310195** (0.11978)
CHANGE	0.268939 (0.15690)	0.247982 (0.15143)	
		conditional variance equation	
ω	**0.026781** (0.00966)	**0.023002** (0.00903)	**0.025883** (0.00944)
d	**0.604769** (0.08168)	**0.608060** (0.07880)	**0.610126** (0.08243)
ϕ_1	**0.186055** (0.04770)	**0.185041** (0.04649)	**0.185237** (0.04813)
β_1	**0.771159** (0.04595)	**0.772632** (0.04429)	0.774653 (0.04600)
CHANGE	-0.236667 (0.12508)		**-0.180560** (0.12031)
Asymmetry ln(ξ)	**-0.056710** (0.02192)	**-0.056403** (0.02190)	**-0.057475** (0.02198)
DF (ν)	**8.581282** (1.2665)	**8.490878** (1.2279)	**8.532061** (1.2508)
Log likelihood	-5348.52	-5349.51	-5350

Note: Estimated parameters together with standard errors (in parentheses) are reported. The bolded parameters are statistically significant at α=0.05. Skewed Student distribution was used with DF (degrees of freedom) and asymmetry coefficient reported. Numbers correspond to models: (1) dummy added to both equations; (2) dummy added to conditional mean equation; (3) dummy added to conditional variance equation.

Table 4 presents the results of estimated models with separate dummies for reference rate cuts and raises. Once more, the estimates of models with and without announcement dummies are quite similar. The introduction of two dummies into the base model (into both equations) results in increasing the value of logarithm of likelihood function, which suggests that news of monetary decisions give additional information when modeling daily WIG20 returns. In fact, model (4) has the highest log likelihood of all considered models. However, not all dummy variables are statistically significant. When adding dummies UP and DOWN into the mean and variance equation separately it becomes clear that the effect is created either when the DOWN dummy is inserted into the conditional mean equation (6) or when the UP dummy is inserted into the conditional variance equation (8). After excluding variables without statistical significance form model (4), model (9) has been reached as a consensus. The news of a decrease in the NBP reference rate impacts the market by increasing the level of market returns. The overall coefficient has a positive value of 0.14 . On the other hand, when we consider the dummy standing for reference rate increases it is visible that in Poland such announcements decrease volatility notably. Monetary decisions to the contrary have no statistical significance in regard to market volatility. It is in line with earlier findings by Filipowicz [2013].

Finally, both conditional mean and conditional variance estimations from model (9) are presented in Figure 3. The dynamic of conditional variance clearly shows the period of increased volatility during the global finance crisis present in the sample.

Table 4: The estimates of ARMA(1,1)-FIGARCH(1, *d* ,1) with dummy variables UP and DOWN

parameters	(4)	(5)	(6)	(7)	(8)	(9)
			conditional mean equation			
a_1	**-0.290574** (0.11023)	**-0.272962** (0.10800)	**-0.282217** (0.10851)	**-0.283044** (0.10897)	**-0.275008** (0.10843)	**-0.290337** (0.10899)
$-b_1$	**0.324072** (0.11993)	**0.303777** (0.11820)	**0.315504** (0.11798)	**0.315371** (0.11892)	**0.306280** (0.11851)	**0.324682** (0.11835)
UP	-0.196209 (0.28952)	-0.154648 (0.22373)				
DOWN	**0.483366** (0.16175)		**0.474200** (0.16562)			**0.474717** (0.16479)
			conditional variance equation			
ω	**0.027906** (0.01016)	**0.023114** (0.00906)	**0.022889** (0.00899)	**0.025404** (0.00920)	**0.023377** (0.00934)	**0.025166** (0.00914)
d	**0.605573** (0.08341)	**0.609204** (0.07940)	**0.610388** (0.07885)	**0.608406** (0.08283)	**0.608278** (0.07940)	**0.610130** (0.08226)
ϕ_1	**0.182190** (0.04796)	**0.185394** (0.04660)	**0.183326** (0.04656)	**0.184246** (0.04832)	**0.185826** (0.04665)	**0.181944** (0.04823)
β_1	**0.770160** (0.04805)	0.773652 (0.04469)	**0.773663** (0.04420)	**0.773195** (0.04643)	**0.773126** (0.04469)	**0.773535** (0.04596)
UP	**-0.540273** (0.27541)			-0.464179 (0.13372)		**-0.463285** (0.13355)
DOWN	-0.191659 (0.20293)				-0.023880 (0.16437)	
Asym ln(ξ)	**-0.055658** (0.02176)	**-0.058272** (0.02192)	**-0.054958** (0.02177)	**-0.058252** (0.02200)	**-0.057747** (0.02193)	**-0.055383** (0.02182)
DF (ν)	**8.507569** (1.2497)	**8.454288** (1.2230)	**8.440996** (1.2171)	**8.573899** (1.2597)	**8.479928** (1.2304)	**8.539870** (1.2514)
Log likelihood	-5345.465	-5350.44	-5347.96	-5348.87	-5350.6	-5346.24

Note: Estimated parameters together with standard errors (in parentheses) are reported. The bolded parameters are statistically significant at α=0.05. Skewed Student distribution was used with DF (degrees of freedom) and asymmetry coefficient reported. Numbers correspond to models: (4) dummies UP and DOWN added to both equations; (5) dummy UP added to conditional mean equation; (6). dummy DOWN added to conditional mean equation; (7) dummy UP added to conditional variance equation; (8) dummy DOWN added to conditional variance equation; (9) dummy DOWN added to conditional mean equation and dummy UP added to conditional variance equation.

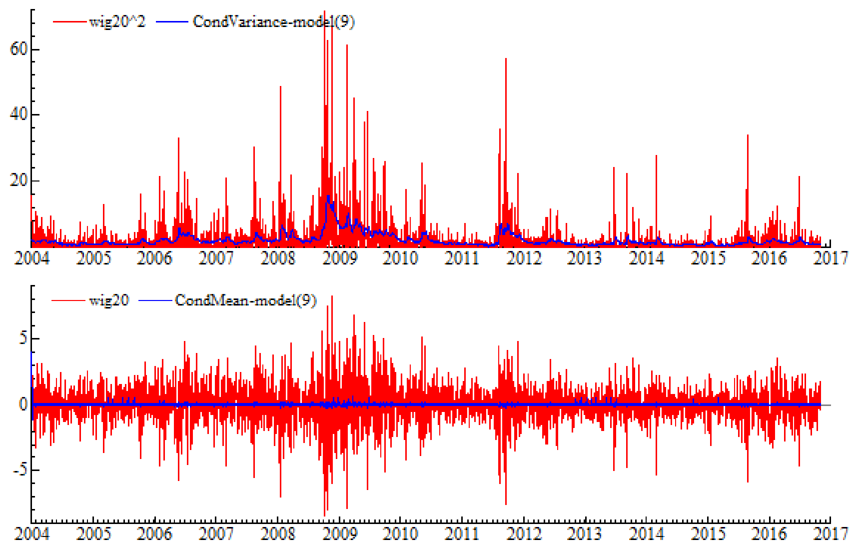

Figure 3: Estimation of conditional mean and variance from model (9) as well as actual WIG20 returns and squared returns

6. Concluding remarks

This paper provides a characterization of daily WIG20 returns on the Polish market from 2004 to 2016. We find that the volatility process of the time series is well described by the FIGARCH process. The estimate of the long memory parameter is found to be statistically significant, implying that in that regard daily WIG20 returns are similar to high frequency data.

We also provide a quantitative analysis of the impact of shocks on both the conditional mean and conditional variance – using the daily data of WIG20 combined with Polish monetary announcements (of changes in the reference rate), we examine the impact of news on returns and volatility of this index. In particular, this paper investigates how the effects vary depending on whether the change in the reference rate was an increase or a decrease.

This study shows several important results. First, adding dummy variables representing changes of the interest rate to the conditional mean and variance equations increases the logarithm value of the likelihood function. In fact, it is highest for the model with two separate dummy variables representing cuts and raises. This result confirms that news such as monetary announcements can be used as a factor relevant to explaining the behaviour of returns and volatility. Second, WIG20 quotes respond asymmetrically depending on the exact nature of the interest rate change – whether it is a cut or a raise. Interest rate cuts have an effect by increasing the level of market returns, but are not significant in regard to volatility, whereas reference rate raises impact the market by decreasing volatility, but have no significant effect on market returns. This observed decrease in volatility may be due to a calming effect on the market established by confirming the expectations of market participants (expectations are represented in the level of stock index in advance of the announcement). It may also be due to central bank's communication strategy being able to dispel any doubts felt by investors on the stock market.

A logical step forward in this field of research is to examine the impact of monetary announcements on high-frequency data as well as on prices of other types of assets.

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