

# **Stock prices volatility and trading volume: Evidence from selected world financial companies' shares**

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## **Abstract**

*Current paper has focused on stock price–volume relation. The aim of the article is to examine whether the prices volatility of selected world financial companies' shares differs within the both samples, below its average of trading volume and the above. It is estimated GARCH-M models from daily data of 13 selected financial companies within after crisis period from 2010 to 2013. Our period was split into three sub-periods to compare its results. It was not founded any strong significant relationship between trading volume and stock prices volatility.*

*Keywords: Stock market, volatility, trading volume, GARCH model*

*JEL codes: G15, G17, C58*

## **1. Introduction**

It is well-known that price and trading volume are two fundamental variables in any analysis of market interactions. Trading volume, despite its intensive used by practitioners, has been long playing second fiddle to stock returns in academic research. The relation between stock price changes and trading volume (return–volume relation) has received considerable attention in the field of finance over the past two decades (Gebka and Wohar, 2013; Wang et al., 2012; Chen 2013). Due to the global financial crisis and recent changes on global financial markets it could be very interesting to investigate relationship between stock prices volatility and trading volume of selected financial companies' shares to investigate possible changes after crisis period.

The aim of the study is to examine whether the price's volatility of selected world financial companies' shares differs within the both samples, below its average of trading volume and the above. The structure of the remainder of the paper is easily summarized. The next section presents an overview of recent literature. Section three describes data, discusses the econometric model and the methodology employed. Section four provides discussion on empirical results, while the last section five briefly concludes.

## **2. Literature Review**

The relationship between volatility, measured by realized volatility, and trading volume for 25 NYSE stocks investigated Rossi and Magistris (2013). They show that volume and volatility are long memory but not fractionally cointegrated in most cases. Even they also find right tail dependence in the volatility and volume innovations, tail dependence is informative on the behavior of the volatility and volume when large surprising news impact on the market. They estimate a fractionally integrated VAR with shock distributions modeled with a mixture of copula functions. The model is able to capture the main characteristics of the series, say long memory, marginal non-normality and tail dependence. They argue it is interesting to note that the presence of tail dependence is consistent with the information based explanation of the volatility volume relationship that is transaction volume carries information to the market, especially during days of high market activity, corresponding to anomalous events. Separate analysis of NASDAQ and NYSE listed stocks allowed for a detailed examination of the price and volume effect at an intra-day level was made also by Kappou et al. (2010). They argue that the price–volume relationship masks the profits that are available to

arbitrageurs who are willing to trade on an intra-daily basis. While index funds persist in favoring accurate tracking over profitability, arbitrageurs will continue to benefit.

Whether the empirical linkages between stock returns and trading volume differ over the fluctuations of stock markets, i.e., whether the return to volume relation is asymmetric in bull and bear stock markets, investigated Chen (2013). Using monthly data for the S&P 500 price index and trading volume from 1973 to 2008, strong evidence of asymmetry in contemporaneous correlation is found. As for a dynamic (causal) relation, it is found that the stock return is capable of predicting trading volume in both bear and bull markets. However, the evidence for trade volume predicting returns is weaker.

Gebka and Wohar (2013) analyzed the causality between past trading volume and index returns in the Pacific Basin countries. Their OLS results indicate no causal link between trading volume and returns. Nevertheless, the quantile regression method reveals strong nonlinear causality, positive for high return quantiles and negative for low ones. In their study, they employ also the modified iterative cumulative sum of squares algorithm to identify breaks in volatility of returns. These break dates allow them to partition each country-specific sample into periods of distinctive statistical features of index returns, i.e., to identify different market regimes. These were then used to test the notion of whether the volume–return causality, both linear and in quantiles, is occurring randomly or clustered and concentrated in certain periods, e.g., of high volatility.

Dajčman (2013) focused his study on European stock returns' volatility. His paper investigates multiscale interdependence between the stock markets of Germany, Austria, France, and the United Kingdom. Inter alia, he proved that major financial market crises had a significant impact on return volatility of investigated stock markets as well. Among them, the global financial crisis of 2007-2008 had the greatest and the most durable impact. His study also suggests strong comovement between stock market returns of Germany, France, and the United Kingdom which exists at all scales, while the Austrian stock market is less correlated with the three biggest stock markets in Europe.

Louhichi (2011) investigated the relationship between volume and volatility on Euronext in France. More specifically, the study aims to determine which component of trading volume (trade size or number of transactions) drives this relation for the CAC40 Index as well as for individual stocks. Firstly, it is confirmed the strong positive relationship between volume and volatility. Secondly, including volume in the conditional variance of stock returns significantly reduces the persistence of volatility. Thirdly, it is showed that the well-known positive relationship between volatility and volume is generated by the number of trades. He mentioned that a Wall Street adage says “It takes volume to make prices move.”

In the Australian market it was tested the hypothesis the relationship between trading volume and stock returns by Bheenick and Brooks (2010). They explored this relationship by focusing on the level of trading volume and thin trading in the market. Their results suggest that trading volume does seem to have also some predictive power for high volume firms and in certain industries of the Australian market. However, for smaller firms, trading volume does not seem to have the same predictive power to explain stock returns in Australia. On the other hand they argue their analysis of the individual stock data cannot be generalized because they find this evidence only for certain categories of stock. Specifically, segregating the market in different categories of high and low volume stocks makes a difference in their results and they find volume to have predictive power in the high volume setting.

By employing various econometric tests, Azad et al. (2013) first provides conclusive evidence of South-Asian market inefficiency. It then extracts evidence of manipulation periods from legal cases and analyses price–volume relationship during these periods. They argue first that a price increase accompanied by a high volume is an indication of bullish sentiments. Second, a price decline accompanied by a volume is an indication of bearish sentiments. Their study draws the regulators' attention to the need for appropriate reforms in order to prevent market manipulation in these markets. Such manipulations harm public confidence in capital markets and prevent their growth and development. Ning and Wirjanto (2009) examined the extreme return–volume relation in six emerging East-Asian equity markets. Their empirical results indicate that there is significant and asymmetric return–volume dependence at extremes for these markets.

Four different theories appear to explain well the relationship between volatility and volume, Kao and Fung (2011) suggested. First, the mixture-of-distribution hypothesis (MDH) relates trading

volume to the number of new information arrivals. Second, the sequential-arrival-of-information hypothesis (SAIH) indicates that information arrives to traders at different times. The volatility is then potentially predictable with knowledge of trading volume. Third, the dispersed belief hypothesis suggests that informed and uninformed traders interpret and react to the same information in different ways. Finally, the asymmetrical information hypothesis suggests that informed traders, using private information, often cluster on one side of a market, resulting in lower price volatility.

### 3. Data and methodology

Obtained data are from Yahoo finance database and include data of 13 financial companies across the world stock indices. For better summary of obtained data there are names of companies and indices in Table 1. Daily stock prices of open as well as close values and its trading volume come from estimating period from 1<sup>st</sup> January 2010 to 1<sup>st</sup> October 2013. The estimation period is divided to the three sub-periods (2010-2013, 2011-2013, 2012-2013), to compare results of longer and shorter time periods.

Table 1: Selected financial companies

Country	Index	Company
USA	NYSE World Leaders	Bank of America Corp.
		Citygroup, Inc.
China	Hang Seng	Bank of China, Limited
		The Bank of East Asia, Limited
Austria	ATX	ERSTE Group Bank
		Raiffeisen Bank International
Belgium	BEL 20	KBC Group
France	CAC 40	AXA Group
		Societe Generale Group
Great Britain	FTSE 100	BNP Paribas SA
		HSBC Holdings PLC
Netherland	AEX	Barclays PLC
		ING Groep

Source: Author's illustration.

Daily stock returns are calculated according related literature through using natural logarithms as it is described below in equation (1):

$$R_{it} = (\log CV_{it} - \log OV_{it}) * 100, \quad (1)$$

where  $R_{it}$  is stock return of  $i$  company in time  $t$ ,  $CV_{it}$  means close value and  $OV_{it}$  means open value of its daily price. To test the stationarity of stocks' returns, augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) tests were applied.

Then it is constructed two kinds of dummy variables due to amount of selected stocks' trading volume  $V_{it}$ . First, if  $V_{it} < \bar{V}_{it}$ , it will be 1 and if  $V_{it} > \bar{V}_{it}$ , than it will be zero. Second opposite, if  $V_{it} > \bar{V}_{it}$ , it will be 1 and if  $V_{it} < \bar{V}_{it}$ , than it will be zero. Symbol  $\bar{V}_{it}$  means is trading volume's arithmetic mean of selected stocks.

Due to the existing residual heteroskedasticity in our data sample we use Autoregressive Conditional Heteroskedasticity model to examine, if there is relationship between stock prices volatility and shares' trading volume. Sabiruzzaman et al. (2010) suggest that the GARCH model is a useful innovation that allows a parsimonious specification: a first-order GARCH model contains only three parameters. Estimation of GARCH parameters together with the mean model can be done by iterative process using maximum likelihood assuming normal error distribution. A best-fitted

GARCH model should capture all dynamic aspects of the model's mean and variance. The estimated residuals should be serially uncorrelated and should not display any remaining conditional volatility.

Byun and Cho (2013) suggest that GARCH-type models are widely used to estimate volatility of financial asset returns and show good performance. Asai and Brugal (2013) conducted the heteroskedasticity-corrected Granger causality tests, in order to investigate interdependence of the Brazil and the US stock markets, based on daily return, range and trading volume. In order to compare with the new HVAR approach, they also consider methodology of the univariate and multivariate GARCH models with asymmetric effects, trading volumes and heavytails. Stavárek and Heryán (2012) used GARCH-M method to estimate day of the week effect in stock markets of Visegrad countries. According to them it is estimated GARCH-M (1,1) model with constructed dummy variables by equations (2) and (3):

$$R_{it} = \alpha_0 + R_{it} * D_n + \lambda h_t + \varepsilon , \quad (2)$$

$$h_t^2 = \alpha + R_{it} * D_n + \beta \varepsilon_{t-1}^2 + \gamma h_{t-1}^2 , \quad (3)$$

where  $R_{it}$  means volatility through daily returns of selected stocks,  $D_n$  is dummy variable due to lower or higher return,  $h_t$  is conditional variance,  $\varepsilon$  is residual term and  $\lambda$  means GED parameter to show how the volatility of lower or higher stocks' volume affects development of stock returns' volatility.

#### 4. Discussion on empirical results

In Appendix of the paper we can see output of selected financial companies' GARCH models. It was reached statistically significant positive coefficients of prices volatility divided on basis of shares' trading volume in all cases, except three coefficients from all 78 models (Barclays, BN Paribas, Raiffeisen). Problem of residuals' heteroskedasticity negatively influenced just nine models. However, we see that robustness of our models suffers from non-significant variance equation in most cases. Just 17 models of 9 companies are in good condition. Volatility coefficients of both lower and higher stocks' trading volume differ at maximum of 0,004. Even through, there are some weaknesses in the paper. We can reject hypothesis that development of trading volume has an impact on prices' volatility of selected shares.

If we compare results for our three sub-periods, the most valuable results (9) were reached within whole estimating period 2010 – 2013. No significant results were reached for Asian companies from Hang Seng stock index as well as for two companies from European ATX and FTSE 100 indices. Empirical analysis suffers from unavailability of trades' number because the well-known positive relation between volatility and volume is generated by the number of trades (Louhichi, 2011). Then we could find maybe some significant price–volume relation even in developed financial markets.

#### 5. Conclusion

The aim of the current paper was to examine whether the prices volatility of selected world financial companies' shares differs within the both samples, below its average of trading volume and the above. From significantly valuable results it is reject hypothesis of existing any strong price–volume relation within selected stocks. Positive impact of prices volatility of the both samples was very close to the other in all cases.

In future research it can be paid more attention also to Central and Eastern Europe (CEE) stock markets and comparison its selected companies within the same problematic of price volatility and trading volume as well. Kavkler and Festić (2011) argue that capital markets in CEE countries are not very well developed, in general, stock market capitalization is relatively low and the private sector has relied more on bank finance than on stock market financing. Due to them stock markets in the EU New Member States economies are also dominated by a small number of firms. Because banking systems typically developed before stock markets, countries should focus on developing the basic infrastructure for investors' protection, contract enforcement, sound accounting standards for both credit and equity markets. Therefore it could be interesting to investigate if there is different situation within current problematic than in developed economies, too.

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**Appendix:**

	Citygroup, Inc.						Bank of America Corp.					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>
$\alpha_0$	0,0649 <sup>a</sup>	-0,0005	0,0000 <sup>a</sup>	-0,0015	0,0004	-0,0003 <sup>c</sup>	-0,0063 <sup>c</sup>	0,0001	-0,0152 <sup>a</sup>	-0,0020 <sup>a</sup>	0,0013	-0,0002 <sup>a</sup>
$R_{it} * D_n$	0,9748 <sup>a</sup>	1,0003 <sup>a</sup>	1,0000 <sup>a</sup>	0,9992 <sup>a</sup>	0,9961 <sup>a</sup>	1,0002 <sup>a</sup>	0,9974 <sup>a</sup>	0,9978 <sup>a</sup>	0,9989 <sup>a</sup>	0,9984 <sup>a</sup>	1,0903 <sup>a</sup>	0,9999 <sup>a</sup>
Variance Equation												
$\alpha$	1,0161 <sup>a</sup>	0,5957 <sup>b</sup>	0,0101	0,5495 <sup>b</sup>	0,4032 <sup>a</sup>	0,6158 <sup>a</sup>	1,4144 <sup>a</sup>	0,6299	3,2079	0,3264 <sup>c</sup>	0,2631	0,0004
$\beta$	0,3813 <sup>a</sup>	0,1608 <sup>b</sup>	134,5088	0,2184 <sup>c</sup>	0,3713 <sup>a</sup>	0,1456	0,7743 <sup>b</sup>	0,0549	2,6740	0,9790 <sup>c</sup>	0,4046	40,8519
$\gamma$	0,3909 <sup>a</sup>	0,3952 <sup>c</sup>	0,7830 <sup>a</sup>	0,4383 <sup>b</sup>	0,4203 <sup>a</sup>	0,2083 <sup>b</sup>	0,5318 <sup>a</sup>	0,4226	0,4994 <sup>a</sup>	0,5938 <sup>a</sup>	0,9236 <sup>a</sup>	0,6214 <sup>a</sup>
$R_{it} * D_n$	-0,4063 <sup>a</sup>	0,0762 <sup>a</sup>	-0,0021	0,0686 <sup>a</sup>	0,1776 <sup>b</sup>	-0,1514 <sup>a</sup>	-0,8656 <sup>a</sup>	0,0636 <sup>c</sup>	-1,8584	0,0761	-1,2092	0,0002
$\lambda$	0,3917 <sup>a</sup>	0,4691 <sup>a</sup>	0,0862 <sup>a</sup>	0,5298 <sup>a</sup>	0,6147 <sup>a</sup>	0,4375 <sup>a</sup>	0,3917 <sup>a</sup>	0,6845 <sup>a</sup>	0,2543 <sup>a</sup>	0,3078 <sup>a</sup>	0,4225 <sup>a</sup>	0,1302 <sup>a</sup>
Durbin-Watson stat	2,1946	2,1183	2,1939	2,0820	2,1109	2,1428	2,2326	2,1961	2,2317	2,1572	2,1489	2,2072
ARCH LM test												
Prob. F												
Prob. Chi-Square(1)												
	Bank of China, Limited						The Bank of East Asia, Limited					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>
$\alpha_0$	0,0000 <sup>a</sup>	-0,0274	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	0,0044 <sup>a</sup>	0,0003	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	-0,0191 <sup>a</sup>	-0,0024 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>
$R_{it} * D_n$	1,0000 <sup>a</sup>	0,9878 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0045 <sup>a</sup>	1,0009 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0289 <sup>a</sup>	1,0034 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>
Variance Equation												
$\alpha$	284,1035	0,3803 <sup>a</sup>	5,3036	6,3196	2,2131	0,3060 <sup>b</sup>	3,5455	1,1872 <sup>c</sup>	0,2993 <sup>c</sup>	0,9268	3,3685	29,5287
$\beta$	414,2502	-0,0132	4,5193	37,0167	0,8722	0,1988	49,9981	4,2273 <sup>a</sup>	3,9326	7,3822	26,4853	29,7049
$\gamma$	0,7419 <sup>a</sup>	0,4418 <sup>b</sup>	1,0030 <sup>a</sup>	0,7963 <sup>a</sup>	0,8143 <sup>a</sup>	0,4772 <sup>a</sup>	1,0044 <sup>a</sup>	0,6514 <sup>a</sup>	0,5259 <sup>a</sup>	0,4813 <sup>a</sup>	1,0203 <sup>a</sup>	0,9996 <sup>a</sup>
$R_{it} * D_n$	-14,0214	0,1255 <sup>a</sup>	1,7075	3,6842	3,3822	0,1775 <sup>a</sup>	-5,4436	0,2387	-0,1629	-0,3978	-1,5956	-6,5007
$\lambda$	0,0551 <sup>a</sup>	0,8919 <sup>a</sup>	0,0743 <sup>a</sup>	0,0814 <sup>a</sup>	0,1533 <sup>a</sup>	0,3412 <sup>a</sup>	0,0498 <sup>a</sup>	0,1525 <sup>a</sup>	0,2147 <sup>a</sup>	0,2338 <sup>a</sup>	0,0482 <sup>a</sup>	0,0885 <sup>a</sup>
Durbin-Watson stat	1,9276	2,2005	1,9876	2,1836	1,9671	2,2917	1,9931	2,0510	1,8852	1,9619	1,9796	2,0686
ARCH LM test												
Prob. F			0,0010				0,0000				0,0000	
Prob. Chi-Square(1)			0,0010				0,0000				0,0000	

Note: Symbols <sup>a</sup>, <sup>b</sup> and <sup>c</sup> means statistical significantly results at 1 %, 5 % and 10 % level.

	AXA Group						Barclays PLC					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>								
$\alpha_0$	0,0000 <sup>a</sup>	0,0015	0,0022 <sup>a</sup>	0,0001 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	-0,0008 <sup>a</sup>	0,0000	0,0040 <sup>a</sup>	0,0000 <sup>a</sup>	-0,0005	
$R_{it} * D_n$	1,0000 <sup>a</sup>	1,0010 <sup>a</sup>	0,9981 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0018 <sup>a</sup>	1,0000 <sup>a</sup>	1,0012 <sup>a</sup>	1,0000 <sup>a</sup>	0,9806	
Variance Equation												
$\alpha$	0,9384 <sup>b</sup>	0,4576 <sup>a</sup>	5,9722	34,7282	3,4010	0,1450	112,0837	6,0441	2,7311	3,5297	3,4097	N/A
$\beta$	17,4583 <sup>b</sup>	0,1773 <sup>b</sup>	67,1895	27,3724	21,1393	27,3327	101,9938	3,7337	5,6937	2,7754	0,0894	
$\gamma$	0,6525 <sup>a</sup>	0,5122 <sup>a</sup>	0,4475 <sup>a</sup>	1,0153 <sup>a</sup>	0,9783 <sup>a</sup>	0,8816 <sup>a</sup>	0,6814 <sup>a</sup>	1,0197 <sup>a</sup>	0,7346 <sup>a</sup>	0,8500 <sup>a</sup>	0,5926	
$R_{it} * D_n$	1,2160 <sup>b</sup>	0,0662 <sup>a</sup>	-3,4389	18,0005	-2,3916	0,3275	-96,8265	0,7960	-2,9901	-0,4903	-0,0288	
$\lambda$	0,1557 <sup>a</sup>	0,5736 <sup>a</sup>	0,1148 <sup>a</sup>	0,0577 <sup>a</sup>	0,0503 <sup>a</sup>	0,1176 <sup>a</sup>	0,1095 <sup>a</sup>	0,0558 <sup>a</sup>	0,1871 <sup>a</sup>	0,1467 <sup>a</sup>	1,9801 <sup>a</sup>	
Durbin-Watson stat	1,7919	2,0606	1,8315	2,0910	1,9980	2,0714	2,0019	2,0040	2,0156	2,0363	1,8119	
ARCH LM test												
Prob. F				0,0000								
Prob. Chi-Square(1)				0,0000								
	BNP Paribas SA						ERSTE Group Bank					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>								
$\alpha_0$	0,0005 <sup>a</sup>	-0,0066	-0,0147 <sup>a</sup>	-0,0028	0,0436 <sup>a</sup>	0,0000 <sup>a</sup>	0,0022 <sup>a</sup>	-0,0032	-0,0057 <sup>a</sup>	-0,0018		-0,0004
$R_{it} * D_n$	1,0002 <sup>a</sup>	0,9979	0,9875 <sup>a</sup>	0,9988 <sup>a</sup>	0,9586 <sup>a</sup>	1,0000 <sup>a</sup>	1,0122 <sup>a</sup>	0,9990 <sup>a</sup>	0,9965 <sup>a</sup>	1,0003 <sup>a</sup>		1,0010 <sup>a</sup>
Variance Equation												
$\alpha$	1,3763 <sup>b</sup>	1,3828	1,7125 <sup>a</sup>	0,4606 <sup>a</sup>	0,9841 <sup>c</sup>	0,1297	0,8248	1,1847	6,3337	1,2461	N/A	0,9444 <sup>c</sup>
$\beta$	2,1306 <sup>b</sup>	0,1422	5,6727 <sup>b</sup>	0,5285 <sup>b</sup>	0,4834 <sup>c</sup>	7,0570	2,6545	-0,0039	11,0711	-0,0406 <sup>a</sup>		0,1617
$\gamma$	0,5929 <sup>a</sup>	0,5945 <sup>b</sup>	0,5966 <sup>a</sup>	0,4714 <sup>a</sup>	0,5936	0,9983 <sup>a</sup>	0,0623 <sup>a</sup>	0,4247	0,6740 <sup>a</sup>	0,4545		0,6655 <sup>a</sup>
$R_{it} * D_n$	-0,6134 <sup>a</sup>	0,0031	0,8840 <sup>b</sup>	0,0603 <sup>b</sup>	-0,7853 <sup>b</sup>	0,3161	0,4932 <sup>c</sup>	0,1143 <sup>a</sup>	4,0284	0,1051 <sup>c</sup>		0,2652 <sup>a</sup>
$\lambda$	0,2451 <sup>a</sup>	1,9704 <sup>a</sup>	0,2495 <sup>a</sup>	0,4617 <sup>a</sup>	0,4126 <sup>a</sup>	0,1062 <sup>a</sup>	0,0187 <sup>a</sup>	0,4837 <sup>a</sup>	0,1573 <sup>a</sup>	0,5098 <sup>a</sup>		0,3461 <sup>a</sup>
Durbin-Watson stat	2,0477	2,1071	2,1190	2,2107	2,0789	2,2081	1,7493	2,1975	1,7366	2,2316		2,2652
ARCH LM test												
Prob. F		0,0185								0,0250		
Prob. Chi-Square(1)		0,0185								0,0250		

Note: Symbols <sup>a</sup>, <sup>b</sup> and <sup>c</sup> means statistical significantly results at 1 %, 5 % and 10 % level.

	HSBC Holdings PLC						ING Groep					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>
$\alpha_0$	0,0017 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000 <sup>a</sup>	0,0000	0,0041 <sup>a</sup>	0,0000 <sup>a</sup>	0,0067 <sup>a</sup>	0,0002	-0,0056 <sup>a</sup>	-0,0155 <sup>a</sup>
$R_{it} * D_n$	0,9985 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>	1,0014 <sup>a</sup>	1,0000 <sup>a</sup>	0,9975 <sup>a</sup>	1,0002 <sup>a</sup>	1,0060 <sup>a</sup>	1,0064 <sup>a</sup>
Variance Equation												
$\alpha$	1,1425 <sup>a</sup>	1,3046	9,5554	0,9449	0,4451	0,2311 <sup>c</sup>	1,8810 <sup>b</sup>	32,3078	1,7728 <sup>b</sup>	1,6776 <sup>a</sup>	0,7195	0,0949 <sup>a</sup>
$\beta$	3,0984 <sup>b</sup>	12,6770 <sup>b</sup>	7,5339	0,4180	0,3005	0,3229	2,5527 <sup>c</sup>	26,4159	2,5637 <sup>b</sup>	-0,0468 <sup>a</sup>	52,6069	0,0778 <sup>c</sup>
$\gamma$	0,8106 <sup>a</sup>	0,7817 <sup>a</sup>	1,0087 <sup>a</sup>	1,0147 <sup>a</sup>	0,4477 <sup>c</sup>	0,4321 <sup>b</sup>	0,5349 <sup>a</sup>	1,0092 <sup>a</sup>	0,6387 <sup>a</sup>	0,1266	0,5595 <sup>a</sup>	0,9149 <sup>a</sup>
$R_{it} * D_n$	-2,0454 <sup>b</sup>	0,4021	-5,3613	0,3651	-0,2576 <sup>a</sup>	-0,1213 <sup>a</sup>	0,9097	0,6460	-1,1472 <sup>b</sup>	0,1506 <sup>a</sup>	-0,6533	-0,1473 <sup>a</sup>
$\lambda$	0,1783 <sup>a</sup>	0,1026 <sup>a</sup>	0,0501 <sup>a</sup>	0,0690 <sup>a</sup>	0,1693 <sup>a</sup>	0,2212 <sup>a</sup>	0,1801 <sup>a</sup>	0,0634 <sup>a</sup>	0,2481 <sup>a</sup>	0,3272 <sup>a</sup>	0,1329 <sup>a</sup>	0,3837 <sup>a</sup>
Durbin-Watson stat	1,8915	2,1453	1,8174	2,1034	1,8666	2,1719	2,0898	2,1639	2,1282	2,1708	1,9754	2,2386
ARCH LM test												
Prob. F												
Prob. Chi-Square(1)												
	KBC Group						Raiffeisen Bank International					
	1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>	<i>P</i> < <i>M</i>	<i>P</i> > <i>M</i>
$\alpha_0$	0,0000 <sup>a</sup>	0,0002	0,0000 <sup>a</sup>	-0,0003	0,0000 <sup>a</sup>	0,0154	0,0000 <sup>a</sup>	-0,0060	0,0000 <sup>a</sup>	-0,0008	0,0000 <sup>a</sup>	-0,0001 <sup>a</sup>
$R_{it} * D_n$	1,0000 <sup>a</sup>	0,9930 <sup>a</sup>	1,0000 <sup>a</sup>	0,9995 <sup>a</sup>	1,0000 <sup>a</sup>	0,9930 <sup>a</sup>	1,0000 <sup>a</sup>	1,0005	1,0000 <sup>a</sup>	0,9996 <sup>a</sup>	1,0000 <sup>a</sup>	1,0000 <sup>a</sup>
Variance Equation												
$\alpha$	0,2791 <sup>c</sup>	0,4987 <sup>a</sup>	0,5128	0,8384 <sup>a</sup>	23,3112	1,3480 <sup>a</sup>	0,9610	2,1943	6,4046	1,0980 <sup>b</sup>	15,5702	-7356,1720
$\beta$	41,4527 <sup>c</sup>	0,4574 <sup>a</sup>	23,9907	0,9228 <sup>a</sup>	72,4520	0,0566	14,9101 <sup>c</sup>	0,1456	104,9522	0,6190 <sup>c</sup>	23,0613	9970,2880
$\gamma$	0,4516 <sup>a</sup>	0,5123 <sup>a</sup>	0,9981 <sup>a</sup>	0,4058 <sup>a</sup>	0,8429 <sup>a</sup>	0,4499 <sup>b</sup>	0,9110 <sup>a</sup>	0,5952 <sup>a</sup>	0,9889 <sup>a</sup>	0,4825 <sup>a</sup>	1,0103 <sup>a</sup>	0,9908 <sup>a</sup>
$R_{it} * D_n$	-0,0415	-0,0891 <sup>a</sup>	-0,0281	0,1352 <sup>a</sup>	11,9304	-0,2320 <sup>a</sup>	0,4439	0,0045	1,5692	0,1389 <sup>a</sup>	-13,2927	-2091,1690
$\lambda$	0,0841 <sup>a</sup>	0,7915 <sup>a</sup>	0,0578 <sup>a</sup>	0,3896 <sup>a</sup>	0,0752 <sup>a</sup>	0,8852 <sup>a</sup>	0,0929 <sup>a</sup>	1,9673 <sup>a</sup>	0,0667 <sup>a</sup>	0,3083 <sup>a</sup>	0,0635 <sup>a</sup>	0,0574 <sup>a</sup>
Durbin-Watson stat	1,8659	1,7920	1,9068	1,7561	1,9523	2,1082	1,9439	2,1258	1,9816	2,0904	1,8936	2,2155
ARCH LM test												
Prob. F											0,0000	
Prob. Chi-Square(1)											0,0000	

Note: Symbols <sup>a</sup>, <sup>b</sup> and <sup>c</sup> means statistical significantly results at 1 %, 5 % and 10 % level.

		<b>Societe Generale Group</b>					
		1/2010 - 10/2013		1/2011 - 10/2013		1/2012 - 10/2013	
		<i>P&lt;M</i>	<i>P&gt;M</i>	<i>P&lt;M</i>	<i>P&gt;M</i>	<i>P&lt;M</i>	<i>P&gt;M</i>
$\alpha_0$		0,0000 <sup>a</sup>	0,0001	0,0000 <sup>a</sup>	-0,0249 <sup>c</sup>	0,0000 <sup>a</sup>	-0,0015
$R_{it} * D_n$		1,0000 <sup>a</sup>	0,9999 <sup>a</sup>	1,0000 <sup>a</sup>	1,0079 <sup>a</sup>	1,0000 <sup>a</sup>	0,9968 <sup>a</sup>
Variance Equation							
$\alpha$		-13,3424	0,2538 <sup>a</sup>	15,4106	0,8784 <sup>a</sup>	24,4289	0,8907 <sup>c</sup>
$\beta$		67,8774	0,1404 <sup>a</sup>	58,5121	0,1934 <sup>b</sup>	31,6948	0,0939
$\gamma$		1,0009 <sup>a</sup>	0,0689 <sup>a</sup>	1,0074 <sup>a</sup>	0,4309 <sup>a</sup>	0,9531 <sup>a</sup>	0,4617 <sup>b</sup>
$R_{it} * D_n$		-7,8494	0,0464 <sup>b</sup>	6,0391	-0,1348 <sup>a</sup>	-17,2821	-0,1439 <sup>a</sup>
$\lambda$		0,0675 <sup>a</sup>	0,0195 <sup>a</sup>	0,0454 <sup>a</sup>	0,6445 <sup>a</sup>	0,0808 <sup>a</sup>	0,5139 <sup>a</sup>
Durbin-Watson stat		1,8565	2,0273	1,8720	2,0082	1,8140	2,0926
ARCH LM test							
Prob. F				0,0000		0,0208	
Prob. Chi-Square(1)				0,0000		0,0209	

Note: Symbols <sup>a</sup>, <sup>b</sup> and <sup>c</sup> means statistical significantly results at 1 %, 5 % and 10 % level.