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The Impact of External Factors on Stock Return Volatility in the European Banking Sector

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Abstract

Purpose: The main aim of the paper is to examine the impact of external determinants on the banking stock return volatility to evaluate it in terms of the stock market capitalization.
Design/methodology/approach: The research was conducted on 182 banks from 26 countries. The sample selected for the study includes all European banks listed on the stock exchange. Quarterly data from the period between 2004 and 2016 was used; it was collected and compiled over a period of 2 years. The research method applied was the panel data model with fixed effects (with or without a robust estimator) and random effects.
Findings: Determinants that have a major and statistically significant impact on the analyzed dependent variables are: the unemployment rate, the real interest rate, the beta in Sharpe's Single-Index Model and the implied volatility of the S&P 500 index and the EURO STOXX50 index.
Research limitations/implications: Insights about the strength and direction of influence of these variables on stock return volatility are a valuable addition to the existing body of knowledge that investors resort to when making decisions relating to the capital market.
Limitations: The main limitation of this study lies in the fact that the results of the analysis apply solely to the banking sector.
Originality/value: Insights about the strength and direction of influence of these variables on stock return volatility are a valuable addition to the existing body of knowledge that investors resort to when making decisions relating to the capital market.

Keywords: stock return volatility, banking, implied volatility.

JEL: G11, G15, G21

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Wpływ determinant na zmienność stóp zwrotów z akcji w sektorze bankowym w Europie

Streszczenie

Cel: zbadanie wpływu zewnętrznych determinant na zmienność zwrotu z akcji banków w celu oceny jej pod kątem kapitalizacji giełdowej.

Projekt/metodyka/podejście: badanie przeprowadzone zostało na 182 bankach z 26 krajów. Wybrano do badania próbę, która obejmuje wszystkie banki europejskie notowane na giełdzie. Wykorzystano dane kwartalne z okresu 2004–2016, które był zbierane i kompilowane przez okres 2 lat. Zastosowaną metodą badawczą był panelowy model danych z efektami stałymi (z lub bez solidnego estymatora) oraz efektami losowymi.

Wyniki: determinantami, które mają istotny i statystycznie istotny wpływ na analizowane zmienne zależne, są: stopa bezrobocia, realna stopa procentowa, beta w modelu jednowskaźnikowym Sharpe'a oraz implikowana zmienność indeksu S&P 500 i EURO STOXX 50.

Ograniczenia/implikacje badawcze: głównym ograniczeniem badania jest analiza tylko sektora bankowego.

Oryginalność/wartość: spostrzeżenia na temat siły i kierunku wpływu tych zmiennych na zmienność stóp zwrotu z akcji są cennym uzupełnieniem dotychczasowej wiedzy, z której korzystają inwestorzy, podejmując decyzje dotyczące rynku kapitałowego.

Słowa kluczowe: zmienność stop zwrotu z akcji, bankowość, zmienność implikowana.

1. Introduction

The historical volatility of numerous data (e.g. stock prices, interest rates, currency prices) has been analyzed by numerous economists. This variable is used in the process of risk management by many institutions that are potentially impacted by changes in the price of assets with respect to which it is calculated. In mathematical terms, historical volatility is defined as the standard deviation of the examined variable over a specific time interval, calculated taking into account continuous capitalization (Hull, 2011).

Estimation of stock return volatility on the basis of historical data may serve as a measure of uncertainty about the future rate of return on a share (Hull, 1998). A review of literature evidences that numerous studies have been conducted with a view to identifying factors that affect stock returns. First of all, it has been confirmed that the latter are impacted by macroeconomic and market determinants (see Chen & Roll, 1986; Kaul, 1987; Mauro, 2000; Geetha et al., 2001), and – in some cases – by certain internal parameters of a listed company (see Banz, 1981; Basu, 1983; Bahandari, 1988; Campbell, 1991; Fama & French, 1992; Cooper et al., 2003; Beccalli et al., 2006; Castrén et al., 2006). Research has confirmed the statistically significant impact of certain factors; however, many models are sufficiently adjusted to the realities of the market (Chodnicka-Jaworska & Niewińska, 2016). Hence, it seems justified to examine the impact of external and internal factors on the historical stock return volatility.

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In order to better understand the historical stock return volatility, an analysis of the European banking sector will be carried out. The main aim of the paper is to examine the impact of macroeconomic factors on the banks' historical stock returns volatility. This impact will also be verified in terms of the capitalization of the banks selected for the study. A database was built for this purpose. It included all European banks listed on the stock exchange, with market capitalization exceeding EUR 100 million during the period under examination. The database for the study was prepared over a period of 2 years. The research method applied was the panel data model with fixed effects (with or without a robust estimator) and random effects.

Expanding the body of knowledge on stock return volatility is important above all in the context of portfolio investments, and with respect to highly liquid and homogeneous assets. The stocks of banks seem to lend themselves particularly well to this type of analysis due to their high liquidity (given substantial share capital of these institutions) and high levels of transparency (due, inter alia, to supervision requirements). The analysis will focus solely on European banks. Assets comprising shares of financial institutions are among the most important in investment portfolios. It is, therefore, particularly important to appropriately define the volatility parameter in order to correctly assess investments and estimate future stock returns of institutions operating in the financial sector.

The article consists of four parts. It begins with a review of extant literature on stock return volatility; a research gap in this field of study is identified. The database and the research methodology are outlined in the second part. In the third part, the research results are discussed, along with their interpretation in the light of formulated conjectures. The main conclusions from the analysis are presented in the final part.

2. Literature Review

A review of literature reveals a clear focus of research on volatility prediction, with less attention paid to mechanisms that affect it. Several authors have attempted to identify the determinants, but these analyses are clearly outnumbered by studies that place emphasis on prediction, based primarily on GARCH and ARCH models (Pagan & Schwert, 1990; Alberg et al., 2008).

In 1989, G. Schwert published his analyses of the volatility of share prices on the market and evidenced its correlation with the business cycle. He also posited that evaluating future volatility solely on the basis of historical rates of return, without taking into account macroeconomic variables, can be used to explain only a small part of movements of (aggregated) volatility on the stock exchange (Schwert, 1989). Campbell and Hentschel contributed to Schwert's findings and characterized the volatility of rates of return on financial assets. They insisted on a negative correlation between the volatility

of returns and returns themselves. Campbell and Hentschel studied monthly and daily data on the NYSE and ASE stock index in 1926–1988. Their research sparked interest in consumption as a phenomenon with reference to which stock market volatility can be explained (see Cochrane, 1999; Mehra & Prescott, 2003; Bansal & Yaron, 2004; Tauchen, 2005). In 1993, Heston presented latent factors that explain the dynamics of the volatility of returns. According to his model, stock return volatility may be forecast using two variables: the inflation rate and the industrial production. In his study published in 1996, Campbell proved that stock return volatility affects the value of dividends.

In 1997, K. Daly examined factors affecting stock return volatility through an analysis of companies listed on the Australian stock market. The research was based on data from the Australian All Industrials Stock Market Index from the period between July 1972 and January 1994. The volatility of the index was tested on a monthly basis using generalized least squares model (GLS). Daly used in his study explanatory variables, i.e. rates of return from the aforementioned stock market index, interest rates (interest on 3-month money bills in Australia), the volatility of the monthly wholesale price index, the volatility of the monthly percentage change in the industrial production index, the volatility of money supply, current account deficit (volatility of the current account deficit in Australia) and the volatility of foreign currency exchange rates. The absence of statistically significant correlation was found only between the volatility of the currency market and the volatility of the stock market in Australia.

Another study on factors affecting the volatility of stock returns was conducted by Antonio Mele (2007). He examined an extensive time series which comprised as many as 660 monthly observations (January 1948 – December 2002). The main objective of this study was to explore the influence of business cycle determinants on stock return volatility. The following were used as independent variables: stock price-to-dividend ratio, monthly fluctuations of the stock price-to-dividend ratio, constantly decreasing real rates of return, deflation of nominal CPI equivalents, interest rate without risk (monthly yield on Treasury bills), increase in stock return volatility. Five years later, Mele, Corradi and Distaso expanded this analysis. In their work, they explained stock return volatility on the basis of macroeconomic data and unobservable variables, using the "no-arbitrage model". Monthly VIX data, i.e. the implied volatility of the S & P500 index, was used as a dependent variable. A much shorter time series was examined (from January 1990 to December 2006, i.e. 204 observations). Changes of the CPI index and of the industrial production index (672 observations) were used as independent variables in the study. The research confirmed the important impact of industrial production increases. In the long run, constant levels of industrial production lead to a 10% reduction in volatility.

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In addition, the researchers proved in their analyses that approximately one third of volatility levels can be accounted for by macroeconomic indicators.

Engle, Ghysels and Sohn (2008) analyze the impact of inflation and increased industrial production on daily stock return volatility. Data used in the study spans a long period, similarly to the research carried out by Schwert (1989). Each independent variable was analyzed separately. Engle, Ghysels and Sohn also confirm that macroeconomic variables (inflation and increased industrial production) have a statistically significant impact on stock return volatility.

In 2012, Christiansen, Schmeling and Schrimpf published a study based on their research concerning the determinants of macroeconomic and financial volatility. The researchers focused on the analysis of stock return volatility. Their model encompassed 38 macroeconomic and financial factors. The researchers emphasized the importance of understanding volatility, as it may be affected by market participants' decision about investment and the allocation of assets. A deeper understanding of the impact of macroeconomic fluctuations on stock market volatility is interesting in itself, as it may reveal correlations between stock price changes and risk factors, as well as cyclical variables. Christiansen, Schmeling and Schrimpf also argued that this knowledge may be instrumental in predicting future income from stock market investments.

The authors of the above studies examined primarily the impact of determinants on stock return volatility. In many cases, their research was based on stock exchange indexes (e.g. Grossman & Shiller 1981; Daly 1997; Mele et al., 2012, Marozva & Magwedere, 2017). Another dilemma frequently encountered by researchers and market practitioners is the period of time that ought to be taken into account for the purpose of calculating historical volatility. The most popular method of estimating volatility based on historical data consists in selecting a particular time interval and the number of previous rates of return that are to be used in calculations; then, the standard deviation equation is applied. In order to address this research problem, data on historical volatility was used, taking into account returns from the previous 30, 60, 90, 180 and 360 days.

In 2017, an analysis of the impact of macroeconomic fundamentals (industrial production, real interest rate, inflation, money supply and exchange rate) on the volatility of the stock market in 2000–2014 was published. The study was conducted on a small sample which only included shares in Pakistani companies. It was proven that macroeconomic factors, i.e. inflation, export and industrial production index, have an impact on volatility (Haider, Hashmi, & Ahmed, 2017).

Another analysis that attempted to determine the impact of macroeconomic factors, that is, exchange rate, gross domestic product, gold price, inflation and oil price fluctuations, on stock return volatility is a paper relating to

the Bombay Stock Exchange. Unfortunately, the research was limited only to India's main stock index (Sarbapriya & Malayendu, 2016).

In 2017, Marozva and Magwedere published a study with the analyses of the relationship between the macroeconomic variables, leverage and the stock returns volatility on the Johannesburg Stock Exchange. This article shows that leverage affects the volatility of stock prices (Marozva & Magwedere, 2017).

In 2019, Horng examined and proved the influence of the stock return volatility in Japan, US and UK capital markets on the Singapore stock return volatility. The empirical results also show the different influences of the good news and the bad news (Horng, 2019).

Ho, Shi, and Zhang published their paper in 2020 where they showed studies about the influence of news on volatility returns of the Chinese bank stocks. They used daily database form 2007–2014. The majority of Chinese banks have not shown significant relations neither forward looking nor delayed between news and stock return volatility. The analysis based on the results of information news flow suggested that positive news stronger influences the banking stock return volatility in China as opposed to negative (Ho et al., 2020).

The literature review reveals a certain research gap regarding factors affecting the volatility of stock returns. In addition, variables that are described and included in the analysis have a limited impact on the examined phenomenon. Researchers and market practitioners strive to identify the main factors affecting stock return volatility and their side effects for the real economy. Capital market practitioners set great store by understanding the mechanisms affecting share prices. In both cases, understanding how the volatility of stock returns proves a major challenge for both theoreticians, investors and policy makers responsible for economic policy (Corradi et al., 2013).

3. Research Method

The main aim of this study is to identify the external factors (3 subgroups: macroeconomics, cost of money over time and those related to the stock market) of stock return volatility in the European banking sector.

In this paper, the following research questions were defined: (1) What is the impact of the bank size on the strength and direction of factors determining how the bank stock return volatility changes? (2) Which determinants have the biggest influence on the return volatility of banking stocks?

In order to respond to these questions, a database was constructed which includes all European banks listed on stock exchange, whose average market capitalization in the period between January 2004 and December 2015 exceeded EUR 100 million. It consists of a total of 182 banks from

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26 countries. Quarterly data was used for the analysis and sourced from Thomson Reuters Eikon and Bloomberg databases.

Five different measures of historical volatility were selected as dependent variables: 30-day, 60-day, 90-day, 180-day and 360-day volatility. Volatility is a measure of risk of asset price changes, in this case banks' share prices, based on the standard deviation of logarithmic returns. It is presented as annual standard deviation, taking into account historical data on returns from the previous 30, 60, 90, 180 and 360 days. These measures are expressed as percentages.

Independent variables related to external factors reflect the country's economic situation and the condition of the financial market. They were classified into three subgroups: macroeconomic; cost of money over time; and those related to the stock market. The first subgroup consists of macroeconomic factors. The most popular indicators characterizing the condition of the economy were selected, namely: quarterly change of GDP growth, quarterly change of Consumer Price Index, quarterly change of Producer Price Index, quarterly change of retail sales dynamics and unemployment rate. They were selected for the analysis with the aim of examining the impact of the economy on the stability of stock prices. The second subgroup, i.e. indicators describing the cost of money, includes the following: real interest rate, long-term interest rate, and lending interest rate. These factors were examined in order to understand how the cost of money affects the volatility of stock prices. The last subgroup relates to the macroeconomic assessment of the capital market in various countries. The impact of such variables as beta in Sharpe's single-index model, implied volatility of EURO STOXX 50 and S&P 500, quarterly change of stock market turnover and quarterly change of stock market capitalization was analyzed.

The database was divided into three research groups on the basis of the average stock market capitalization of the analyzed banks during the period under examination. Banks with low market capitalization (i.e. up to EUR 2 billion) were classified into the small-bank subgroup (106 banks). The second subgroup in this category were medium-size banks, with capitalization ranging between EUR 2 billion and EUR 5 billion (28 banks). The third subgroup comprised the so-called large banks with high levels of capitalization exceeding EUR 5 billion (48 banks).

Given the specific nature of the collected data, panel data models were used for the analysis of the impact of external factors on stock return volatility. This model allows a cross-sectional analysis of banks on different European stock exchanges. In order to estimate single-equation panel models that do not take into account endogenous delayed variables, panel models based on the least squares method are used, namely panel data models with random effect (RE) and panel data model with fixed effect (FE) (Dańska-Brosiak, 2011). The general equation used in these models is as follows:

$$y_{i,t} = \sum_{k=0}^{n} \gamma_k x_{i,t}^{T} + \mu_{i,t}, \quad i = 1,\ldots, N, \quad t = 1,\ldots, T \tag{1}$$

where:

$y^{T}_{i,t}$ – stock return volatilities of a European bank listed on the stock exchange (*i-t*) over time (*t*)

[$vol30d_{i,t}$ – *30-day*; $vol60d_{i,t}$ – *60-day*; $vol90d_{i,t}$ – *90-day*; $vol180d_{i,t}$ – *180-day*; $vol360d_{i,t}$ – *360-day*]

$x^{T}_{i,t}$ – vector of independent variables of a European bank listed on the stock exchange (*i-t*) over time (*t*)

[*gdpqq – Quarterly change of GDP growth; cpiqq – Quarterly change of Consumer Price Index; ppiqq – Quarterly change of Producer Price Index; retailsalesqq – Quarterly change of retail sales dynamics; unemployment – Unemployment rate; realinterestrate – Real Interest Rate; longterminterestrate – Long-Term Interest Rate; lendinginterestrate – Lending Interest Rate; Beta – Beta in Sharpe's single-ratio model; eurostoxx50volidx – Implied volatility of EURO STOXX 50; sp500volidx – Implied volatility of S&P 500; tunoverseqq – Quarterly change of stock market turnover; marketcapseqq – Quarterly change of stock market capitalisation*]

γ – vector of structural parameters

$\mu_{i,t}$ – random component

In addition, Spearman's rank correlation coefficients were calculated for the above variables in order to verify the assumption of regression analysis. If the model is correctly constructed, collinearity should not occur (highly correlated explanatory variables). Highly correlated variables were therefore eliminated from the model and are absent from the final version.

Two tests are used to test the significance of group effects in the above panel models: Wald and Lagrange multiplier. These tests examine whether it is justified to use the above-described research method (Dańska-Brosiak, 2011). Based on the results of statistics obtained from these tests, all null hypotheses were rejected, which confirmed the legitimacy of using panel models with group effects (FE and RE models).

While conducting the stock return volatility study in the European banking sector, the Hausman test was also performed for all subgroups (small, medium-size and large banks). Its results allowed for making a decision regarding the application of the appropriate type of models (FE or RE). Sometimes in the database under test there were heteroscedastic problems in the data panel and then the FE model with robust errors was estimated (ROBUST). In Table 1, in the TEST line, there is information about which model has been selected.

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4. Results

Table 1 presents the results of these analyses. The first category of external factors are macroeconomic variables. Among them, the unemployment rate is a statistically significant variable that has an impact on each examined dependent variable in all subgroups. In the small bank subgroup, a 1-percent increase in the unemployment rate in a given country translates into an increase of approx. 2 percentage points in the 360-, 180-, 90-, 60- and 30-day stock return volatility of these banks. In the case of banks with an average level of capitalization, a 1-percent increase in the unemployment rate triggers a 1.6-pp increase in all examined volatilities; in the large bank subgroup, the same situation prompts an increase of approx. 1.5 pp in dependent variables. Rising unemployment rates are a symptom of a downturn, which should trigger a drop in stock prices, as investors may prefer to invest into more liquid assets and withdraw from the stock market. This is why a rising unemployment rate translates into a rise of all analyzed stock return volatilities. The research demonstrates that the larger the bank, the less it is impacted by information about the worsening economic situation in the country.

The variable defining quarterly changes of the Gross Domestic Product has a significant impact on stock return volatility in the case of banks with medium capitalization levels. An increase in GDP by 1 pp translates into a 0.01-0.02-pp decrease in these volatilities. This testifies to the low – nearly minimal – impact of this variable on the dependent variables examined.

An important external factor affecting stock return volatility in the case of banks with high capitalization levels are changes in the price index of consumer goods and services. A 1-pp increase in the inflation rate triggers the following changes: a 1.7-pp increase of 360-day volatility, a 2.6-pp increase of 180-, 60- and 30-day volatility, and a 3-pp increase of 90-day volatility. Rising inflation triggers changes in the analyzed variables and is a statistically significant factor only in the case of large banks. Inflation is one of the most important macroeconomic indicators. It has a direct impact on the stock market, which has been confirmed by Fama and Schwert. A rise in the inflation rate brings about negative rates of returns and, consequently, increases stock return volatility.

Another important factor is the variable related to retail sale changes; in the subgroup of banks with medium levels of capitalization, a 1-pp increase of this variable results in the following changes: 360-day volatility increases by 1.1 pp; 180-day volatility by approx. 0.9 pp; and 90- and 60-day by approx. 0.7 pp. The impact of macroeconomic factors on the analyzed dependent variables confirms that the market reacts to positive information about the country's economic growth with a decreased volatility of bank stock returns. This correlation further confirms the so-called volatility asymmetry of stock return.

Indicators of the cost of money over time also significantly affect the level of volatility analyzed in the study. The real interest rate has an impact on the examined variables, as its increase of 1 pp may result in the following volatility increases: approx. 1.31 pp in the case of small banks, approx. 1.36 pp for medium-size banks, and 2.78 pp for large institutions. Therefore, this variable affects most high-capitalization banks. Long-term interest rates have a significant impact on the subgroup of small banks. A 1-pp rise in long-term interest rates translates into the following: 360-day volatility increases by approx. 0.4 pp, 180-day by 1.5 pp, 90-day by approx. 1.7 pp, 60-day by approx. 1.2 pp and 30-day by 1.4 pp. Increased interest rates are expected to cool down the market. Loans become more expensive, which causes a drop in banks' income. Banks' stock prices can, therefore, be expected to slump, which, in turn, increases volatility. This correlation also confirms the impact of real and long-term interest rates on volatility.

All variables used in the study – i.e. stock-market related factors – have a statistically significant impact on dependent variables. The first variable in this category is the beta, which describes the bank's risk in relation to its stock index. A rising beta denotes a greater risk relative to the market benchmark; therefore, an increase of this variable of as little as 1 pp translates, on average, into a 4.6-pp increase in volatility in the subgroup of small banks, and a 8-pp increase in the case of large banks. This variable was not included in the model used for analyzing the volatility of banks with medium capitalization levels.

The implied volatilities of S&P 500 and EURO STOXX 50 indexes have a statistically significant impact on all dependent variables examined. The analysis performed as part of the research indicates that a 1-pp increase in the implied volatility in the S&P 500 index brings about a 0.4 pp increase of all examined dependent variables in the subgroup of small banks. In the subgroup of banks with average levels of capitalization, volatilities increase by approx. 0.8 pp, and in the subgroup of large banks – by approx. 1.5 pp. The implied volatility of the EURO STOXX 50 index increases all examined volatilities in small banks by 0.5 pp on average, by approx. 1 pp in medium-size banks and by 1.4 pp in large banks. Based on these three variables from the group of stock-market related factors, we can conclude that they have a much greater impact on the volatility of rates of return in the case of large banks, compared to small or medium entities. Increased implied volatility of these indexes triggers a drop in prices on the equity market. Stock return volatilities of high-capitalization banks are more reactive to declines in the value of these variables.

The determinant of quarterly capitalization rate changes is statistically significant and its increase of 1 pp triggers an increase in 180- and 360-day volatility of approx. 0.15 pp for small banks, approx. 0.23 pp for medium-size banks and 0.38 pp for large banks. In the case of remaining volatilities, an increase of this determinant brings about a decrease of approx. 0.15 pp (low-capitalization banks), of approx. 0.17 pp. (medium-capitalization banks)

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and of approx. 0.25 pp. (high capitalization banks). The impact of this variable is consistent, i.e. its increase brings about an increase in long-term (360- and 180-day) volatility, and a decrease in short-term volatility (90-, 60-, 30-day). The impact is greater in the subgroup of high-capitalization banks compared to other subgroups.

The last external factor that has a statistically significant impact on the analyzed variables is public trading: in this case, a 1-pp increase translates into a 0.01-0.02 pp decrease in 360-, 180- and 90-day volatility in all analyzed subgroups. From the point of view of investors, information on increased public trading is good news, as it can be interpreted as a symptom of greater liquidity of financial instruments; hence, increased public trading triggers a decrease in stock return volatility. This factor denotes a greater liquidity in the analyzed capital markets; it is statistically significant for 360-, 180- and 90-day volatility, even if its impact is limited.

5. Discussion

Eventually, 85 small, 27 medium and 47 large banks were examined using the panel model. Banks with a shorter history (i.e. those whose shares had been traded on the stock exchange over a shorter period of time) were rejected. Tested models seem to reflect reality more accurately in the case of medium and high-stock capitalization banks.

The results of Heston's as well as Engle, Ghysels and Sohn's, and Haider, Hashmi and Ahmed's studies on the volatility of stock return determinants confirm a significant impact of the CPI inflation index (Heston, 1993; Engle, Ghysels, & Sohn, 2008; Haider, Hashmi, & Ahmed, 2017; Marozva & Magwedere, 2017). The examination of determinants of the historical volatility of stock prices of European banks confirms the impact of this factor. The analysis carried out in subgroups of banks classified according to their levels of stock market capitalization provide evidence for a significant impact of this variable only on the stock return volatility of large banks.

The real interest rate has a significant impact on the analyzed dependent variables in all subgroups of banks classified according to their size. These results confirm the findings of Kerry J. Daly, who, upon an analysis of factors affecting volatility in the Australian stock market, proved that stock volatility is affected by interest rate fluctuations (Daly, 1997). The impact of the real interest rate on the historical volatility is twice as strong in the case of large banks compared to low- and medium-capitalization banks. The impact of the interest rate on the stock returns volatility was also confirmed in Thampanya, Wu, Nasir and Liu's paper, which was published in 2020. Additionally, their study verifies that fundamental factors (e.g. GDP, money supply, interest rate, inflation rate and exchange rate) are important in stock market volatility in developed (Singapore) and more developed emerging markets (Malaysia and Thailand) than in Indonesia and the Philippines (emerging markets).

The results of the analysis do not lend themselves to comparison with those presented in the majority of existing papers, as literature related to variability determinants remains scarce and existing analyses tend to be limited to a single index within a selected market.

6. Conclusions

The analysis of external determinants affecting banks' historical volatility was carried out in three subgroups; entities were classified according to their stock market capitalization. Certain factors seem to have a greater impact on the dependent variables examined; other factors have proven to be statistically significant only with respect to certain subgroups. These correlations are clearly visible and related to the size of the bank.

The following determinants have an important and statistically significant impact on dependent variables examined: the unemployment rate, the real interest rate, the beta in Sharpe's single-indicator model and implied volatilities of S&P 500 and EURO STOXX50. The varying impact of variables and their correlation with the size of the analyzed banks are worthy of particular attention in the analysis.

Among macroeconomic factors, the impact of the unemployment rate in a given country ought to be emphasized. This variable is statistically significant in the case of all volatilities examined in each subgroup. The research seems to confirm that unemployment rates have a stronger impact on stock return volatility of small and medium-size banks compared to large entities.

The results of the research on external factors indicate that macroeconomic variables have a stronger impact on the stock returns volatility of small and medium-size banks compared to large institutions, while the cost of money and stock-market related factors affect stock return volatility of large banks (beta and implied volatilities of S&P 500 and EURO STOXX50).

The main limitation of this study lies in the fact that the results of the analysis apply solely to the banking sector. Bank shares are typically characterized by high liquidity (as these institutions are holders of large capital assets) and a high level of transparency (e.g. owing to supervision requirements). Therefore, we cannot assume that similar results would be attained in other sectors. Another limitations of this study is the analysis period, between January 2004 and December 2015 quarterly data was used, when in fact most economic factors are published monthly or quarterly. Return volatility can be calculated continuously.

In the future, research should be extended to other sectors and include comparisons with other regions (e.g. the US, the EU, the CEE). Additionally, future studies may expand upon this study to examine the influence of news and stock returns volatility in Europe and make a comparison to Ho, Shi, and Zhang's paper.

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Annex

	LOW-CAPITALIZATION BANKS	MEDIUM-CAPITALIZATION BANKS	HIGH-CAPITALIZATION BANKS																							
	vol 360d	vol 180d	vol 90d		vol 60d		vol 30d		vol 360d		vol 180d		vol 90d		vol 60d		vol 30d		vol 360d		vol 180d		vol 90d		vol 60d		vol 30d	
MACROECONOMIC																												
GDPQQ	-0.18	-	-0.09	-	0.10	-	0.24	-	0.17	-	-0.01	-	-0.01	-	-0.01	-	-0.02	-	-0.01	-	-0.28	-	-0.48	-	-0.46	-	-0.39	-	-0.57	-
											***		**		***		**													
CPIQQ	-0.73	-	0.04	-	0.17	-	-0.33	-	-0.22	-	0.09	-	1.24	-	1.52	-	1.18	-	1.61	-	-	1.68	-	2.75	-	3.04	-	2.60	-	2.53
																						**		***		***		***		***
PPIQQ	-	-0.43	-	-0.28	-	0.23	-	0.08	-	0.77	-1.59	-	-0.92	-	-0.25	-	0.27	-	-0.61	-	-0.05	-	0.12	-	0.68	-	0.52	-	0.19	-
											***		*																	
RETAILSALESQQ	-0.30	-0.52	-0.27	-0.43	-0.40	-0.50	-0.16	-0.27	-0.30	-0.37	1.15	-	0.89	-	0.69	-	0.77	-	0.02	-	0.42	0.14	0.84	0.55	0.62	0.20	0.46	0.23	0.06	-0.20
		*									**		**		*		*													
UNEMPLOYMENT	-	2.86	-	2.23	-	2.08	-	2.52	-	1.86	-	3.12	-	3.50	-	3.40	-	3.46	-	3.10	1.40	1.72	1.25	1.68	0.93	1.67	1.32	1.75	1.15	1.58
		***		***		***		***		***		***		***		***		***		***	***	***	***	***	***	***	***	***	***	***
COST OF MONEY OVER TIME																												
LONGTERMINTERESTRATE	-	0.37	-	1.53	-	1.71	-	1.20	-	1.42																		
		*		***		***		***		***																		
REALINTERESTRATE	1.13	1.30	1.48	1.42	1.40	1.31	1.21	1.21	1.30	1.32	0.66	1.34	1.41	1.70	1.20	1.39	1.54	1.74	1.25	1.40	3.19	2.94	3.51	3.17	3.10	2.61	2.78	2.41	2.22	1.89
	***	***	***	***	***	***	**	**	**	**		*	*	***	*	**	**	**	*	**	***	***	***	***	***	***	***	***	***	***
LENDINGINTERESTRATE	0.05	0.11	0.23	-0.16	0.29	-0.27	0.71	-0.04	0.84	-0.35	0.84	-0.17	0.58	-0.26	-0.11	-0.84	-0.20	-0.93	-0.59	-1.34										
							**		***							**		**		***										
RELATED TO STOCK MARKET																												
BETA	6.17	5.17	5.15	4.92	4.54	4.53	4.61	2.95	4.21	3.46											13.30	14.42	8.72	10.44	8.54	7.46	3.90	5.69	3.00	4.81
	***	***	***	***	***	***	***	***	***	***											***	***	***	***	***	***	***	***	***	***
SP500VOLIDX	0.37	-	0.42	-	0.38	-	0.41	-	0.40	-	-	0.71	-	0.83	-	0.81	-	0.86	-	0.94	-	1.24	-	1.50	-	1.51	-	1.63	-	1.49
	***		***		***		***		***			***		***		***		***		***		***		***		***		***		***
EUROSTOXX50VOLIDX	-	0.47	-	0.53	-	0.50	-	0.55	-	0.50	0.78	-	0.96	-	0.96	-	1.01	-	1.12	-	1.12	-	1.47	-	1.47	-	1.60	-	1.50	-
		***		***		***		***		***	***		***		***		***		***		***		***		***		***		***	
TUNOVERSEQQ	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	-0.01	0.00	0.00	-0.01	-0.02	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	0.00
	**	***	*	***	*	**					***	***		**		*					***	***	***	**	**	**	*			
MARKETCAPSEQQ	0.23	0.17	0.11	0.09	-0.10	-0.10	-0.18	-0.18	-0.17	-0.16	0.34	0.25	0.25	0.09	-0.04	-0.21	-0.13	-0.32	-0.08	-0.23	0.42	0.49	0.30	0.33	-0.17	-0.15	-0.28	-0.27	-0.33	-0.32
	***	***	**	**	*	*	***	***	**	**	***	***	**	*		***	*	***		***	***	***	***	***	**	**	***	***	***	***
_CONS	17.03	-8.93	14.20	-8.66	14.26	-7.34	10.48	-10.41	9.52	-5.05	11.40	-9.35	9.03	-14.09	15.27	-7.25	14.36	-8.31	15.26	-2.91	-23.45	-27.02	-24.82	-28.00	-22.20	-23.45	-21.31	-23.37	-15.98	-18.27
	***	***	***	***	***	**	***	***	***	*	*			***	**	*	**	*	**		***	***	***	***	***	***	***	***	***	***
NO OBS	ok. 2580										ok. 810										1814									
NO GRUP	85	85	85	85	85	85	85	85	85	85	23	24	24	24	24	24	24	24	24	24	47	47	47	47	47	47	47	47	47	47
WITHIN	0.06	0.18	0.05	0.15	0.05	0.12	0.05	0.13	0.04	0.08	0.15	0.55	0.13	0.49	0.15	0.44	0.16	0.42	0.16	0.37	0.31	0.34	0.29	0.30	0.30	0.31	0.31	0.33	0.30	0.30
BETWEEN	0.09	0.16	0.19	0.25	0.27	0.29	0.25	0.21	0.23	0.28	0.01	0.22	0.07	0.34	0.00	0.31	0.01	0.35	0.15	0.21	0.47	0.43	0.36	0.33	0.42	0.23	0.18	0.19	0.15	0.18
OVERALL	0.15	0.25	0.18	0.26	0.17	0.24	0.18	0.22	0.15	0.19	0.12	0.46	0.13	0.47	0.10	0.44	0.12	0.43	0.07	0.36	0.34	0.35	0.29	0.30	0.31	0.28	0.28	0.28	0.26	0.26
TEST	FE	FE	FE	RE	FE	RE	RE	FE	RE	RE	ROB	ROB	ROB	FE	ROB	FE	ROB	FE	ROB	FE	FE	FE	FE	FE	RE	FE	FE	FE	FE	FE

GDPQQ – *Quarterly change of GDP growth;* CPIQQ – *Quarterly change of Consumer Price Index;* PPIQQ – *Quarterly change of Producer Price Index;* RETAILSALESQQ – *Quarterly change of retail sales dynamics;* UNEMPLOYMENT – *Unemployment rate;* LONGTERMINTERESTRATE – *Long-Term Interest Rate; REALINTERESTRATE – Real Interest Rate; LENDINGINTERESTRATE – Lending Interest Rate; BETA – Beta in Sharpe's single-ratio model; EUROSTOXX50VOLIDX – Implied volatility of EURO STOXX 50; SP500VOLIDX – Implied volatility of S&P 500; TUNOVERSEQQ – Quarterly change of stock market turnover; MARKETCAPSEQQ – Quarterly change of stock market capitalisation*

***, **, * – significance levels of 99%, 95% and 90% respectively.

Tab. 1. Estimation results for the impact of external determinants on the volatility of returns on European banks' stocks. Source: Calculated by the author.