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The Relationship Between Stock Market Development and Macroeconomic Fundamentals in the Visegrad Group

Abstract

This study examines the effect of specific macroeconomic factors on the stock prices of selected financial sector companies listed on the Central European Exchanges (Budapest Stock Exchange, Prague Stock Exchange, Bratislava Stock Exchange, or Warsaw Stock Exchange). We investigate the nature of the causal relationships between macroeconomic factors and stock prices. The long-term causality, tested using the Johansen cointegration test, and the short-run dynamics between the variables, examined using the VECM model, are explored using quarterly data from the 2005–2014 period. The short-term causality shows the possibility of time series fluctuations; however a steady state should be achieved in the long-term. In general, we confirmed that macroeconomic fundamentals had a negative impact on stock prices. The interest rate, which also has a negative impact, is the most prominent predictor of the long-run developments. We also found very rare examples of macroeconomic variables that explain changes in stock prices within the VECM framework.

Keywords: *stock prices, macroeconomic fundamentals, Visegrad Group, causality, VECM*

JEL: E02, G15, G21

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1. Introduction

This paper investigates the dynamic linkages between macroeconomic factors and stock market developments. There has already been considerable research on this relationship. Two basic theoretical approaches and interpretations of this relationship are frequently used. The efficient market hypothesis (Fama 1970, pp. 383–403) assumes that stock prices already contain all the relevant information, while the theory of arbitration (Ross 1976, pp. 341–360 or Chen et al. 1986, pp. 383–403) provides a framework in which the effect of the macroeconomic and microeconomic variables on stock prices is confirmed. The existing literature provides strong evidence of the existence of linkages between stock prices and macroeconomic fundamentals, mainly for the general stock market indices. The aim of this paper is to examine the character of this relationship between macroeconomic fundamentals and stock prices of selected financial companies in the Visegrad Group (composed of four countries: the Czech Republic, Hungary, Poland and Slovakia). Specifically, we provide a test for long-term equilibrium relationships and also we analyze the short-term dynamics and transmission of shocks from the macroeconomic environment to the stock market.

We believe that the financial sector in the Visegrad group deserves additional study. The interaction between the financial sector and the national economy is a broad area of research. The relationship between them may have far-reaching significance for the overall direction of individual countries within the global economic system. This paper explains the development of individual financial markets in the Czech Republic, Hungary, Poland and Slovakia in the broader macroeconomic context. The very creation of the Visegrad Pact was prompted by a desire to establish mutual cooperation, sharing, and knowledge transfer to transform the participants´national economies into market economy systems. Since each of the countries began their transformations independently, focusing on their separate economic situations and the development of their financial sectors may be of interest.

Recent years have been marked by a recovery of the world economy from the impact of the financial crisis and the subsequent European debt crises. In this connection it is important to determine the impact these crises had on the financial companies in the Visegrad group and to determine the other impacts they had on the national economies. Currently it is widely recognized that a well-functioning financial system is crucial to economic growth. An efficient financial system increases financial savings and the range of investment allocations and reduces asymmetric information or transaction costs. Financial markets develop based on the overall macroeconomic development. According to Garcia and Liu (1999, pp. 29–59), a continual monetary expansion that stimulates economic growth requires more financial services; consequently, the financial system adapts itself to the financing needs of the real sector and aligns with its autonomous development.

Although the most prominent economic sector of in the Visegrad Group is manufacturing, the financial sector is one of the fastest developing sectors among the respective national economies; in addition the financial sector comprises the highest proportion of the service sector. According to the Global Financial Development Database, bank assets to GDP exceed 60% in all observed countries. The Czech Republic has the highest ratio with more than 69%; Poland has approximately 65%, Slovakia 64% and Hungary approximately 60% bank assets to GDP. In addition, the Czech Republic has the highest ratio of financial system deposits to GDP (67%). The remaining countries have a ratio of approximately 50%. Therefore, in our paper we specifically used blue chip stocks of important banks, insurance companies and financial funds. Blue chip stocks are stocks of large companies that have strongly positive reputations. These companies create a presumption that there are real linkages between the observed variables.

The macroeconomic variables used in most of the reviewed estimations in the literature are the GDP, the interest rate, the inflation rate, the money supply, and the unemployment rate. The remainder of this paper is organized as follows. The relevant literature is reviewed in Section 2. The data and the methodology used in this paper are introduced in Section 3. The results of the empirical estimation are reported in Section 4. The conclusions and summary of the main findings are contained in Section 5.

2. Review of the literature

The relationship between the development of the financial sector stock market and macroeconomic factors was an important issue debated by Choi et al. (1992, pp. 983–1004). This empirical work presents and estimates a multifactor model for the behavior of the stocks of the 48 largest US banking institutions, the interest rate, and the exchange rate risk factors. Standard results were obtained for the interest rate variable; the stock market´s development is directly dependent on interest rates and vice versa. Similarly, Garcia and Liu (1999, pp. 29–59) examined the relationship between the stock market development of financial companies and macroeconomic determinants. Their paper found that real income, the savings rate, the financial intermediary development and stock market liquidity are important determinants of the development of the stock market, particularly market capitalization of financial companies in selected industrial and developing countries. In accordance with Calderon and Liu (2003, pp. 321–334), who also investigated the direction of causality between financial development and the economic growth of 109 developing and industrial countries, discovered that financial development generally leads to economic growth, and in addition this effect is larger with longer sampling intervals.

Several other empirical studies have examined the relationship between selected macroeconomic variables and stock prices. Early studies were concerned with developed countries. Fama (1981, pp. 545–565) and Chen et al. (1986, pp. 383–403) analyzed the long-term relationships between the changes in stock prices and the macroeconomic fundamentals in the United States. Fama discovered a strong positive correlation between common stock returns and real GNP, money supply, inflation, interest rates and industrial production. Chen et al. reported that short-term interest rates, inflation, aggregate production and the default risk premium impacted stock market movements.

The objective of this work is to explore this relationship for countries in the Visegrad group. In particular we review the literature focused on Central and Eastern European markets. Hanousek and Filler (1997, pp. 623–638) investigated the existence of a significant relationship between the factors of money supply, trade, or government debt and the negative impact of equity prices for countries in the Visegrad Group. The researchers found that several economic factors (money supply, exports, and imports) create contemporaneous changes in equity prices in the Czech Republic. In the other three countries, lagged economic variables (export, import, and trade balance) affect equity prices.

In contrast, Horobet and Dumitr (2009, pp. 1–17) examined cointegration, the Granger causality tests, and innovation accounting techniques to capture the relationship between stock prices and gross domestic product, the consumer price index, money supply, the interest rate and real exchange rates. The results of the consumer price indexes, household consumption, and the real exchange rates for the Czech Republic, Poland and Hungary were consistent with economic reasoning. While the consumer price indexes were positively related to stock prices, the real exchange rates behaved contrarily. The remaining one did not provide a universal conclusion for those economies.

The causal linkage between stock prices, economic output, and money supply development in Central and Eastern European countries was investigated by Kulhánek (2012, pp. 135–145). He reviewed quarterly data from 1995 to 2012 in his analysis. Based on the cointegration tests, and the vector autoregressive and vector error correction models, it was discovered that in all cases there is a long-term cointegration relationship among the variables investigated. The research concluded that the broad monetary aggregate and stock market development have a certain predictive content for real economic activity in the long-term.

The following two papers investigated the relationship between stock prices and a selected macroeconomic variable. Stoica et al. (2014, pp. 47–62) provided empirical evidence of the impact of domestic and international short-term interest rate shocks on the movements of Central and Eastern European capital markets. The researchers´vector error correction model results determined that the international interest rate had a noticeable effect on the stock market indexes of the Czech Republic, Hungary, Poland and Romania.

Gajdka and Pietraszewski (2016, pp. 179–196) examined the cross-country correlation between the long-term stock rate of return and the real GDP growth of Central and Eastern European countries. The researchers found that the correlation coefficients were slightly positive in the period before financial crises and slightly negative after financial crises.

3. Data and methodology

The purpose of this research is to identify the nature of the relationship between macroeconomic variables and stock prices. The variables under investigation are the GDP, the interest rate, the inflation rate, the money supply and the unemployment rate. The macroeconomic variables used in the estimations are the gross domestic product-expenditure approach measured in national currency, the short-term interest rate in percent per annum, consumer prices, annual inflation, the money supply M3 measured in national currency, and the unemployment rate. The macroeconomic variables are from the OECD statistical database or from the national statistical offices. All data on the stock prices of the financial companies selected were obtained from the Central European Exchanges (the Budapest Stock Exchange, Prague Stock Exchange, Bratislava Stock Exchange, and Warsaw Stock Exchange). The sample period of our dataset is composed of quarterly data from 2005Q1 to 2015Q4.

The financial companies selected were listed on the Bratislava Stock Exchange, the Budapest Stock Exchange, the Prague Stock Exchange and the Warsaw Stock Exchange. The actual market capitalization of shares and units of the Bratislava Stock Exchange (BSSE) is EUR 4,194 million. The official share index of the BSSE is the Slovak Share Index (SAX) where Všeobecná Úverova Banka (VUB) has the largest weighting with 21.30%. The most marketable company in the regulated free market in 2015 was Tatra Banka (TTB). The banking sector´s profit growth in 2015 was EUR 626 million, representing a year-on-year increase of 11.7%. The growth was largely based on the growth in lending and on reductions in funding and credit risk costs. In 2015, all banks in Slovakia continued to meet the minimum capital requirements, and the common equity Tier1 ratio remained at 16%.

The Budapest Stock Exchange (BSE) has a market capitalization of EUR 441 mil. It is composed of the official index of blue-chip shares (BUX) and of the index of Mid and Small Cap shares (BUMIX). The financial companies that were chosen had the largest share weighting in both indices. OTP Bank (OTP) has a 35.5% weighting in the BUX index, Graph iSOFT Park SE has a weighting of 14.9% on the BUMIX and FHB has a 9.5% weighting on the BUMIX. The banking sec-

tor closed 2015 with a profit of EUR 97 milllion. The profitability of the Hungarian banking and insurance sector remains below that of the other sectors of the region. Although several institutions have relatively high non-performing portfolios and low profitability, the capital adequacy ratio is 20%.

The market capitalization of the Prague Stock Exchange (PX) is EUR 36,041 million. Two companies that are part of this study are among the top three companies with the largest proportion of market capitalization on the PX. The Erste Group Bank (EGB) has the highest proportion of approximately 22.2%; Komerční Banka (KB) has the third highest with 18%. The last financial company analyzed is RMS Mezzanine which is a successfull company providing non-bank funding in the Czech Republic. The domestic banking sector is profitable in the long term; its profit for 2015 totaled EUR 2.47 billion; and had a 6.1% growth rate. The results of the banking stress tests show that the financial sector remains highly resistant to adverse development scenarios. The total capital ratio increased by 0.4% to 18.4 %.

The Warsaw Stock Exchange (GPW) has the highest actual market capitalization of countries in the Visegrad Group with EUR 59.2 billion. Financial companies are the main components of the official domestic index WIG. These companies comprise approximately 40% of the WIG. The chosen companies are all primary constituents of the WIG; this includes Bank Pekao (PEK), which has the highest proportion of total equity turnover at 9.32%. The remaining companies chosen were Bank Zachodni WBK (BZW), Best (BES), BMP AG (BMP), Bank BPH (BPH), Capital (CAP), Getin (GET) and ING Bank (ING). The domestic banking sector is characterized by high average credit risk weightings (80% for commercial banks); this reflects the conservative methods of estimating the capital requirements for credit risk. The total capital requirement did not change substantially; the total capital ratio remains approximately 15%.

Chart 1 shows the stock price development of the selected financial companies in the Visegrad Group. Although the Warsaw Stock Exchange has the highest market capitalization in the Visegrad Group, its stock prices had the greatest fluctuation because of the pronounced strengthening in capital after 2005. All the stock exchanges experienced declines thereafter, from 2008 to 2011. This was caused by both the global financial and the European debt crises.

The development of the macroeconomic variables selected is presented in Chart 2. In Chart 1, for better illustration, we used GDP growth and M3 growth. The most volatile variables for all countries are GDP and M3. The only European country that did not experience an economic recession during the global financial crises and the subsequent debt crisis was Poland. The Polish national economy is not as open, and thus not as exposed to outside influences, as the Czech Republic, Hungary and Slovakia. In contrast, Hungary had the most negative economic contraction (–7.5%). The Czech Republic and Slovakia, experienced the lowest GDP values; approximately –5%. The actual GDP growth values are similar to the beginning of the observed period.

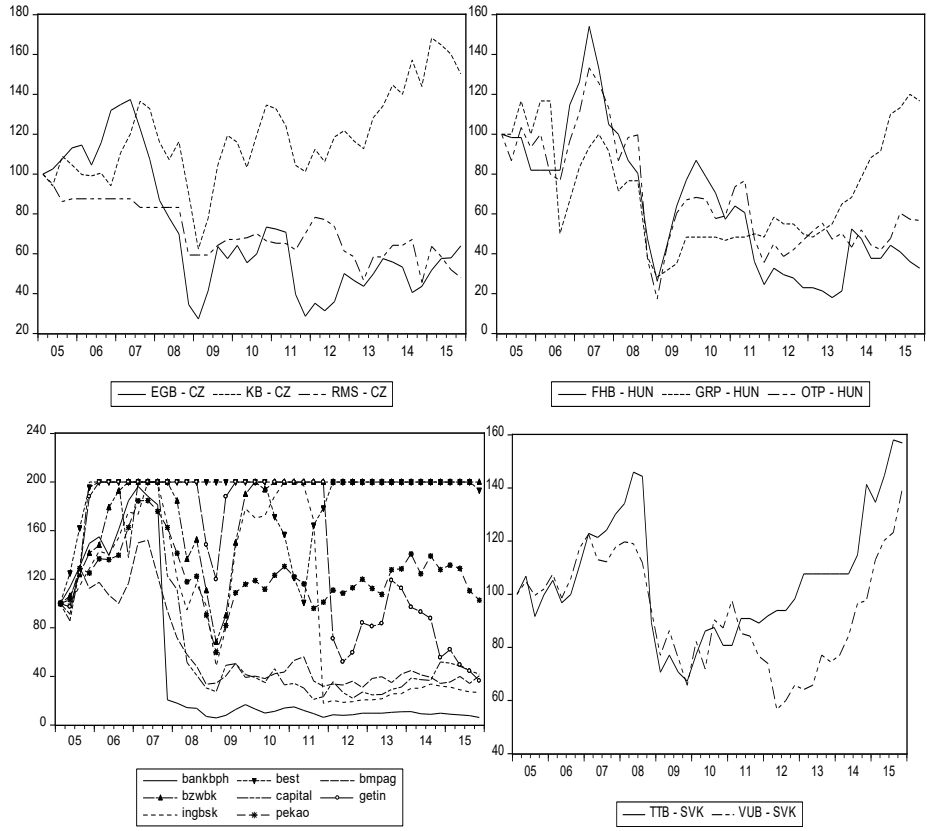

Chart 1. Development of stock prices of the selected financial companies (2005Q1=100 %)
Source: CEE Stock Exchanges (Author´s compilation).

The Visegrad Group experienced low inflation rates, as did other European Union countries. By reducing the primary interest rates, European countries attempted to achieve an inflation target of approximately 2%. Furthermore, Slovakia was the first economy in the Visegrad Group where the interest rate became negative. The growing threat of long-term deflation could lead to negative interest rates in adjoining countries.

The Slovak economy had a continuously higher unemployment rate than the European average. Poland also had a high unemployment rate during this period. Conversely, the Czech Republic had one of the lowest unemployment rates in the European Union. The final macroeconomic factor investigated was M3, which appears to co-move similarly in all Visegrad Group countries.

The purpose of our empirical analysis is to investigate whether macroeconomic fundamentals were cointegrated with the stock prices of selected financial companies. In this study, cointegration and causality tests were conducted using the methods demonstrated in Johansen and Juselius (1990, pp. 169–210) and Granger

(1967, pp. 424–438). The basic requirement for these analyses is to determine the stationarity of variables at the original level. Therefore, we used a standard Augmented Dickey-Fuller (ADF) test and a Philips-Perron (PP) test.

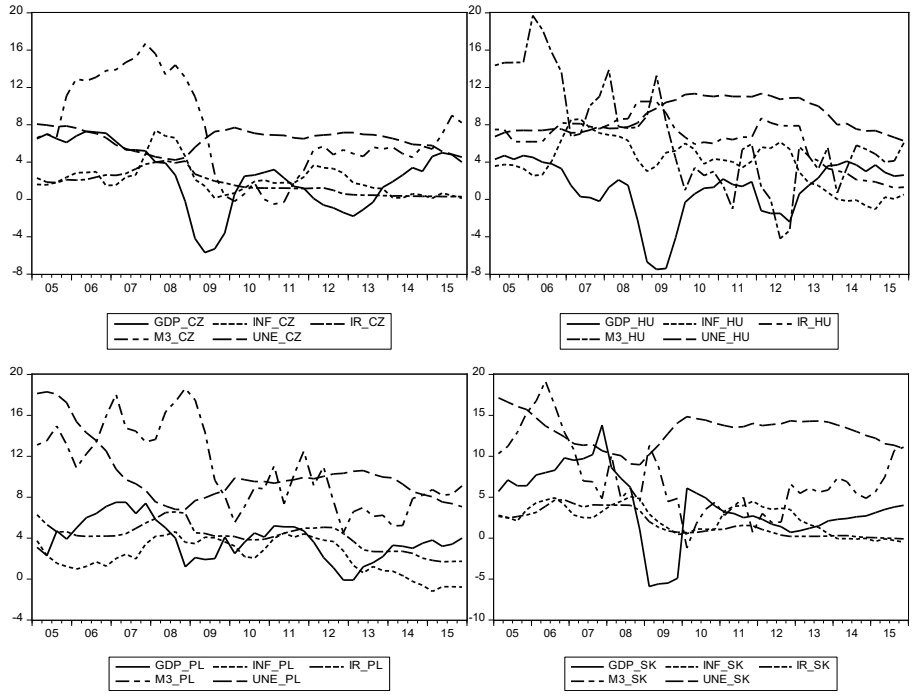

Chart 2. Behavior over time of the selected macroeconomic variables (in %)

Source: OECD database (Author´s compilation).

The Johansen cointegration method is applied to prove a long-run equilibrium between the observed variables and to prove the presence of cointegrating vectors in non-stationarity time series. The principal mathematic formulation of a vector autoregressive (VAR) is:

$$\Delta Z_t = C_0 + \sum_{i=1}^{K} \Gamma_i \Delta Z_{t-1} + \Pi Z_{t-1} + \eta_t \qquad (1)$$

where Zt is a vector of non-stationary variables, C0 is the constant term, and η is the white noise term. The variables Γ and Π in the matrix contain the value of the cointegrating vectors. For the number of cointegrating vectors, Johansen and Juselius (1990, pp. 169–210) specified two ratio test statistics. The first ratio statistic is the maximum Eigenvalue statistic for the null hypothesis of precisely r cointegrating vectors against the alternative hypothesis r + 1 vectors. The second is called the Trace test; it is specified for the hypothesis of at most r cointegrat-

ing vectors. If the variables are cointegrated, the vector error correction models (VECMs) can be estimated. The VECMs directly estimate the speed at which a dependent variable returns to equilibrium after a change in other variables. We apply the following VECM specification:

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \ldots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t \qquad (2)$$

4. Empirical results

In our analysis, we first calculated logarithm values for all time series. For the non – stationary data we used the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) stationarity tests, which have been widely used in the econometric literature. To properly construct the tests, we need to know the optimal lag length. This is calculated using the VAR Lag Order Selection Criteria and the VAR Lag Exclusion Wald Test. Based on the consensus of three different information criteria (Akaike, Schwarz, and Hannan-Quinn) we were able to determine a one quarter lag as the optimal delay. A cointegrating equation appears in the subsequent output of the Johansen test, presented in Table 1.

As is shown in Appendix 1, the cointegrating vectors have been proved in all cases. In three cases we found one cointegration vector, in four cases two cointegration vectors, in four models we found three cointegration vectors, and in five cases we found four cointegration vectors. Table 1 shows that the unemployment rate is positive in most of the cases and GDP is negative.

More specific results are shown in Table 2, where a single sign indicates a prevailing effect, and a double sign denotes a largely prevailing effect. GDP has a largely negative prevailing effect on stock prices in Poland and Slovakia. Conversely, double positive signs are confirmed in the relationship between the inflation rate and the stock prices in Poland and Slovakia and between the unemployment rate and the stock prices in the Czech Republic, Poland and Slovakia. The interest rate does not provide a general conclusion; for M3 a negative effect prevails on stock prices in the Czech Republic, Hungary and Slovakia.

The coefficient of GDP was statistically significant in six cases, but only for an OTP company, which is in accordance with economic theory when the relationship between GDP and the fundamental values of shares is positive. Increased production and consumption increase corporate profits, and thus the value of the underlaying shares. In contrast, the impact of inflation on the value of shares is ambiguous, depending on what entities in the economy prevail. A statistically significant positive effect was confirmed in five financial companies, while a negative impact was confirmed in one.

Table 1. Results of Johansen cointegration tests

EGB / GDP, INF, IR, M3, UNE (CZE)	
Equation	EGB = –1073.76–115.49 GDP+ 1.55 INF+ **17.07 IR**+ 173.1 M3+41.07 UNE (266.805) (2.691) (5.472) (112.701) (33.301)
KB / GDP, INF, IR, M3, UNE (CZE)	
Equation	KB = –29.694 + 1.468 GDP – 0.0134 INF **+ 0.204 IR** – 0.052 M3 + 0.981 UNE (2.101) (0.023) (0.045) (0.881) (0.264)
RMS / GDP, INF, IR, M3, UNE (CZE)	
Equation	RMS = –1110.3 + 276.74 GDP – 2.02 INF **– 15.94 IR – 182.55 M3** + 3.59 UNE (185.348) (1.999) (3.953) (77.736) (23.129)
FHB / GDP, INF, IR, M3, UNE (HUN)	
Equation	FHB = –403.74 + 41.927 GDP **+ 14.151 INF** – 1.012 IR **– 28.823 M3 + 9.813 UNE** (4.967) (7.083) (0.506) (3.312) (1.151)
GRP / GDP, INF, IR, M3, UNE (HUN)	
Equation	GRP = 87.087 **– 12.236 GDP – 17.722 INF + 1.384 IR + 11.172 M3 – 2.423 UNE** (1.509) (2.173) (0.157) (1.101) (0.356)
OTP / GDP, INF, IR, M3, UNE (HUN)	
Equation	OTP = –161.608 **+ 16.414 GDP** – 0.927 INF – 0.286 IR **– 11.168 M3 + 3.922 UNE** (2.863) (4.080) (0.294) (1.910) (0.663)
TTB / GDP, INF, IR, M3, UNE (SVK)	
Equation	TTB = –326.18 **– 56.957 GDP + 88.129 INF** + 45.319 IR – 32.213 M3 + 7.28 UNE (24.980) (16.847) (93.201) (17.817) (4.846)
VUB / GDP, INF, IR, M3, UNE (SVK)	
Equation	VUB = –0.409 **– 4.187 GDP + 4.533 INF + 20.068 IR – 3.375 M3 + 1.563 UNE** (1.511) (0.959) (5.375) (1.074) (0.280)
BPH / GDP, INF, IR, M3, UNE (POL)	
Equation	BPH = 253.39 **– 70.106 GDP + 68.077 INF** – 0.148 IR **+ 47.037 M3 + 1.308 UNE** (10.728) (20.445) (1.046) (7.151) (0.553)
BMP / GDP, INF, IR, M3, UNE (POL)	
Equation	BMP = 118.344 **– 32.257 GDP + 44.813 INF** – 0.56 IR **– 21.539 M3 + 0.892 UNE** (5.815) (9.682) (0.571) (3.896) (0.304)
BZW / GDP, INF, IR, M3, UNE (POL)	
Equation	BZW = –133.499 – 27.008 GDP + 57.739 INF – 1.63 IR + 15.254 M3 + 0.765 UNE (3.623) (6.678) (0.348) (2.415) (0.203)
CAP / GDP, INF, IR, M3, UNE (POL)	
Equation	CAP = 1199.1 – 166.33 GDP + 587.52 INF – 27.772 IR + 73.157 M3 – 5.583 UNE (192.120) (312.775) (16.926) (128.819) (9.910)
GET / GDP, INF, IR, M3, UNE (POL)	
Equation	GET = 206.225 – 38.739 GDP + 21.079 INF – 1.963 IR + 21.473 M3 + 1.101 UNE (19.474) (33.554) (1.817) (13.037) (1.009)
ING / GDP, INF, IR, M3, UNE (POL)	
Equation	ING = 569.20 – 139.622 GDP – 85.942 INF + 7.711 IR + 89.049 M3 + 1.732 UNE (28.815) (49.896) (2.710) (19.228) (1.447)
BES / GDP, INF, IR, M3, UNE (POL)	
Equation	BES = –1876.8 + 328.37 GDP – 562.94 INF + 21.65 IR – 175.76 M3 + 2.79 UNE (196.981) (340.074) (18.418) (132.139) (9.927)
PEK / GDP, INF, IR, M3, UNE (POL)	
Equation	PEK = 83.141 – 20.072 GDP + 38.768 INF – 1.005 IR + 12.395 M3 + 0.756 UNE (2.956) (5.272) (0.278) (1.974) (0.160)

Source: Authors' calculations.

Table 2. Prevailing effects between observed variables

Economy/Factors	GDP	INF	IR	M3	UNE
Czech Republic	+	-	+	-	+ +
Hungary	+	-	-	-	+
Poland	– -	+ +	– -	+ +	+ +
Slovakia	– -	+ +	+ +	– -	+ +

Source: Authors' calculations.

Table 3. Results of the Vector Error Correction Models

	TTB	VUB	BZW	CAP	PEK
CointEq1	0.0021 (0.0054) [0.3869]	–0.1479 (0.0716) [–2.0659]	–0.1031 (0.0833) [–1.2367]	–0.0121 (0.0058) [–2.0739]	–0.21822 (0.0864) [–2.5245]
Stock Price (–1)	0.1147 (0.1605) [0.7146]	0.0269 (0.1705) [0.1582]	0.5207 (0.1898) [2.7427]	0.0293 (0.1500) [0.1958]	0.4864 (0.1839) [2.6436]
GDP (–1)	3.0871 (1.7907) [1.7239]	3.1220 (1.9363) [1.6123]	4.4318 (2.2223) [1.9942]	7.7960 (7.3519) [1.0604]	3.4763 (1.7662) [1.9681]
INF (–1)	2.1052 (0.8858) [2.3765]	3.2621 (0.8831) [3.6938]	0.6424 (4.5617) [0.1408]	–2.7557 (12.176) [–0.2263]	2.0317 (3.7117) [0.5473]
IR (–1)	2.1944 (5.8315) [0.3763]	3.7063 (5.7274) [0.6471]	–0.6288 (0.2823) [–2.2275]	–1.7678 (0.7739) [–2.2840]	–0.5875 (0.2322) [–2.5299]
M3 (–1)	–0.6768 (1.0302) [–0.6570]	1.7391 (1.0424) [1.6683]	0.0694 (1.8055) [0.0384]	6.4113 (4.2443) [1.5105]	1.6809 (1.4993) [1.1211]
UNE (–1)	0.1003 (0.5297) [0.1893]	–1.1145 (0.5998) [–1.8581]	0.7504 (0.4592) [1.6342]	1.4652 (1.1999) [1.2211]	0.9689 (0.3929) [2.4659]
R^2	0.3621	0.3781	0.3883	0.2871	0.3719
Adj. R^2	0.2527	0.2714	0.2835	0.1648	0.2643
F-stat.	3.3117**	3.5454 *	3.7036 *	2.3488**	3.4545**

Note: Standard errors in round brackets and t-statistics in square brackets. All variables used in the VECM are first differenced.

Source: Authors' calculations.

However, the interest rate has an opposite effect on stock prices. A decline in interst rates increases the value of shares and vice versa. Interest rate movements have a dual effect on stock prices; one is on the expectations of growth or decline in revenues due to changes in the discount factor; and the other is the effect on the amount of liquidity in the financial system. Our empirical estimations found four companies with a positive relationship and only one company with a negative statistically sig-

nificant relationship. Similarly, the relationship between the unemployment rate and stock prices is also generally negative. A higher unemployment rate leads to lower per capita income and thus lower consumption and investment, which reduces corporate profits and stock prices. Conversely, the money supply positively affects stock prices. Our results indicate seven statistically significant relationships.

Where cointegration vectors appeared, VECM can be estimated. Given that the VEC mechanism is inserted into the Johansen procedure, the deviation from long-run equilibrium is corrected through a series of partial short-run adjustments. Table 3 shows the estimates of the VECM with an earlier specified one quarter lag, which thus met the criterion of overall significance (F-stat.) at the 1% or 5% level of significance. The overall significance of each model is computed using the F-stat. coefficient; the coefficient R^2 explains a proportion of the total variability managed through a created VECM.

From the VECM results, it is evident that five models met the criterion of overall significance (F-stat.) at the 1% or 5% level of significance. The VECM coefficient of cointegration equation (CointEq1) are statistically significant in three models (VUB, CAP, PEK). The sign of the coefficient is negative in these. Negative models indicate that an increase in macroeconomic fundamentals has a negative impact on stock prices. The size of the adjustment coefficient is generally low and does not exceed 15% for VUB and CAP. The highest adjustment coefficient of the statistically significant models was obtained for PEK (21.8 %). This finding clearly shows that .nearly 22% of the deviation from the long-run equilibrium is corrected in the following quarter. The results for all the models are in Appendix 2.

5. Conclusions

In this study, we analyzed the relationship and the interaction between selected macroeconomic variables and the stock prices of financial companies in the Visegrad Group. The relations between the observed factors have far-reaching implications for the overall direction of the individual countries within the global economic system. Specific companies could have a negligible macroeconomic environment effect, but have a relatively high importance in terms of sector analyses and the national stock market.

Among the most important macroeconomic variables that have an impact on the stock price we include the GDP, the inflation rate, the interest rate, the money supply and the unemployment rate. All these variables affect stock prices. The relationship between GDP with M3 and the fundamental values of shares is mainly positive, as increased production and consumption increase corporate profits, and thus the value of the underlying shares. In contrast, the impact of inflation on the value of shares

is not significant, and the impact of the interest rate and the unemployment rate is negative. We investigated the nature of the causal relationships between the macroeconomic factors and the stock prices using the Johansen cointegrating test and VECM.

Initially, we used the Johansen cointegrating test to investigate the existence of long-term equilibrium relationships. The evidence obtained from the analysis suggests that we can determine the long-term equilibrium relationship in all cases. Although the results did not provide a universal conclusion for all countries in the Visegrad Group, in general the unemployment rate has a positive sign, and the GDP has a negative sign. The coefficient of the GDP is statistically significant in six cases, of the inflation rate in six cases, of the interest rates in five cases, of the money supply measured by M3 in seven cases, and of the unemployment rate in six cases. Most of the effects are not in accordance with economic theory. This finding could be the result of structural changes that are affected by financial and debt crises. This theory is also supported by the VECM model result.

In the cases where the variables have been cointegrated, we were able to estimate the VECM. We discovered that the VECM coefficient of cointegration equation was statistically significant in only three models. The speed with which the deviations from the long-term equilibrium were corrected was relatively slow, with the exception of Bank Pekao of Poland, where nearly 22% of the deviation from the long-run equilibrium was corrected in the following quarter.

The coefficient R^2 explains the proportion of the total variability managed through a created VECM. This coefficient is very low primarily due to the economic conditions in the sample period. The nonsignificant and low R^2 result from the possible presence of autocorrelation, heteroscedasticity or nonnormality distribution. Therefore, it is possible to analyze the regression model and precisely specify the relationship between the observed variables.

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Appendix

Appendix 1. Results of Johansen cointegration tests

	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4	r ≤ 5
EGB / GDP, INF, IR, M3, UNE (CZE)						
Trace Statistics Max-Eigen Statistics	128.6218 * 41.8096 **	86.8123 * 27.4471	59.3651 ** 25.3814	33.9836 16.0921	17.8916 10.6377	7.2538 7.2538
Equation	EGB = –1073.7 – 115.48 GDP + 1.549 INF + 17.067 IR + 173.103 M3 + 41.069 UNE (266.805) (2.6912) (5.4724) (112.7012) (33.3013)					
KB / GDP, INF, IR, M3, UNE (CZE)						
Trace Statistics Max-Eigen Statistics	148.0316 * 47.9188 *	100.112 * 37.444 **	62.6686 * 24.1794	38.489 ** 14.3247	24.1645 ** 14.1702	9.9942 ** 9.9942 **
Equation	KB = –29.6947 + 1.4684 GDP – 0.0139 INF + 0.2046 IR – 0.0527 M3 + 0.9811 UNE (2.1011) (0.0231) (0.0449) (0.8808) (0.2638)					
RMS / GDP, INF, IR, M3, UNE (CZE)						
Trace Statistics Max-Eigen Statistics	136.7481 * 45.0344 **	91.7136 * 32.7068	59.0068 ** 24.0171	34.9897 15.6062	19.3835 13.2790	6.1045 6.1045
Equation	RMS = –1110.3 + 276.746 GDP – 2.022 INF – 15.939 IR – 182.55 M3 + 3.5912 UNE (185.348) (1.9999) (3.9535) (77.7364) (23.1298)					
FHB / GDP, INF, IR, M3, UNE (HUN)						
Trace Statistics Max-Eigen Statistics	137.3504 * 54.8506 *	82.499 ** 35.255 **	47.2446 20.6246	26.6200 14.1115	12.5085 7.3083	5.2002 5.2002
Equation	FHB = –403.7 + 41.927 GDP + 14.1507 INF – 1.0122 IR – 28.8229 M3 + 9.813 UNE (4.9674) (7.0838) (0.5064) (3.3123) (1.1516)					
GRP / GDP, INF, IR, M3, UNE (HUN)						
Trace Statistics Max-Eigen Statistics	158.9583 * 61.5624 *	97.3959 * 44.0305 *	53.3654 26.9517	26.4138 14.4265	11.9873 7.4039	4.5834 4.5834
Equation	GRP = 87.08 – 12.236 GDP – 17.7215 INF + 1.3846 IR + 11.1722 M3 – 2.4227 UNE (1.5094) (2.1733) (0.1572) (1.1013) (0.3561)					
OTP / GDP, INF, IR, M3, UNE (HUN)						
Trace Statistics Max-Eigen Statistics	141.0866 * 49.3275 *	91.7591 * 34.4802	57.2789 ** 28.5314	31.3953 20.1352	11.2602 6.5348	4.7253 4.7253
Equation	OTP = –161.6 + 16.4137 GDP – 0.9277 INF – 0.2861 IR – 11.1683 M3 + 3.9221 UNE (2.8632) (4.0802) (0.2946) (1.910) (0.6635)					

TTB / GDP, INF, IR, M3, UNE (SVK)						
Trace Statistics Max-Eigen Statistics	158.7195 * 56.7957 *	101.923 * 40.3827 *	61.5410 * 29.2656 **	32.2754 16.1556	16.1198 12.0908	4.0291 4.0291
Equation	TTB = –326.2 – 56.957 GDP + 88.1291 INF + 45.3195 IR – 32.2129 M3 + 7.282UNE (24.9805) (16.8472) (93.2004) (17.8172) (4.8466)					
VUB / GDP, INF, IR, M3, UNE (SVK)						
Trace Statistics Max-Eigen Statistics	184.1784 * 74.4531 *	109.725 * 44.6539 *	65.0713 * 28.9734 **	36.097 ** 21.4077	14.6901 11.8134	2.8767 2.8767
Equation	VUB = –0.409 – 4.1870 GDP + 4.5328 INF + 20.0685 IR – 3.3748 M3 + 1.5628 UNE (1.5112) (0.9594) (5.3754) (1.0744) (0.2803)					
BPH / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	192.6723 * 65.8723 *	126.8001* 43.8943 *	82.9056 * 35.9858 *	46.9198 * 23.3149**	23.6049 ** 18.7023 **	4.9026 4.9026
Equation	BPH = 253.39 – 70.1066 GDP + 68.077 INF – 0.1485 IR + 47.0369 M3 + 1.308 UNE (10.7281) (20.4453) (1.0465) (7.1509) (0.5533)					
BMP / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	179.5152 * 59.2549 *	120.260 * 40.7592 *	79.5011 * 34.2281 *	45.2729 * 21.5452	23.7277 ** 17.9093 **	5.8184 5.8184
Equation	BMP = 118.34 – 32.2569 GDP + 44.813 INF – 0.5625 IR – 21.5388 M3 + 0.8917 UNE (5.8152) (9.6824) (0.5712) (3.8966) (0.3046)					
BZW / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	192.8253 * 68.5870 *	124.238 * 41.2139 *	83.0243 * 33.7290 **	49.2952 * 30.1865 *	19.1087 13.7246	5.3841 5.3841
Equation	BZW = –133.499 – 27.008 GDP + 57.7389 INF – 1.6316 IR + 15.25 M3 + 0.765UNE (3.6233) (6.6787) (0.3484) (2.4152) (0.2034)					
CAP / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	167.9791 * 51.1306 *	116.848 * 41.4507 *	75.3976 * 31.2788 **	44.1188 * 25.810 **	18.3086 13.3528	4.9558 4.9558
Equation	CAP = 1199.1 – 166.33 GDP + 587.522 INF – 27.772 IR + 73.157 M3 – 5.5833 UNE (192.120) (312.775) (16.9262) (128.819) (9.9107)					
GET / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	173.9505 * 56.7646 *	117.185 * 41.1421 *	76.0437 * 32.5145 **	43.5292 * 25.824 **	17.7046 11.8524	5.8521 5.8521
Equation	GET = 206.22 – 38.7396 GDP + 21.0796 INF – 1.963 IR + 21.4734 M3 + 1.101 UNE (19.4741) (33.5541) (1.8173) (13.0369) (1.0096)					

ING / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	168.1378 * 60.5375 *	107.600 * 40.6895 *	66.9107 * 32.5939 **	34.3168 17.8102	16.5065 10.0813	6.4252 6.4252
Equation	ING = 569.203 – 139.622 GDP – 85.942 INF + 7.711 IR + 89.0490 M3 + 1.732 UNE (28.8153) (49.8963) (2.7101) (19.2284) (1.4477)					
BES / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	170.8122 * 52.5253 *	118.286 * 42.4856 *	75.8013 * 31.1722 **	44.6291 * 22.791 **	21.8378 ** 12.5839	9.2539 ** 9.2539 **
Equation	BES = –1876.8 + 328.37 GDP – 562.945 INF + 21.65 IR – 175.763 M3 + 2.796 UNE (196.981) (340.074) (18.4188) (132.139) (9.9277)					
PEK / GDP, INF, IR, M3, UNE (POL)						
Trace Statistics Max-Eigen Statistics	186.7932 * 65.4738 *	121.319 * 40.108 **	81.2112 * 36.2216	44.9895 * 26.352 **	18.6371 13.5469	5.0902 5.0902
Equation	PEK = 83.14 – 20.072 GDP + 38.7687 INF – 1.0049 IR + 12.3956 M3 + 0.7563 UNE (2.9565) (5.2722) (0.2778) (1.9743) (0.1603)					

*Note: *, ** and *** denote significance at the 1%, 5% and 10% levels. The critical value of trace statistics for the null hypothesis of no cointegration (r=0) is 108.55 (5% level), for the null hypothesis of at most one cointegrating relationship (r≤1) is 69.38 (5% level); for the null hypothesis of at most two cointegrating relationship (r≤2) is 45.94 (5% level); for the null hypothesis of at most three cointegrating relationship (r≤3) is 26.64 (5% level); for the null hypothesis of at most four cointegrating relationship (r≤4) is 11.75 (5% level); and for the null hypothesis of at most five cointegrating relationship (r≤5) is 5.13 (5% level). The critical values of Max – Eigen statistic for the same hypotheses are 39.17, 23.44, 19.29, 14.89, 6.62 and 5.13 (all at 5% level). The numbers in parentheses are beneath the standard error.*

Source: Authors´calculations.

Appendix 2. Results of the Vector Error Correction Models

	EGB	**KB**	**RMS**	**FHB**	**GRP**	**OTP**	**TTB**	**VUB**
CointEq1	–0.0001 (0.0025) [–0.061]	–0.2824 (0.1486) [–1.899]	–0.0208 (0.0167) [–1.2499]	–0.1198 (0.0471) [–2.541]	–0.0373 (0.1079) [–0.346]	–0.2469 (0.0926) [–2.665]	0.0021 (0.0054) [0.3869]	–0.1479 (0.0716) [–2.066]
Stock Price (–1)	0.1808 (0.1746) [1.035]	0.1939 (0.1730) [1.121]	–0.0107 (0.1670) [–0.0644]	0.0518 (0.1701) [0.304]	0.0085 (0.1734) [0.049]	0.1361 (0.1799) [0.756]	0.1147 (0.1605) [0.7146]	0.0269 (0.1705) [0.158]
GDP (–1)	2.5146 (4.1705) [0.603]	1.9425 (1.9200) [1.011]	31.5984 (22.8533) [1.3826]	3.3963 (3.2681) [1.039]	5.2076 (2.7642) [1.883]	9.0626 (3.3587) [2.698]	3.0871 (1.7907) [1.7239]	3.1220 (1.9363) [1.612]

	EGB	KB	RMS	FHB	GRP	OTP	TTB	VUB
INF (–1)	0.0485 (0.0532) [0.912]	–0.0062 (0.0295) [–0.209]	–0.0224 (0.2736) [–0.0818]	8.3760 (4.7926) [1.747]	3.9664 (3.9744) [0.997]	5.2728 (5.3169) [0.992]	2.1052 (0.8858) [2.3765]	3.2621 (0.8831) [3.693]
IR (–1)	–0.1316 (0.2757) [–0.477]	–0.1523 (0.1517) [–1.004]	0.0851 (1.4710) [0.0578]	–0.3593 (0.3109) [–1.155]	–0.0783 (0.2712) [–0.288]	–0.2416 (0.3401) [–0.710]	2.1944 (5.8315) [0.3763]	3.7063 (5.7274) [0.647]
M3 (–1)	–0.9953 (2.1202) [–0.469]	–2.1221 (1.1069) [–1.917]	2.7077 (10.2143) [0.2651]	–1.6430 (2.0215) [–0.812]	–2.4772 (1.5361) [–1.612]	–3.0268 (2.0223) [–1.496]	–0.6768 (1.0302) [–0.6570]	1.7391 (1.0424) [1.668]
UNE (–1)	1.2584 (0.7895) [1.593]	0.0071 (0.4763) [0.014]	2.8001 (4.1561) [0.6737]	–0.9813 (1.1645) [–0.842]	0.6243 (0.8546) [0.730]	0.3554 (1.1794) [0.301]	0.1003 (0.5297) [0.189]	–1.1145 (0.5998) [–1.858]
R^2	0.1737	0.2316	0.0418	0.2347	0.2415	0.2726	0.3621	0.3781
Adj. R^2	0.0320	0.0998	–0.1224	0.1036	0.1115	0.1479	0.2527	0.2714
F-stat.	1.2262	1.7582	0.2547	1.7898	1.8576	2.1869	3.3117**	3.5454*

	BPH	BMP	BZW	CAP	GET	ING	BES	PEK
CointEq1	–0.0128 (0.0746) [–0.171]	–0.0838 (0.0721) [–1.162]	–0.1031 (0.0833) [–1.236]	–0.0121 (0.0058) [–2.0739]	–0.0021 (0.0352) [–0.060]	0.0498 (0.0300) [1.661]	0.0059 (0.0039) [1.506]	–0.21822 (0.0864) [–2.5245]
Stock Price (–1)	0.0871 (0.1899) [0.458]	0.2817 (0.2126) [1.324]	0.5207 (0.1898) [2.742]	0.0293 (0.1500) [0.1958]	0.2348 (0.1663) [1.412]	–0.2143 (0.2034) [–1.053]	0.0299 (0.1673) [0.178]	0.4864 (0.1839) [2.6436]
GDP (–1)	–5.9735 (5.5285) [–1.080]	–3.5379 (2.6699) [–1.325]	4.4318 (2.2223) [1.994]	7.7960 (7.3519) [1.060]	2.5631 (5.4247) [0.472]	–2.6508 (6.0232) [–0.440]	7.7733 (5.2484) [1.481]	3.4763 (1.7662) [1.9681]
INF (–1)	23.4716 (11.655) [2.013]	–0.1557 (5.3101) [–0.029]	0.6424 (4.5617) [0.140]	–2.7557 (12.176) [–0.2263]	–5.4709 (9.0341) [–0.605]	22.2639 (12.145) [1.833]	–9.3308 (9.1367) [–1.021]	2.0317 (3.7117) [0.5473]
IR (–1)	–2.0143 (0.7548) [–2.668]	–0.3979 (0.3512) [–1.132]	–0.6288 (0.2823) [–2.227]	–1.7678 (0.7739) [–2.2840]	–0.9136 (0.5553) [–1.644]	–1.2476 (0.7972) [–1.565]	–0.2104 (0.5929) [–0.354]	–0.5875 (0.2322) [–2.5299]
M3 (–1)	1.1791 (4.8482) [0.243]	4.4958 (2.4587) [1.828]	0.0694 (1.8055) [0.038]	6.4113 (4.2443) [1.5105]	–2.3299 (3.0273) [–0.769]	–11.779 (5.9884) [–1.966]	1.2975 (3.2128) [0.403]	1.6809 (1.4993) [1.1211]
UNE (–1)	0.5515 (1.1448) [0.481]	0.7997 (0.5529) [1.446]	0.7504 (0.4592) [1.634]	1.4652 (1.1999) [1.2211]	0.1356 (0.8616) [0.157]	–0.6591 (1.2113) [–0.544]	–0.7284 (0.9384) [–0.776]	0.9689 (0.3929) [2.4659]
R^2	0.2181	0.1918	0.3883	0.2871	0.2210	0.2448	0.1226	0.3719
Adj. R^2	0.0839	0.0532	0.2835	0.1648	0.0875	0.1153	–0.0277	0.2643
F-stat.	1.6266	1.3844	3.7036 *	2.3488**	1.6553	1.8912	0.8154	3.4545**

Note: Standard errors in round brackets and t-statistics in square brackets. All variables used in the VECM are first differenced.

Source: Authors' calculations.

Streszczenie

ZWIĄZEK MIĘDZY ROZWOJEM RYNKU AKCJI A PODSTAWAMI MAKROEKONOMICZNYMI GOSPODAREK PAŃSTW GRUPY WYSZEHRADZKIEJ

W opracowaniu poddano analizie wpływ poszczególnych czynników makroekonomicznych na ceny akcji wybranych spółek z sektora finansowego, notowanych na giełdach państw Europy Środkowej (w Budapeszcie, Pradze, Bratysławie i Warszawie). Zbadano charakter związków przyczynowych między czynnikami makroekonomicznymi a cenami akcji. Zarówno przyczynowość długoterminowa, testowana za pomocą testu kointegracji Johansena, jak i krótkookresowa dynamika związków przyczynowych pomiędzy zmiennymi, analizowana przy użyciu modelu VECM, zostały zbadane z wykorzystaniem danych kwartalnych z lat 2005–2014. Przyczynowość krótkoterminowa wskazuje na możliwość wahań szeregów czasowych. Stan ustalony powinien zostać jednak osiągnięty w długim okresie. Generalnie potwierdzono, że warunki makroekonomiczne miały negatywny wpływ na ceny akcji. Stopa procentowa, która oddziałuje niekorzystnie, jest najbardziej widocznym predyktorem zmian długoterminowych. Wskazano również bardzo rzadkie przykłady zmiennych makroekonomicznych, które wyjaśniają zmiany cen akcji w modelu VECM.

***Słowa kluczowe**: ceny akcji, warunki makroekonomiczne, Grupa Wyszehradzka, przyczynowość, VECM*