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Stock prices and macroeconomic variables in CEE – first results for Hungary

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The analysis of the macroeconomic environment and stock markets are fundamental topics in the spectrum of economic research. My aim is to explore the relationship between stock prices and macroeconomic variables in Central and Eastern European markets. In this paper, I focus on the Hungarian stock market and economy to uncover the connection between stock prices and selected macro factors. I apply a vector autoregressive (VAR) model on a quarterly dataset from 1995 to 2017. The results suggest that, generally, there is a weak relationship between stock prices and macroeconomic variables in Hungary, with only inflation (–), the euro-forint exchange rate (+) and the DAX index (–) having significant connection with the BUX index, the Hungarian stock market index. Dividing the sample into two periods (before and after accession to the EU) provides no further insight into the connection, as the quarterly data may be insufficient to calculate reliable estimates in the smaller subsamples.

Keywords: stock prices, macroeconomic variables, VAR model, Central and Eastern Europe

1. Introduction

Stock market analysis has been in the center of attention for financial economists for the past decades. Technological advances have improved stock market procedures and evaluation methodologies as well, allowing researchers to form a better picture of the market and explanatory factors. Investors and policy makers also closely follow market developments, as a huge amount of capital is at stake and recent events have shown that capital markets may have an effect on the stability of the whole economy.

In my research, I analyze the relationship between stock prices and selected macroeconomic variables, to determine whether the economic fundamentals have a connection with stock market movements. My aim is to investigate this relationship in the Central and Eastern European countries, because this region has received limited focus in this field of financial research. In this paper, I briefly review the related literature, then introduce the vector autoregressive (VAR) model, which is often applied to uncover the relationship under discussion. In the empirical part of my paper, I concentrate on the Hungarian stock market and economy, to report the first results of my research.

The structure of the study is as follows: Section 2 reviews the literature focusing on the stock price and macro factors relationship, Section 3 presents the methodology applied in the empirical part of the paper, Section 4 introduces the variables included in the model and summarizes the descriptive statistics and the sources of the data, Section 5 reports and analyses the model estimations, and finally, Section 6 gives the concluding remarks.

2. Literature review

In this section, I review the literature related to the connection between stock prices and macroeconomic variables. Generally speaking, the results of the empirical studies very much depend on the analysed country group or region, the time period, the variables included in the model and the applied methodology. I briefly summarize the approach of the papers and their conclusions regarding the stock price and macro factors relationship.

Asprem (1989) analyses ten countries from Western and Northern Europe between 1968 and 1984. They include a wide selection of variables in the model, including inflation, industrial production, consumption, investment, employment, exchange rate, bond rates, money aggregates and a US stock index. The dependent variable – as is usual in the literature – is the stock market index of the given country, rather than individual stocks. This helps eliminate firm-specific effects and allows focusing on market-level interactions. Asprem (1989) finds positive relationship between stock prices and employment, inflation and bond rates, while growth expectations, money aggregates and US stock returns tend to have a positive connection with stock prices.

Mookerjee and Yu (1997) explore the Singaporean stock market and economy to find some linkages between stock prices and macro factors. Singapore is a small, open economy, like the countries in Central and Eastern Europe, thus their results could be relevant for the region as well. Applying cointegration and causality methods on a monthly dataset from 1984 to 1993, they show that money supply (M1 and M2) and foreign exchange reserves have a strong relationship with stock prices, while foreign exchange rates do not.

Bilson et al. (2001) cover twenty developing and least developed countries, where the stock markets are less established than in rich countries; again, this is somewhat true for CEE countries as well. They sort the selected macro variables into two groups: local (money supply, inflation, industrial production) and global (MSCI World Index) factors. Analysing monthly data from 1985 to 1997, they find that local factors generally have a stronger connection with stock prices. Aburgi (2008) follows a similar approach, while researching four Latin American countries (Argentina, Brazil, Chile and Mexico); however, their results are contrasting. Using vector autoregression (VAR) model on a dataset spanning sixteen years (1986–2001), they conclude that global factors elicit a stronger effect on stock prices.

Laopodis (2011) and Peiró (2016) analyse developed European countries, namely France, Germany and UK, while the former study includes Italy as well, comparing them with the US stock market and economy. Laopodis (2011) uses monthly data from 1990 to 2009, Peiró (2016) covers the period of 1969–2013 with annual data. The macro variables examined by both papers are industrial production and interest rate, while Laopodis (2011) adds inflation and oil price to the model. Applying cointegration and VAR model, Laopodis (2011) reveals that the results are different for countries using the euro as their official currency from what is experienced in other countries. Peiró (2016) finds that for European countries both factors influence stock prices, while in the US only industrial production is significant.

Errunza and Hogan (1998) differ from the previously introduced studies, because they do not focus on stock prices, but their main variable is stock return volatility. Researching seven developed European countries and the US on a monthly dataset from

1959 to 1993, their GARCH and VAR models find significant relationship between industrial production, money supply, inflation and stock return volatility in the European countries, but not in the US.

Jain and Rosett (2006) explore the connection between macro variables and another valuation metric, the E/P ratio (which is the reciprocal of the price earnings ratio, P/E). They analyse the Standard and Poor's 500 stock market index from 1952 to 2003, macro factors selected being expected GDP growth, expected inflation, real interest rate, risk premium, maturity structure and dividend payout ratio. Results show that these factors have mixed interaction with the E/P ratio, with inflation having the opposite effect in different time periods, real interest rates having no influence and expected GDP growth indicating an ambiguous relationship.

Chen (2009) takes a unique approach, analysing the relationship between macroeconomic variables and the frequency of recessions in the stock market. They also use monthly data of the S&P500 index and macro factors including interest rate spreads, inflation, industrial production, money aggregates (M1 and M2), unemployment, base rate, foreign exchange rate and government debt. They find that these macro factors can predict recessions better than actual stock market returns, spreads and inflation providing the best estimations.

Finally, I summarize two studies, which focus on the relationship between stock prices and monetary policy, but their variables are quite similar to what I intend to include in my research. Li et al. (2010) compare the effect of monetary policy shocks on stock prices in Canada and the US on a monthly dataset from 1988 to 2003. Their monetary policy variables are inflation, foreign exchange rate, base rate and M2 money aggregate. Their VAR model indicates that monetary restriction (i.e. increased base rate) has a smaller, brief effect on stock prices in Canada, while in the US the response to a shock is bigger and more prolonged. Belke and Beckmann (2015) research the connection between monetary policy and stock market returns in developed countries, e.g. the Eurozone. The time period analysed is different for the countries, generally covering from the 1980s to 2013. Monetary policy variables include money supply, inflation, long and short-term interest rates, ten-year government bond return and capital flows. Their cointegrated VAR model shows that a long-term relationship exists between the monetary policy factors and stock returns; however, it is harder to identify short term connections. They conclude that central banks have limited means to influence stock market returns through monetary policy.

Based on the aforementioned literature, I conclude that there is no clear-cut relationship between stock prices and macroeconomic variables. The results are greatly affected by the evaluated countries and time period, the selected macro factors and the methodology applied. My aim is to uncover the nature of the relationship between stock prices and macroeconomic variables in Central and Eastern Europe, starting with Hungary.

3. Methodology

After reviewing the related literature, I continue with the methodological part of my paper. The studies discussed above apply different techniques to quantify the relationship between stock prices and macroeconomic variables. One of the most frequently used methods is the vector autoregressive (VAR) model, which is a popular way of analyzing time series data. In this section, I introduce the VAR approach and the steps, which should be taken into consideration when it is applied.

Standard procedure in time series analysis is to check whether the variables are stationary or not. Stationarity means that the first and second moments (i.e. the mean and the variance) of the series are constant in time (Lütkepohl–Kratzig 2004). A generally used test is the augmented Dickey–Fuller (ADF) test, where the null hypothesis states that the time series is not stationary (Kiss 2017). If the null hypothesis cannot be rejected, taking the difference of the variable usually solves the problem of non-stationarity.

The vector autoregressive (VAR) model estimates an equation for every variable in the analysis, including the lagged values of every variable among the independent variables as well. The structure of the VAR model allows the endogeneity of all the variables, thus it is useful for evaluating complex relationships between economic factors (Lütkepohl–Kratzig 2004). One downside of the VAR approach is that economic theory usually does not provide specific guidance for identifying the optimal lag length, though the methodological literature offers two methods to determine the ideal number of lags: cross-equation restrictions and information criteria (Brooks 2008). In the empirical part of my paper, I use the Akaike Information Criterion (AIC) to determine the optimal lag length.

Although the VAR model is able to estimate an equation for every variable under discussion, my sole focus in this paper is to find which macro factors influence stock prices in Hungary. The VAR model equation for stock prices in one country is expressed as follows:

$$r_t = \alpha + \sum_{i=1}^{n} \beta_i r_{t-i} + \sum_{i=1}^{n} \gamma_i y_{t-i} + \varepsilon_t$$

where r_t denotes change of stock prices (returns) in period t, β_i is the coefficient of lagged values of stock returns, γ_i is the coefficient of the lagged macro variables y_{t-i}, while n indicates the optimal lag length determined by AIC. The selection of macro factors is discussed in the next section of the paper.

After estimating the VAR model, I graph the impulse response functions of stock prices to the macro variables. The impulse response functions measure the time profile of the effect of a shock in the explanatory variables on the dependent variable (Aburgi 2008). Another technique to illustrate VAR system dynamics is the forecast error variance decomposition. Variance decomposition determines how much of the forecast error variance of a variable is explained by shocks in each of the explanatory variables (Brooks 2008).

4. Data

The previous section introduced the VAR model estimation technique and the related illustration methods, but the analyzed variables have not been determined yet. In this section, I list the selected macro factors, which will be used in the model to capture the relationship between stock prices and macroeconomic variables is Hungary. I also summarize the descriptive statistics of the variables and sources of information.

The central variable of my research is the stock price variable. A general approach observed in the literature is to use a stock market index as a proxy for market-level stock prices in order to eliminate firm specific variations. The official stock market index of the Budapest Stock Exchange is the BUX index, which will be analyzed as the market-level stock price for the Hungarian stock market.

The selection of macroeconomic variables is not as well-defined in the literature as stock market index usage. As we have seen in the literature discussion, the studies analyze a diverse collection of factors, which could have a relationship with stock price movements. In this paper, I will include GDP growth, inflation, central bank base rate, foreign exchange rate, oil price and the DAX index in the model.

The DAX index, which is the German stock market index, is added to the model as a proxy for stock market developments outside the assessed market, i.e. Hungary. I choose the DAX index, because the German stock market is one of the most significant in Europe, and Hungary has very deep trade connections with the German economy. The DAX and the BUX index data were collected from Stooq.com.

Inflation is a macroeconomic variable, which is included in most of the studies discussed in Section 2. Generally, the consumer price index (CPI) is used as the inflation metric. CPI data for Hungary were downloaded from the online database of the Central Bank of Hungary, MNB. Other macroeconomic variables obtained from MNB are the base rate and the euro-forint foreign exchange rate. The base rate serves as the main instrument of monetary policy, thus it is a proxy for monetary easing or restriction. Foreign exchange rates can play a significant role in a small, open economy and Hungary is heavily integrated into the European common market, thus the euro-forint (EURHUF) exchange rate is another factor of interest.

To account for the general performance of the Hungarian economy, GDP is also included in the model. Seasonally adjusted GDP data were collected from the Eurostat online database. Oil price is added to the analysis in order to take the developments of the commodity and energy markets into consideration. Brent oil price data were also obtained from the Stooq.com online database.

One of the challenges of time series analysis is how frequently the evaluated data are published. For most economic variables, the frequency is – at best – quarterly data. For the abovementioned factors, I could collect quarterly data from the given sources from the first quarter of 1995 to the last quarter of 2017. Variables, which have quotations, i.e. the BUX and DAX index, the EURHUF exchange rate and the oil price, have higher frequency data. In those cases, the value on last day of the quarter is used in the analysis (an alternative approach would be to use the quarterly averages).

As discussed in Section 3, the ADF test was applied to check whether the variables to be included in the model are stationary or not. Not surprisingly, the null hypothesis can be rejected at the 5% significance level only for the inflation variable (which is already a differenced version of the general price level). The other variables have to be differentiated in order to obtain stationary series. Log-differentiation is used for the BUX and DAX index, the EURHUF exchange rate, the GDP and the oil price data, while the base rate series is first-differenced. The differentiated variables are all stationary at very small significance levels.

The Johansen cointegration test was also run on the log-level variables to validate the application of the VAR methodology. Table 1 presents the eigenvalues, the Trace test statistics and the corresponding p-values of the Johansen cointegration test. Cointegration is not an issue here. Brooks (2008) writes that cointegration is present when the number of cointegrating vectors is between zero and the number of variables, and the Trace test shows that this is not the case for our data (p-values below and little above the 5% significance level). Thus, I continue with the VAR methodology, using the differentiated time series.

Table 1 Johansen cointegration test

Rank	Eigenvalue	Trace test	p-value
0	0.4942	151.25	0.0000
1	0.3222	91.273	0.0003
2	0.2682	57.048	0.0046
3	0.1515	29.567	0.0534
4	0.1138	15.111	0.0556
5	0.0496	4.4779	0.0343

Source: own based on own calculations

The descriptive statistics of the stationary time series are summarized below in Table 2. It appears that the Hungarian stock market provided higher returns in the sampled period than the German market, although the BUX index had a higher standard deviation as well, implying riskier investment possibilities. Oil price increased a little over the evaluated period; however, it had a relatively high standard deviation. The forint depreciated against the euro, while inflation and GDP growth were also positive between 1995 and 2017.

Table 2 Descriptive statistics, Hungary, 1995Q1–2017Q4

Variable	Mean	Median	S.D.	Min	Max	Source
ld_bux	3.81%	4.96%	15.20%	–53.50%	47.00%	Stooq
ld_gdp	2.21%	2.19%	2.16%	–2.13%	8.96%	Eurostat
inflation	1.74%	1.30%	2.11%	–1.39%	11.20%	MNB
d_baserate	–0.30%	–0.15%	0.85%	–2.50%	3.00%	MNB
ld_eurhuf	0.74%	0.60%	4.14%	–12.70%	15.50%	MNB
ld_oil	1.44%	4.26%	17.70%	–77.40%	36.40%	Stooq
ld_dax	2.09%	4.01%	12.50%	–45.90%	30.10%	Stooq

Notes: ld_ denotes log-differentiation, d_ denotes first difference
Source: own construction based on MNB, Eurostat and Stooq data

5. Results

In this section, I report the VAR model estimations of stock prices and macroeconomic variables for Hungary. First, I show the estimates for the whole sample, ranging from 1995Q1 to 2017Q4. Then, I divide the sample into two periods: 1995Q1–2004Q2 and 2004Q3–2017Q4. In May 2004, Hungary and several other Central and Eastern European countries joined the European Union (EU), which had a great impact on their economies. Thus, it seems a good idea to cut the sample at

2004Q2 and explore the relationship between stock prices and macro factors before and after the EU accession.

5.1. Results for Hungary, 1995–2017

The VAR model estimations of the BUX index for the whole sample from 1995 to 2017 are reported in Table A of the Annex. For brevity, Table 3 below presents only the significant variables of the estimations.

Table 3 Significant variables of the VAR model estimations, BUX, 1995Q1–2017Q4

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
ld_bux_2	0.3714	0.1606	2.3120	0.0243	**
inflation_2	−2.9814	1.4465	−2.061	0.0438	**
ld_eurhuf_2	0.9854	0.4688	2.1020	0.0399	**
ld_dax_1	−0.3221	0.1830	−1.761	0.0836	*
ld_dax_2	−0.3054	0.1792	−1.705	0.0935	*

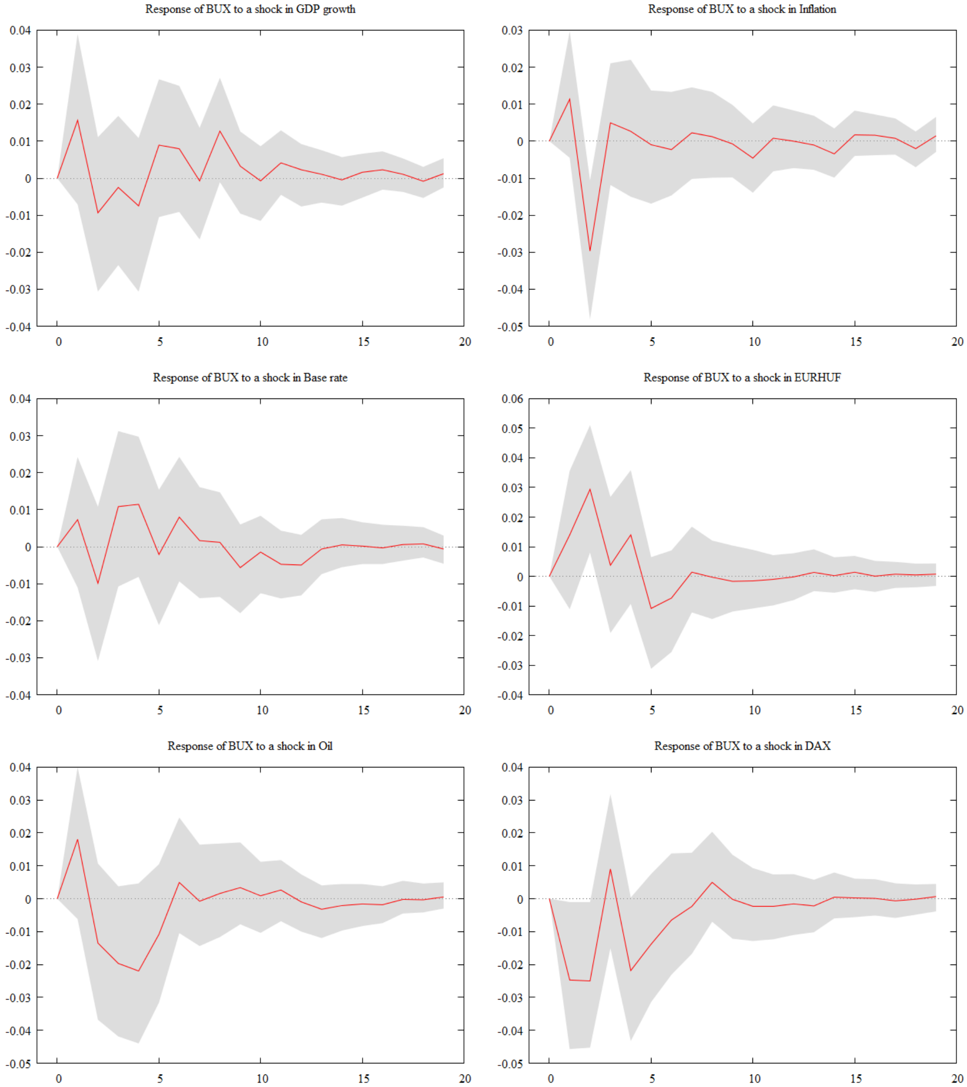
Notes: *significance at the 10% level, **significance at the 5% level
Source: own construction based on own calculations

Table A of the Annex contains the lagged estimates of each macroeconomic variable and of the BUX index as well. Maximum lag length was determined by the Akaike Information Criterion, thus four lags were included for each variable. According to the estimates, there is no strong relationship between stock prices and the evaluated macro variables in Hungary. The GDP, the base rate and the oil price variables show no significance for every lagged value, thus, stock prices in Hungary seem to be insensitive to general economic performance and monetary policy changes.

Significant variables (reported in Table 2 above) at the 5% level are the two-lagged BUX itself, inflation and EURHUF exchange rate, while the one and two-lagged DAX index is significant at the 10% level. The positive coefficient of the two-lagged value of the EURHUF exchange rate indicates that forint depreciation has a positive effect on Hungarian stock prices. One explanation is that a relatively cheaper HUF is beneficial for the export activities of the Hungarian firms, thus driving stock prices higher. A depreciated forint is also attractive to foreign investors, who could invest forint positions into Hungarian stocks, resulting in higher demand and eventually increased prices in the stock market. Inflation and the DAX index, however, show a negative relationship with the BUX index. Inflation can increase production factor prices and lower consumer demand, creating unfavorable circumstances for firms, thus increasing the chance of a declining stock market. The negative coefficients of the one and two-lagged DAX index values reveal an intriguing connection between the Hungarian and the German stock markets. The estimates imply that the two markets usually move in the opposite direction in a half-a-year time-window. Investors may have incentives to allocate their resources from the more developed stock markets to less developed ones during economic upturns (e.g. higher returns), while they could decide to withdraw their investments from riskier markets in times of crisis.

Figure 1 illustrates the impulse response functions of BUX to shocks in the analyzed macroeconomic variables.

Figure 1 Impulse response functions of BUX to shocks in the macroeconomic variables, 1995Q1–2017Q4



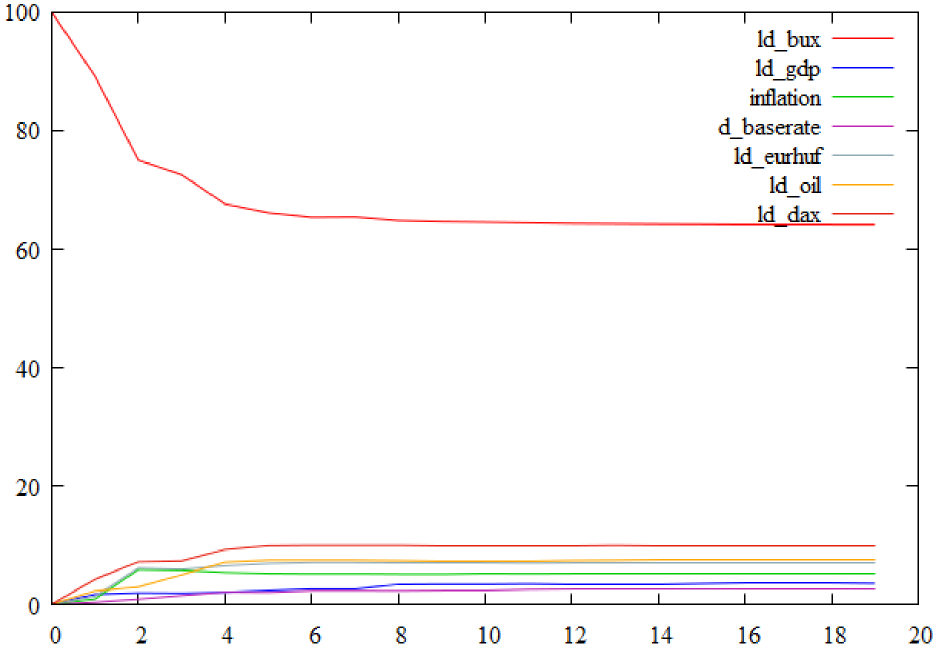
Source: own construction based on own calculations

The impulse response functions shown in Figure 1 tell a similar story to what we have interpreted from the VAR model. Generally, there is no clear-cut response of BUX to shocks in the macroeconomic variables, especially GDP and the base rate causing ambiguous effect. Shocks to inflation, the DAX index and oil price tend to have a negative influence on Hungarian stock prices for 4-6 quarters, while the

EURHUF exchange rate shows a positive relationship with the BUX index performance.

Figure 2 depicts the forecast error variance decomposition of the BUX index for the whole sample period, from 1995 to 2017. The forecast error variance decomposition of BUX shows how much of its forecast error variance is determined by shocks in the macroeconomic variables included in the model. Unsurprisingly, most of it is explained by the BUX index itself, but this is usually observed in the empirical works (Brooks 2008). More than 60% of the variance is explained by the BUX itself in the long run, with the DAX index providing the biggest explanatory power among the other variables, while GDP and the base rate again show little connection with stock prices.

Figure 2 Forecast error variance decomposition of BUX, 1995Q1–2017Q4



Source: own construction based on own calculations

Based on the aforementioned results, I conclude that Hungarian stock prices and macroeconomic variables generally have a weak relationship during the period from 1995 to 2017. Only inflation (-), EURHUF exchange rate (+) and the DAX index (–) show some significant connections with the BUX index on the whole sample.

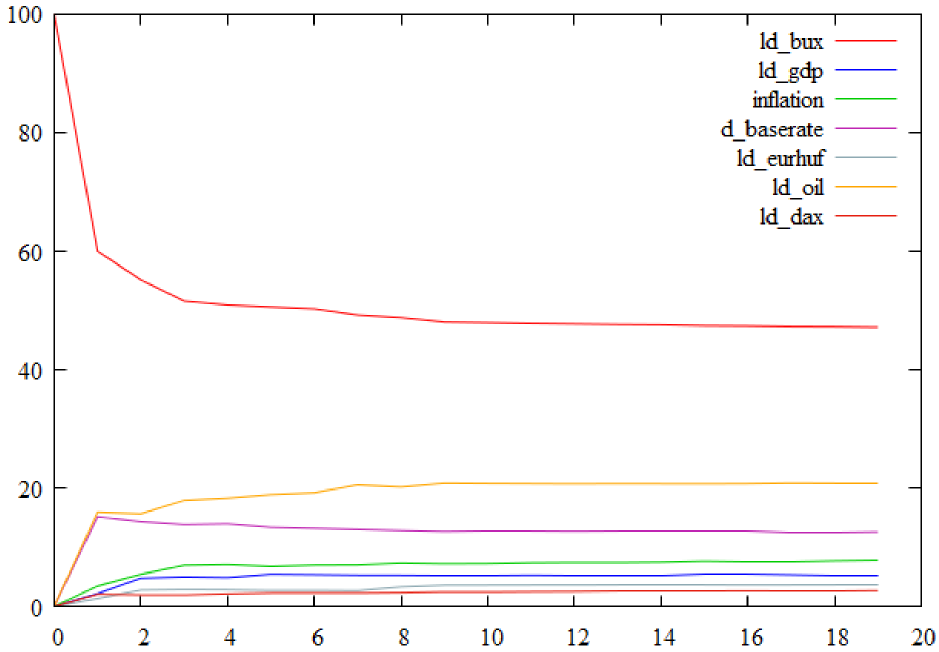
5.2. Results for Hungary, subsamples 1995Q1–2004Q2 and 2004Q3–2017Q4

After reporting the results for the whole sample, I continue with the first subsample, which covers the period from 1995Q1 to 2004Q2, i.e. the period prior to EU accession. Table B of the Annex presents the VAR model estimates for the BUX index in the first subsample.

Table B reports the coefficients of the lagged values of the macroeconomic variables in the model. Unfortunately, only the coefficients of the two-lagged inflation and one-lagged oil price are significant even at the 10% level, thus it seems that no meaningful relationship can be identified between stock prices and macroeconomic variables before EU accession. The problem might be the relatively short time window, the nine and a half years providing thirty-eight observations of each variable, which might be insufficient for the methodology used.

For brevity, I omit the impulse response functions of BUX for the first subsample. Figure 3 illustrates the forecast error variance decomposition of BUX to shocks in the macro factors for the period from 1995Q1 to 2004Q2.

Figure 3 Forecast error variance decomposition of BUX, 1995Q1–2004Q2



Source: own construction based on own calculations

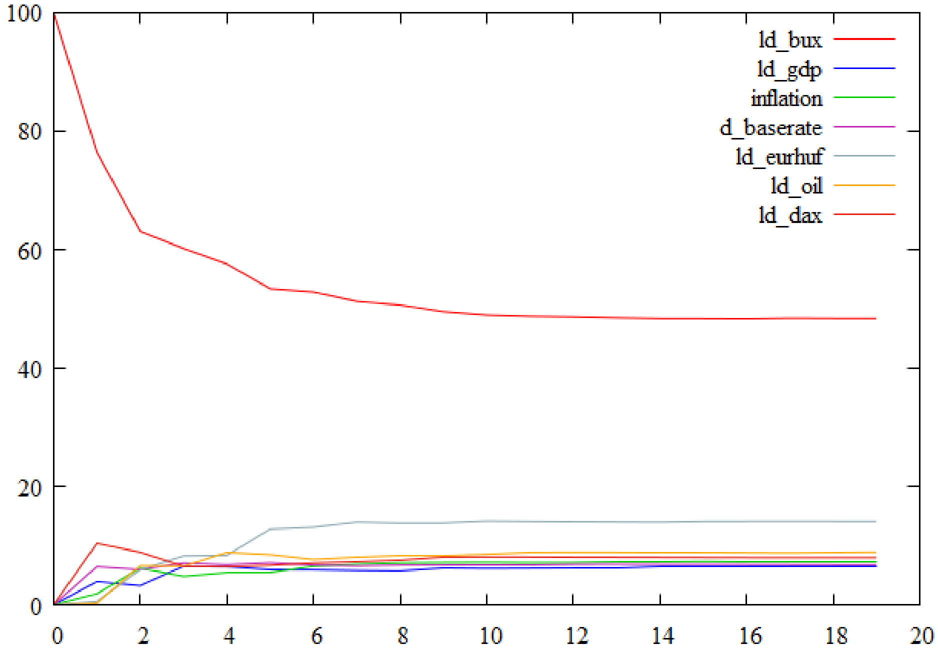
Figure 3 shows a similar picture to what we have observed in Figure 2, most of the forecast error variance of BUX being determined by itself. However, the percentage decreases to around 50% in the long run. The main macroeconomic variable in this subsample is the oil price, which explains approximately 20% of the forecast error variance of the BUX index in the long term.

The first subsample of 1995Q1–2004Q2 does not provide further insight into the relationship between stock prices and macroeconomic variables. The period from 2004Q3 to 2017Q4 contains the quarters after EU accession, which had a great impact on the economy of Hungary and other Central and Eastern European countries. Table C of the Annex reports the VAR model estimates for the second subsample period.

Table C presents the coefficients of the macroeconomic variables for the period from 2004Q3 to 2017Q4. Again, the relationship between stock prices and macro factors appears to be weak, with only the two and three-lagged oil price and the one-lagged DAX index value showing significance at the 10% and 5% level, respectively (apart from the BUX index itself). The second subsample consists of thirteen and a half years, meaning each variable has fifty-four observations, which is greater than in the first subsample, although it still seems to be insufficient.

Figure 4 pictures the forecast error variance decomposition of BUX in the second subsample. It shows that yet again the biggest portion of the forecast error variance of BUX is explained by itself, the long-term percentage stabilizing at around 50%. Of the macroeconomic variables, the euro-forint exchange rate provides the greatest explanatory power in the period from 2004Q3 to 2017Q4, with over 15% of the forecast error variance explained.

Figure 4 Forecast error variance decomposition of BUX, 2004Q3–2017Q4



Source: own construction based on own calculations

Dividing the whole sample into two subsamples has not given us a clearer picture of the connection between stock prices and macroeconomic variables. In fact, the results reported for the quarters spanning 1995Q1–2004Q2 and 2004Q3–2017Q4 indicate that a dataset of higher frequency might be needed to evaluate the effect of accession to the European Union on the stock price and macro factors relationship. Alternatively, statistical break point tests could be applied to identify structural breaks in the time series, but those should be elaborated in a separate study.

6. Conclusion

In this paper, I attempted to explore the relationship between stock prices and selected macroeconomic variables in a Central and Eastern European country, Hungary. The macro factors taken into consideration were GDP, inflation, central bank base rate, EURHUF exchange rate, oil price and the DAX index, while the focus was on the Hungarian stock market index, the BUX index.

I applied a vector autoregressive (VAR) model to uncover the connection between stock prices and macroeconomic variables. Using a quarterly dataset between 1995 and 2017, I reported that only inflation (–), the euro-forint exchange rate (+) and the DAX index (–) have some significant relationship with the BUX index. After dividing the whole sample into two subsamples, 1995Q1–2004Q2 and 2004Q3–2017Q4, to measure the effect of European Union accession, I found that none of the macroeconomic variables seems to have profound relationship with stock prices in Hungary in the periods analyzed. However, the subsamples might not have enough observations to back this result, higher frequency data might be needed to make a clearer picture.

The next step is to include the other Central and Eastern European countries in the model to explore the relationship between stock prices and macro variables in the whole region. If possible, higher frequency data should be used in order to make better estimates when comparing subsample results. The methodological part could be developed into a more complex model and other techniques applied as well, such as panel methods and break point tests. I believe that more data and more advanced methodology will help us understand the relationship between stock prices and macro factors better and provide further insight into the underlying connection.

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References

Aburgi, B. (2008): Empirical relationship between macroeconomic volatility and stock returns: Evidence from Latin American markets. *International Review of Financial Analysis*, 17, 2, 396–410.

Asprem, M. (1989): Stock prices, asset portfolios and macroeconomic variables in ten European countries. *Journal of Banking & Finance*, 13, 4–5, 589–612.

Belke, A. – Beckmann, J. (2015): Monetary policy and stock prices – Cross-country evidence from cointegrated VAR models. *Journal of Banking & Finance*, 54, C, 254–265.

Bilson, C. – Brailsford, T. – Hooper, V. (2001): Selecting macroeconomic variables as explanatory factors of emerging stock market returns. *Pacific-Basin Finance Journal*, 9, 4, 401–426.

Brooks, C. (2008): *Introductory Econometrics for Finance.* Cambridge University Press, Cambridge.

Chen, S–S. (2009): Predicting the bear stock market: Macroeconomic variables as leading indicators. *Journal of Banking & Finance*, 33, 2, 211–223.

Errunza, V. – Hogan, K. (1998): Macroeconomic Determinants of European Stock Market Volatility. *European Financial Management*, 4, 3, 361–377.

Jain, P. – Rosett, J. (2006): Macroeconomic variables and the E/P ratio: Is inflation really positively associated with the E/P ratio? *Review of Quantitative Finance and Accounting*, 27, 1, 5–26.

Kiss, G. D. (2017): *Volatilitás, extrém elmozdulások és tőkepiaci fertőzések.* JATEPress, Szeged.

Laopodis, N. (2011): Equity prices and macroeconomic fundamentals: International evidence. *Journal of International Financial Markets, Institutions and Money*, 21, 2, 247–276.

Li, Y. – Iscan, T. – Xu, K. (2010): The impact of monetary policy shocks on stock prices: Evidence from Canada and the United States. *Journal of International Money and Finance*, 29, 5, 876–896.

Lütkepohl, H. – Kratzig, M. (2004): *Applied Time Series Econometrics.* Cambridge University Press, Cambridge.

Mookerjee, R. – Yu, Q. (1997): Macroeconomic variables and stock prices in a small open economy: The case of Singapore. *Pacific-Basin Finance Journal*, 5, 3, 377–388.

Peiró, A. (2016): Stock prices and macroeconomic factors: Some European evidence. *International Review of Economics and Finance*, 41, C, 287–294.

Annex

Table A VAR model estimations, BUX, 1995Q1–2017Q4

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0197	0.0267	0.7387	0.4631	
ld_bux_1	0.2227	0.1646	1.3530	0.1813	
ld_bux_2	0.3714	0.1606	2.3120	0.0243	**
ld_bux_3	0.0997	0.1629	0.6118	0.5430	
ld_bux_4	−0.0089	0.1609	−0.0555	0.9559	
ld_gdp_1	1.1323	1.0995	1.0300	0.3074	
ld_gdp_2	0.3272	1.0210	0.3205	0.7498	
ld_gdp_3	−0.5181	0.9514	−0.5446	0.5881	
ld_gdp_4	−1.0913	0.9603	−1.137	0.2604	
inflation_1	0.9576	1.5230	0.6288	0.5320	
inflation_2	−2.9814	1.4465	−2.061	0.0438	**
inflation_3	1.2045	1.4952	0.8055	0.4238	
inflation_4	1.0797	1.4625	0.7383	0.4633	
d_baserate_1	1.6416	2.4147	0.6798	0.4993	
d_baserate_2	−1.0133	2.4782	−0.4089	0.6841	
d_baserate_3	0.6411	2.3526	0.2725	0.7862	
d_baserate_4	2.5944	2.3078	1.1240	0.2656	
ld_eurhuf_1	0.4792	0.4957	0.9666	0.3377	
ld_eurhuf_2	0.9854	0.4688	2.1020	0.0399	**
ld_eurhuf_3	0.3766	0.5006	0.7523	0.4549	
ld_eurhuf_4	0.6024	0.4760	1.2650	0.2108	
ld_oil_1	0.1163	0.0985	1.1810	0.2423	
ld_oil_2	−0.1081	0.1016	−1.064	0.2919	
ld_oil_3	−0.0706	0.1025	−0.6892	0.4934	
ld_oil_4	−0.1383	0.1037	−1.335	0.1871	
ld_dax_1	−0.3221	0.1830	−1.761	0.0836	*
ld_dax_2	−0.3054	0.1792	−1.705	0.0935	*
ld_dax_3	0.0644	0.1849	0.3483	0.7289	
ld_dax_4	−0.1687	0.1923	−0.8777	0.3837	

Notes: *significance at the 10% level, **significance at the 5% level
Soucre: own construction based on own calculations

Table B VAR model estimations, BUX, 1995Q1–2004Q2

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.227237	0.159379	−1.426	0.1794	
ld_bux_1	0.189395	0.334411	0.5664	0.5816	
ld_bux_2	0.168623	0.337322	0.4999	0.6262	
ld_bux_3	−0.148634	0.308990	−0.4810	0.6391	
ld_gdp_1	1.58153	3.03430	0.5212	0.6117	
ld_gdp_2	2.96596	3.16711	0.9365	0.3675	
ld_gdp_3	1.97515	2.94442	0.6708	0.5150	
inflation_1	2.93226	3.22831	0.9083	0.3816	
inflation_2	−4.86033	2.56495	−1.895	0.0824	*
inflation_3	3.24703	3.53097	0.9196	0.3759	
d_baserate_1	7.14845	5.19334	1.376	0.1938	
d_baserate_2	−5.08389	5.60846	−0.9065	0.3825	
d_baserate_3	3.91888	4.94698	0.7922	0.4436	
ld_eurhuf_1	0.492613	1.88026	0.2620	0.7978	
ld_eurhuf_2	2.41781	1.70240	1.420	0.1810	
ld_eurhuf_3	−1.57688	1.50743	−1.046	0.3161	
ld_oil_1	0.607266	0.333071	1.823	0.0933	*
ld_oil_2	0.343142	0.344435	0.9962	0.3388	
ld_oil_3	−0.0221204	0.299877	−0.07376	0.9424	
ld_dax_1	−0.361415	0.366187	−0.9870	0.3431	
ld_dax_2	−0.0705739	0.344450	−0.2049	0.8411	
ld_dax_3	−0.220028	0.407307	−0.5402	0.5989	

Notes: *significance at the 10% level
Source: own construction based on own calculations

Table C VAR model estimations, BUX, 2004Q3–2017Q4

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.0432050	0.0586312	−0.7369	0.4697	
ld_bux_1	−0.693247	0.327475	−2.117	0.0470	**
ld_bux_2	−0.0723906	0.282497	−0.2563	0.8004	
ld_bux_3	0.738072	0.253503	2.911	0.0086	***
ld_bux_4	0.367531	0.329498	1.115	0.2779	
ld_gdp_1	2.15419	1.77751	1.212	0.2397	
ld_gdp_2	3.00551	1.96338	1.531	0.1415	
ld_gdp_3	0.221988	1.47705	0.1503	0.8820	
ld_gdp_4	−2.04406	1.39115	−1.469	0.1573	
inflation_1	2.11865	2.46979	0.8578	0.4012	
inflation_2	1.20450	2.54579	0.4731	0.6412	
inflation_3	0.202045	2.61975	0.07712	0.9393	
inflation_4	−2.38010	2.73635	−0.8698	0.3947	
d_baserate_1	−1.78880	6.85680	−0.2609	0.7969	
d_baserate_2	−6.17855	6.09857	−1.013	0.3231	
d_baserate_3	8.31362	6.84048	1.215	0.2384	
d_baserate_4	4.71505	5.93938	0.7939	0.4366	
ld_eurhuf_1	0.889364	0.628663	1.415	0.1725	
ld_eurhuf_2	0.890638	0.674818	1.320	0.2018	
ld_eurhuf_3	0.804726	0.732294	1.099	0.2849	
ld_eurhuf_4	0.868487	0.658704	1.318	0.2022	
ld_oil_1	−0.0996123	0.156590	−0.6361	0.5319	
ld_oil_2	−0.255146	0.146186	−1.745	0.0963	*
ld_oil_3	−0.349823	0.178054	−1.965	0.0635	*
ld_oil_4	−0.207896	0.149933	−1.387	0.1808	
ld_dax_1	0.767864	0.361767	2.123	0.0465	**
ld_dax_2	0.0531623	0.340155	0.1563	0.8774	
ld_dax_3	−0.544003	0.369066	−1.474	0.1560	
ld_dax_4	−0.298981	0.384729	−0.7771	0.4462	

Notes: *significance at the 10% level, **significance at the 5% level, ***significance at the 1% level

Source: own construction based on own calculations