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INSPECTING THE INFLUENCE OF MACROECONOMIC FACTORS ON STOCK RETURNS: THE CASE OF SERBIA

Inspekcija uticaja makroekonomskih faktora na povrat akcija – slučaj Srbije

Abstract

In many developed economies, a stable financial market is the basis for the growth and development of a country's well-being. The movement of stock prices is, in many ways, a reflection of the development of the largest companies in a country. In this paper, we deal with the analysis of the impact of macroeconomic indicators such as inflation, interest rates, and exchange rates on stock prices on the stock market. The goal of the paper is a deeper understanding of how the movements of macroeconomic indicators affect the movement of stock prices and, at the same time, the economic growth of the largest companies. The analysis used monthly data on changes in inflation, interest rates, and exchange rates, together with the prices of shares of companies listed on the Belgrade Stock Exchange (BelexLine index) for the period from 2015 to 2021. The index itself contains a sample of 29 companies. The findings indicate the existence of a unidirectional relationship between interest rate changes and stock prices, and a bidirectional relationship between stock price changes and changes in inflation and interest rates. In addition to these two tests, the authors graphically show the impulse response of indicators as well as the decomposition of data variation, which indicates that the changes in stock price are explained mostly by the variance in the stock price itself. The results also indicate that the primary change of the BelexLine index to itself is positive, while in other periods there is a negative reaction, but at the end of the period, there is stabilization after the original occurrence of the shock.

Keywords: *stock exchange, BelexLine index, macroeconomic variables*

Sažetak

U mnogim razvijenim ekonomijama stabilno finansijsko tržište je osnova za rast i razvoj blagostanja jedne zemlje. Kretanje cena akcija je po mnogo čemu odraz razvoja najvećih kompanija u jednoj zemlji. U ovom radu bavimo se analizom uticaja makroekonomskih pokazatelja kao što su inflacija, kamatne stope i kursevi na cene akcija na berzi. Cilj rada je dublje razumevanje kako kretanja makroekonomskih pokazatelja utiču na kretanje cena akcija i, istovremeno, na privredni rast najvećih kompanija. U analizi su korišćeni mesečni podaci o promeni inflacije, kamatnih stopa i kurseva, zajedno sa cenama akcija kompanija koje se kotiraju na Beogradskoj berzi (BelexLine indeks), za period od 2015. do 2021. godine. Sam indeks sadrži uzorak od 29 kompanije. Nalazi ukazuju na postojanje jednosmernog odnosa promene kamatnih stopa na cene akcija, kao i dvosmernog odnosa između promena cena akcija i promena inflacije i kamatnih stopa. Pored ova dva testa, autori grafički prikazuju impulsni odziv indikatora kao i dekompozicija varijanse podataka što ukazuje da se promene cene akcija uglavnom objašnjavaju varijansom same cene akcija. Rezultati takođe ukazuju da je primarna promena BelexLine indeksa na sebe pozitivna, dok u ostalim periodima dolazi do negativne reakcije, dok na kraju perioda dolazi do stabilizacije nakon prvobitnog nastanka šoka.

Ključne reči: *berza, BelexLine indeks, makroekonomske varijable*

Introduction

The exchange of money and capital is a basic element of financial markets or stock exchanges. The capital market, as a form of the financial market, is a crucial and inseparable part of any economy. In addition to the financial market, interest rate, inflation as well as the exchange rate represent a very important element of economic growth and development. So, it is very important to understand the mutual relationship between these indicators and the capital market or, in the case of this research, the stock market and the movement of company share prices on that market. Business entities (companies, banks, financial institutions, and other financial intermediaries) meet and connect individuals who need financial resources with those who have excess cash and are ready to invest in the stock market in exchange for compensation for the risk taken [25, p. 2]. The stock market is considered one of the most important economic indicators of the country. The Serbian financial capital market is still in its early stages, with few shares in circulation and a low amount of total transactions [9, pp. 183-197]. The interest rate, together with inflation and the exchange rate, is a key macroeconomic indicator that is directly related to economic growth. Efficiency is one of the main conditions for the success of the market, as few people can make extraordinary profits in an inefficient market, which is why people lose faith in the market. In such cases, if the interest rate that banks pay to depositors increases, people transfer their money from the stock market to the bank [39, pp. 123-132] The stock market, as the most active and central component of the financial sector, serves as a "barometer" of the real economy [22, pp. 173-208]. It is a vital location for businesses to collect cash and for ordinary people to manage their savings [21, pp. 83-93]. Global central banks modify their policy rule (key interest rates) downward when their economies are suffering and upward when inflationary pressures are mild [1, pp. 20-35]. [31, pp. 154-166] suggests that the stock market allows the economy to hedge long-term liabilities in real capital. As a result, establishing the stock market's efficiency is crucial for investors, legislators, and other major players who provide long-term real capital to the economy. In theory, stock price will be affected by inflation because it is determined by the company output. Interest rates are one of the methods used by the central bank to manage inflation. In theory, stock prices will be affected by inflation since it will influence investors' investment decisions [41, pp. 42-68].

Also, many other factors in addition to the macroeconomic factors that are the subject of this study have an impact on stock prices. Looking at the broader picture of factors, one should keep in mind the effect of various factors not only on the stock market but also on the entire financial market. In Serbia, the underdevelopment of the entire financial market is present due to an excessive and dominant influence of banks as well as the lack of innovations in the financial sector, which represents the backbone of the development of the financial market [27, pp. 269-279]. There is a special period before and after the Covid-19 pandemic where there was a sudden increase in inflationary pressure as well as increased volatility of the exchange rate and a more restrictive monetary policy. Shortly after the pandemic began, it became apparent that this world shock would have a significant impact on global economic activity and inflation [38, pp. 23-40]. Gordon [12, pp. 99-105] argues that the discount rate should be determined by the expected rate of return on equity or dividend yield on stocks. As a result, increases in inflationary expectations and actual inflation rates should increase the expected stream of future nominal dividend payments for stocks, causing the stocks to rise in value. In this paper, we will focus on the impact of interest rates, inflation, and exchange rates on stock prices. According to research by Graham and Harvey [13, pp. 187-243], managers in American companies consider the interest rate risk the second most important element of risk, after the market risk. According to financial theory, changes in interest rates affect both the firm's expectations of future corporate cash flows and the discount rate used to value these cash flows, and thus the value of the company. When all cash flows are predictable, the interest rate can be used to illustrate the time value of money [40, p. 4]. The use of the key interest rate, inflation, and exchange rate in this study is largely supported by Fisher's theory [6]. Fisher's theory states that the difference between the nominal interest rate of two countries will be equal to

the difference in inflation between the two countries. The theory talks about the mutual connection between interest rates and inflation, as well as the connection between these two factors and the exchange rate. The theory seeks to explain the interrelationship and close connection between money supply, demand, economic growth, development, and factors such as inflation, interest rates, and exchange rates. Based on the great connection of these three factors, the authors try to understand their influence on the price movements of shares in Serbia. One of the goals of this research is to determine how the Belgrade Stock Exchange is ranked and to understand the impact of macroeconomic variables.

As previously stated, the purpose of this paper is to better understand how interest rates, inflation, and exchange rates affect the movement of stock values as well as the economic growth of the largest corporations. The paper is divided into four parts. After the introduction and insight into the theoretical literature, we move onto the statistical analysis and finally draw conclusions and recommend future research directions. In the first part of the analysis, monthly data on percentage interest rates were used, along with the share prices of listed companies from 2015 to 2021. The application of the research of macroeconomic factors and their influence on the movement of stock prices originates from the Arbitrage Pricing Theory, which is based on the modern portfolio theory. The theory talks about the use of various factors in trying to predict the movement of share prices. This research serves as a starting point for the application of arbitrage pricing theory on the example of the Serbian Stock Exchange. Limitations of the study are the use of only three macroeconomic factors, the use of gold prices, oil prices, and bond prices in future research advised.

Literature review

In this part of the study, the authors review the relevant literature. In the first part, the authors list relevant research done according to geographical criteria, where they mention the studies that included the analysis of various factors on share prices in certain countries or groups of countries. In the second part of the review, the authors list the studies that dealt with the analysis of specific sectors of the economy, such as the agricultural sector, the banking sector, and the real estate sector.

One of the many types of research such as the study [30, pp. 200-212], found that the use of macroeconomic variables provides an effective technique for automatically identifying and extracting macroeconomic factors that affect the actions of different sectors and offers an accurate prediction of the future share price, according to the consequences on e.g. Stock Exchange in Ghana. A more recent study by Prasad, Bakhshi & Seetharaman [32, p. 126] studied the impact of macroeconomic factors in the US market on the CBOE VIKS index, which is a short-term measure of real risk on the stock market. The study indicated a positive impact of capital market volatility and the financial stress index on the VIKS index, while returns on fixed-income securities did not show a strong effect. The findings of the study by Celebi & Honig [7, p. 18] show that compared to the period before and after the crisis, in the German financial market, a greater number of variables and economic indicators had a significant impact on stock returns during the year. This suggests that the market driven by macroeconomic factors is dominant in the post-crisis era. An analysis of the Turkish stock market found that economic development, the relative value of domestic currency, portfolio investments, and foreign direct investments increase the stock market index, while interest rates and crude oil prices have the opposite effect [8, p. 8]. A study of BRICS stock markets found that there is no longer a two-way causal relationship between stock returns and inflation in the post-crisis eras, with the exception of the pre-crisis period. In the long run, the study found a unidirectional causal relationship between the GDP growth rate and stock returns both in the pre-crisis period and in the total period [36, pp. 110-118]. Only in the case of Brazil did the study find a strong positive correlation between changes in inflation and stock growth. The Granger causality study found a unidirectional relationship between stock returns and rising inflation in Russia, India, and South Africa, but a bidirectional relationship in China [37]. In their conceptual study [20, pp. 85-106], Keshadi and Wadhva investigated how macroeconomic factors affect stock returns. The

results show that stock prices are significantly influenced by GDP, money supply, industrial production price index, consumer price index, and inflation. Although consumption, oil prices, exchange rates, and interest rates had no effect on stock prices, national income showed a negative relationship with them. Abdo, Kudah & Kudah [2, pp. 1-14] investigated the influence of macroeconomic factors on the movement of stock prices on the Amman Stock Exchange and determined that GDP growth had a direct and statistically significant positive relationship with stock returns, while inflation was turned out to have a negative impact. A study by Fahlevi [11, pp. 157-163] showed that there is a statistically significant relationship between exchange rate changes, interest rates, and stock returns of all companies listed on the Indonesian Stock Exchange, negative in the case of interest and positive in the case of exchange rates. A similar study by Wijaya & Muljo [42, pp. 63-73] covering companies listed on the Indonesian Stock Exchange indicates a positive effect of inflation on stock returns, which was previously investigated and confirmed by Basard, Modeljadi & Indravati [5, pp. 310-320]. McMillan [29, p. 9] implies that higher inflation rates and money growth often reduce returns while supporting the market in times of crisis. Higher inflation and money growth, on the other hand, have shown consistent positive predictive power since the financial crisis and reflected a change in risk perception of higher values. In the previous three years, many studies included the impact of the Covid-19 pandemic on the economy. One of the studies looked at the impact of the pandemic on inflation and its relationship with stock price movements in the Nigerian stock market. The study pointed to the negative impact of the pandemic on stock returns, due to the increase in inflationary pressure during the pandemic and the crisis period [17]. Tripathi and Kumar [36] examined the BRICS stock markets before and after the crisis. They found bidirectional long-run causality between stock prices and money supply and oil prices, as well as unidirectional long-run causality between stock prices and GDP, inflation, and interest rates. This work is based on several works by the author [4, pp. 1497-1521], [24, pp. 603-616]. Both studies looked at how macroeconomic factors affect the stock returns of listed companies in Pakistan. The results of the variance decomposition showed that most of the movement in the KSE 100 index was caused by its shocks. As a result, stock price forecasting has been found to be highly dependent on exchange rate movements, inflation, and interest rates.

Pratana, Aji & Vitjaksono [33] dealt with the analysis of the impact of company-specific and macroeconomic factors on the stock returns of companies from the agri-food sector in the Indonesian market. The results showed that company-specific factors have no relationship with stock returns, while macroeconomic factors such as inflation and exchange rates have a negative impact on stock returns. Analyzing banks listed on the Indonesian Stock Exchange, the study by Kusumaningtias, Vidagdo & Nurjannah [20, pp. 97-108] showed the negative influence of interest rates, inflation, and exchange rates on the movement of bank share prices. Research results of Huy, Dat & Anh [16, pp. 189-205] indicate that the use of a seven-factor model, which included GDP growth, inflation, interest rate, exchange rate, the movement of the VNIndex, the risk-free exchange rate, and the movement of the SP500 index and their impact on the share prices of the joint-stock commercial bank Sacombank (STB) in Vietnam. The study's findings indicated that GDP growth, CPI decline, and lower interest rates had a significant impact on stock appreciation. In the study by Huy, Nhan, Bich, Hong, Chung & Huy [17, pp. 189-205], the effects of several macroeconomic factors on the stock price of one of the largest real estate businesses in Vietnam were investigated. The research study found a negative correlation between Vinigroup's share price and Vietnam's risk-free rate and commercial bank deposit rate, but a positive correlation between Vinigroup's share price and Vietnam's loan interest rate.

Methodology and hypothesis

The focus of this study is to analyze the effect of macroeconomic variables on the movement of stock prices on the Belgrade Stock Exchange. The analysis covers the period from 2015 to 2021, while the study used monthly data, so that the study includes 84 observations. The subject of the study is the BelexLine index, the largest stock index on the Belgrade Stock Exchange, as a dependent variable,

while the data on the exchange rate, interest rate, and inflation were taken as independent variables. In Table 1 the authors show more precisely the variables used as well as the sources of the data themselves.

Table 1: Variables

Variable		Source
BELEXLINE	$BELEXLINE_t = \ln (C_t / C_{t-1})$	Belgrade Stock Exchange
EXCH	$EXCH_t = \ln (R_t / R_{t-1})$	World Bank
INT	$INT_t = \ln (IR_t / IR_{t-1})$	World Bank
CPI	$CPI_t = \ln (CPI_t / CPI_{t-1})$	World Bank

Source: Authors

In addition to the variables used, the calculation method is also shown in Table 1. Ct represents the index points of the BelexLine index for a given month, while Ct-1 represents the index points of the previous month. Stock returns are calculated by taking the logarithm of the quotient of these two items. The same method is used to calculate the change in the exchange rate (EXCH), interest rate (INT), and inflation (CPI), where the logarithm of the rate and exchange rate of one period with the rate and exchange rate of the previous period is also performed. The most important requirement for the econometric approach, stable data, is one of the conditions underlying the econometric research of time series [28]. It refers to the constant mean and variance values of the time series. The authors use the Augmented Dickey-Fuller test to determine the stationarity of the data in their analysis. The optimal lag test determines the optimal lag length to be used in the analysis that follows, as well as parameter estimation for the VAR model. This was done because of the causality assessment and the sensitivity of the VAR model to lag time. To accurately calculate the lag length, it is necessary to first review the data [43]. The tests used are the Akaike Information Criterion [3], Hannan-Quinn [34], and Schwarz Criterion [35].

One dynamic linear model that is often applied for long- and medium-term forecasts of economic variables is the VAR model. Causality can also be established using VAR models. The VAR model is a multivariate time series analysis used in econometrics [44, pp. 261-268]. The threshold value for accepting the statistical significance of the influence of a certain variable is 1.96. Using the VAR model, the authors derive the following formula, which is the basis of this study:

$$Xb = \alpha + \beta 1X1b - 1 + \beta 2X2b - 1 + \beta 3X3b - 1 + \epsilon \quad (1)$$

Where:

Xb = Vector element from BelexLine

X1 = Exchange rate

X2 = Interest rate

X3 = Inflation rate

α = Constant vector n x 1

βn = Coefficient from Xb

n = Lag length.

The presence of stability is another crucial factor pertaining to the VAR model's validity. A stability test is necessary to evaluate stability, which the authors did in this study. The calculated VAR model is unstable and cannot be used if the value of the result exceeds the threshold value of one. The analysis of the Impulse Response Function, which is found at the conclusion of the study, was used to assess the effect of the shock of the utilized independent variables on the price of the BelexLine index. The impact of one shock on subsequent shocks in the past, present, and future of the endogenous variables was examined using an impulse response function test. Through the dynamic VAR structure, a shock in the i-endogenous variable might have an immediate impact on the variable and propagate to other endogenous variables. The impulse response function also displays the magnitude influence link between the endogenous variables in addition to its direction. As a result, when a variable in the VAR system is shocked in the presence of new information, both the shocked variable and other variables are affected. The following formula is what the authors used to determine Granger causality:

$$Xt = c1 + \sum_{i=1}^{n} \alpha 1, iXt - 1 + \sum_{i=1}^{n} \beta 1, iYt - 1 + \sum_{i=1}^{n} \gamma 1, iZt - 1 + \sum_{i=1}^{n} \delta 1, iVt - 1 + \epsilon x, t \quad (2)$$

Where:

Xt = Change in BelexLine index

Yt= Change in the exchange rate

Zt = Change in interest rate

Vt = Change in inflation rate

n = Number of lags

e = Standard error

c = Constant.

After presenting the diagnostic tests and statistical models used in the analysis, the authors derive the following hypotheses:

H1: Exchange rate has a significant impact on BelexLine Index

H2: Inflation has a significant impact on BelexLine Index

H3: Interest rate has a significant impact on BelexLine Index

Table 2 shows a descriptive analysis of the variables used. The results of the analysis indicate that the largest amount of change is noticeable in the change of the key interest rate of 0.06132100 in 2019. The largest change in the exchange rate occurred in 2018, while the largest changes in the BelexLine index and inflation occurred in 2019 and 2021, respectively. The largest amount of standard deviation is observed for the key interest rate variable (INT), which indicates that this variable has the largest range between the maximum and minimum amount for the observed period.

Table 2: Descriptive statistics

Variables	Mean	Std. Dev.	Max	Min
BELEXLINE	0.00324900	0.02946100	0.04971700	-0.16663000
EXCH	0.00121400	0.00667500	0.01959200	-0.01367500
INT	-0.02384800	0.04102500	0.06132100	-0.19000000
CPI	0.00091900	0.00547900	0.01342300	-0.01068000

Source: Authors' calculations

Findings and discussion

One of the main conditions for performing a correct regression model is data stationarity. One of the most common unit root tests used in practice is the Augmented Dickey-Fuller (ADF) test. The results indicate the stationarity of all used variables at the level, which represents the fulfilled condition of a correct regression model (see Table 3). In the following step, the authors use more stability tests to fulfill the conditions of a valid Vector Autoregression Model (VAR). The stability test of the VAR model in the appendix uses a threshold value of 1 to establish the stationarity of the variables at a specified number of lags. With the model of 4 lags, Table A in the appendix illustrates that the Modulus does not exceed the threshold value of 1, which proves the stationarity of the data and positively confirms the stability condition of the VAR model. Along with the stability test, Figure A in the appendix is used to graphically present the result of the stability test. It shows that all points do not cross the boundaries of the circle that is on the border of 1, which confirms the obtained results and rejects the null hypothesis of non-stability.

Before performing the stable VAR model and the Granger causality test, the authors need to determine the optimal lag length. For this, the authors used the Akaike Information Criterion (AIC), the Schwartz Criterion (SC), and the Hannan Quinn (HQ) method within a vector autoregression model. Table B in the appendix indicates that the optimal lag length is 1 lag according to AIC and HQ, while the optimal length according to SC is 0 lags. In practice, AIC is generally taken as the most correct, so the authors use a model with an optimal lag length of 1. Also, in addition to the test of the optimal length of the lag duration, a test of the presence of autocorrelation was carried out. The presence of autocorrelation represents one of the main obstacles to deriving a valid VAR model. Autocorrelation represents the presence of a high level of correlation between one variable and its previous values in a certain period of time. In the appendix, Table C presents that, at the accepted lag level of 1, the null hypothesis of the existence of autocorrelation is not rejected.

After checking the stationarity, stability, autocorrelation, and optimal lag length of the model, in Table 4 the authors performed an analysis using the Standard Vector autoregression model (VAR). As explained in the

Table 3: ADF unit root test

Variables		BELEXLINE	EXCH	INT	CPI
Test Critical Values	1% level	-3.5122900	-3.5122900	-3.5122900	-3,5256180
	5% level	-2.8972230	-2.8972230	-2.8972230	-2,9029953
	10% level	-2.5858610	-2.5858610	-2.5858610	-2,5889020
Probability		0,0000	0.0000	0.0000	0.0162
		Level	Level	Level	Level

Source: Authors' calculations

Methodology section, the threshold value for accepting statistical significance is 1.96. The results indicate that the exchange rate does not have a statistically significant relationship with the return of company shares in the BelexLine index, while the interest rate and inflation have a significant and positive influence on the change in share prices. The results indicate the influence of the delay in the return value of the shares contained in the BelexLine index on changes in the key interest rate and the inflation rate. More precisely, this influence can be explained as a reaction of the macroeconomic factors themselves to the previous rise in share prices. The model also shows the influence of the previous value of the key interest rate on its future value. In the continuation of the study, the authors use Variance decomposition analysis for a better understanding of the spread of influence, as well as the Granger causality test of the variables used. The percentage of forecast error variation for the s-period forward BelexLine index that is explained both by its lag and by the lag of other explanatory variables in the system is calculated using the variance decomposition methodology. The findings of the variance decomposition analysis (see Table 5) show that 98.37466% of the variation in the BelexLine index can be attributed to its factors, while the remaining variation is explained by shocks to other variables such as exchange rate changes, interest rates, and inflation that occurred 10 periods before the shocks (0.3122%, 0.3229% and 0.9902%, respectively). The findings also show that as the number of shocks increases, the impact of interest rate changes increases the most.

In Figure 1, the authors use the impulse shock function to analyze the impact of macroeconomic variables on the BelexLine index of the Belgrade Stock Exchange. The impulse response function measures the response of the independent variables to shocks in the dependent variable. The results indicate that the primary change of the BelexLine index is positive, while in other periods there is a negative reaction, but at the end of the period, there is stabilization after the initial occurrence of the shock. Inflation and exchange rate shocks have a minimal

Table 4: Var model

	BELEXLINE	EXCHANGE RATE	INTEREST RATE	INFLATION RATE
BELEXLINE (-1)	0.012457	0.047556	**0.388686**	**0.056442**
	[0.10272]	[1.75916]	**[2.57970]***	**[2.82128]***
EXCHANGE RATE (-1)	0.120368	0.100362	0.169374	-0.082438
	[0.22518]	[0.84227]	[0.25503]	[-0.93486]
INTEREST RATE (-1)	-0.052492	0.02484	**0.3187**	0.016802
	[-0.54453]	[1.15599]	**[2.66101]***	[1.0567]
INFLATION RATE (-1)	0.476816	0.026564	0.514763	0.149787
	[0.69970]	[0.17487]	[0.60799]	[1.33240]
C	0.002488	0.001428	**-0.017682**	0.000685
	[0.54589]	[1.40545]	**[-3.12286]***	[0.91052]
R - squared	0.26536	0.296251	0.464365	0.332581

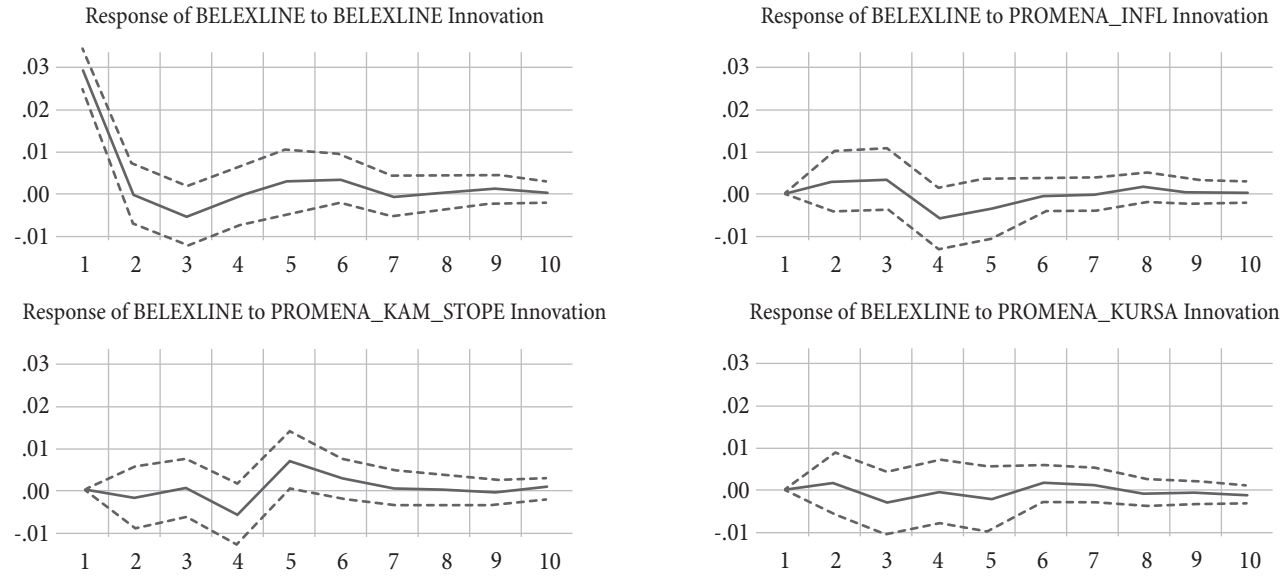
Source: Authors' calculations

Table 5: Variance decomposition

Period	BELEXLINE	EXCH	INT	CPI
1	100	0	0	0
2	98.37466	0.312188	0.322899	0.990252
3	95.93657	1.305258	0.334065	2.424106
4	89.73897	1.231413	3.693972	5.33564
5	84.48557	1.542483	7.914681	6.057263
6	83.85773	1.762654	8.445317	5.934294
7	83.75016	1.873465	8.451416	5.924955
8	83.46986	1.914509	8.422498	6.193134
9	83.41134	1.953846	8.426439	6.208378
10	83.25291	2.05366	8.464194	6.229239

Source: Authors' calculations

Figure 1: Impulse reaction



Source: Authors' calculations

but persistent impact on changes in the BelexLine index, but at the end of the period, stabilization occurs. Interest rate shocks also have a small impact on changes in the BelexLine index, but they have proven to be the strongest of the independent variables used.

Table 6 shows the results of the Granger causality test. Since the probability sum exceeds the threshold value of 0.05, the results show that there is no statistically significant mutual causality between stock price changes and exchange rate changes. As a result, it is not possible to reject the null hypothesis that causality does not exist. The null hypothesis was rejected in three cases. When it comes to the relationship between the price change of the BelexLine index and the interest rate change. Also in the case of the relationship between the interest rate change and the BelexLine index price change and, finally, the inflation rate change. The analysis showed that exchange rate changes have no effect on the prices of shares in the BelexLine index basket, while there is a certain causal relationship with the other two dependent variables. The influence of interest rate and inflation is similar to the findings of Eldomiaty, Saeed, Hammam & AboulSoud [10], Hajilee & Nasser [15], Fahlevi [11], Jareno, Ferrer & Miroslavova [19], Tripathi & Kumar [37].

Conclusion

Understanding macroeconomic factors and the importance of their effect is one of the key items in the predictability of stock price movements. Looking at companies that are listed on the stock exchange and whose shares are traded on the free market, it is of great importance for investors to understand the factors that have any influence on the price movement of those shares. The existence of systemic and

Table 6: Granger causality

Null hypothesis	Chi-sq	Prob.	Decision	Direction
The casual relationship between BelexLine and Exchange rate				
BELEXLINE does not Granger cause EXCH	1.103685	0.8937	Not Rejected	None
EXCH does not Granger cause BELEXLINE	1.303499	0.8608	Not Rejected	
The casual relationship between BelexLine and Interest rate				
BELEXLINE does not Granger cause INT	12.30974	**0.0152***	Rejected at 5%	Bidirectional
INT does not Granger cause BELEXLINE	9.733864	**0.0452***	Rejected at 5%	
The casual relationship between BelexLine and Inflation				
BELEXLINE does not Granger cause CPI	13.49545	**0.0091***	Rejected at 5%	Unidirectional
CPI does not Granger cause BELEXLINE	4.616897	0.3289	Not Rejected	

Source: Authors' calculations

non-systemic risk is mentioned in the literature. Precisely, the systematic risk was named non-diversified risk because of the inability of investors and companies to avoid this type of risk. For this reason, it is of great importance to know the amount of influence of various macroeconomic factors on the movement of share prices. As representatives of macroeconomic factors of particular importance, the authors in this study used the change in the exchange rate, the change in the key interest rate, and the change in inflation on a monthly basis for the period from January 2015 to January 2021. The largest stock index on the Belgrade Stock Exchange, namely BelexLine, was taken as a representative of the share price, where monthly share return data for the same period were used for the analysis. The index contains 29 companies listed on the Belgrade Stock Exchange. Due to the use of time series, the authors decided to use the Vector autoregression model (VAR) as the method of analysis, as well as the Impulse reaction test and decomposition of the variation of the variables used. The results indicated that the exchange rate for the given period had no effect on the price of shares, while the persistence of causality was shown between changes in interest rates and inflation and changes in share prices, which was expected. The decomposition of the variation indicated that the largest percentage of change in the BelexLine index was caused by changes in itself with an increased number of delays, while the influence of other variables increased slightly with an increase in the number of delays, the biggest effect of which is the change in interest rates. The aim of this study is to help investors understand the exact impact of selected macroeconomic variables on stock prices for decision-making when investing in the stock market. The good side of this particular study is the aim to understand the mutual correlation between used variables and the use of the model to predict future changes in stock prices. The limitations of the study are the use of a smaller time frame of the study and the use of only three macroeconomic factors such as the price of gold, crude oil, and bonds. For further research, the authors suggest a comparative analysis of several developing stock markets, such as stock markets in the region. A comparative analysis with more developed markets is also possible in order to see the similarities and differences between the domestic and foreign financial markets.

References

1. Assefa, T. A., Esqueda, O. A., & Mollick, A. V. (2017). Stock returns and interest rates around the world: A panel data approach. *Journal of Economics and Business*, 89, 20-35. DOI: https://doi.org/10.1016/j.jeconbus.2016.10.001
2. Abdo, K. K., Al-Qudah, H. A., Al-Qudah, L. A., & Qudah, M. Z. A. (2021). The effect of economic variables (workers 'diaries abroad, bank deposits, gross domestic product, and inflation) on stock returns in the Amman Financial Market from 2005/2018. *Journal of Sustainable Finance & Investment*, 1-14. DOI: https://doi.org/10.1080/20430795.2021.1883384
3. Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control, 19*, 716-723.
4. Ahmed, R. R., Vveinhardt, J., Streimikiene, D., & Fayyaz, M. (2017). Multivariate Granger causality between macro variables and KSE 100 index: evidence from Johansen cointegration and Toda & Yamamoto causality. *Economic research-Ekonomska istraživanja*, *30*(1), 1497-1521. DOI: http://dx.doi.org/10.1080/1331677X.2017.1340176
5. Basarda, R. F., Moeljadi, M., & Indrawati, N. K. (2018). Macro and micro determinants of stock return companies in LQ-45 Index. *Jurnal Keuangan dan Perbankan*, *22*(2), 310-320. DOI: http://doi.org/Prefix 10.26905
6. Celebi, K., & Hönig, M. (2019). The impact of macroeconomic factors on the German stock market: Evidence for the crisis, pre-and post-crisis periods. *International Journal of Financial Studies*, *7*(2), 18. DOI: https://doi.org/10.3390/ijfs7020018
7. Cooray, A. (2002). *The Fisher effect: A review of the literature* (No. 0206, Research Papers, Macquarie University, Department of Economics).
8. Demir, C. (2019). Macroeconomic determinants of stock market fluctuations: The case of BIST-100. *Economies*, *7*(1), 8. DOI: https://doi.org/10.3390/economies7010008
9. Đaković, M., Andrašić, J., & Cicmil, D. (2022). Testing the applicability of the Capm model using selected shares listed on the Belgrade Stock Exchange. *Facta Universitatis, Series: Economics and Organization*, *19*(22), 183-197. DOI: https://doi.org/10.22190/FUEO220614014D
10. Eldomiaty, T., Saeed, Y., Hammam, R., & AboulSoud, S. (2020). The associations between stock prices, inflation rates, and interest rates are still persistent: Empirical evidence from stock duration model. *Journal of Economics, Finance and Administrative Science*, *25*(49), 149-161.
11. Fahlevi, M. (2019). The influence of exchange rate, interest rate and inflation on stock price of LQ45 index in Indonesia. In *First International Conference on Administration Science (ICAS 2019)* (pp. 157-163). Atlantis Press. DOI: https://doi.org/10.2991/icas-19.2019.34
12. Gordon, M. J. (1959). Dividends, earnings, and stock prices. *The Review of Economics and Statistics*, *41*(2), 99-105. URL: http://www.jstor.org/stable/1927792
13. Graham, J. R., & Harvey, C. R. (2001). The theory and practice of corporate finance: evidence from the field. *Journal of Financial Economics*, *60*, 187-243. DOI: https://doi.org/ 10.1016/s0304-405x(01)00044-7
14. Granger, C. W. J. (1969). Investgating causal relations by econometric models and cross-spectral models. *Econometrica*, *37*(3), 424-438.

15. Hajilee, M., & Nasser, O. M. A. (2017). The impact of interest rate volatility on stock market development: Evidence from emerging markets. *The Journal of Developing Areas*, *51*(2), 301-313.
16. Huy, D. T. N., Dat, P. M., & Anh, P. T. (2020). Building and Econometric model of selected factors Impact on Stock Price: A case study. *Journal of Security & Sustainability Issues*, 9. DOI: https://doi.org/10.9770/jssi.2020.9.M(7)
17. Huy, D. T. N., Nhan, V. K., Bich, N. T. N., Hong, N. T. P., Chung, N. T., & Huy, P. Q. (2021). Impacts of internal and external macroeconomic factors on firm stock price in an expansion econometric model—a case in Vietnam real estate industry. In *Data Science for Financial Econometrics* (pp. 189-205). Springer, Cham. DOI: https://doi.org/10.1007/978-3-030-48853-6_14
18. Jelilov, G., Iorember, P. T., Usman, O., & Yua, P. M. (2020). Testing the nexus between stock market returns and inflation in Nigeria: Does the effect of COVID-19 pandemic matter? *Journal of Public Affairs*, *20*(4), e2289. DOI: https://doi.org/10.1002/pa.2289
19. Jareño, F., Ferrer, R., & Miroslavova, S. (2016). US stock market sensitivity to interest and inflation rates: a quantile regression approach. *Applied Economics*, *48*(26), 2469-2481.
20. Keswani, S., & Wadhwa, B. (2019). Effect of macroeconomic variables on stock market: a conceptual study. *International Journal of Management, IT and Engineering*, *7*(10), 85-106.
21. Kim, W. C., & Mauborgne, R. (1999). Creating new market space. *Harvard Business Review*, *77*(1), 83–93.
22. Krippner, G. R. (2005). The financialization of the American economy. *Socio-Economic Review*, *3*(2), 173-208. DOI: https://doi.org/10.1093/SER/mwi008
23. Kusumaningtyas, N., Widagdo, B., & Nurjannah, D. (2021). The Effect of Interest Rate, Inflation and Exchange Value on Stock Returns with Profitability as Intervening Variables. *Jurnal Manajemen Bisnis dan Kewirausahaan*, *1*(2), 97-108. DOI: https://doi.org/10.22219/jamanika.v1i2.16773
24. Khan, I., Mir, F. N., & Jaber, K. H. (2017). Oil prices, macroeconomic forces, and stock returns: evidence from an ardl bound testing approach. *International Journal of Business and Society*, *18*(S3), 603-616.
25. Ljutić B. Ž. (2007). *Bankarsko i berzansko poslovanje-investicioni pristup* (Banking and stock market business - investment approach). Belgrade.
26. Lone, U. M., Darzi, M. A., & Islam, K. U. (2021). Macroeconomic variables and stock market performance: a PMG/ARDL approach for BRICS economies. *Macroeconomics and Finance in Emerging Market Economies*, 1-26. DOI: https://doi.org/10.1080/17520843.2021.1983704
27. Mekinjić, B., Grujić, M., & Vujičić-Stefanović, D. (2020). Influence of digitalisation and technological innovations in the financial market on the development of the financial market. *Ekonomika preduzeća*, 68(3-4), 269-279. DOI: https://doi.org/10.5937/EKOPRE2004269M
28. Mushtaq, R. (2011). *Augmented dickey fuller test.* DOI: https://dx.doi.org/10.2139/ssrn.1911068
29. McMillan, D. G. (2021). The time-varying relation between stock returns and monetary variables. *Journal of Risk and Financial Management*, *15*(1), 9. DOI: https://doi.org/10.3390/jrfm15010009
30. Nti, K. O., Adekoya, A., & Weyori, B. (2019). Random forest based feature selection of macroeconomic variables for stock market prediction. *American Journal of Applied Sciences*, *16*(7), 200-212.
31. Ologunde, A.O., Elumilade, D.O. and Asaolu, T. O. (2006). Stock Market Capitalization and Interest Rate in Nigeria: A Time Series Analysis. *International Research Journal of Finance and Economics*, *4*, 154-166.
32. Prasad, A., Bakhshi, P., & Seetharaman, A. (2022). The Impact of the US Macroeconomic Variables on the CBOE VIX Index. *Journal of Risk and Financial Management*, *15*(3), 126. DOI: https://doi.org/10.3390/jrfm15030126
33. Pratama, M. I. S., Aji, T. S., & Witjaksono, A. D. (2022). Analysis of the Effect of Profitability Ratio, Solvency Ratio, Market Value Ratio, Inflation, and Exchange Rate on Stock Return (Case Study of the Agriculture Sector on the IDX from 2016 to 2019). International *Journal of Multicultural and Multireligious Understanding*, *9*(3), 166-175. DOI: http://dx.doi.org/10.18415/ijmmu.v9i3.3601
34. Quinn, B. G. (1980). Order determination for a multivariate autoregression. *Journal of the Royal Statistical Society*, *42*(2), 182-185.
35. Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics*, *6*, 461-464.
36. Tripathi, V., & Kumar, A. (2015). Relationship between macroeconomic factors and aggregate stock returns in BRICS stock markets – A panel data analysis. *New Age Business Strategies in Emerging Global Markets, First Impression*, 104-123. SSRN: https://ssrn.com/abstract=2757527
37. Tripathi, V., & Kumar, A. (2015). Short run causal relationship between inflation and stock returns-An empirical study of BRICS Markets. *Asian Journal of Management Applications and Research*, *5*(01). SSRN: https://ssrn.com/abstract=2649108
38. Tabaković, J. (2022). Inflation factors during the pandemic: Global trends and the case of Serbia. *Ekonomika preduzeća*, *70*(1-2), 23-40. DOI: https://doi.org/10.5937/EKOPRE2202023T
39. Uddin, M. G. S., & Alam, M. M. (2007). The impacts of interest rate on stock market: empirical evidence from Dhaka Stock Exchange. *South Asian Journal of Management and Sciences*, *1*(2), 123-132.
40. Van Horne C. J., & Wachowicz Jr J. M., (2007), *Osnovi finansijskog menadžmenta* (Basics of financial management), Dvanaesto izdanje (Twelfth edition). Belgrade: Data status.
41. Wulandari, D. (2017). The influance of inflation and interest rates on stock prices in Indonesia. Prosiding *Pluralisme Dalam Ekonomi Dan Pendidikan*. ISSN, 2407, 42-68.
42. Wijaya, D. A., & Muljo, H. H. (2022). The Effect Analysis of Solvency Ratio, Profitability Ratio and Inflation on Stock Return. *Business Economic, Communication, and Social Sciences (BECOSS) Journal*, *4*(1), 65-73. DOI: https://doi.org/10.21512/becossjournal.v4i1.7833
43. Widarjono, A. (2007). *Ekonometrika Teori dan Aplikas.* Ekonomi FE UII : Yogyakarta.
44. Zuhroh, I., Kusuma, H., & Kurniawati, S. (2017). An approach of Vector Autoregression Model for inflation analysis in Indonesia. *Journal of Economics, Business, & Accountancy Ventura*, *20*(3), 261-268.

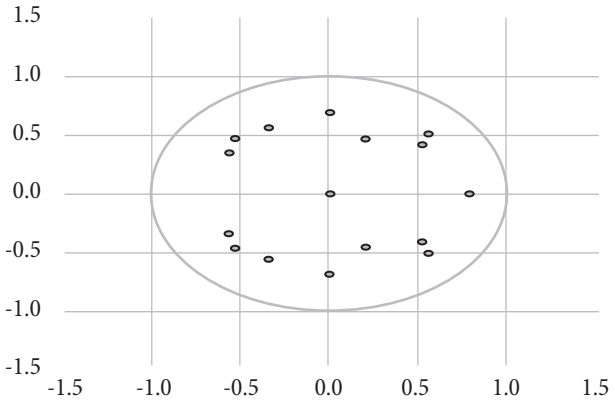
Appendix

Table A: Var stability condition check

Root	Modulus
0.787066	0.787066
0.561531 - 0.507201i	0.756683
0.561531 + 0.507201i	0.756683
-0.520257 - 0.468653i	0.700217
-0.520257 + 0.468653i	0.700217
0.009497 - 0.691648i	0.691713
0.009497 + 0.691648i	0.691713
0.520776 - 0.418243i	0.667933
0.520776 + 0.418243i	0.667933
-0.559285 - 0.350203i	0.659880
-0.559285 + 0.350203i	0.659880
-0.335720 - 0.560269i	0.653154
-0.335720 + 0.560269i	0.653154
0.207438 - 0.454314i	0.499431
0.207438 + 0.454314i	0.499431
0.011849	0.011849

*No unit root lies outside the unit circle
*VAR satisfies the stability condition
Source: Authors' calculations

Figure A: Inverse roots



Source: Authors' calculations

Table B: VAR Lag order selection criteria

Lag	LogL	AIC	SC	HQ
0	896,4744	-22,59429	-22,47432*	-22,54622
1	920,5313	-22,79826*	-22,19840	-22,55794*
2	927,8892	-22,57947	-21,49972	-22,14689
3	934,0978	-22,33159	-20,77195	-21,70675
4	945,1356	-22,20596	-20,16644	-21,38887

Source: Authors' calculations

Table C: Autocorrelation

Lag	LRE*statistic	df	Probability
1	15.33	(16,199.2)	0.5
2	10.12	(16,199.2)	0.86
3	14.85	(16,199.2)	0.535

Source: Authors' calculations

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