



INFLATION RATE IMPACT ON THE SHARE RETURNS OF REAL SECTOR COMPANIES IN AP VOJVODINA *

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Abstract:

Taking into account the current trends in the domestic financial market, the subject of this research is the analysis, testing and quantification of the inflation rate impact on the daily share returns of the real sector companies in AP Vojvodina. The aim of the research is to generate concrete, practically tested and quantified knowledge about the possibilities and efficiency of the GARCH models application to quantify the inflation rate impact on the share returns of the observed companies. The period covered by the survey is from 2006 to 2016 and it includes the real sector companies of AP Vojvodina whose shares are quoted within the stock exchange index BELEXline. The research results show the exact correlation between the daily return rates of the observed companies and the financial risk factor - the inflation rate. The results also show a positive impact of the variable inflation rate on the returns of companies NIS a.d (0.013876), Sojaprotein a.d (0.019167) and Vital a.d (0.051056), and a negative impact on the returns of the company Veterinary Institute a.d (-0.000183). The research results confirm the role and significance of the application of econometric models in order to quantify financial risk factors of returns from investment activities in the real sector companies of AP Vojvodina.

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INTRODUCTION

Stock exchanges are considered important institutions of the financial system because they encourage the growth of all economic sectors by allocating savings from surplus entities to financing the deficit units and enable optimum distribution and use of scarce capital resources, thus providing the basis for long-term sustainable economic growth and development. As the stock market is considered to be a key to economic progress, the research focus is on defining the factors of financial risk that influence and determine the share returns. Although financial theory provides specific factors for companies and industries, there is a growing recognition among financial researchers that macroeconomic variables play a key role in determining a stock market performance.

Among macroeconomic variables, inflation is considered as one of the most important factors that influence share returns. Inflation is an increase in the general level of prices of goods and services in the economy that leads to a purchasing power decrease and/or a money value decrease. The earliest conclusions about the relationship between inflation and share returns are based on hypotheses presented by Irving Fisher in 1930. Based on the Fisher hypothesis, it can be concluded that the share return is directly proportional to the expected inflation rates. Therefore, there should be a positive correlation between the inflation rate and the share returns, whereas the nominal investment share returns should be accompanied by an inflation increase and thus protect investors from the decrease of the real money value.

On the other hand, the opposite view of the negative relationship between inflation and the share returns is also present. Fama (1981) explained that the negative correlation between share returns and inflation was caused by a positive correlation between the share returns and the real activity and the negative correlation between inflation and real activity.

Secondary market shares are sold on the basis of supply and demand, and therefore reflect the quality of a company or a joint-stock company operation. In addition, the economic environment of a company should be taken into account, i.e. the financial risk factors, such as inflation, foreign exchange rate, the state credit rating and similar affect the share returns. According to Adamović (2008), it is very important that a state reduces the hyperinflation to a low level (one-digit inflation) – otherwise, there will be no serious economic progress. But the stabilisation policy must not interact with a policy of economic growth. Stabilisation reduces inflation, but its long-term operation slows down the pace of economic growth and brings poverty. A solid monetary policy that implies an overvalued exchange rate of national currency and high interest rates can not trigger new jobs. Such a policy only slows down every economic development (Kitanović and Krstić, 2010).

Being one of the basic determinants of the time value of money, the expected inflation must be taken into account when investing in stocks or making financial decisions on investments. Therefore, investors have the task to predict factors affecting the portfolio performance and accordingly make decisions based on their own expectations, knowing that the inflation is one of those factors that influence the portfolio. The factors that affect the price of shares are divided into external and internal factors. External factors determine the macroeconomic environment in which the company operates. The main external factors are economic activity - GDP, inflation, exchange rate, the balance of payments, external debt, conditions in the industrial branch, existing market characteristics, political factors, etc. Internal factors are the result of the company's operation (Damnjanović, 2017).



The market price of shares reflects the quality and performance of the company's operation, and it is, therefore, an indicator of the justified share investments. Therefore, it is very important for investors in the financial market to approach a detailed financial analysis before assessing the value of the shares in which they intend to invest, as well as to quantify the impact of financial risk factors, such as inflation.

Testing and analysing the impact of the inflation rate on the share return of real sector companies in AP Vojvodina through GARCH econometric models in the domestic financial market, not only provide qualitative information on the impact effectiveness, but also analyse the differences between the observed impacts. The following hypotheses were tested in this research:

Basic hypothesis H0: GARCH model successfully tests the inflation impact on the share return of real sector companies in AP Vojvodina.

Furthermore, the additional hypothesis tested in the research goes as follows:

H1: The inflation rate positively influences the returns of the real sector companies in AP Vojvodina.

The paper is structured in the following way: the research subject, the goal, and the hypotheses are defined in the introductory notes. The next part of the paper presents relevant research literature. The third part deals with the methodology and sample used in the research. The results and discussion are presented in the last section, which is followed by the conclusions and references. The industrial companies examined in this study are headquartered in AP Vojvodina and they operate (sell their services, merchandise or products) all over the territory of the Republic of Serbia, yet, the research results are reliable and unrestricted.

LITERATURE REVIEW

The main tasks of the central bank are to maintain the price stability and the stability of the financial system. In addition, recent experience explicitly indicates that inflation is the result of the interaction of monetary objectives and market expectations and that it must be seen as a credibility problem. Kitanović and Krstić (2010) state that the inflation-measuring statistics are conceptualised in the way that they almost always overestimate the developmental scores, and they rarely, or never, show them in real terms. The total growth of prices would be a signal for overheating of the entire economy, with the resulting growth of interest rates and decreased production investments and employment.

Additionally, Serbian financial market has been characterized by insufficient development, low trading volume stocks, "shallowness", lack of continuous stock trading, low liquidity, lack of market transparency, high transaction costs, incomplete application of international accounting standards and low level of corporate governance.

According to Štajner, Ivanišević, Katić, and Penezić (2015), numerous factors, such as macroeconomic, political, socio-economic, demographic, technological, and environmental, affect the performance of companies. The service sector has gained a dominant role in Serbia's economic development after 2001. Moreover, the authors conclude that, whether it is about an expansion of the existing organisation, an establishment of a new one or a particular investment project, general regional information provides a quality basis and starting point for further analyses that should result in quality investment decisions.

The data have proven that higher inflation is mainly related to developing countries, and the volatility of stocks is higher in those countries than in developed markets (Barakat, Elgazzar and Hanafy, 2016). Since the 1930s, the research has shown that almost every country has had the worst stock



returns during high inflation periods. Real stock returns have been equal to the actual returns minus inflation. The evaluation results of the stock market index of S&P 500 over a ten-year period show that the highest real returns occurred when the inflation rate was between 2 and 3%. Inflation greater than or equal to 2 to 3% usually means that the U.S. macroeconomic environment has got problems that have varying impacts on the stock prices. More important than the actual returns is the volatility of returns caused by inflation and knowing how to invest in such an environment because of the financial risk. Financial market research has shown that at a high inflation time, the stock prices rise, while in the deflation period with low inflation rates, returns are higher; however, it may not be necessarily true for all financial markets.

Tripathi and Kumar (2014) studied the relationship between inflation and stock returns in BRICS countries¹ using panel analysis in the period from 2000 to 2013. The results show that there existed a significant positive correlation between inflation rates and stock returns in India and China and a significant negative correlation in Russia and Brazil. The panel results for individual markets did not reveal any long-term equilibrium in Russia, India and South Africa, while in case of Brazil and China, the results showed an established long-term equilibrium of the inflation rate and stock returns. Further integration tests on the panel found no long-term correlations between stock returns and inflation rates.

Engle, Ghysels and Sohn (2013) used GARCH models to assess the volatility of macroeconomic variables on the stock market. They got encouraging results in terms of long-term forecasting. The models included a long-term component forecast driven by inflation and industrial production growth. They concluded that the ideas of the short- and long-term component models guided by economic sources could be potentially extended to multivariate settings.

According to Duarte (2013), a stock's inflation risk can be written as the product of the market price of inflation risk and the stock's quantity of risk. In scientific research, it is proven that stocks whose returns covary negatively with inflation shocks have unconditionally higher returns. This implies that the average market price of the risk of inflationary shocks is negative: periods with positive inflationary shocks usually tend to be poor states of nature, and investors are willing to pay insurance in the form of lower mean returns when holding an inflation-mimicking portfolio. Furthermore, the paper concludes that the negative inflationary risk arises because high inflation today predicts low growth in future real consumption.

The authors Ang, Briere and Signori (2012) studied the inflation hedging ability of individual stocks in their research work. While the poor inflation hedging ability of the aggregate stock market has long been documented, there is considerable heterogeneity in how individual stock returns covary with inflation. Stocks with good inflation-hedging abilities have had higher returns, on average, than stocks with low inflation betas and tend to be drawn from the energy and technology sectors.

In their scientific research, Campbell and Vuolteenaho (2004) proved that high inflation was positively correlated with rationally expected long-term real dividend growth. It was further considered that inflation was a subjective risk premium. However, inflation is largely related to the wrong price, supporting Modigliani-Cohn's (1979) thesis that investors have subjective growth forecasts extrapolating previous nominal growth rates without taking into account the impact of time-varying inflation.

1 BRICS is an acronym for the association of the five major emerging economies: Brazil, Russia, India, China and South Africa. BRICS members are all developing countries, but they are distinguished by large, rapidly growing economies and significant impacts on regional and global affairs. Since 2014, five BRICS countries represent nearly 3 billion people, which account for 40% of the world's population and have a combined nominal GDP of \$ 16,039 trillion, i.e. 20% of the world GDP.



Since the aforementioned studies on the correlation between the inflation rate and stock returns clearly prove that the inflation rate shows either a positive or a negative effect depending on certain factors (e.g. the development of the financial market), the authors were motivated to examine the nature of these connections in the case of real sector companies in AP Vojvodina.

The review has shown diverse results of the inflation impact on stock markets and company return rates. The paper will present whether the impact of inflation is significant and to what extent, in relation to the returns of real sector companies in AP Vojvodina.

METHODOLOGY

The research sample included daily values, as well as the calculated return rates of the real sector companies of AP Vojvodina, listed in the Belexline Index: NIS a.d Novi Sad, Sojaprotein a.d Bečej, Vital a.d Vrbas, Veterinarski zavod a.d Subotica and Budućnost a.d Bačka Palanka. The period covered by the survey is from January 1, 2006, to December 31, 2016. The inflation rate impact was also observed in the ten-year period from 2006-2016.

According to Brooks (2008), the rate of returns can be shown as follows:

$$r_t = (\ln P_t / P_{t-1}) * 100 \tag{1}$$

where r_t is the logarithmic return rate of the observed shares at time t , while P_t and P_{t-1} are the empirical values of the shares of the observed series in the period t and in the previous period, i.e. in the period of the first delay.

In this paper, an appropriate methodology for modelling volatility and testing of research hypotheses has been used. The application of the GARCH (*Generalized Autoregressive Conditional Heteroskedasticity*) model is used to confirm the basic H0 and the auxiliary H1 hypotheses in the research; the most favourable GARCH model, showing the significance of the inflation rate impact, was selected for each company share and each observation period.

The GARCH model describes processes in which volatility changes are presented in the following way (Brooks, 2008). In the work on the sample, we use the GARCH (1,1) model for the time series Y_t

$$y_t = \varepsilon_t \tag{2}$$

$$\varepsilon_t = \sqrt{h_t} \eta_t, \eta_t \xrightarrow{IID} N(0,1) \tag{3}$$

$$h_t = a_0 + \sum_{i=1}^q a_i \varepsilon_{t-i}^2 + \sum_{j=1}^p b_j h_{t-j} \tag{4}$$

$$h_t = C_0 + C_1 h_{t-1} + C_2 \varepsilon_{t-1}^2 \tag{5}$$

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \dots + \alpha_q Y_{t-q} + \varepsilon_t \tag{6}$$

where h_t is a conditional variance, i.e. deviation from ε_t according to the information available in a time t . The GARCH(1.1) model connects a conditional variance h_t with the past squared errors and



past conditional variances. The basic version of the GARCH (1.1) model includes the inflation rate to measure the impact, so the GARCH (1.1) model is now as follows:

$$Y_t = C_0 + C_1 Y_{t-1} + \dots + C_q Y_{t-q} + ST_{INFL.} + \varepsilon_t \quad (7)$$

In order to select the best variations of the GARCH model, the following types of GARCH models have been used:

$$\log(h_t) = a_0 + \sum_{i=1}^q a_i g(\eta_{t-i}) + \sum_{i=1}^p b_i \log(h_{t-i}) \quad (8)$$

the EGARCH model in the form:

where $\varepsilon_t = \sqrt{h_t} \eta_t$ and $g(\eta_t) = \theta \eta_t + \gamma [|\eta_t| - E|\eta_t|]$ which are the pondered values of innovation in a model with the asymmetric effect between the positive and negative returns of the financial asset, while θ and γ are constant. The basic version of the EGARCH model includes the inflation rate to measure the impact, so the EGARCH model is now as follows:

$$\log h_t^2 = C + \beta \ln(h_{t-1}^2) + \alpha (\varepsilon_{t-1}) + C_1 ST_{INFLAC.} \quad (9)$$

and the TARARCH model that has the following form:

$$h_t^2 = w + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j}^2 + \sum_{i=1}^p \gamma_i I_{t-i} \varepsilon_{t-i}^2 \quad (10)$$

$$\text{where is } I_{t-1} = \begin{cases} 1 & \text{ako je } \varepsilon_{t-1} < 0 \\ 0 & \text{ako je } \varepsilon_{t-1} \geq 0 \end{cases}$$

where the function indicator is I_{t-1} , while α and β represent non-negative parameters that satisfy the condition $\alpha + \beta < 1$. Also, in the TGARCH model, the conditional volatility h_t^2 is positive if $\alpha + \gamma \geq 1$, while the process is stationary in a covariance if and only if $(\alpha + \frac{\gamma}{2}) + \beta < 1$. The parameter γ measures the asymmetric or leverage effect in the sense that the artificial variable takes the value 1 if the residuals are negative or the value 0 if the residuals are non-negative. The basic version of the TGARCH model includes the inflation rate to measure the impact, so the TGARCH model is now as follows:

$$h_t^2 = C_0 + (\alpha + \gamma I_{t-1}) \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + C_1 ST_{INFLAC.} \quad (11)$$

where α and β represent non-negative parameters satisfying the condition $\alpha + \beta < 1$. Also, in the custom TGARCH model, the conditional volatility h_t^2 is positive if $\alpha + \gamma \geq 1$, while the process is stationary in covariance if and only if $\alpha + (\frac{\gamma}{2}) + \beta < 1$. The parameter γ measures the asymmetric or leverage effect in the sense that the artificial variable takes the value 1 if the residuals are negative, or the value is 0 if the residuals are non-negative.



All models in this paper were estimated using EViews, by the Marquardt algorithm optimization and Bollerslev and Wooldrige method for standard errors estimates. GARCH model parameters are estimated using the quasi-maximum likelihood – QML.

In the study, the selection of the adequate model was based on AIC (*Akaike Information Criterion*), SICS (*Schwarz Information Criterion*) and HQC (*Hannan-Quinn*) information criteria that were used to choose the most favourable models and confirming the research hypotheses. According to Gujarati (2010), the used criteria are calculated as follows:

$$AIC = 1_n(\widehat{\sigma^2}) + \frac{2k}{T} \tag{12}$$

$$SIC = 1_n(\widehat{\sigma^2}) + \frac{k}{T} 1_n T \tag{13}$$

$$HQC = 1_n(\widehat{\sigma^2}) + \frac{2k}{T} 1_n(1_n(T)) \tag{14}$$

where $\widehat{\sigma^2}$ is the residual variance, which is equivalent to the residual sum of the squares divided by the number of observations in the series, $k=p+q+1$ is the total number of estimated parameters, and T is the sample size. From the above-mentioned criteria, the strictest penalties are imposed by SIC criterion, AIC has the mildest penalties, while HQC is somewhere in-between. Although according to Brooks (2008), the best criterion cannot be claimed, the most favourable models were selected according to the lowest SIC information criterion.

In order to quantify the impact of the inflation rate, GARCH 1.1, TGARCH, and EGARCH models including the inflation will be applied for all the observed returns of companies from AP Vojvodina during the monitoring period. Then, using the AIC, SIC and HQC information criteria, the most favourable GARCH model will be selected between GARCH 1.1, TGARCH and EGARCH for the observation period, and separately for each AP Vojvodina company whose returns were observed. Finally, the comparison of the results of the selected most favourable GARCH models will be presented in order to quantify the impact of inflation rate and test the hypotheses.

The link to the data used in the research for stock prices time series and inflation rate is: <https://data.mendeley.com/datasets/9gw8jwm6kd/1>

RESEARCH RESULTS AND DISCUSSION

This part of the paper will present the research results of the applied GARCH model for analyzing, testing and quantification of the impact of the inflation rate on the returns from the investment activities in the real sector companies of AP Vojvodina. In the following section, the best model for each of the observed companies in the monitored period will be first selected, and then the residual motion will be graphically presented. The following tables refer to the presentation of the best models and the display of the normal distribution of the sample.

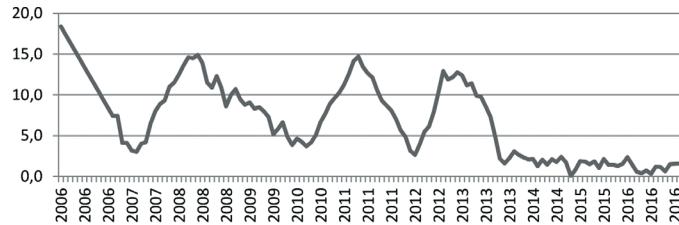


Figure 1. Inflation rate movement in the period from 2006-2016

Source: The authors' work based on data from the NBS, 2017².

Figure 1 shows the inflation rates in Serbia in the observed ten-year period from 2006 to 2016. As a factor of financial risk, the inflation rate showed cyclical movement, due to the structural problems of the Serbian economy inherited from the previous period. During the observed period, the inflation rate had been steadily growing and declining, until the middle of 2013, when the inflation rate stabilized at the level of one to three per cent on average.

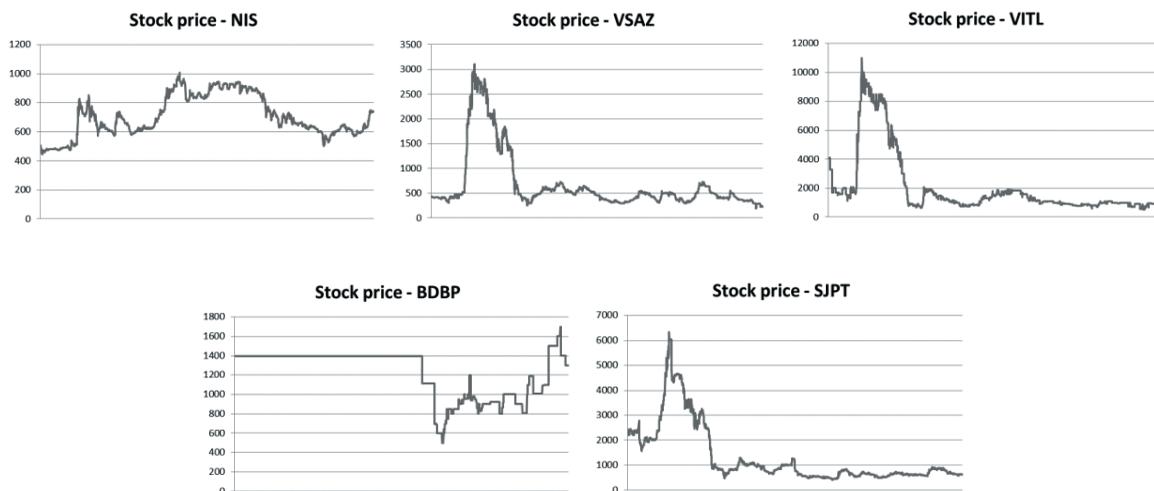


Figure 2. Stock prices data of the observed company in the period from 2006-2016

Source: Calculation by the authors

The prices of shares were observed at the daily level (daily rates of return) while the inflation rate was observed on a monthly basis. The relationship between the inflation rate and the daily rates of return was observed over a ten-year period, which implied medium and long-term effects.

Table 1 presents a comparative overview of the GARCH model results for the impact of the inflation rate on the share returns of the observed companies of AP Vojvodina: NIS a.d. Novi Sad, Sojaprotein a.d. Becej, Vital a.d. Vrbas, Veterinarians Zavod a.d. Subotica and Budućnost a.d. Bačka Palanka, and in accordance with the above criteria, the optimal chosen models³.

2 Source: Central Bank of Serbia, <http://www.nbs.rs/>

3 It was not possible to establish a model for measuring the inflation rate impact on the returns of Budućnost a.d. Bačka Palanka (BDBP) due to the statistical significance of the probability density function (*Log likelihood*) estimated in the observed data values (for log likelihood = -1,996,392 => F-test=0.028 that is <0.05).

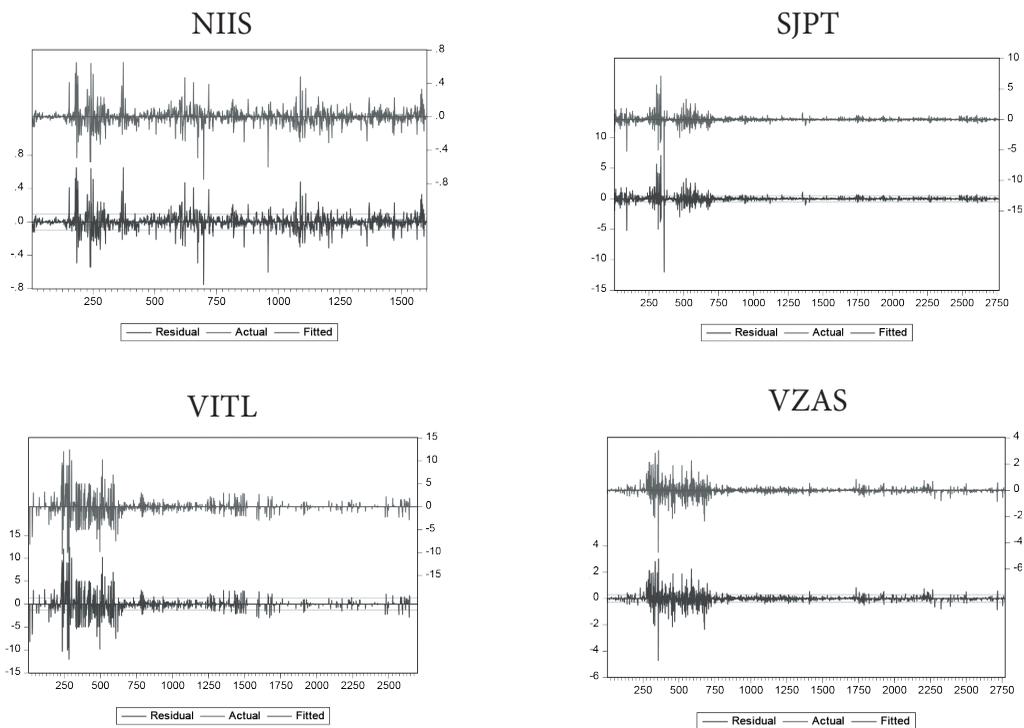


Kompanije APV	GARCH 1.1			TGARCH			EGARCH		
	AIC	SIC	HQC	AIC	SIC	HQC	AIC	SIC	HQC
NIIS	-4.863995	-4.754255	-4.819403	-4.849108	-4.717420	-4.795597	-4.857902	-4.857902	-4.857902
SJPT	2.055199	2.055199	2.055199	2.059074	2.059074	2.059074	2.048371	2.048371	2.048371
VITL	2.738930	2.738930	2.738930	2.886774	2.886774	2.886774	2.726628	2.726628	2.726628
VZAS	-2.802415	-2.802415	-2.802415	-2.872138	-2.872138	-2.872138	-2.852639	-2.852639	-2.852639

Table 1. Representative criteria for selecting optimal models

Source: Calculation by the authors

Based on the AIC, SIC and HQC criteria in Table 4.1, the most favourable GARCH models in the observation period were selected. The lower the AIC, SIC and HQC criteria, the more favourable the model. The results of the criteria applied for the optimal choice of GARCH models showed that EGARCH model was most favourable for measuring the inflation impact on the returns of the companies NIS, SJP and VITL, while TGARCH model was most favourable for VZAS.



Graph 1. Movement of the residual return rates of real sector companies in APV for the observed period from 2006 to 2016

Source: Calculation by the authors

Graph 1 shows the movement of the residual return rates of the observed companies in AP Vojvodina: NIS a.d Novi Sad, Sojaprotein a.d Bečej, Vital a.d Vrbas, Veterinarski zavod a.d Subotica in the observed period. The entire observation period clearly shows the extremely large fluctuations in the residual returns in the period marked by the global financial crisis. In the lower part of the graph, the



blue frame lines mark the average residual values of the daily return rates of the observed companies. Showing the movement of the residual returns, the graphs SJPT, VITL and VZAS represent fewer oscillations that indicate reduced trade volume. In the final observation years, small residual oscillations were also noticed, which indicates a slow recovery of the Serbian financial market from the consequences of the global financial and economic crisis.

Y - NIIS		Y - SJPT		Y - VITL		Y - VZAS	
Variance Equation EGARCH		Variance Equation EGARCH		Variance Equation EGARCH		Variance Equation TGARCH	
C(1)	-0.963087	C(1)	-1.053873	C(1)	-0.412522	C	0.003220
C(2)	0.438051	C(2)	0.551809	C(2)	-0.272910	RESID(-1)^2	0.047202
C(3)	0.064212	C(3)	-0.346755	C(3)	-0.379705	RESID(-1)^2* < 0	-0.111806
C(4)	0.931301	C(4)	0.328761	C(4)	0.668852	GARCH(-1)	0.513685
ST_INFL	0.013876	ST_INFL	0.019167	ST_INFL	0.051056	ST_INFL	-0.000183

where: C and C (1) are constants, RESID (-1)^2 is the square of the standardised residuals, i.e. the coefficient of the 1st order delays of the asymmetric adapted TGARCH model, GARCH (-1) - the GARCH effect of the univariate custom TGARCH model, RESID (-1)^2* < 0 - the asymmetric or leverage effect, C(2) - the ARCH effect, C(3) - the leverage effect, C(4) - the GARCH effect, ST_INFL - represents the independent variable of inflation rate models.

Table 2. The estimated parameters of the optimal GARCH model for measuring the inflation rate impact on the real sector shares of AP Vojvodina

Source: Calculation by the authors

Table 2 presents the most favourable evaluated GARCH models for measuring the inflation rate for the real sector companies of AP Vojvodina: NIS a.d Novi Sad, Sojaprotein a.d. Bečej, Vital a.d. Vrbas, Veterinarski zavod a.d Subotica in the observed period from 2006-2016.

The evaluated EGARCH model shows the positive impact of the inflation rate (0.013876) on the daily returns of NIS shares. The obtained results of the EGARCH model show that if the inflation rate was changed by 1 unit, the daily return rate Y of NIS a.d. Novi Sad shares would be 0.484353. This would further mean that if 1,000,000 funding units were invested in the shares of NIS a.d, the daily return would be 4,843.53 units.

The evaluated EGARCH model shows the positive impact of the inflation rate (0.019167) on the daily returns of Sojaprotein shares. The obtained results of the EGARCH model show that if the inflation rate was changed by 1 unit, the daily return rate Y of Sojaprotein a.d Bečej shares would be -0.50089. This would further mean that if 1,000,000 funding units were invested in the shares of Sojaprotein a.d, the daily return would be -5,008.91 units.

The evaluated EGARCH model shows the positive impact of the inflation rate (0.051056) on the daily returns of Vital shares. The obtained results of the EGARCH model show that if the inflation rate was changed by 1 unit, the daily return rate Y of Vital a.d Vrbas shares would be -0.34523. This would further mean that if 1,000,000 funding units were invested in the shares of Vital a.d, the daily return would be -3,452.29 units.

The estimated TGARCH model shows the negative impact of the inflation rate (-0.000183) on the daily returns of Veterinarski zavod shares. The obtained results of the TGARCH model show that if the



inflation rate was changed by 1 unit, the daily return rate Y of Veterinarski zavod a.d Subotica would be 0,452118. This would further mean that if 1,000,000 funding units were invested in the shares of the Veterinary Institute a.d, the daily return would be 4,521.18 units.

The research did not deal with marginal changes of the inflation rate (an increase from 1% to 2% might have a positive impact on stocks, but an increase from 9% to 13% may trigger a decline) and the impact on the market price of the shares. The paper tested only influence the rate of inflation as a factor influencing the daily rates of return. Future research could be focused on testing the marginal changes in inflation rates and impact on stock prices.

NIS a.d Novi Sad		Sojaprotein a.d Bečej		Vital a.d Vrbas		Veter. zavod a.d Subotica	
Series: Standardized Residuals							
Sample of data (adjusted) 21603		Sample of data (adjusted) 22767		Sample of data (adjusted) 22699		Sample of data (adjusted) 12771	
Included Observations of standardized residuals after adjustments 1602		Included Observations of standardized residuals after adjustments 2766		Included Observations of standardized residuals after adjustments 2698		Included Observations of standardized residuals after adjustments 2771	
Mean	-0.028170	Mean	0.024182	Mean	-0.093564	Mean	-0.049842
Median	-0.168407	Median	0.038538	Median	-1.62E-05	Median	0.032568
Maximum	3.956099	Maximum	3.701462	Maximum	5.301347	Maximum	3.968955
Minimum	-2.380546	Minimum	-3.347844	Minimum	-6.517267	Minimum	-4.350492
Std. Dev.	1.007914	Std. Dev.	1.003339	Std. Dev.	1.050697	Std. Dev.	1.017090
Skewness	0.663569	Skewness	0.181282	Skewness	-1.737992	Skewness	0.038116
Kurtosis	4.933591	Kurtosis	6.054484	Kurtosis	21.70036	Kurtosis	10.53410
Jarque-Bera	30.02123	Jarque-Bera	51.64307	Jarque-Bera	1974.748	Jarque-Bera	312.2269
Probability	0.000000	Probability	0.000000	Probability	0.000000	Probability	0.000000

Table 3. Distribution of standardized residuals daily returns of real sector companies of AP Vojvodina for the observed period from 2006 to 2016

Source: Calculation by the authors

Table 3 shows the value of basic statistical information for returns of investment in the real sector companies of AP Vojvodina: NIS a.d Novi Sad, Sojaprotein a.d Bečej, Vital a.d Vrbas, Veterinarski zavod a.d Subotica in the observed period from 2006-2016. First, the average daily returns had a negative sign for NIS (-0.03), Vital (-0.09) and Veterinary Institute (-0.05), while Sojaprotein shares had an average positive daily return (0.02). The table also shows the maximum and minimum return values of the real sector companies of AP Vojvodina: NIS a.d Novi Sad, Sojaprotein a.d Bečej, Vital a.d Vrbas, Veterinarski zavod a.d Subotica in the observed period, whose shares are quoted at the Belgrade Stock Exchange, Belexline. Furthermore, the amount of standard deviation shows the potential risk of investing in the observed shares of the real sector companies of AP Vojvodina. The standard deviation for NIS was (1.01), for Sojaprotein (1.00), for Veterinary Institute (1.02), while the largest deviation from



the average daily returns was recorded for Vital shares (1.05). The obtained results of the standard deviation in the observed Serbian financial market can be interpreted as a lack of larger trading activities within the Belexline index. Also, the asymmetry values of skewness and the values of the flattening of distribution (kurtosis - tells about the thickness of distribution tails, i.e. the possibilities for extreme events, the extreme movements in returns) of the observed real-sector companies of the APV speak of an abnormality in the distribution of the return. The values of the asymmetry of the distribution function in the observed period for NIS (0.66), SJPT (0.18) and VZAS (0.04) were slightly positive, which means that the right (positive) tail of the daily return distribution was longer with more positive than negative movements, which was not the case for VITL shares (-1.74). The distribution flattening was in values above 3 for NIS (4.93), SJPT (6.05), VITL (21.70) and VZAS (10.53) and it shows that the probability of extreme return movements of the observed shares was high.

CONCLUSIONS

The research results undoubtedly point to the importance of the research subject through the prism of validation, quantification and optimization of the inflation impact on investment activities in modern business conditions. The research tests the place, role and significance of the inflation rate on the assessment of the daily returns of real sector companies in AP Vojvodina: NIS a.d Novi Sad, Sojaprotein a.d Bečej, Vital a.d Vrbas, and Veterinarski zavod a.d Subotica. As researchers, the authors emphasized the importance of analysis and optimisation of the model performance in investing activities in the real sector of AP Vojvodina in the observed financial market, whose main features are instability and low efficiency.

The basic H0 hypothesis was set up, assuming that the application of the GARCH model can successfully test the inflation impact on the share returns of real sector companies in AP Vojvodina. The research and results, obtained by using the GARCH model, confirmed the basic hypothesis. On the given sample, the daily returns trends of the real sector companies in AP Vojvodina and the financial risk factor - the inflation rate in the observed period were directly correlated. The exception was the return of the shares of Budućnost a.d Bačka Palanka, where it was not possible to create a model because of the statistical significance of the probability density function (*Log likelihood*) estimated in the observed data values. In practice, this means that the share trade of Budućnost a.d recorded an extremely small volume in the observed period from 2006 to 2016, which resulted in equal (same) prices over a longer period, so the daily returns were equal to zero. Due to the high illiquidity and low volume of trading, the shares of Budućnost a.d. Bačka Palanka, the authors were not able to establish a model, i.e. to measure the inflation rate impact on returns.

Assuming that the inflation rate positively influenced the returns of the real sector companies of the AP Vojvodina in the observed period, the H1 hypothesis is partially confirmed. The research results show the positive impact of the inflation rate variable on the returns of the companies NIS a.d Novi Sad (0.013876), Sojaprotein a.d Bečej (0.019167) and Vital a.d Vrbas (0.051056), and a negative impact on the returns of Veterinarski zavod a.d Subotica (-0.000183). Company-specific factors like price elasticity of demand for the company products, financial leverage, currency exposure, etc. may affect the nature of relationship between inflation and stock prices, and this may help explain the heterogeneity observed in the results (the case of VZAS where the impact of inflation was different) and this should certainly be taken into account in the further research.



It can be concluded that the common feature of all observed shares of real sector companies in AP Vojvodina in the period from 2006 to 2016 is that there was no distribution normality and that different sample asymmetries and distortions were manifested in different periods.

The aforementioned facts point to the importance of testing the differences between various models of inflation impact evaluation and their different “behaviour” in certain market circumstances in the observed period. It was necessary to perform a holistic, comprehensive and systematic approach to the analysis, quantification and validation of investment expectations for the observed financial market of Serbia and the real sector companies of AP Vojvodina whose shares are listed within the Belexline index. The special quality of the research results stems from the fact that the study focused on the financial market of the developing country (Republic of Serbia), with a relatively small number of studies published with this topic.

The scientific contribution of work is reflected in the quality and significance of the research results and the possibilities of efficient application of methods that quantify the significance of the inflation rate influence on the level of daily returns of the real sector companies of AP Vojvodina. The practical contribution of the work is in the expanded possibilities of efficient application of the assessment of the inflation rate impact on the daily rates of return in everyday business decision-making on investment activities.

Despite the above contributions, on the one hand, the authors dealt with the problems and challenges that arose from the specificities of returns listed under the stock exchange index Belexline (developing financial market) and, on the other, the need for adjusting the tested GARCH models to the specificities of these markets. The largest research challenge was to apply econometric models and adjust the inflation rate impact on the observed returns of the shares of real sector companies in AP Vojvodina, thus enabling them to successfully apply and obtain results that are based on science and practice. The research did not deal with marginal changes of the inflation rate and the impact on the market price of the shares. The paper tested the inflation only as a factor influencing the daily rates of return. The directions for future research could be focused on testing the marginal changes of inflation rates and impact on stock prices.

Future research in this area should focus on expanding research focus on other company shares within the financial markets of developing countries, as well as extending the impact of financial factors. This will increase the flexibility of the tested econometric (GARCH) models in the light of the maximization of the effects from the investment activities. In this sense, the focus of future research will be extended and the applied methodology significantly modified to a higher level of flexibility and adaptability, taking into account the dynamics of changes in the financial markets caused by globalized trends.

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UTICAJ STOPE INFLACIJE NA PRINOSI OD AKCIJA U KOMPANIJAMA REALNOG SEKTORA U AP VOJVODINI

Rezime:

Uzimajući u obzir aktuelne trendove na domaćem finansijskom tržištu, predmet istraživanja u radu je analiziranje, testiranje i kvantifikacija uticaja stope inflacije na dnevne stope prinosa akcija kompanija realnog sektora AP Vojvodine. Cilj istraživanja jesu konkretna, u praksi testirana i kvantifikovana saznanja o mogućnostima i efikasnosti primene GARCH modela u funkciji kvantifikacije uticaja stope inflacije na stope prinosa akcija posmatranih kompanija. Vremenski period obuhvaćen istraživanjem je od 2006. do 2016-te godine i uključuje kompanije realnog sektora AP Vojvodine čije se akcije kotiraju u okviru berzanskog indeksa BELEXline. Rezultati istraživanja pokazuju tačnu korelacionu vezu između dnevnih stopa prinosa posmatranih kompanija i faktora finansijskog rizika - stope inflacije. Rezultati takođe pokazuju pozitivan uticaj varijable stope inflacije na prinose akcija kompanija NIS a.d (0.013876), Sojaprotein ad (0.019167) i Vital a.d (0.051056), a negativan uticaj na prinose akcija kompanije Veterinarski zavod a.d (-0.000183). Rezultati istraživanja potvrđuju ulogu i značaj primene ekonometrijskih modela u svetlu kvantifikacije faktora finansijskih rizika na prinose od aktivnosti investiranja u kompanije realnog sektora AP Vojvodine.

Ključne reči:

stopa inflacije,
prinosi akcija,
GARCH modeli,
realni sektor,
rizik,
investiranje.