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RECONSIDERING MONETARY POLICY: EXAMINATION OF THE RELATIONSHIP BETWEEN INTEREST RATE AND NOMINAL GDP GROWTH IN NORTH MACEDONIA

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Abstract

The subject of examination is the impact of short-term and long-term interest rates on nominal GDP in the period from 2004 to 2021 in the Republic of North Macedonia. The research is based on descriptive statistics, analysis of correlations between GDP and different periods of interest rates at the moment (t) and periods (t+1 to t+4) on the one hand and the other hand (t-1 to t-4), the tests for stationarity and cointegration, as well as evaluation of the VECM model. Additionally, based on the estimated VECM model, the Granger causality test was conducted, as well as the variance decomposition and impulse response function of GDP were calculated for all endogenous variables. The evaluated VECM model, and the equations within it, are statistically significant, exhibits a good fit, and the obtained results are stable and reliable. The results for North Macedonia in the analyzed period suggest that long-term and short-term interest rates are negatively correlated with nominal GDP and are in line with economic theory and empirical literature. Interest rates on treasury bills (short-term interest rates) have a statistically significant and negative impact on GDP in the long term (at a statistical significance level of 5%), while in the short term, they have a causal relationship with economic growth at a 10% statistical significance level. Interest rates on government bonds (long-term interest rates) do not have an impact on GDP in the short and long term.

Keywords: Interest rates on treasury bills, Interest rates on government bonds, Nominal GDP, North Macedonia

1. Introduction

Banks make money by taking deposits and paying low interest on those deposits and making loans at a higher interest rate, i.e. they "borrow short" from mortgagors and "lend long" to borrowers (McDonald, 2022). Financial institutions have great autonomy in determining interest rates, and great autonomy over the ratio of interest rates on deposits and loans denominated in local currency, although the reference interest rates for deposits and loans are set by the central bank (Li, 2022). All the major schools of economics, namely the classical, neoclassical, Keynesian, neoclassical, post-Keynesian, Austrian, and some ecological schools argue that lower interest rates stimulate economic growth and vice versa (Lee & Werner, 2018).

According to Snowdon & Vane (2005), the classical theory of interest rate determination plays a key role in ensuring that a deficiency in aggregate demand does not occur. Marshall, in his theory of the business cycle, attributes neutrality to interest rates. Changes in money, changes in the quantity of bank credit substitutes, and the price level transform neutral nominal interest rates into movements that affect real activity (Humphrey, 2004). The neoclassical school argues that in an economy with market power when the growth rate of the economy is greater than the real interest rate but less than the net marginal product of capital, this contributes to these two effects being in conflict (Ball & Mankiw, 2021). The neoclassical school argues that in an economy with market power when the growth rate of the economy is greater than the real interest rate but less than the net marginal product of capital, this contributes to these two effects being in conflict (Dimand, 2019).

On the other hand, Keynes' explanation of the determination of the interest rate indicated a lack of its classical predecessors, where the interest rate was determined by the demand for money about the supply of money

determined by the monetary authorities (Snowdon & Vane, 2005). The first part of the Keynesian analysis of investment demand states that investment is higher if the interest rate on loans is lower (McDonald, 2022). The incentive for lower interest rates on investment is one of the main channels of monetary influence in all macroeconomic theories, on the other hand, the negative impact of higher interest rates on investment hinders the macroeconomic effect of expenditure policy (Hall, et al., 1977). If the Keynesian theory claims that the interest rate combines the demand for liquidity and the money supply set by the central bank, on the contrary, the neoclassical theory suggests that the interest rate is the equilibrium price of capital and is determined by the supply of capital (savings) and the demand for capital (investment) (Kehrwald, 2014).

According to Amadeo (2022) monetarists say that central banks are more powerful than the government because they control the money supply, i.e. monetarists believe that monetary policy is more effective than fiscal policy (government spending and tax policy). One of the tools that governments have is monetary policy to influence the overall performance of the economy, i.e. through instruments such as interest rates to adjust the amount of money in the economy (Jahan & Papageorgiou, 2014). Seen according to economic theory, an increase in the money supply allows banks to lend more money to consumers, which contributes to the reduction of interest rates on loans and positively affects the economy. However, monetarists analyze real interest rates more than nominal ones, even though most published rates are nominal rates, while real rates remove the effects of inflation (Amadeo, 2022). Federal Reserve Chairman Bernanke cited the work of Milton Friedman in his decision to cut interest rates and increase the money supply to stimulate the economy during the global recession that began in 2007 in the United States (Jahan & Papageorgiou, 2014).

The abandonment of monetary aggregates is in itself a significant departure from orthodox monetary policy. Economists have argued that changes in the money supply, controlled by the central bank, contain important information about the future course of price movements and, secondly, interest rate policies themselves have been criticized as leading to undetermined price levels (Gnos & Rochon, 2007). Post-Keynesians argue that money is endogenous. This claim rests on evidence that in most countries, short-run money demand functions are unstable and that significant aggregates, such as M2 or M3, are very difficult to control (Gnos & Rochon, 2007). On the other hand, in the analysis of interest rates, according to Kalecki, it was argued that the long-term interest rate was a relevant interest rate for influencing investment decisions since it varied so little over time and could be taken as fixed and is ignored as a factor that creates cyclical variations in investment decisions (Lee, 2003).

Analyzing the classical, neoclassical, Keynesian, and monetary policy views on the impact of interest rates on economic activity, on the one hand, on the other hand, we cannot neglect the Austrian economic school. Austrian School theory warns that a free market economy will recover quickly, provided the government does not try to help by lowering interest rates and causing a misallocation of resources (McDonald, 2022). The Austrian school sees business cycles as a consequence of excessive growth in bank credit due to artificially low interest rates set by the central bank (Polleit, 2007).

The subject of the research is the analysis of the impact of long-term and short-term interest rates on the nominal gross domestic product in the Republic of North Macedonia for the period from 2004 to 2021. Hence, given the linear relationship and the cause/effect relationship of the variables of interest, the individual hypotheses (H1a) and (H1b) arise: Do long-term interest rates not cause/cause economic growth in the long/short term; the individual hypotheses (H2a): Do short-term interest rates have a negative/positive impact on nominal GDP growth; and (H2b): Short-term interest rates do not/have a causal impact in the short term on nominal GDP.

The aim of the research is an examination of the relationship between interest rates and nominal GDP growth. Apart from the basic objective of examining the correlation between the impact of interest rates and economic growth on the one hand, on the other hand, the objective is to examine their mutual cointegration and causality.

2. Literature review

Interest rates are the price of money, their movement in economic equilibrium is key to economic activity because, without equilibrium, quantities become more important than prices (Lee & Werner, 2018). According to Lee and Werner's research, it is confirmed that in reality, one cannot expect partial, let alone general equilibrium, where equilibrium is a theoretical construct that is unlikely to be observed in practice. An oft-repeated claim by most economic schools and central banks is that lower interest rates will stimulate economic growth and higher rates will slow it down, but Werner in his research finds the opposite finding that price variables (interest rates) have little explanatory power, while quantitative variables (amount of credit generation) have greater explanatory power (Lee & Werner, 2018). There are two main lines of literature: the first, the Keynesian view, that a higher interest rate reduces investment and thus economic growth, and the second, the MacKinnon-Shaw hypothesis, that an increase in the interest rate improves the efficiency of investment and accelerates economic growth.

Relying on the empirical literature, a group of authors examines the causal relationship of interest rates with changes in economic growth according to Araujo (2017) and Jacobs, et al. (2020). Another group argues the negative impact of interest rates on economic activity (Bosworth, 2013; Harswari, 2017; Christie, et al., 2021). A third group investigates the impact of low/negative interest rates on economic activity (Cour-Thimann & Jung, 2020; Kenji, 2021).

The long-term real interest rate plays a vital role in the transmission of shocks to economic growth a survey of 27 EU countries and 4 OECD countries according to Jacobs, et al. (2020). On the other hand, Araujo (2017) indicates that there is no statistically significant relationship between interest rates and economic growth in the United States, the European Union, and Japan using the method of ordinary least squares.

Capital markets are highly integrated globally and it makes no sense to model, analyze, or forecast interest rates in a framework with the nearby economy. There is only a weak relationship between real interest rates and economic growth (Bosworth, 2013). In 20 countries in Asia, the interest rate has a negative significant impact on the gross domestic product according to Harswari (2017), and on the other hand, in the Southern African Customs Union (SACU) countries, the interest rate harms growth in the long run (Christie, et al., 2021).

The ECB reacted to risks to price stability and the evolution of the federal funds rate, thereby confirming the importance of links to international interest rates (Cour-Thimann & Jung, 2020). The situation in which nominal growth rates exceed nominal long-term interest rates should not be considered eternal. The long-term movement of nominal long-term interest rates is shaped by the potential growth rate and the expected inflation rate (Kenji, 2021).

3. Methods

This research used quarterly data from the databases of the National Bank of the Republic of North Macedonia (NBRNM), the Ministry of Finance (MoF), and the State Statistical Office (SSO) for the period from 2004 to 2021. The research took into account the interest rates of treasury bills, the interest rates of government bonds, and the nominal gross domestic product of the RNM (Table 1). The interest rates of treasury bills and government bonds are calculated based on the data from NBRSM and are expressed in percentages (%), but we have previously compared and checked them with the interest rates of securities from the database of the Ministry of Finance. The nominal GDP was calculated based on the current prices in millions of denars from the SSO database and since it is expressed in absolute amounts in further research, their logarithmic transformation was made using the statistical software Eviews.

Table 1. Variables, Description, and Source

Variable	Description Source	Source
KS_DZ	Interest rates on treasury bills (short-term interest rates)	NBRNM
KS_DO	Interest rates on government bonds (long-term interest rates)	NBRNM
BDP	Nominal GDP (current prices), millions of denars	SSO

Source: Authors' calculation

The purpose of the comparison of interest rate data from the two databases was based on the fact that government securities are risk-free securities issued by the Ministry of Finance on behalf of the Government of the Republic of North Macedonia, and government securities are also sold through auctions that are organized through the agent of the Ministry of Finance, which is NBRSM (finance.gov.mk, 2022). The first analysis of the accumulated data from the Ministry of Finance was reduced to the grouping of the interest rates of the government securities with foreign exchange clauses in a period of 3 months, 6 months, 12 months, and from 2 to 30 years. Interest rates without a foreign exchange clause are also grouped, where interest rates on treasury bills are guaranteed for up to 12 months, while interest rates on government bonds are guaranteed from 2 to 15 years. Since the beginning of the issuance of continuous government securities by the MoF, the portfolio consisted of treasury bills of 1 month, 3 months, 6 months, and 12 months and government bonds with maturities of 2 years, 3 years, 5 years, 10 years and 15 years (finance.gov.mk, 2022). The performance of first analysis of the data from the Ministry of Finance was carried out by analyzing the average interest rates on treasury bills, that is, the average values of short-term interest rates with and without a foreign exchange clause with a maturity period of 1 to 12 months on the one hand. On the other hand, the average interest rates on government bonds (long-term interest rates) with and without a foreign exchange clause, with a maturity period of 2 to 30 years, were grouped and analyzed1. We derived the corresponding monthly data on short-term and long-term interest rates, provided by the Ministry of Finance through a moving average of the previous three months, through the quarterly values of interest rates on treasury bills and government bonds.

The second analysis boils down to analyzing the interest rates of government bills according to the archive of held auctions of treasury bills and government bonds from the NBRNM database[2]. The research relies on the short-term and long-term interest rates from the NBRNM database because the values provided to the respective variables by the MF are derived through the average values. The nominal GDP values for 2021Q1 were not updated from the SSO database and the value was obtained with the average of the previous two quarters, i.e. (2021Q1 and 2021Q2). For interest rates on treasury bills, the values for the first and third quarters of 2006 are provided as an average of two previous values so that there is no break in the time series. The GDP growth rate was subsequently analyzed following the Lee and Werner model, but in further research, the variables are first differenced, where variables are seasonally adjusted using the Census 12 method, additively, to avoid possible bias as a result of the pronounced seasonal influence, given that it is a question of quarterly data.

The analysis is based on the available data on nominal GDP in the Republic of North Macedonia, interest rates on treasury bills (short-term securities), and interest rates on government bonds (long-term securities), where from a methodological point of view the analysis is based on the approach of Lee and Werner. Namely, they use dynamic conditional correlation – DCC-GARCH dynamic models, and we use a VECM model with several different specifications for the time lags. According to empirical studies, the VAR model can be specified in the form of VECM if the set of variables are stationary at I(1) and the variables in the system have a long-term relationship, that is, they are cointegrated. If cointegration between the series is detected, we know

[1] https://finance.gov.mk/statistical-review-3/?lang=en (accessed on: 25.03.2022)
[2] https://www.nbrm.mk/auktsii_na_drzhavni_khartii_od_vriednost.nspx (accessed on: 25.03.2022)

that there is a long-run equilibrium relationship between them, so we apply VECM to evaluate the short-run properties of the cointegrated series (Asari, et al., 2011).

$$\Delta logBDP\_SA = \beta_{0.1} + \alpha_{1.1}(\log BDP\_SA_{t-1} - \delta_1 KS\_DO\_SA_{t-1} - \delta_2 KS\_DZ\_SA_{t-1} - \delta_3 @TREND(04Q1) - \delta_0) + \beta_{1.p.1} \sum_{p=1}^{n} \Delta logBDP\_SA_{t-p} + \beta_{2.p.1} \sum_{p=1}^{n} \Delta \text{KS\_DO\_SA}_{t-p} + \beta_{3.p.1} \sum_{p=1}^{n} \Delta KS\_DZ\_SA_{t-p} + \beta_{k.1} DUM\_2020 + u_1 \quad (1)$$

In mathematical form, the estimated VECM model can be shown as in equation (1); the GDP equation is analyzed, because the research relies on the impact of long-term and short-term interest rates on nominal GDP. The coefficients β_0 denote the intercept coefficient in the equation, while the coefficients α_1 are the cointegration coefficients. According to the econometric theory, the cointegration coefficients should be statistically significant and negative, thus indicating that the model tends to return to the long-term equilibrium with an adjustment speed equal to the cointegration coefficient. The equation $(\log BDP\_SA_{t-1} - \delta_1 \text{KS\_DO}_{t-1} - \delta_2 KS\_DZ\_SA_{t-1} - \delta_3 @TREND(04Q1) - \delta_0)$ denotes the cointegration relationship between the variables, this equation shows the long-run association of the variables. The short-term relationship, on the other hand, is expressed through the coefficients β_1, $\beta_{2,}$ and β_3, that is, through the lags (p) of each of the endogenous variables, (n) is the differentiated optimal number of time lags, the dummy variable for the second quarter in 2020, and (u_1) is the random error.

4. Results

In the descriptive statistics for the variables, nominal GDP, short-term and long-term interest rates are seasonally unadjusted and analyzed while seasonally adjusted for further analysis under unit root, cointegration, and analysis of the marginal (long-term) and short-term impact of interest rates on economic growth. It is noted that the nominal GDP, in the investigated period, with maximum values was recorded in the fourth quarter (Q4) of 2020. Although it is the period of the coronavirus crisis, the effects of state measures to encourage economic growth in RNM are noticeable. On the other hand, the lowest amounts of nominal GDP were registered in the first quarter (Q1) of 2004 (Table 2). Among long-term interest rates, the highest rate was registered in the third quarter (Q3) of 2005 at 12.06%, while the lowest rate was recorded in the period of the coronavirus crisis in the fourth quarter (Q4) of 2020 at 1.3%. The average of long-term interest rates for 72 observations in RSM is 5.5% with a standard deviation of 2.8. Short-term interest rates of 10.56% were recorded in the third quarter (Q3) of 2005, consequently, the highest rate was also recorded for long-term interest rates. The lowest short-term interest rate for the researched period was registered in the first quarter (Q1) of 2021 at 0.4%. In a total of 72 observations of short-term interest rates, the average value is 4% and the standard deviation is 2.9.

Table 2. Descriptive statistics

Measure	BDP	KS_DO	KS_DZ
Average	124978,8	5,5	4,0
Median	123628	5,2	3,9
Maximum	185599	12,1	10,6
Minimum	60543	1,3	0,4
Std. Dev.	33787,5	2,8	2,9
Observations	72	72	72

Source: Author's calculations

In the following, the line graphs of the three variables are interpreted, where the need for seasonal adjustment is noted (Figure 1). GDP has seen constant growth over the years, with the seasonal impact of long-term interest rates being pronounced and declining until the third quarter of 2021 to 1.65%. Also, a noticeable downward trend was registered in short-term interest rates, which reached 0.5% by the third quarter of 2021. Volatility was significantly more pronounced in the pre-crisis period until 2009 (we have a drop in interest rates, and then their growth), where after the great economic crisis, the downward trend of long-term and short-term interest rates became more and more certain. Because there is a seasonal influence in the variables and it is especially observed in the GDP, a seasonal adjustment is approached, as can be seen, the impact of the great economic crisis has no significant impact on the GDP. On the other hand, in the second quarter (Q2) of 2020, i.e. at the time of the coronavirus crisis, a significant drop in nominal GDP (both unadjusted GDP and adjusted GDP) was observed. Therefore, in further research for the second quarter of 2020, a dummy variable is introduced to avoid the volatility of the time series in the calculations. It is noted that the dummy variable is statistically significant in all periods of lags and in the period of the coronavirus crisis with two-time lags, an average of 19% reduced economic growth was recorded, where the coefficient = (-0.19); standard error = (-0.03) and t-statistic = [-7.02259].

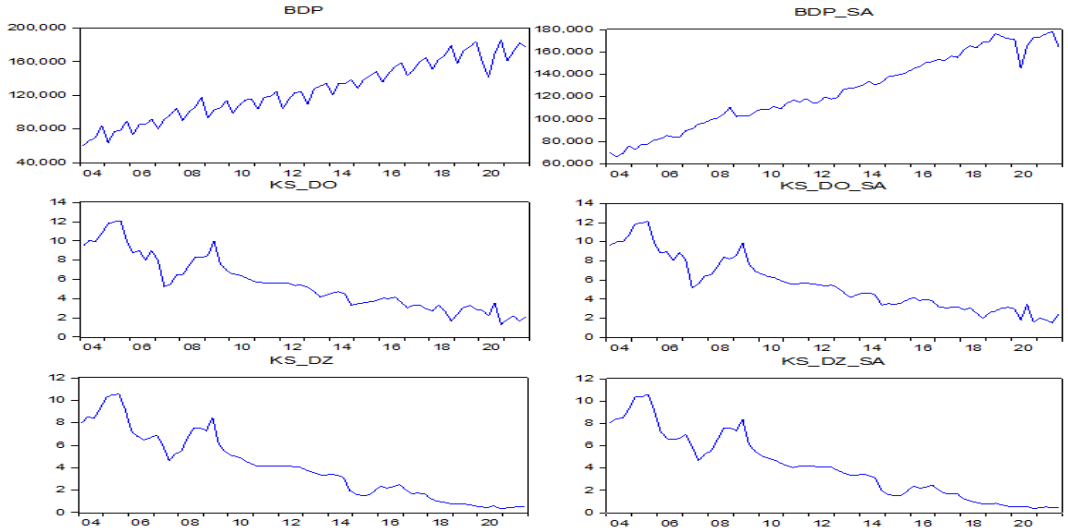

Figure 1. Modeling non-seasonal and seasonal adjustment

Source: Authors' calculation, based on the data submitted by the National Bank and State Statistical Office of the Republic of North Macedonia

The research relies on the correlation of nominal GDP with short-term and long-term interest rates, for the current and 4 periods back, and 4 periods forward. This approach is based on research by Lee and Werner who find a positive relationship, contrary to economic theory. From the aspect of correlation, a negative linear relationship is expressed (Table 3) where for long-term interest rates and GDP it ranges between -0.86 and -0.90, while for short-term interest rates and GDP, the average value of the correlation is - 0.90. There is a strong negative relationship between short-term and long-term interest rates on GDP. The negative linear relationship between short-term interest rates on GDP is more pronounced compared to the negative linear relationship between long-term interest rates on economic growth. When analyzing the correlations between GDP and different periods of short-term and long-term interest rates at time (t) and periods (t+1 to t+4) are almost identical compared to the correlations of GDP and interest rates periods (t-1 to t-4). This result of the linear relationship confirms that short-term and long-term interest rates negatively follow economic growth.

Table 3. Correlation between nominal GDP and short-term and long-term interest rates

Period	BDP	Period	BDP
KS_DO (t-1)	-0,88	KS_DZ (t-1)	-0,90
KS_DO (t-2)	-0,89	KS_DZ (t-2)	-0,91
KS_DO (t-3)	-0,90	KS_DZ (t-3)	-0,91
KS_DO (t-4)	-0,90	KS_DZ (t-4)	-0,91
KS_DO (t)	-0,88	KS_DZ (t)	-0,90
KS_DO (t+1)	-0,89	KS_DZ (t+1)	-0,91
KS_DO (t+2)	-0,87	KS_DZ (t+2)	-0,90
KS_DO (t+3)	-0,86	KS_DZ (t+3)	-0,90
KS_DO (t+4)	-0,88	KS_DZ (t+4)	-0,90

Source: Author's calculations

Hansen & Seshadri (2013) analyze long-term interest rates and productivity growth as proxies of economic growth with a focus on estimating their long-term correlation in the United States. Their results indicate a moderately negative correlation, which implies that long-term low-interest rates will tend to high economic growth and vice versa.

To determine the order of identification of the time series of the variables, the extended Dickey-Fuller test (Table 4) was used, with automatic selection of lags, based on the Schwartz information criterion, with a maximum of 11 included lags (Eviews default).

Table 4. Unit root and stationarity (p-values)

Test specification	KS_DO_SA	KS_DZ_SA	BDP_SA
Intercept	0,5981	0,7676	0,6311
Trend and intercept	0,0895	0,0245	0,0037
None	0,1000	0,0608	0,9966
1st difference - None	0,0000	0,0000	0,0000

Source: Author's calculations

The test is made for three specifications (with intercept, with trend, and intercept, as well as none). If the variable is non-stationary about its original values, the approach is to perform this test on its first difference (differenced values), without including the trend and intercept in the test equation.

The number of endogenous variables in the survey is 3 and considering the nature of the quarterly data, the maximum number of time lags we would include in the construction of the model is 12, covering 3 years. The Akakike information criterion, as well as the majority of other information criteria, show that the optimal number of time lags is 3 when we enter a criterion below 10 time lags in the specifications. On the other hand, when we enter a criterion of more than 10 time lags in the specifications, then the optimal number of time lags is 12. The focus of the research will be on 3 optimal time lags because the optimal number of time lags is determined based on VAR - the model for non-stationary variables, when differentiating them and when conducting the Johansen cointegration test, one lag is lost when evaluating the VECM model. Hence, the number of time lags taken into account in the analysis is 2, that is, a period of half a year.

Namely, if it is assumed that there is no trend in the cointegration equation, the tests show a different number of cointegration equations. On the other hand, if we consider that there is a trend in the cointegration equation, the tests are almost unanimous that there is one cointegration equation (Table 5). To simplify the analysis, it

will proceed based on the fourth specification, that is, by including a linear trend in the data, as well as an intercept and trend in the cointegration equation.

Table 5. Johansen's Cointegration Test

Lags	Data Trend:	None	None	Linear	Linear	Quadratic
	Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
		No Trend	No Trend	No Trend	Trend	Trend
2	Trace	2	3	3	**1**	1
	Max-Eig	2	3	1	**1**	1

Source: Author's calculations

When evaluating the models, the adjusted coefficient of determination in the two-time lag model is 0.53 with 69 observations included and the F-statistic is 10.56. In the model, there is no presence of heteroskedasticity and autocorrelation at the level of statistical significance of 0.05. When analyzing the normal distribution with the Cholesky method for the covariance, we analyzed the first component, that is, the GDP component, where the Jarque-Bera statistic indicates that there is no normal distribution of the residuals (Table 6).

Table 6. Summary of key statistical indicators from the evaluated VECM model

Indicators	**VECM_2**
CointEq1	-0,19
R-squared	0,58
Adj. R-squared	0,53
F-statistic	10,56
Prob. F-statistics	0.000
Breusch-Godfrey Serial Correlation (1 lag) – LM Test	0,033 *
White test – no White cross term included	4,13*
Jarque-Bera statistics	13,4
Observations	69
Note: Coefficients marked with * are statistically insignificant at the 0.05 level	

Source: Author's calculations

In the estimated model, we have three endogenous variables, where no inverse root is outside the boundaries of the inverse-root graph and the model is in a stable state. It can be concluded that it is stationary, there are 2 single inverse roots in the model (Figure 2), which is by the rule: the number of single inverse roots in the VECM model should be equal to the number of endogenous variables minus the number of cointegration equations.

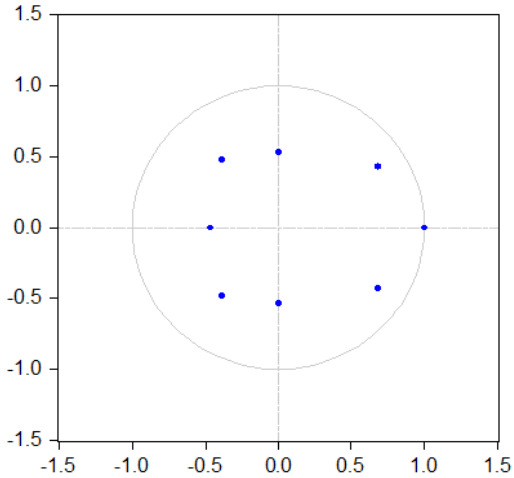

Figure 2. Inverse roots in the estimated VECM model
Source: Authors' calculation

In the analysis of the prediction metrics within the sample, a static prediction (one period ahead) was performed for the variable BDP_SA, to evaluate the predictive capacities of the model. When evaluating the forecast, the indicators are followed, consequently the RMSE (root mean squared error). The MAE (mean absolute error) metric and the MAPE (mean absolute percentage error) metric. As expected, the prediction error, according to all three indicators, decreases with increasing number of lags in the model. For illustration, the MAPE for the model with 2-time lags is 1.84%.

In the evaluated model, only the interest rates on treasury bills are statistically significant, the t-statistic=[2.79807]. The cointegration coefficients are significant, where the model tends to return to balance, that is, the model has a long-term relationship and converges to a long-term equilibrium, given that the data has a trend in the concluded equations, we assume that we will have a trend in the cointegration relationships as well. Between GDP, short-term and long-term interest rates in RNM there is a statistically significant cointegration relationship with a cointegration coefficient of -0.19.

Short-term interest rates have a statistically significant and negative impact on GDP (the null hypothesis of H2a is not rejected); while the long-term have no significant impact (the null hypothesis of H1a is not rejected). Namely, the result is that long-term interest rates do not have a statistically significant impact on economic growth in the long term.

In the short-term relationship, in the estimated model, long-term interest rates have no impact on GDP (the null hypothesis of H1b is not rejected); while interest rates on treasury bills have a cause-and-effect relationship on economic growth (the null hypothesis of H2b is rejected), the causality is at the level of statistical significance of 10% (p = 0.0769), (Table 7).

If in the context of the results of the Granger causality test, we take into account the direction of GDP towards interest rates, the test shows the presence of causality of GDP towards long-term interest rates. The causal relationship of GDP on interest rates of government bonds is at the level of statistical significance of 1% (p = 0.0034). Certain signs of influence are observed in GDP towards short-term interest rates, at the level of statistical significance of 5% (p = 0.0151). There is also a certain influence of long-term interest rates on short-term interest rates, but not vice versa, at the level of statistical significance of 1% (p = 0.0027), where the theory that short-term interest rates follow long-term interest rates is confirmed.

Table 7. Granger causality test

	Dependent			
Independent	Variables	ΔLOG(BDP_SA)	Δ(KS_DO_SA)	Δ(KS_DZ_SA)
	ΔLOG(BDP_SA)	-	11,36***	8,38**
	Δ(KS_DO_SA)	1,41	-	13,34***
	Δ(KS_DZ_SA)	5,13*	3,68	-
Note: *, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively**				

Source: Author's calculations

Although, according to the evaluated models, most of the variations of GDP are explained through its lags, a significant part is also explained through the variations of long-term interest rates, while short-term interest rates explain a very small part of the variations of GDP in RNM (Figure 3-left). The variance decomposition is analyzed up to the 10th period back, through the variance decomposition of GDP through its lags and the variance decomposition of GDP through the changes in short-term and long-term interest rates. Decomposing the variance of GDP through its lags up to 10 periods back, GDP itself will explain about 70%. In addition, from the variance analysis, the impact of long-term interest rates on GDP can be observed, which increases over time, that is, in the long term, it reaches 27% of the variations in the evaluated model. On the other hand, when decomposing the variance of GDP, it is noted that in the long term, the impact of short-term interest rates on GDP is small, reaching up to 4%.

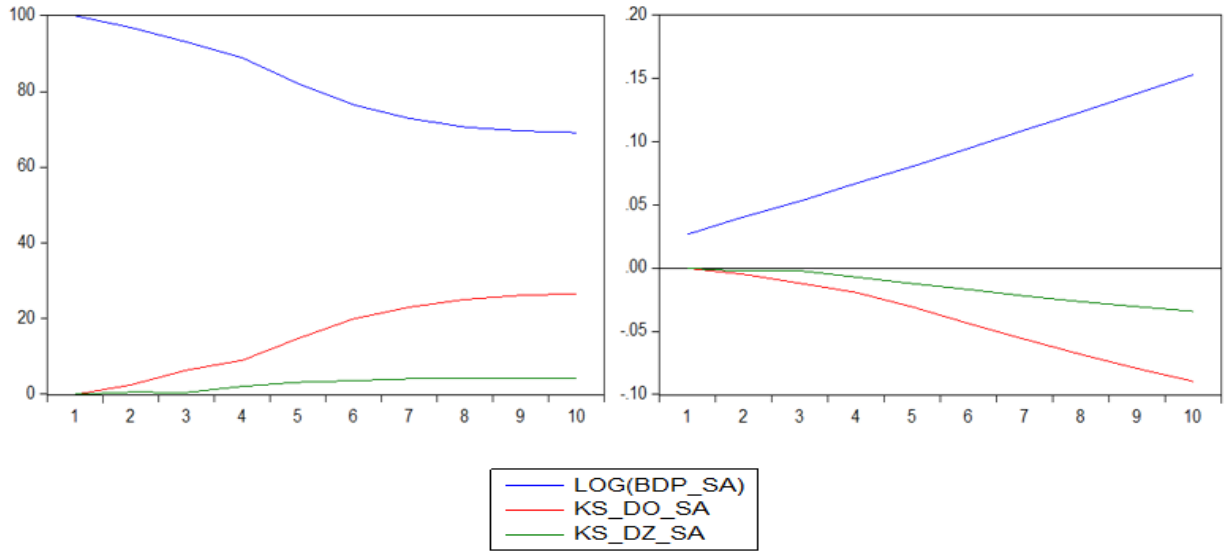

Figure 3. Decomposition of variance of GDP (left Figure) and impulse responses (accumulated) to GDP for the remaining endogenous variables (right Figure)
Source: Authors' calculation

Regarding the impulse response of GDP as a result of interest rate shocks, the results show that a shock to long-term interest rates would cause significantly more pronounced distortions in GDP than an eventual shock to short-term interest rates, which would amortize relatively quickly and the system would return to balance. To analyze the relationship of the endogenous variables, we use the impulse response through which the reactions of the other variables are monitored during a possible shock to another variable. In the research, the analysis of the accumulated impulse responses of the combined representation of the GDP responses is taken (Figure 3-right).

In the accumulated impulse responses, the directions of the long-term impact of GDP for all endogenous variables are followed. In the evaluated model, the shock of long-term interest rates causes negative effects on GDP starting from the second period with a tendency to increase in the long term. The short-term interest rate shock causes negative effects on GDP after the third period with a tendency to increase in the long term.

5. Conclusions

The research is based on the impact of short-term and long-term interest rates on nominal GDP by applying the VECM model, in the period from 2004 to 2021, in the Republic of North Macedonia. According to the theoretical and empirical literature, there is a strong negative linear relationship (correlation) between GDP and interest rates in the RNM, which is slightly more pronounced in the case of short-term interest rates. This correlation is present for 4 past and 4 future periods of interest rates. With GDP there is a pronounced seasonal influence, while with interest rates the season has no visible influence, the variables are non-stationary of the first order and there is a co-integration (long-term) relationship between them.

The focus of the research is set with 2-time lags. The model is statistically significant and has a fit of 53%. Regarding the predictive capacities of the models, they have been evaluated using several indicators related to the prediction error. As expected, the prediction error according to all three indicators decreases with an increasing number of lags in the model, but the difference is not large.

According to the evaluated model, there is a statistically significant cointegration relationship between GDP, and short-term and long-term interest rates in RNM, the cointegration coefficient is -0.19. Regarding the long-term impact, short-term interest rates have a statistically significant and negative impact on GDP, while long-term interest rates do not have a significant impact.

Unlike the long-term relationship, in the short-term relationship, long-term interest rates have no impact on GDP, while interest rates on treasury bills have a causal relationship with economic growth at the 10% statistical significance level. Certain signs of influence are observed in the reverse direction, from GDP to interest rates, especially long-term interest rates. Also, a certain influence of long-term on short-term interest rates is noticeable, but not the other way around. The results are consistent with economic theory and the findings of central banks, that lower interest rates, in our case interest rates on treasury bills, lead to higher economic growth. The research findings are contrary to Lee Werner's research, where their results in both dimensions (correlation and causality) confirm that interest rates do not contribute to economic growth, that is, their research confirms that higher growth causes higher interest rates. The Bank of England, the European Central Bank, and the Bank of Japan cannot stimulate growth by cutting rates, instead, the Fed stimulates growth by raising rates, while cutting rates causes weaker growth (Lee & Werner, 2018).

Although, according to the evaluated models, most of the variations in GDP are explained through their lags, a significant part is also explained through the variations of long-term interest rates, while short-term interest rates explain a very small part of the variations of GDP in RNM. Regarding the impulse response of GDP as a result of interest rate shocks, the results show that a shock to long-term interest rates would cause significantly more pronounced distortions in GDP than an eventual shock to short-term interest rates, which would amortize relatively quickly and the system would return to balance.

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