DETERMINANTS OF BENCHMARK INTEREST RATE: EVIDENCE FROM TURKISH BOND MARKETS

Mehmet Kuzu
Bayburt Universty, Department of Business Administration, Bayburt, Turkey.
Mehmetkuzu86@gmail.com , ORCID:0000-0001-5354-4368

ABSTRACT

Purpose- The aim of this study is to analyze the determinants of benchmark interest rate for Turkey that on framework of Turkey's economic and financial determinants of the political cycle of Turkey and examine their relationships and the interactions of indicators to determined benchmark interest rates.
Methodology- In this study, Augmented Dickey Fuller unit root test was applied to select the method by which long and short term relationships will be determined. Since the series are stationary at the same level, the VAR model was established and the short-term relationships were examined with the long-term vector error correction model with the Johansen cointegration test. Impulse-response analysis, variance decomposition and historical decomposition tests were carried out within the framework of the Granger test test in order to determine the interactions between variables.
Findings- The benchmark interest rate is balanced in the short and long term with the selected variables and the deviations in the short term can be corrected in the long term. The variables that affect the benchmark interest the most are gold, inflation and US 10-year bond rates.
Conclusion- The sensitivity of the benchmark rate is high against the shock waves arising from gold prices, inflation and US 10-year bond rates. Central bank Weighted average funding cost is more determinant in the formation of market rates than real interest rates. In short, the central bank monetary policy, inflation expectations and interest rates and gold prices abroad determines the formation of market interest for Turkey.

Keywords: Benchmark rate, real interest, government bonds, VAR model, Johansen Cointegration Test.
JEL Codes: F37, G23, f39

1. INTRODUCTION

Benchmark interest; It refers to the secondary market interest of the Government Bond, which has 2 years to maturity and has a coupon payment every 3 months. This interest; TRT130515T11 is the interest of the government bond for Turkey. This interest is named as benchmark interest since it is taken as a reference for many transactions. Benchmark interest rate is a financial tool used to determine the base price of bonds. This interest rate is the market price of the bond that is bought and sold in the secondary market. The development of the bond markets is related to inflation rates.

Global financial system; The use of fund surpluses in advanced countries to emerging countries in return for capital gains has been structured within the framework of financial policy. In a sense, at the global level, it can be stated that investors carry their savings from financial markets where the cost of money is low to the markets where the cost is higher for capital gain.

The global financial political cycle, which became institutionalized in the 2000s, triggered financial and real sector crises in a certain period as a result of periodic structural financial fragilities in emerging market economies. As a result of these crises, the emerging market economies demanding credits from the creditors in advanced economies or the IMF caused the establishment of a dependency relationship between advanced and emerging markets economies.

The increase in interest rate hike expectations in advanced economies causes an increase pressure on the benchmark interest rates in emerging economies. The interest rate shocks that emerged with this pressure caused exchange rate and inflation shocks. In a sense, the factor that provides the systemic link between advanced and emerging market economies in the functioning of the global financial system is the benchmark interest rates in both country groups. Therefore, the expectation

of an increase and increase in the benchmark interest rates of emerging countries reveals systemic risks that may cause financial and economic crises due to interest shocks in emerging markets. Identifying the determinants of the benchmark bond interest rate and their interactions is vital in monitoring, preventing and controlling these risks.

There are two main approaches in determining interest rates. These are real powers and monetarist approaches. Real power theory; tells that the rate of interest is determined by real factors. Real factors; It is based on the principle that savings supply and investment demand determine the interest rate in capital markets. According to Keynes' monetarist approach, interest is a purely monetary phenomenon. In this context, theories to explain interest rates; Classical interest theory, neo-classical creditable funds theory, Keynesian Liquidity preference approach, Neo Keynesian Hick-Hanse theory and Tobin portfolio theory. And also, Barr and Pesaran(1997), Calvo, Leiderman and Reinhart (1993), Dooley, Fernandez-Arias and Kletzer(1996) and Frankel (1994) maintain that changes in international interest rates have been a key factor influencing capital flows to emerging market countries in the 1990s.

There is a negative relationship between the price of bonds and interest rate. As the price of bonds increases, their interest decreases. Relatively high inflation in emerging economies decreases the value of bonds and causes the interest rates of bonds to increase. Therefore, investors in these markets demand nominal interest; They add a risk premium in addition to real interest and inflation expectations. Besides, role of various macroeconomic policies and fundamentals for the debt-crisis and provided the empirical rationale for using certain economic fundamentals in the determination of the risk-premium in international capital markets (Sachs, 1985). As a consequence of capital flows, the relations between stock and bond returns have positve sign in short time while the long-term stock-bond relation is significantly negative (Lin, Yang, Marsh and Chen, 2018).

This study in Turkey as an emerging market benchmark rate will be tried experimentally determined in accordance with structured theoretical framework determinants and interactions. This framework is based on the theoretical determinants of interest rates and the financial political cycle explained by the global financial system. Depended variable of the 2-year government bond interest was selected as the benchmark interest for Turkey. The Central Bank weighted average funding cost, real interest, inflation, USD / TL rate, real effective exchange rate, CDS (Credit Default Swap) and the US 10-year benchmark bond rate were selected as determining variables.

Johansen cointegration method has been used to perform long-term and short-term equilibrium analysis of independent variables with the dependent variable. Short-term equilibrium analysis was conducted with error correction model. The VAR model is established to determine the interactions of independent variables with the benchmark interest rate. Based on this model, granger/wald tes, variance decomposition, impulse-response analysis, and historical decomposition tests were performed.

With the variance decomposition method, the degree of explanation of the dependent variable periodically was determined. Then, the responses of the dependent variable to the shocks occurring in the independent variables were tested using impulse-response analysis. Extent of disclosure of the variables are calculated retroactively for Turkey with the historical decomposition method. The results obtained from these tests are explained in relation to each other. In addition, the obtained results were reviewed for Turkey in line with the theoretical framework of the subject.

2. LITERATURE REVIEW

Experimentally selected literature on government bond rates has generally emerged within the framework of the effect of interest rates in advanced economies on bonds in emerging market economies. The methodologies used are generally cointegration, VAR, ARCH-GARCH and panel data tests. Selected literature is summarized in the table below.

Table 1: Selected Literature

Author	Term	Frequency	Country	Method	Findings
Demir and Sever (2008)	1987-2007	Monthly	Turkey	Johansen Cointegration	They found that there is a correct relationship between the amount of domestic debt and the interest rate.
Berument and Malatyalı (1999	1988-1996	Monthly	Turkey	Arch And Garch	They found that nominal interest rates increased in response to inflation risk, and that there was an inandrse relationship between borrowing maturity and interest rates.

Masatçı and Darıcı (2006)	1996-2004	Monthly	Turkey	Johansen Cointegration	US Federal Reserand (Fed) interest rates, interest rates could not be found in Turkey a positiand impact on as expected.
Clare and Lekkos (2000)	1979-2000	Monthly and Daily	Germany, England and USA	VAR	It has been found that the yield curands of each of these markets are affected by international factors. It has also been obserandd that the impact of these factors increases significantly in times of financial crisis.
Norliza, Muhammad and Masron (2009)	2001-2008	Monthly	Malasia	Johansen Cointegration	Interest rates, CPI and industrial production index haand a significant effect on corporate bond yield spreads.
Şenkesen (2009)	2003-2008	Monthly	Turkey	Reggression	As a result of the analysis, it was reandaled that inandstor sensitivity has a determining effect on bond yields.
Rodionova (2010)	2003-2009	Monthly	Russia	Johansen Cointegration And Var	According to the results of the study, inflation and its expectations, exchange rate and money supply increase explain less than a third of the moandments of bond returns.
Poghosyan, 2014	1980-2010	Daily	Advanced Economies	Cointegration	In the short term, the changes in bond yields deviate from the long-term balance in response to changes in the positiand effect of the debt / GDP ratio, the positiand effect of real money market interest rates and the negatiand effect of inflation.
Yavuz (2012)	2002-2010	Monthly	Turkey	Garch	CPI and industrial production in Turkey is one of about a third of the volatility of the bond market in Turkey Analysis, Euro / £ exchange rate and reached results can be explained by the volatility of the US bond yields.
Chowdhury, Bayar and Kılıç (2013)	2000-2009	Monthly	Emerging markets countries	Panel data	The results of the analysis show that there is a positiand relationship between the bond index and foreign direct inandstments and inflation, while there is a negatiand relationship between the bond index and GDP, total foreign debt stock.
Fen, Yee, Ling, Cher and Yean (2014)	1996-2003	Quarterly	Malasia	Ols	According to the research results, there is a positiand relationship between the short term interest rate and the bond returns.
Lebedeff (2014)	1997-2011	Daily	Scandinavia Countries	Impulse-Response	It shows that US macroeconomic news has a more pronounced effect oandrall than news from European countries. We see that the Finnish and Swedish goverment bond markets responded the most to the spilcreditdr effect of foreign macroeconomic news.
Hsing (2015)	1999-2014	Monthly	Spain	Egarch	The analysis results in a higher gt debt to GDP ratio, a higher treasury bill ratio, a lower GDP growth rate, a higher expected inflation rate, a higher US 10-year goverment bond yield, a lower expected

					nominal effectiand exchange rate, or the goverment debt crisis caused the Spanish goverment bond yield to rise.
(Simoski,2019)	2000-2020	Monthly	Emerging Markets	vector error correction (VEC)	The obtained results from the models estimated show that short-term interest rates are the main drivers of longterm government bond yields for all three countries thus supporting Keynes's conjectures in the context of Latin American emerging markets.
Ngo etc.(2020)	2006-2019	Monthly	Vietnam	Egarch	The findings of this study indicate that the variation of Vietnam government bond yields is in compliance with the theories of term structure of interest rate. The results also indicate that a proportion of the variation in the yields on Vietnam government bonds is attributed to the interest rate itself in the previous period, base rate, foreign interest rate, return of the stock market, fiscal deficit, public debt, and current account balance.

3. THE THEORETICAL FRAMEWORK OF THE CONCEPT OF BONDS

Bond; These are debt securities with a maturity of 1 year or more by public authorities or incorporated companes. Basic concepts about bonds; nominal (nominal) value, maturity, coupon rate and return to maturity concepts. The current price of the bond and the nominal price of the bond are different concepts. The current price of the bond changes constantly depending on the supply and demand of the bonds according to the conditions in the market.

The nominal price of the bond is the price that will be paid to the holder of the bond at the end of maturity. Nominal value represents the amount to be paid to the holder of the bond at maturity. Maturity; It is the time when the payment will be made to the holder of the bond. Coupon payments represent interim payments to be made. In other words, if the bond is held until the end of maturity, the return to the investor refers to the return to maturity. It is the interest rate that equates the present value of the payments obtained from the bond to the current market value. There is a negative relationship between the price of the bond and the interest rate.

Bonds can be classified as non-coupon bonds, coupon bonds and foreign exchange indexed bonds. Bonds without coupons are discount bonds. The price of the bond is less than its nominal value. Foreign Exchange Indexed Bonds are bonds that can be issued in indexed to foreign currency during inflationary periods. Coupon bonds; are divided into 3 as discounted, premium and break-even bonds.

Table 2: Types of Coupon Bonds

COUPON BOND TYPES	PRICE	PRICE YIELD
Discount Bond	Present price < nominal value	Yield to maturity > coupon rate
Premium Bond	Present price > nominal value	Yield to maturity < coupon rate
Breakeven Bond	Present price = nominal value	Yield to maturity = coupon rate

The theoretical discussion of the experimental results should be done around the factors affecting the demand and supply of the bond. When the demand and supply curve of the bond come together, we find the equilibrium price and interest rate of the bond in the bond market. Equilibrium bond price is found by equating the amount of bonds offered to the amount of bonds demanded.

Table 3: Factors Affecting Bond Demand and Supply

FACTORS AFFECTING DEMAND	DEMAND	BOND PRICE	BOND INTEREST
Fortune	+	+	-
Expected Return	+	+	-
Liquidity	+	+	-
Risk	-	-	+
Inflation Expectations	-	-	+
FACTORS AFFECTING THE SUPPLY	**SUPPLY**	**BOND PRICE**	**BOND INTEREST**
Profitability of Investments	+	-	+
Budget Deficit	+	-	+
Inflation Expectations	+	-	+

4. DATA AND METHODOLOGY

In the study, Augmented Dickey Fuller, Johansen cointegration, vector error correction model, Granger Block externality test, impulse-response analysis, variance decomposition and historical decomposition methods were used.

The level at which the variables become stationary is examined with the Dickey Fuller test. The long-term relationship between series stationary at the same level is investigated with the help of the Johansen cointegration test. In the study, johansen test was used instead of ARDL model because time series became stationary in their first differences.

When examining the stationarity of the series, two hypotheses are established. (Augmented- Dickey Fuller, 1979) These hypotheses can be expressed as follows.

H0: Time series contain unit root.

H1: Time series do not contain unit root.

In this context, H0, which is the null hypothesis that expresses that time series at the level value contains unit root, was accepted at the 0.05 significance level for all time series. The H1 hypothesis stating that the series do not contain unit roots was rejected. Therefore, the first difference of the series is taken. Time series h0, which is the null hypothesis stating that the first difference value contains unit root, was rejected at the 0.05 significance level for all series. The h1 hypothesis, which states that the series do not contain unit roots, was accepted.

After the long and short term equilibrium analysis, a model was established in the first difference values within the framework of the unit root test results in order to determine the interaction between variables (Brooks, 2014).

With the variance decomposition, it is determined which variable is the most effective on a time series; Whether this variable, which is found to be effective, can be used as a policy tool is determined by impulse-response functions. Action-response functions; It is a method that reflects the effect of a standard error shock that will occur in one of the random error terms on the present and future values of the internal variables. (Özgen and Güloğlu, 2004: 97, Barışık and Kesikoğlu, 2006: 71).

Whether the long-run model works or not, short-run relationships and short-run deviations from balance are analyzed with the error correction model. After short and long term relationships, interactions between variables are examined with the VAR model. Accordingly, Granger Block Externality test was conducted to determine the internal and external variables among the variables. Accordingly, the order of the variables was determined and the periodic weight of the variables in explaining the dependent variables was examined using variance and historical decomposition models. With the impact-response analysis, the status of the variables to be policy variability was examined.

In the study, as a benchmark interest rate of 2-year government bonds turkey is chosen. The theoretical framework that is drawn to this variable we examined the interaction, the annual inflation (CPI), the real effective exchange rate index, USD / TRY rate, real interest rates, gold prices (International), US 10-year government bond yield ,, Central Bank of the Republic of Turkey Weighted average funding cost and CDS premiums variables are included in the analysis. Information on the Data Set is summarized on the table.

Table 4: Data Set

VARIABLE	CODE	TERM	FREQUENCY	SOURCE
Benchmark Interest	TR2YBOND	2011.02-2020.07	Monthly	Investing.Com
US 10-Year Bond Interest	US10YBOND	2011.02-2020.07	Monthly	Investing.Com
Cent. Bank. Net. Fund cost.	TCBWFR	2011.02-2020.07	Monthly	Tcmb
Real effective exchange rate	REEXR	2011.02-2020.07	Monthly	Tcmb
Gold (Logarithmic)	LOGGOLD	2011.02-2020.07	Monthly	Investing.Com
Credit Default Swap	CDS	2011.02-2020.07	Monthly	Investing.Com
Annual inflation (CPI	CPI	2011.02-2020.07	Monthly	Tcmb
USD / TL	US_TL_EXC	2011.02-2020.07	Monthly	Investing.Com
Real Interest (According to the CPI and Benchmark Interest	REINT	2011.02-2020.07	Monthly	Investing.Com, Tcmb

Figure 1: Graps of Data
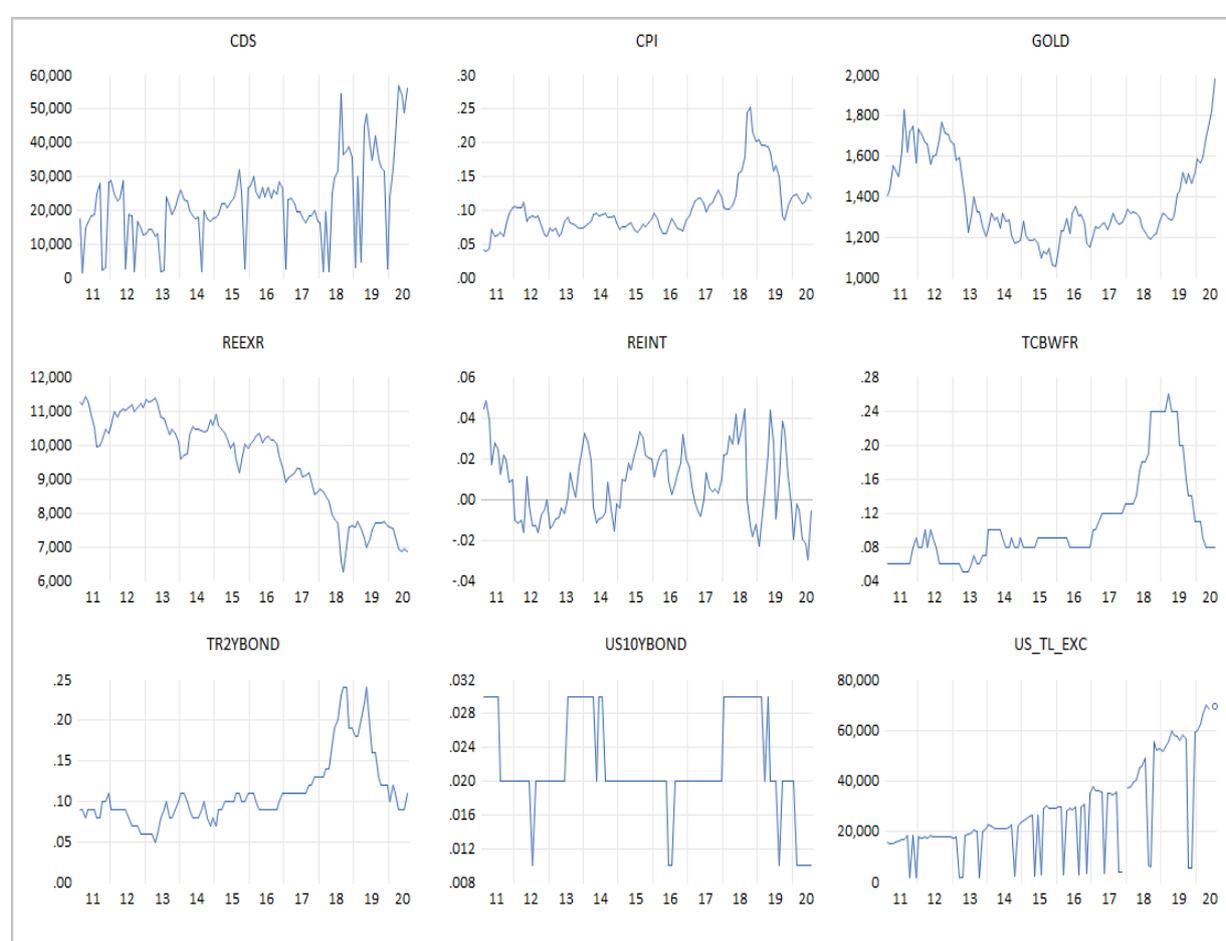
5. FINDINGS AND DISCUSSIONS

According to Augmented Dickey Fuller Test results, all series become stationary at the first difference level. In the creation of unit root test models, T statistic value was selected for the appropriate lag length, and models containing trend and constant terms were not selected. Since the variables are stationary at the same level, the Johansen cointegration test, which is structured at level values, is performed in the next step.

Table 5: Results of Unit Root Tests

Null Hypothesis: Unit root (individual unit root process)				
Series: CDS, CPI, LOGGOLD, REEXR, REINT, TCBWFR, TR2YBOND, US10YBOND, US_TL_EXC				
Date: 09/04/20 Time: 18:18				
Sample: 2011M02 2020M07				
Exogenous variables: None				
Automatic selection of maximum lags				
Automatic lag length selection based on Asymptotic t-statistic (p=0.1): 0 to 12				
Total number of observations: 924				
Cross-sections included: 9				
Method			Statistic	Prob.**
ADF - Fisher Chi-square			14.9924	0.6625
ADF - Choi Z-stat			0.64691	0.7412
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				
Intermediate ADF test results UNTITLED				
Series	Prob.	Lag	Max Lag	Obs
CDS	0.9334	10	12	103
CPI	0.8039	12	12	101
LOGGOLD	0.8524	0	12	112
REEXR	0.1160	10	12	103
REINT	0.0670	12	12	101
TCBWFR	0.6472	12	12	101
TR2YBOND	0.5030	7	12	106
US10YBOND	0.3962	11	12	102
US_TL_EXC	0.8662	7	11	95
Null Hypothesis: Unit root (individual unit root process)				
Series: CDS, CPI, LOGGOLD, REEXR, REINT, TCBWFR, TR2YBOND, US10YBOND, US_TL_EXC				
Date: 09/04/20 Time: 18:20				
Sample: 2011M02 2020M07				
Exogenous variables: None				
Automatic selection of maximum lags				
Automatic lag length selection based on Asymptotic t-statistic (p=0.1): 5 to 12				
Total number of observations: 902				
Cross-sections included: 9				
Method			Statistic	Prob.**
ADF - Fisher Chi-square			192.158	0.0000
ADF - Choi Z-stat			-11.7488	0.0000
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				
Intermediate ADF test results D(UNTITLED)				
Series	Prob.	Lag	Max Lag	Obs
D(CDS)	0.0000	9	12	103
D(CPI)	0.0000	11	12	101
D(LOGGOLD)	0.0026	5	12	106
D(REEXR)	0.0004	9	12	103
D(REINT)	0.0000	11	12	101
D(TCBWFR)	0.0003	11	12	101
D(TR2YBOND)	0.0012	12	12	100
D(US10YBOND)	0.0146	10	12	102
D(US_TL_EXC)	0.0000	11	11	85

In order to establish the var model for the cointegration test, the appropriate lag length was selected according to the LR criteria information criteria.

Table 6: Selection of Lag Lenght

VAR Lag Order Selection Criteria
Endogenous variables: TR2YBOND LOGGOLD CPI CDS REEXR REINT TCBWFR US_TL_EXC US10YBOND
Exogenous variables:
Date: 09/04/20 Time: 23:17
Sample: 2011M02 2020M07
Included observations: 101

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-770.4069	NA	0.000170*	16.85954	18.95682*	17.70858*
2	-689.4061	133.1301	0.000176	16.85953*	21.05408	18.55760
3	-636.3457	77.75182	0.000333	17.41279	23.70461	19.95990
4	-565.5185	91.16378	0.000485	17.61423	26.00333	21.01038
5	-467.4923	108.7023*	0.000472	17.27708	27.76345	21.52226

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

In the 5th lag length, a cointegration model including deterministic trend and constant term is used. According to the results, 4 cointegration vectors according to trace values and 3 cointegration vectors according to max eigen values were determined.

Table 7: Results of Johansen Cointegration Test

Date: 09/04/20 Time: 22:57
Sample (adjusted): 2011M08 2020M05
Included observations: 99 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: TR2YBOND LOGGOLD CPI CDS REEXR REINT TCBWFR US_TL_EXC US10YBOND
Lags interval (in first differences): 1 to 5
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05			
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**		
None *	0.596644	343.7134	228.2979	0.0001		
At most 1 *	0.491303	253.8277	187.4701	0.0000		
At most 2 *	0.456911	186.9133	150.5585	0.0001		
At most 3 *	0.320826	126.4756	117.7082	0.0124		
At most 4	0.283512	88.17466	88.80380	0.0555		
At most 5	0.182219	55.16862	63.87610	0.2168		
At most 6	0.150813	35.25371	42.91525	0.2348		
At most 7	0.110426	19.06965	25.87211	0.2767		
At most 8	0.072822	7.485400	12.51798	0.2966		

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05			
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**		
None *	0.596644	89.88569	62.75215	0.0000		
At most 1 *	0.491303	66.91442	56.70519	0.0036		
At most 2 *	0.456911	60.43769	50.59985	0.0036		
At most 3	0.320826	38.30093	44.49720	0.2017		

At most 4	0.283512	33.00604	38.33101	0.1803		
At most 5	0.182219	19.91492	32.11832	0.6588		
At most 6	0.150813	16.18406	25.82321	0.5283		
At most 7	0.110426	11.58425	19.38704	0.4548		
At most 8	0.072822	7.485400	12.51798	0.2966		
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values						

Cointegration equation and long-term coefficients are estimated within the scope of cointegration vectors. The coefficients of gold, CDS, real exchange rate, Central Bank weighted average interest, US 10-year bond interest and trend variable coefficients are positive and other variables have negative coefficients. According to T values, the coefficients of gold, CDS, real interest, Central Bank interest, dollar rate and trend variable are statistically significant.

Table 8: Coefficents of Cointegration Test

Cointegrating Eq.	CointEq1
TR2YBOND(-1)	1.000000
LOGGOLD(-1)	0.284796
	(0.05939)
	[4.79542]
CPI(-1)	-7.665373
	(1.04590)
	[-7.32896]
CDS(-1)	3.87E-06
	(1.4E-06)
	[2.86128]
REEXR(-1)	2.22E-05
	(1.8E-05)
	[1.20666]
REINT(-1)	-5.435786
	(1.01105)
	[-5.37639]
TCBWFR(-1)	5.408285
	(0.78301)
	[6.90706]
US_TL_EXC(-1)	-5.21E-06
	(1.4E-06)
	[-3.71532]
US10YBOND(-1)	3.034315
	(1.41301)
	[2.14742]
@TREND(11M02)	0.001470
	(0.00071)
	[2.07183]
C	-2.229428
(*****) standart errors [****] T statistics value	

An error correction model was established to test the model in the short term. With the error correction model, it was investigated whether the deviations that will occur from the balance in the short term reach the balance in the long term. The model was created with reference to max eigen values. Accordingly, since there are 3 cointegration vectors, error correction term coefficient coefficients should be negative and statistically significant. It fulfills this condition according to the estimated parameters. Among the error correction terms, 2-year benchmark interest, real interest and central bank

interest are statistically significant. Inflation, real exchange rate and dollar rate variables are positive and other variables are negative. In the next step, block externality, variance decomposition, impulse-response analysis and historical decomposition methods were used to determine the interactions between variables.

Table 9: Coefficents of Error Correction Models

Error Correction	CointEq1	Standart Errors	T statistic
D(TR2YBOND)	-0.122333	(0.03975)	[-3.07778]
D(LOGGOLD)	-0.355104	(0.17886)	[-1.98543]
D(CPI)	0.020849	(0.04388)	[0.47518]
D(CDS)	-70267.57	(36307.4)	[-1.93535]
D(REEXR)	8.012.264	-998.211	[0.80266]
D(REINT)	-0.147636	(0.03819)	[-3.86618]
D(TCBWFR)	-0.129862	(0.03387)	[-3.83416]
D(US_TL_EXC)	72718.77	(48963.4)	[1.48516]
D(US10YBOND)	-0.023129	(0.01293)	[-1.78926]

According to unit root tests, the variables are stationary at the 1st difference values. For this reason, the 1st difference levels of the Var model variables were used. First, the appropriate lag length has been tried to be determined. 4. The assumptions of the Var in Lag model are provided (Brooks,2014).

Table 10: Lag Length Selection for Var Model Established with First Differences

VAR Lag Order Selection Criteria
Endogenous variables: D(TR2YBOND) D(CDS) D(CPI) D(LOGGOLD) D(REEXR) D(REINT) D(TCBWFR) D(US10YBOND) D(US_TL_EXC)
Exogenous variables: C
Date: 09/04/20 Time: 23:48
Sample: 2011M02 2020M07
Included observations: 99

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-924.6656	NA	0.001257	18.86193	19.09785*	18.95739*
1	-807.8522	210.0282	0.000614*	18.13843	20.49763	19.09296
2	-735.0018	117.7380	0.000751	18.30307	22.78555	20.11669
3	-659.8551	107.7862	0.000933	18.42132	25.02707	21.09402
4	-561.8999	**122.6914***	0.000809	18.07879*	26.80782	21.61057
5	-501.1471	65.04845	0.001732	18.48782	29.34014	22.87869

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 11: Results of Var Model Assumption Tests

|	
AR ROOT (Modulus	0,88-0,13
PORTMENTAU AUTOCORELATION (probability	0,0
NORMALITY (Jacque Barea, inverse hypothesis. probability)	-0,48
HETERODASTICY (chi square test, inverse hypothesis, probability)	0,18

As a reference, the wald test was applied to test causality and block externality at 5% and 10% levels. Based on the results obtained, it is concluded that the benchmark interest is internal and other variables are exogenous.

Table 11.Wald Test

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/04/20 Time: 23:55
Sample: 2011M02 2020M07
Included observations: 101

Dependent variable: D(TR2YBOND)			
Excluded	Chi-sq	df	Prob.
D(CDS)	4.205315	4	0.3789
D(CPI)	10.21416	4	0.0370
D(LOGGOLD)	15.41639	4	0.0039
D(REEXR)	3.694171	4	0.4490
D(REINT)	4.783512	4	0.3102
D(TCBWFR)	9.976218	4	0.0408
D(US10YBOND)	7.402005	4	0.1161
D(US_TL_EXC)	11.85696	4	0.0184
All	72.99420	32	0.0000
Dependent variable: D(CDS)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	5.038748	4	0.2833
D(CPI)	6.102921	4	0.1916
D(LOGGOLD)	4.234535	4	0.3752
D(REEXR)	13.14825	4	0.0106
D(REINT)	6.050511	4	0.1954
D(TCBWFR)	16.54254	4	0.0024
D(US10YBOND)	2.993819	4	0.5589
D(US_TL_EXC)	5.824938	4	0.2126
All	64.45845	32	0.0006
Dependent variable: D(CPI)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	2.612159	4	0.6247
D(CDS)	9.339441	4	0.0532
D(LOGGOLD)	6.461441	4	0.1672
D(REEXR)	16.50454	4	0.0024
D(REINT)	2.811187	4	0.5899
D(TCBWFR)	10.23513	4	0.0366
D(US10YBOND)	1.503212	4	0.8261
D(US_TL_EXC)	5.645856	4	0.2272
All	60.56941	32	0.0017
Dependent variable: D(LOGGOLD)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	3.803314	4	0.4333
D(CDS)	3.034725	4	0.5520
D(CPI)	4.917517	4	0.2959
D(REEXR)	4.252658	4	0.3729
D(REINT)	5.474941	4	0.2419
D(TCBWFR)	2.068496	4	0.7232
D(US10YBOND)	4.749355	4	0.3140
D(US_TL_EXC)	2.634527	4	0.6207
All	29.59256	32	0.5889
Dependent variable: D(REEXR)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	4.176662	4	0.3826
D(CDS)	2.773780	4	0.5964
D(CPI)	3.175610	4	0.5289

| D(LOGGOLD)	5.735437	4	0.2198
D(REINT)	5.164807	4	0.2708
D(TCBWFR)	5.535830	4	0.2366
D(US10YBOND)	5.524373	4	0.2376
D(US_TL_EXC)	5.195080	4	0.2679
All	37.94123	32	0.2167
Dependent variable: D(REINT)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	2.163181	4	0.7058
D(CDS)	2.914421	4	0.5722
D(CPI)	2.572335	4	0.6317
D(LOGGOLD)	5.986557	4	0.2002
D(REEXR)	5.576077	4	0.2331
D(TCBWFR)	6.969830	4	0.1375
D(US10YBOND)	1.180201	4	0.8813
D(US_TL_EXC)	2.235588	4	0.6925
All	36.38459	32	0.2718
Dependent variable: D(TCBWFR)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	3.429657	4	0.4887
D(CDS)	5.189175	4	0.2684
D(CPI)	0.470122	4	0.9763
D(LOGGOLD)	2.206224	4	0.6979
D(REEXR)	4.299448	4	0.3670
D(REINT)	0.430807	4	0.9799
D(US10YBOND)	2.812523	4	0.5897
D(US_TL_EXC)	2.604055	4	0.6261
All	72.43549	32	0.0001
Dependent variable: D(US10YBOND)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	1.717716	4	0.7875
D(CDS)	12.02932	4	0.0171
D(CPI)	4.349590	4	0.3608
D(LOGGOLD)	8.153120	4	0.0861
D(REEXR)	2.758867	4	0.5990
D(REINT)	3.405027	4	0.4925
D(TCBWFR)	8.919555	4	0.0631
D(US_TL_EXC)	4.790207	4	0.3095
All	46.46200	32	0.0474
Dependent variable: D(US_TL_EXC)			
Excluded	Chi-sq	df	Prob.
D(TR2YBOND)	2.826535	4	0.5873
D(CDS)	3.717382	4	0.4456
D(CPI)	5.095867	4	0.2776
D(LOGGOLD)	4.127225	4	0.3891
D(REEXR)	2.247607	4	0.6903
D(REINT)	4.468176	4	0.3463
D(TCBWFR)	2.351320	4	0.6714
D(US10YBOND)	0.461209	4	0.9772
All	41.00049	32	0.1323

Figure 2: Granger/Wald Tests Scheme
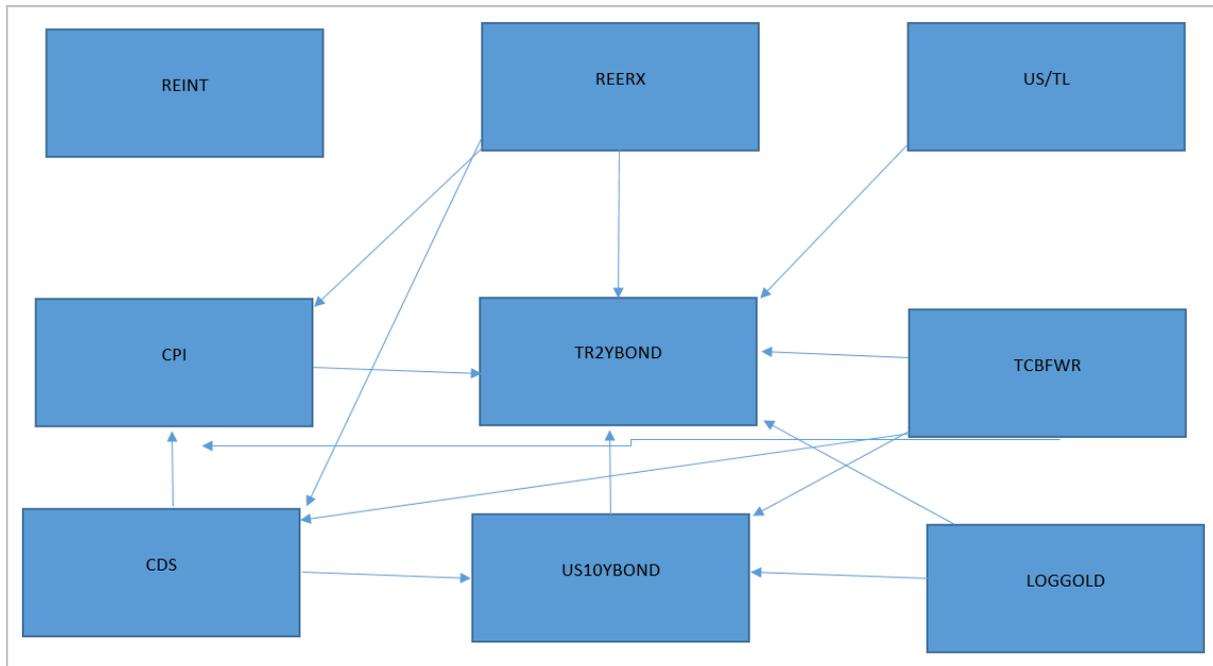
According to the results of variance decomposition, the explanation percentages of the dependent variable are excluded from their effects; gold, inflation, US 10-year bond interest, dollar rate, central bank interest and CDS.

Figue 3: Variance Decomposition Results
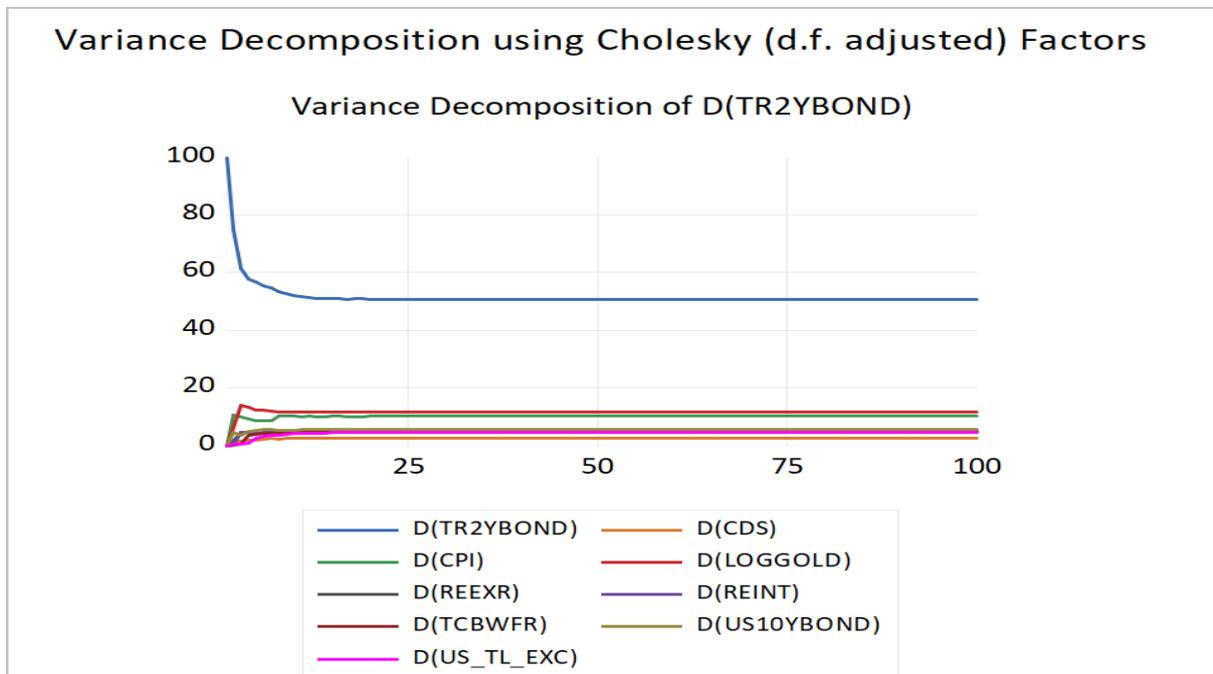
According to the results of the impulse-response analysis, the benchmark bond interest was most affected by inflation, the US 10-year bond interest and the dollar exchange rate shocks, respectively. Shocks occurring over all variables are neutralized after about 19 months.

Figure 4: Impulse-Response Analysis Results
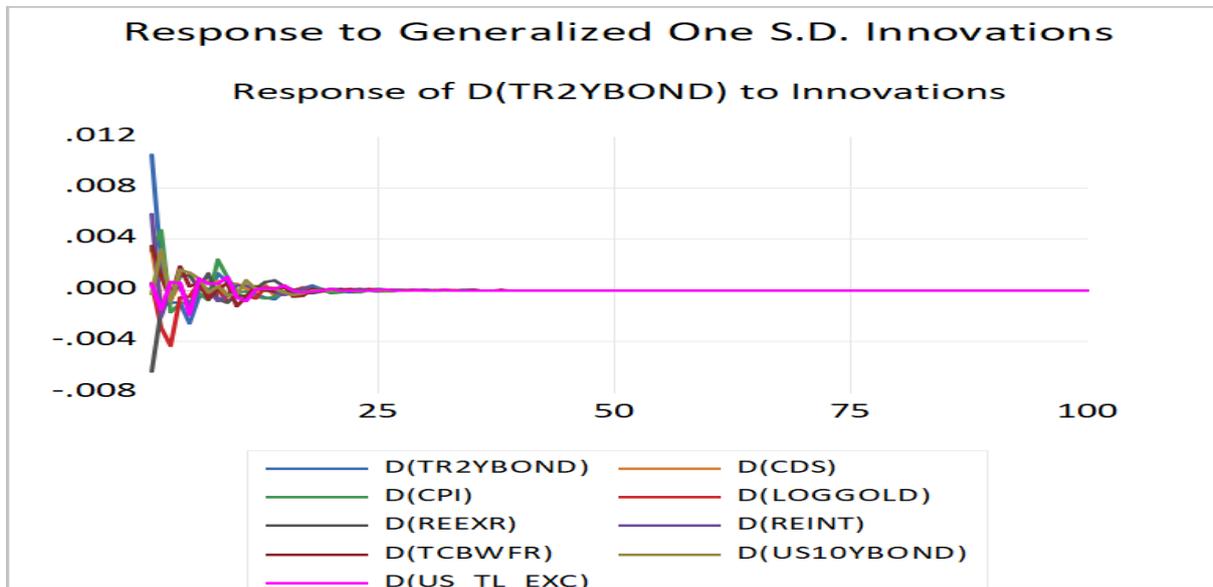
According to the historical decomposition results, it is observed that the disclosure percentage of inflation and real interest rates is high, except for the periods of interest shocks from advanced markets to emerging markets. In periods such as 2013, 2015 and 2017 when financial fragilities increase, it is observed that the US 10-year interest rate and dollar rate variables are more effective. Apart from a sense of shock period shows that Turkey benchmark bond investors to focus on inflation and real returns. In times of crisis and shock, the US 10-year bond rates stand out.

Figure 5: Historical Decomposition Results
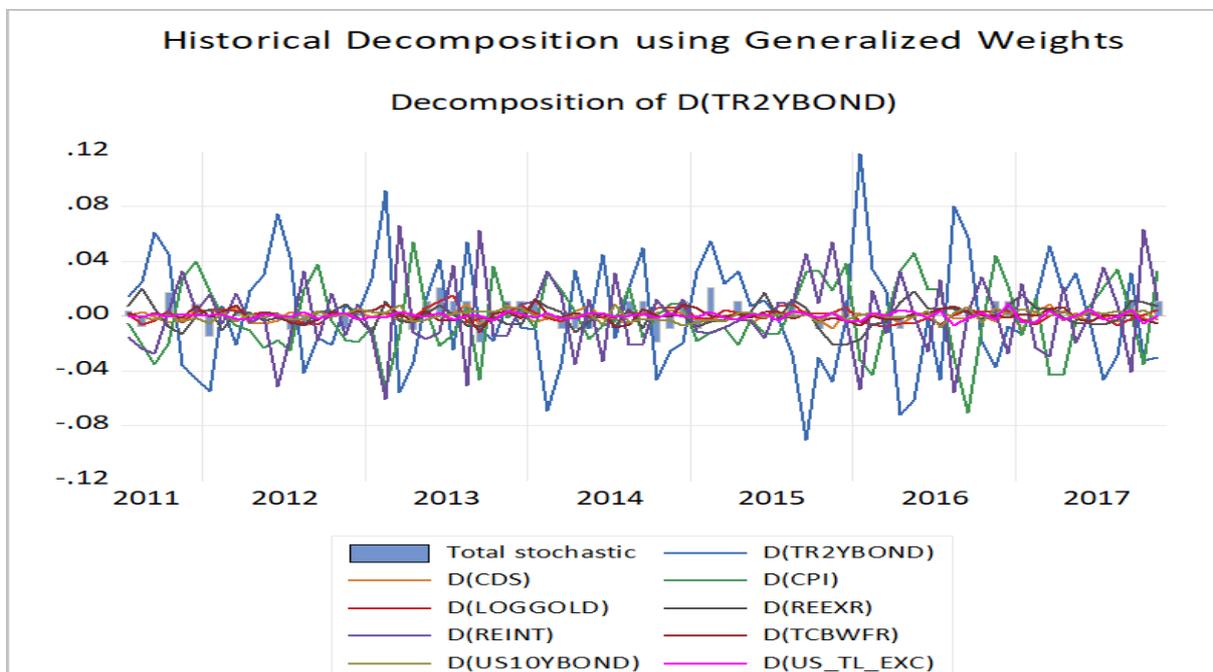
6. CONCLUSION

It was determined that the independent variables selected as a result of the structured models came into balance with the 2-year Turkish government bond benchmark interest rate in the short and long term-run. In addition, error correction terms for real interest rates and central bank weighted average funding cost variables are meaningful in short term.

When the factors affecting the benchmark bond rate are analyzed, it is seen that the variables that have the most effective and significant results on the benchmark rate are gold prices, inflation and the US 10-year bond interest. However, a causality relationship between gold prices and benchmark interest could not be determined. If we compare these results with the theoretical framework, inflationary expectations decreased the demand and price of the bond and increased the interest rate of the bond. According to the impulse-response functions, the short-term impact of gold and US 10-year bond yields; It can be considered in simulating the risk factor affecting the bond demand. Accordingly, with the increasing risk factor with the increase in US bonds, the demand and price of bonds decreased and their interest rates increased. According to the historical decomposition results, it was observed that the explanation effects of inflation and real interest rates increased during the periods of increase in interest rates.

According to the wald test; The causality in terms of gold, inflation, central bank weighted average funding cost, US 10-year bond interest rates and 2-year government bond interest rates from the USD / TL exchange rate were determined.

To briefly summarize the results in the combination of the results of all tests; The 2-year benchmark bond's interest for Turkey, gold as external factors and US 10-year bond yields inflation as internal factors and is sensitive to shocks in the real interest rate. Although the explanatory power of real interest rates is higher, according to causality tests, the Central Bank weighted average funding cost is more determinant on the benchmark rate, which is the market rate.

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