International Journal of Economics and Finance; Vol. 14, No. 8; 2022
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Impacts of Fiscal and Macroeconomic Factors on Vietnam Government Bond Yield

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Received: June 16, 2022 Accepted: July 13, 2022 Online Published: July 18, 2022

doi:10.5539/ijef.v14n8p23 URL: https://doi.org/10.5539/ijef.v14n8p23

Abstract

Government bond yield refers to the borrowing cost for government and the expected return for the individual and institutional investors. Having knowledge of government bond yield helps government operate or adjust the government bond issuance to boost the economic conditions in a country and support investors when diversifying their investment portfolio. To contribute to government bond's literature and government's policy, the determinants of government bond yield in Vietnam are examined by using GARCH-types models for time-series data. The findings show that for the 3-year and 5-year government bonds, there are positive relationships between the percentage change of Central Government Balance, Policy Rate change and government bond yields change; while the percentage change of Exchange Rate and VN Index negatively affect government bond yields change. For 10-year government bond, Policy Rate, VN Index, Inflation and VIX are the most significant determinants of the government bond yields. Their changes positively affect bond yields change while Inflation has a negative relationship with government bond yields change. Moreover, Inflation has more significant impact on the change in long-term government bond yields than that in shorter-term government bond yields.

Keywords: government bond yields, GARCH-types models, fiscal position, macroeconomic factors

1. Introduction

1.1 The Problem

For advanced economies, the government bonds are risk-free financial instruments. For emerging countries such as Vietnam, the government bonds, however, are exposed to a greater degree of risk. Moreover, the world had been witnessing the default of some emerging markets including Greece, Sri Lanka, and so on, which decreased the nation's credit worthiness and challenged the issuance of their government bond. Understanding risks exposed to the government bond is necessary for policy makers since they decrease the government's borrowing cost which is indicated by the government bond yields. It is also essential for investors to forecasting long-term interest rate and pricing corporate securities and other financial instruments. Besides, to the best of our knowledge, only few researchers in Vietnam investigated this problem and developed additional factors affecting the government bond yields and examined them in depth.

1.2 The Rationale for the Research

Government bond market plays a significant role in bond market. In addition to the effective capital mobilization channel for the state budget, government bond market is also a standard financial market because it provides benchmark yield curve and overall credit curve.

In Vietnam, the bond market had been operating since the mid-1990s and expanding from only 2.82 percent GDP in 2001 to 47.8 percent in 2020. There are five types of bonds traded including government bond issued by State Treasury, government-guaranteed bond issued by State-owned policy banks, Municipal bond issued by local government, corporate bond issued by incorporated entities, and green bond. And the government bond market accounted for the biggest proportion at 28.28 percent GDP in size, followed by the corporate bond, and government-guaranteed bond, which indicates that government bond issuance plays a vital role in developing the bond market in Vietnam. Developing a government securities market is meaningful for macroeconomic and

microeconomic conditions. An effective government securities market provides a channel for government budget deficits funding instead of borrowing from the central bank, which can reduce the amount of fund borrowed directly from the central, and, thereby, declining the possibility of the damage of government budget deficits and the likelihood of rising foreign currency-dominated debt. Moreover, its development can smooth the transmission and implementation of monetary policy. Through government securities market, authorities can adjust consumption and investment expenditures to deal with the shocks. Therefore, the government's exposure to interest rate, currency, and other financial risk decreases and the government's borrowing costs decline. For microeconomic aspect, the development of government securities market ensures the financial stability and the improvement of financial intermediaries in market. That is why the government concerns about the factors influencing the government bond yields which indicate the government's cost of borrowing.

The development of government securities market also affects the investor confidence. Therefore, the government bond yield which refers to the expected return the investor gains on a bond for investors. In addition, for corporates, government bond yield is a benchmark for them to determine the price of corporate bonds and other financial securities. Besides, bond yield also refers to the magnitude of risk that the investor must face when investing in bond. Higher bond yield is a sign of greater risk. Hence, this proved that government bond yield is also an important indicator which is focused on by financial institutions, individual investors, and corporates.

The purpose of our study is to examine the determinants of Vietnam government bond yields. We divide them into three types of factors including fiscal position, macroeconomic factors, and global factors. Specifically, our study investigates the effects of specific variables such as government budget deficit, inflation, exchange rate, domestic policy rate, stock market return, S&P500 stock market volatility index (VIX) on Vietnam government bond yields.

1.3 Literature Review

1.3.1 Bond Yield

Bond yield refers to the expected return that investor generates on fixed-income securities over a specific period. Moreover, bond yield also interprets the risk that investor must face when investing in bond. Investors frequently require higher bond yield as a compensation for higher risk they face.

1.3.2 The Determinants of Government Bond Yield

To the best of our knowledge, most of the papers examine two types of factors that affect government bond yield including fiscal variables and macroeconomic variables. Hence, we decided to divide the literature review part into three parts as follows.

1) Fiscal Factors

Fiscal factors, known as fiscal policy variables, refer to the use of government spending and tax policies influencing economic conditions, especially macroeconomic conditions such as inflation, GDP growth, employment and so on. There are several research papers studying the impact of fiscal variables on government bond yields. To our knowledge, most papers used government debt-to-GDP and primary balance over GDP as the proxies for fiscal policy. Including, government debt-to-GDP and primary balance measure the performance of long-term and short-term fiscal policy, respectively.

- Government Debt

Government debt-to-GDP ratio (Public debt ratio) is the indicator for a nation's capacity of paying back its debt. In terms of developed countries, (Gruber & Kamin, 2012) examined the effect of fiscal variables on Government bond yield in the OECD and G-7 countries during the period from 1988 to 2007 by using panel approach, stating that higher net debt ratio increases the Government bond yield in the long run and fiscal variables affect more greatly G-7 nations' government bond yield than that of OECD countries. This interprets that the government bond yields in the more advanced economies are more market driven. Similarly, for 22 developed countries, (Poghosyan, 2014), examined the short-run and long-run determinants of advanced economies' government bond yields, and found that government debt-to-GDP ratio has the significantly positive effect on government bond yields in both short run and long run. These results are also in line with those of (Malešević Perović, 2015). For developing and emerging market, the paper also interprets that financial development rises the magnitude of the level of the increase in government bond yields in CEE region and the crisis increase the effect of government debt ratio on government bond yield in the same countries. By using fixed effect panel method on the data of 26 emerging countries, (Jaramillo & Weber, 2013) showed that government debt is the factor driving the increase in nominal government bond yields and plays a significant role in determining the government bond yield during

the time of high global risk aversion.

Besides, by applying the ARCH models including GARCH, TGARCH, and EGARCH with the sample in Vietnam during the period from 2006 to 2019, Trinh et al. (2020) indicated that public debt ratio has a significantly negative impact on Vietnam government bond yield volatility because the country had benefited from several factors including gradual fiscal consolidation, strict limits on government guarantees, and financial repression that kept interest rates low over the previous decade. As a result, the public debt had been managed well and had not yet exceeded the debt ceiling of the governments.

- Government Deficit

To measure government deficit or surplus, some variables including overall, primary, or structural balance are used in the literature. For developed countries, according to Gruber and Kamin (2012), with the panel approach, the increase in the primary and structural balance boosts government bond yields in G-7 countries in the long run. However, Jaramillo and Weber (2013) showed that the negative effect of primary balance is insignificant in 22 developed nations. By employing FLGS approaches with data from 20 European countries from 1992 to 2015, Jalles (2019) also showed that the budget balance has a significantly negative impact on government bond yields. In terms of emerging market, Malešević Perović (2015) examined that the coefficient of primary balance is negative and significant, meaning that an increase in primary deficit over GDP leads to a decrease in government bond yield in the CEE nations and there is no non-linearity in the relation between government bond yield and primary balance. For emerging countries, the significantly negative coefficient of overall balance is found in (Jaramillo & Weber, 2013). Furthermore, Chionis et al. (2014) mentioned that it is a factor that investors concentrate on during the crisis while they do not focus on the variable before the crisis. Moreover, by employing panel regression method with the scope of 20 emerging market, Gadanecz et al. (2018) indicated that there is a significantly negative relationship between fiscal deficit and local currency sovereign bond yield.

2) Macroeconomic Factors

- Economic Conditions

Economic condition is reflected by GDP growth, Inflation rate, or Consumer Price Index (CPI). For developed nations, by using OLS regression in the context of Croatia, Mihelja Žaja et al. (2018) found that higher GDP growth leads to the decline in the borrowing cost of government, which is proxied by government bond yield while harmonized Consumer Price Index affects negatively and significantly government bond yield during the crisis period and the recovery period. In addition, Jalles (2019) indicated that current GDP growth has a significantly negative impact on government bond yield while the impact of current Inflation rate is not significant. The paper's results also reveal that creditors concentrate more on forecasted Inflation rate when pricing the government bond yield. In the scope of 19 nations in Europe Monetary Union, Pappas and Kostakis (2020) used fixed effect panel regression to investigate the negative (positive) impact of GDP growth (Inflation rate) on long-term government bond yield. Specifically, in Spain, Hsing (2015) found that GDP growth (Inflation rate, respectively) impacts significantly and negatively (positively, respectively) the government bond yields. For emerging markets, Malešević Perović (2015) revealed that the significantly negative relationship between GDP growth and government bond yield was explained by the fact that the growth of GDP increases tax revenue, which leads to the decrease in government's bond issuance, declining the government bond yield in the CEE countries. Moreover, Zhou (2021) showed that Inflation rate has a significantly positive effect on government bond yield in the short run while it has opposite side in the long run. Moreover, Jaramillo and Weber (2013) indicated that GDP growth and Inflation rate are the factors that negatively affect the government bond yield at the time of low global risk aversion. By considering all government bonds on Indonesia Stock Exchange and employing random effect panel regression, Kurniasih and Restika (2015) found that Inflation has a significantly positive effect on government bond yield, because an increase in Inflation rate leads to the decrease in government bond price, thereby, rising the government bond yield.

- Exchange Rate

To measure exchange rate, most papers studying the relationship between macroeconomic factors and government bond yields used nominal exchange rate or real effective exchange rate. For developed economies, Afonso and Nunes (2015), employing panel approach and SUR estimation, examined that the forecasts' corrections of real effective exchange rate have a significantly negative impact on government bond yield, and it varies across 15 nations. Specifically, Hsing (2015) used EGARCH model and stated that the nominal exchange rate has a significantly negative impact on government bond yield in Spain. Regarding to Croatia, Mihelja Žaja et al. (2018) investigates that the exchange rate HRK/EUR affects significantly and positively on government bond yields in the period of economic recovery while it significantly and negatively impacts government bond

yields in the previous period. However, Jalles (2019) showed the results that the real effective exchange rate is not a significant factor in most of their regression models and it negatively affects the dependent variable, government bond yields. In terms of emerging market, Kurniasih and Restika (2015) stated that the Rupiah/USD exchange rate negatively affects Indonesia's yields of government bonds. Additionally, Gadanecz et al. (2018) studied the importance of exchange rate risk in determining local currency sovereign bond yield in depth. This paper used the depreciation of expected exchange rate and implied volatility of exchange rate as independent variables. An increase in the volatility of exchange rate leads to an increase in sovereign bond yields and unfavorable fiscal policies can easily affect the responsiveness of sovereign bond yields to the depreciation of expected change rate. Regarding to South Africa, Zhou (2021) examined the significantly negative impact of nominal effective exchange rate on government bond yields in both short term and long term, which means that the appreciation in domestic currency lowers the government bond yields because the demand for government bond increases.

- Short-term Interest Rate

Short-term monetary policy is proxied by short-term interest rate. In empirical evidence in advanced economies, Poghosyan (2014) considered short-term rate as a significantly positive factor affecting government bond yield in 22 developed nations. Furthermore, Hsing (2015) used the treasury bill rate as a proxy for short-term rate. The paper found that short-term rate has a significantly positive influence on government bond yields, which is in line with (Poghosyan, 2014; Jalles, 2019). For emerging countries, Kurniasih and Restika (2015) indicated that the impact of short-term interest rate is positive since a rise in interest rate can lead to a decline in bond price, which also increases the yield of government bonds in Indonesia. Regarding to India, Akram and Das (2019) considered nominal yields of India's 3-month treasury bill as an indicator for short-term rate and examined that it plays a key role in determining government bond yield in India in both short run and long run. The paper illustrated the significantly positive impact on Indian government bond yields, being consistent with (Akram & Das, 2019; Zhou, 2021).

- Stock Market Index

To measure the equity market's performance, stock market index or stock traded to GDP can be used. To our knowledge, most of the papers used stock market index. After reading the paper conducting in developed countries, we realized that few of them examine the relationship between stock market return and government bond yield. In terms of developing countries, Muharam (2013) indicated that there is a significantly negative relationship between stock market return and government bond yield in Indonesia, which is explained that the demand of stock purchase increases due to the growth of economics, which is the reason for a decrease in government bond yield. However, there exists an insignificantly impact of stock market return on government bond yield, which is found in (Jaramillo & Weber, 2013; Malešević Perović, 2015).

3) Global Condition

Based on International risk is indicated by S&P500 stock market volatility index (VIX), calculated based on the price of S&P500 index options with near-term expiration date. VIX is frequently seen as a measurement of market sentiment. Afonso et al. (2014), Jalles (2019), Pinho and Barradas (2021) used VIX as an independent variable while it is seen as a threshold variable in (Jaramillo & Weber, 2013) to examine whether the effects of fiscal condition depend on the VIX level representing global risk aversion by using panel threshold method. Jalles (2019) stated that the more VIX increases, the more sovereign bond yield increases. In contrast, Santosa and Sihombing (2015) examined that the factor that least dominantly contribute to the slope and curve of Indonesia government bond is VIX.

To sum up, most of the existing articles studied the determinants of government bond yields and sovereign bond yields in advanced economies and emerging markets excluding Asia regions. There are only a limited number of papers examining the factors affecting government bond yields in ASEAN, especially in Vietnam although government bond accounts for the greatest proportion in Vietnam bond market. For these reasons, this research is carried out to fill the gap.

2. Methodology

2.1 Data and Variables

Our study focuses on developing additional factors that affect the government bond yield to help policymakers and investors get more knowledge on the determinants of government bond yield in Vietnam. Based on the previous research papers, we plan to examine the relationship between independent variables including government budget deficit, inflation, exchange rate, domestic policy rate, stock market return, S&P500 stock

market volatility index (VIX) and the long-term government bond yields including 3-year, 5-year, and 10-year government bond yields in Vietnam, dependent variables. We use data from August 2007 to August 2020 according to the availability of data in Vietnam and the capacity of accessing data. Especially, for fiscal position, at the beginning of the study, government deficit and government debt ratio were chosen to represent fiscal positions (default risk of government bond). However, Government Statistics Office of Viet Nam (GSO) and other authorized international database only estimate fiscal data on a yearly basis apart from the Government Deficit. We decided then to choose Monthly Central Government Deficits of Vietnam based on USD, which is forecasted by Thomson and remove Debt ratio because of its unavailability. In terms of other independent variables, we collected monthly data from Investing.com, Thomson Reuters, GSO.

Table 1. The description of selected variables

Factors	Labels	Variables	Sources	Expected sign
Dependent variables				
3-year Government bond yields	D3GOV_Y	The first difference of Monthly 3-year Government Bond Yield	Investing.com	
5-year Government bond yields	D5GOV_Y	The first difference of Monthly 5-year Government Bond Yield	Investing.com	
10-year Government bond yields	D10GOV_Y	The first difference of Monthly 10-year Government Bond Yield	Investing.com	
Independent variables				
Government Deficit	DCG_DEF	The percentage change of Monthly Central Government Budget Deficit based on USD	Thomson Reuters	(+)
CPI	INF	The percentage change of Monthly Consumer Price Index	GSO	(+)
Exchange rate	DEXC	The percentage change of Monthly USD/VND Exchange Rate	Thomson Reuters	(+)
Base rate	DPIR	The first difference of Monthly policy rate	Thomson Reuters	(+)
Stock market return	DVN_Index	The percentage change of Monthly VN index	Investing.com	(-)
VIX	DVIX	The percentage change of S&P500 stock market volatility index	Thomson Reuters	(-)

2.2 Estimated Models

Based on the property of financial time series data concluding volatility clustering, leptokurtosis, leverage effect, the GARCH family approaches are applied to estimate our model, using STATA software. Before running any model, we use diagnostics test for unit root to make sure that the variables are stationary. To test the presence of unit root, we use the Augmented Dickey-Fuller Test (ADF). To test for ARCH effect, we use Lagrange Multiplier (LM) test for autocorrelation in conditional variance of the error term.

2.2.1 GARCH Model

Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model was proposed by Bollerslev and Taylor. The difference between ARCH and the GARCH model is that the conditional variance of the error term (σ_t^2) depends on the value of the square of previous error term under ARCH model, while the latter is affected by the value of conditional variance of the previous error term and the previous squared error term in the GARCH model. The general form of GARCH(p,q) is formulated as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_i \sum_{i=1}^{p} u_{t-i}^2 + \beta_j \sum_{j=1}^{q} \sigma_{t-j}^2 \quad (1)$$

The biggest drawback that ARCH model has been facing is that the lags of the squared residual can be exceptionally large to model all the nature of volatility, which leads to the non-parsimonious model. To fix this problem, the GARCH model was proposed. Including only three parameters, GARCH (1,1) is sufficient to contain an infinite number of the lags of squared error terms that have an influence on the current conditional variance.

In this paper, our proposed model is the following:

$$DGOV_{Y_t} = a_0 + a_1 DCG_{DEF_t} + a_2 Inf_t + a_3 DEXC_t + a_4 DPIR_t + a_5 DVN\_INDEX_t + a_6 DVIX_t + u_t \quad (2)$$

where $u_t \sim (0, \sigma_t^2)$

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (3)$$

This model includes:

$DGOV\_Y_t$: The first difference of the 3-year, 5-year, and 10-year government bond yield (we run separate models for three types of government bond yields)

σ_t^2: The conditional variance of government bond yields at time t

u_t : The error term in equation (2)

DCG_DEF: The first difference of Central Government Deficit.

Inf: The percentage change of Consumer Price Index.

DEXC: The percentage change of exchange rate based on USD.

DPIR: The first difference of Policy Rate.

DVN_INDEX: The percentage change of VN Index.

DVIX: The percentage change of VIX.

2.2.2 E-GARCH Model

The exponential GARCH model, proposed by Nelson is one of the extensions of the GARCH model. EGARCH is the dynamic model that solves non-negativity constraint and leverage effect problems in the innovation process. EGARCH model can address those problems that GARCH model is facing. Specifically, EGARCH model contains the log of conditional variance, which is always positive with any negative or positive parameters so that we do not need to impose non-negative constraints on the parameters. Additionally, EGARCH model takes leverage effect into account while GARCH model only allows symmetric response to positive and negative shocks. The general form of EGARCH (p,q) is:

$$\ln(\sigma_t^2) = \alpha_0 + \sum_{i=1}^{q} \alpha_i \left| \frac{u_{t-i}}{\sqrt{\sigma_{t-i}^2}} \right| + \sum_{i=1}^{q} \gamma_i \frac{u_{t-i}}{\sqrt{\sigma_{t-i}^2}} + \sum_{j=1}^{p} \beta_j \ln(\sigma_{t-j}^2) \quad (4)$$

Where α_0 = constant, α_i = ARCH effects, γ_i = asymmetric effects, and β_j = GARCH effects.

In this paper, our specific EGARCH (1,1) model is as follows:

$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 \left| \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right| + \gamma_1 \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \beta_1 \ln(\sigma_{t-1}^2) \quad (5)$$

3. Results

3.1 Descriptive Statistics

Table 2. Summary statistics for original data

Variable	N	Mean	SD	Min	Max
GOV_Y_3	161	7.08	3.72	0.48	19.50
GOV_Y_5	161	7.44	3.51	1.18	17.00
GOV_Y_10	161	7.97	3.04	2.42	17.10
CG_DEF (billion USD)	155	-0.4405	0.2804	-1.005	0.0499
CPI	161	100.55	0.82	98.46	103.91
PIR	161	7.81	2.73	4.00	15.00
EXC	161	30355.65	2419.34	24459.00	33273.90
VN_INDEX	161	639.93	222.51	245.74	1174.46
VIX	161	20.37	9.08	9.51	59.89

From Table 2, the total number of observations is 161 except for Central Government Deficit based on USD, CG_DEFUSD (155 observations). Most of our data are collected from August 2007 to August 2020 apart from CG_DEFUSD (from August 2007 to April 2020). The table illustrates that the mean of three government bonds yields increase with their duration of maturity, from 7.08% to approximately 7.97%. More specifically, the

longer the government bond's maturities, the higher the government bonds return, which is consistent with the theory. In contrast, the standard deviations of government bonds yields decrease along with the increase in the maturity durations with 3.72% for 3-year government bond, 3.51% for 5-year government bond, and 3.04% for 10-year government bond. This contrasts with the theory that the long-term bonds with lower coupons have the longer durations. These bonds are more volatile in a changing rate environment because they are more susceptible to changes in market interest rates. Bonds having shorter maturity dates or larger coupons, on the other hand, will have shorter duration.

To make sure that our models run effectively, we must check multicollinearity and the stationarity for our data through pairwise correlation, variance inflation factor (VIF), and the Augmented Dickey-Fuller test. After testing ADF for our original data, all of them are not stationary. Therefore, we use the first difference and percentage change for all variables because they are stationary based on ADF test.

After running the models, we also test for correlation among independent variables via pairwise correlation and variance inflation factor (VIF).

Table 3. Pairwise correlation

Var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	1.000								
(2)	0.845	1.000							
(3)	0.744	0.820	1.000						
(4)	0.067	0.004	0.003	1.000					
(5)	-0.151	-0.053	-0.107	-0.093	1.000				
(6)	0.824	0.762	0.720	-0.006	-0.110	1.000			
(7)	0.030	0.136	0.197	-0.033	0.111	0.231	1.000		
(8)	-0.130	-0.148	-0.050	-0.194	-0.036	-0.053	0.061	1.000	
(9)	0.078	0.043	0.066	0.046	-0.157	0.054	-0.139	-0.310	1.000

(1) D3GOV_Y; (2) D5GOV_Y; (3) D10GOV_Y; (4) DCG_DEF; (5) INF; (6) DPIR; (7) DEXC; (8) DVN_INDEX; (9) DVIX

From Table 3, correlation coefficients among independent variables are not high, which is in line with the result of VIF. Based on the table below, VIF of six explanatory variables is around 1, meaning that there is no multicollinearity problem among independent variables.

Table 4. Variance inflation factor

	VIF	1/VIF
DVN INDEX	1.172	.853
DVIX	1.17	.855
DEXC	1.101	.908
DPIR	1.087	.92
INF	1.078	.928
DCG BAL	1.052	.95
Mean VIF	1.11	.

3.2 Estimated Results

After checking for the multicollinearity, stationarity and running basic regression models, we implemented LM test for conditional heteroscedasticity to test for ARCH effect. Based on tables A1, A2, A3 from appendix A, the p-values equal 0.000 from lags 1-12 for 3-year government bond's model and around 0.001-0.005 for six lags 6-12 for 5-year government bond's model. LM test for 10-year government bond yields' regression model has a result that the p-value equals around 0.001 for twelve lags. This interprets that there exist ARCH effects and we decided to run GARCH (1,1) and EGARCH (1,1) models for 3-year, 5-year, and 10-year government bond yield apart. The GARCH (1,1) and EGARCH (1,1) can replace the ARCH (p) model because they are equivalent to ARCH model with infinite number of lags.

Table 5. GARCH and EGARCH results

	(1) D3GOV_Y	(2) D5GOV_Y	(3) D10GOV_Y	(4) D3GOV_Y	(5) D5GOV_Y	(6) D10GOV_Y
	GARCH			EGARCH		
DCG_DEF	.166*	.141**	-.033	.112**	-.008	-.032
	(.085)	(.06)	(.034)	(.052)	(.051)	(.07)
INF	-14.718**	-.782	-18.493***	-10.813	-6.224	-21.202***
	(7.216)	(5.189)	(2.161)	(6.854)	(4.497)	(1.922)
DPIR	1.08***	.482***	.507***	.942***	.557***	.56***
	(.036)	(.044)	(.031)	(.064)	(.043)	(.05)
DEXC	-8.354***	-3.622*	-1.874	-7.075***	-4.193**	.357
	(2.583)	(1.97)	(1.168)	(2.353)	(1.97)	(1.37)
DVN_INDEX	-2.563***	-1.919***	.932***	-2.666***	-2.222***	1.311***
	(.436)	(.301)	(.168)	(.39)	(.328)	(.282)
DVIX	-.125	-.096	.228***	-.088	-.061	.217***
	(.175)	(.153)	(.063)	(.144)	(.122)	(.062)
_cons	.012	-.037	-.039***	-.032	-.031	-.024
	(.039)	(.032)	(.014)	(.037)	(.032)	(.021)
ARCH:L.arch	.12**	.17*	2.549***			
	(.049)	(.097)	(.518)			
ARCH:L.garch	.867***	.758***	.084*			
	(.041)	(.138)	(.047)			
ARCH:L.earch				-.277***	-.112	-.143
				(.092)	(.092)	(.129)
ARCH:L.earch_a				.29***	.333***	1.638***
				(.085)	(.129)	(.176)
ARCH:L.egarch				.972***	.938***	.883***
				(.027)	(.057)	(.039)
ARCH:_cons	.005	.013	.011*	-.021	-.099	-.115
	(.004)	(.01)	(.006)	(.031)	(.104)	(.089)
Observations	154	154	154	154	154	154

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

3.2.1 3-Year Government Bond Yields

From Table 5, for the 3-year government bond yield's model with GARCH approach, the previous error terms of the volatility of government bond yields change have a significant impact on the current volatility of the yields because the coefficient α1 is statistically significant at the 5% level. Additionally, the coefficient β1 is statistically significant at the 1% level, meaning that the current volatility of 3-year government bond yields is significantly and positively affected by the previous volatility of the yields. Most of the independent variables have a significant coefficient except for the VIX. Specifically, the coefficient of DCG_DEF is 0.166 and statistically significant at the 10% level, interpreting that the changes in Central Government Deficit in Vietnam significantly and positively influence the change in 3-year government bond yields, which is the same as our expectation. In other words, the more Central Government Deficit in Vietnam increases, the more 3-year government bond yield rises. And the policy rate has a significantly positive effect on the government bond yields change. This is interpreted from the positive coefficient at the 1% level of significance. However, the coefficient of Inflation is negative (-14.718) at the 5% level of significance, meaning that Inflation has the strong and negative impact on the first difference of government bond yield. The coefficients of DEXC and DVN_INDEX are negative with -8.354 and -2.563, respectively at the 1% significance level. This means that the change in exchange rate and VN Index have the significantly negative relationship with the government bond yields.

In EGARCH model, the coefficient of exponential GARCH term is positive and significant at the 1% level, interpreting that the log of previous variance of the government bond yields change has a significantly positive impact on the log of current variance of the government bond yields change. In addition, the asymmetric coefficient is significant and positive, meaning that the positive shocks have larger effects on the volatility of the

government bond yields than the negative shocks. Most of the explanatory variables have the significant coefficients apart from two independent variables including Inflation and DVIX. The relationship between the change in Central Government Deficit and the government bond yields change is significantly positive. For the policy rate, it also has the significantly positive correlation with the government bond yields. Specifically, the coefficient of DPIR is 0.942 at the 1% level of significance. However, the coefficient of Exchange Rate and VN Index is negative and significant. In other words, the change in Exchange Rate, VN Index significantly and negatively affects the government bond yields change. The more Exchange Rate and VN Index increases, the more the government bond yields change decline. In contrast, the change in Inflation and VIX does not affect the government bond yields change. To compare with the results of GARCH model, all the coefficients are in the same sign as the corresponding ones in GARCH model. There is only one coefficient of Inflation, turned to be insignificant in EGARCH model.

3.2.2 5-Year Government Bond Yields

From the GARCH results in Table 5, the previous error terms of the volatility of government bond yields have a significant impact on the current volatility of the yields because the coefficient α1 is statistically significant at the 10% level. And the previous volatility of the government bond yields has a strong effect on the current volatility of the government bond yields with the positive coefficient at the 1% level of significance. Most of the coefficients are significant apart from Inflation, DVIX. The coefficients of DCG_DEF and DPIR are positive and significant, which means that the increase in the change in CG_DEF and PIR lead to the increase in the government bond yields change. However, the coefficients of DEXC and DVN_INDEX are -3.622 and -1.919 at the 10% and 1% level of significance, respectively. It interprets that the increase in Exchange Rate and VN Index change leads to the decrease the 5-year government bond yields change as we expected.

For EGARCH model, the coefficient β1 is significant and positive, interpreting that the log of previous volatility of the government bond yields significantly and positively affects the log of current volatility of the government bond yields. The asymmetric coefficient is positive and significant, which means that the good shocks have a larger effect on the volatility of government bond yields than bad shocks. The coefficient (α1+β1) is less than 1, meaning that the shock effects declining in the short term in the model. The table reports that three independent variables have the significant coefficients. Including, the coefficient of DPIR is positive (0.557) while DEXC and DVN_INDEX have the negative coefficient with -4.193 and -2.222, respectively. In other words, the change in DPIR and the government bond yields change move in the same direction. On the contrary, the increase in DEXC and DVN_INDEX change leads to the decrease in the change of government bond yields. Besides, the change in Central Government Deficit, Inflation, and VIX do not affect the change in 5-year government bond yields. By using EGARCH (1,1) model, the coefficient of DCG_DEF turned to be insignificant.

3.2.3 10-Year Government Bond Yields

From Table 5, after employing GARCH model for 10-year government bond, the result shows that the coefficient α1 is significantly positive, meaning that the previous error term has a significant impact on the current error term. Additionally, the previous variance of the government bond yields significantly affects the current variance of the yields. Most of the independent variables significantly influence the first difference of 10-year government bond yields except for Central Government Deficit, Exchange Rate. The coefficient of INF, DPIR, DVN_INDEX, and DVIX are significant. Accordingly, if the change in INF increases, there is a decline in the government bond yields change. However, the higher the change in Policy Rate, VN Index and VIX, the higher the change of the government bond yields. Besides, Exchange Rate and Central Government Deficit are not the fundamental factors determining the 10-year government bond yields because their coefficients are not significant.

When applying the EGARCH(1,1) model, the results express the coefficient of egarch_a and egarch are significant at the level of 1%. This interprets that the good news has a larger effect on the 10-year government bond yields volatility than the bad news. Besides, the coefficient of Inflation, DPIR, DVN_INDEX, and DVIX are significant at the 1% level while the coefficient of DCG_DEF and DEXC are insignificant. The EGARCH model yields a smaller INF coefficient that that of the GARCH model. In other words, the negative impact of INF on Government Bond Yield change is greater when measured by the EGARCH model than when measured by the GARCH model. Besides, the coefficients of DPIR and DVN_INDEX are positive and significant. Those coefficients in EGARCH model are larger than ones in GARCH. This means that the positive effects of DPIR and DVN_INDEX on the change in government bond yields in the EGARCH model becomes larger than that of the GARCH model. However, the significantly positive coefficient of DVIX is smaller than that in GARCH model, which interprets that the positive impact of DVIX on government bond yields change in the EGARCH

model turn to be smaller than that when applying the GARCH model.

4. Discussion

When mentioning the relationship between the change in central government deficit and the government bond yield change, by employing the GARCH model, there are two types of government bonds with 3-year and 5-year duration of maturity for which yields change are significantly and positively affected by Central Government Deficit while the impact of it on 10-year government bond yields change is not significant. However, regarding to EGARCH model, only the coefficient of DCG_DEF on the first difference of the 3-year government bond is significant. The significantly positive association of the change in fiscal deficit with the change in government bond yields is consistent with (Malešević, 2015; Jalles, 2019). In other words, the increase in Government Deficit leads to the increase in the change in government bond yields because large government deficit decreases the ability of government to finance the budget deficit and increase the national debt. Government bond yields is known as the compensation for the higher deficit. Additionally, the relationships between the percentage change of Government Deficit and the government bond yields change are weaker than the association between other significant independent variables and government bond yields change. In other terms, the most significant impacts on the change in government bond yields is not Central Government Balance.

In term of inflation, by using GARCH(1,1) and EGARCH(1,1) model, the coefficients of inflation on 5-year government bond yields change are not significant, while the impact of inflation on 10-year government bond yields change is significant at the 1% level. Moreover, in GARCH model, the impacts of Inflation on the change in 3-year government bond yields is significant at the 5% level. In other words, the effect of inflation on the change in long-term government bond yield such as 10-year government bond is more significant than the impact of it on the change in shorter-term government bond yields as (Zhou, 2021) claimed. Most of the coefficients are negative. This is in line with (Mihelja et al., 2018; Zhou, 2021). The reason for it is that based on the fisher effect, the negative association between inflation and real interest rate occurs when the nominal interest rate frequently remains unchanged. Particularly, the lower inflation leads to the higher real interest rate, which increases the cost of borrowing or the bond yields.

Regarding to domestic policy rate, in both GARCH and EGARCH model, the coefficients of DPIR on three types of government bond yields change are positive at the 1% level of significance. It means that the policy rate is the key driver that changing the government bond yields, which is in line with (Simoski, 2019). This is also agreement with the Keynesian Theory that the ability of government to adjust short-term interest rate through setting policy rate is one of the key factors determining the long-term interest rate. When increasing the policy interest rate, the prices of government bonds fall, which results in the increase in the government bond yields.

For exchange rate, the coefficients of exchange rate on 3-year and 5-year government bond yields change are significantly negative while the impact of the change in exchange rate on the first difference of 10-year government bond yields is insignificant. It interprets that the increase in exchange rate USD/VND (the depreciation of Vietnam Dong) makes the government bond yields change fall. This is contrast to some previous research such as (Afonso & Nunes, 2015; Hsing, 2015; Tjandrasa, 2017; Zhou, 2021). Those studies indicate that the depreciation of domestic currency make the fixed income asset less attractive, so the government bond yields rise to compensate for the investment. Moreover, after the 2008-2009 crisis and the period that the exchange rate experiences the increase, the government applied effective exchange rate policy so the exchange rate less volatized. Specifically, to stabilize the exchange rate and foreign currency markets after the crisis, the government implemented measures to buy and sell foreign currencies to intervene the market when needed. Moreover, the government combine the exchange rate policy and monetary policy to reduce the pressure on the foreign currency market and encourage people and organizations to switch from holding the USD to the VND. Besides, the State Bank of Vietnam issued the bills on the open market to attract money. From 2011 to 2015, the government also implemented effective policy to stabilize the exchange rate such as the issuance of Circular No. 03/TT-NHNN dated March 8, 2012, narrowing the cases of borrowing capital in foreign currencies. In the current year, the government also effectively stabilize the exchange rate to deal with the COVID-19 crisis as Ministry of Finance claimed.

In both GARCH and EGARCH model, most of the coefficients of DVN_INDEX on the variances of the first difference of government bond yields is significant at the 1% level. Specifically, the first difference of VN Index significantly and negatively impacts the 3-year and 5-year government bond yields change while it significantly and positively affects the 10-year government bond yields change. It means that 3-year and 5-year government bond yields change rise, and 10-year government bond yields change declines when the change in VN Index decreases. For 3-year and 5-year bond yields, when the stock market declines, investors demand more

government bonds because of its safety to balance their portfolios. That is why the price of government bonds decrease and the government bond yields rise. But this is not true for the 10-year government bonds because of its longer maturity.

By employing GARCH and EGARCH model, most of the coefficients of DVIX is insignificant apart from the coefficient of DVIX on 10-year government bond yields change. Additionally, the coefficient of DVIX on the change in 10-year bond yields is positive. It means that the increase in the implied volatility of S&P500 stock market index, representing global market uncertainty or global risk aversion, leads to the increase in the 10-year government bond yields. This result is not in line with (Hsing, 2015; Pinho & Barradas, 2021). However, this is consistent with the results from (Miyajima et al., 2015). The explanation for this is that when global risk aversion increases, the investors seek for safe asset such as Vietnam's 10-year government bond, which increase the demand for 10-year government bonds. This leads to the decline of bond price and the rise in the 10-year bond yields.

5. Conclusion

To contribute to developing the government securities market, the determinants of the government bond yields play a big role in portfolio management for individuals and organizational investors and in smoothing credit markets. Through consideration of the factors affecting the government bond yields, the related parties can find the effective ways to benefit them in investment and issuance of bonds.

Our study examines the effects of fiscal position (central government deficit) and macroeconomic factors including inflation, exchange rate, domestic policy rate, stock market return, S&P500 stock market volatility index (VIX) on 3-year, 5-year, and 10-year government bond yields in Vietnam from August 2007 to August 2020. The estimated results shows that the GARCH model is more reasonable to model 5-year and 10-year government bond yields change and the other independent variable while EGARCH model effectively model 3-year government bond yields change and explanatory variables. From the research's results, the change in Central Government Deficit/Surplus, Policy Rate have a significantly positive impact on the 3-year and 5-year government bond yields change while the change in Exchange Rate USD/VND, VN Index have a significant and negative effects on these bond yields change. For 10-year government bond, the Inflation significantly and negatively affects the first difference of government bond yields. Otherwise, the change the Policy Rate and VIX significantly and positively affects the first difference of government bond yields.

From the obtained results, we have some recommendations for individuals, organizational investors, policy makers and future research. The consideration of several determinants affecting the government bond yields helps investors realize the potential risks when investing in the government bond with different maturities. The choice of appropriate government bonds contributes to the effective construction of investment portfolios. For government and policy makers, they should focus on considering policy rate, exchange rate USD/VND, and VN Index in priority when examining the cost of borrowing from 3-year and 5-year government bond because they are the most significant determinants affecting the government bond yields rather than the rest. Moreover, Central Government Deficit or Surplus should be also concerned to develop a sound fiscal policy to reduce the cost of borrowing for government. For 10-year government bond, Inflation and VIX are suggested to be considered due to the most significant impacts of them on the government bond yields change. Furthermore, the higher inflation and the lower VIX leads to the lower government bond yields. In other words, the increase in inflation and the decrease in VIX reduce the government's cost of borrowing.

This paper is challenged due to several limitations including the unavailability of data, the ineffective data facilities, small sample size, the explanation based on empirical research and controversial theories. Hence, we suggest that the future studies should consider more government bonds with different maturity and explanatory variables such as government debt, government net lending/borrowing, tax rate, government revenue and spending, credit rating, and so on to have a clear picture of the determinants of government bond yields. Additionally, the future study can apply more advanced models such as TGARCH, GARCH-M to sufficiently model the government bond yields and explanatory variables. In addition, the future research can employ model comparison test to find the best fit models.

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Appendix A. LM test for autoregressive conditional heteroskedasticity

H_0: No ARCH effects

H_1: ARCH(p) disturbance

Table A1. LM test for autoregressive conditional heteroskedasticity – D3_GOV_Y

LM test for autoregressive conditional heteroskedasticity (ARCH) chi2	df	Prob>Chi2
15.310	1	0.000
16.455	2	0.000
18.509	3	0.000
23.660	4	0.000
40.829	5	0.000
42.324	6	0.000
44.201	7	0.000
44.908	8	0.000
44.688	9	0.000
58.498	10	0.000
59.054	11	0.000
60.566	12	0.000

Table A2. LM test for autoregressive conditional heteroskedasticity-D5_GOV_Y

LM test for autoregressive conditional heteroskedasticity (ARCH) chi2	df	Prob>Chi2
0.707	1	0.400
0.781	2	0.677
0.768	3	0.857
0.782	4	0.941
2.059	5	0.841
18.694	6	0.005
21.012	7	0.004
21.108	8	0.007
27.566	9	0.001
29.424	10	0.001
29.870	11	0.002
32.134	12	0.001

Table A3. LM test for autoregressive conditional heteroskedasticity-D10_GOV_Y

LM test for autoregressive conditional heteroskedasticity (ARCH) chi2	df	Prob>Chi2
9.626	1	0.002
13.352	2	0.001
14.183	3	0.003
18.125	4	0.001
26.287	5	0.000
28.935	6	0.000
28.867	7	0.000
28.686	8	0.000
28.803	9	0.001
32.173	10	0.000
35.541	11	0.000
37.903	12	0.000