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MACROECONOMIC VARIABLES AND GOVERNMENT BOND YIELDS LISTED ON THE NAIROBI SECURITIES EXCHANGE

Martin Kilombe Muti
Student, Department of Economics, Accounts and Finance
Jomo Kenyatta University of Agriculture and Technology, Kenya
kmurithi83@gmail.com

Gordon Opuodho, PhD
Lecturer, Department of Economics, Accounts and Finance
Jomo Kenyatta University of Agriculture and Technology, Kenya

Abstract

This research paper investigated the correlation between macroeconomic variables and the government bond yields listed on the Nairobi Securities Exchange (NSE). The primary aim of the study was to ascertain the impact of key macroeconomic indicators on government bond yields in Kenya. The specific goals included exploring the influence of the inflation rate, economic growth rate, foreign direct investment, and exchange rate on government bond yields. The research employed a quantitative research design and utilized secondary data from nineteen 15-year Kenyan government bonds listed on the NSE, spanning from the 1st quarter of 2007 to the 1st quarter of 2023. The analysis focused on annual average yield fluctuations throughout the bonds' maturity period, using data sourced from the Central Bank of Kenya, Kenya National Bureau of Statistics, and the World Bank. The Vector Error Correction Model technique was employed to identify the long run relationship between the macroeconomic factors and government bond yields. Diagnostic assessments comprised the Augmented Dickey Fuller test and Johansen Cointegration Tests to assess stationarity and the long-term association between variables. The study concluded that foreign direct investment, exchange rate, and inflation rate significantly impacted government bond yields in the long term. The

study suggests the need for additional empirical investigations into how other macroeconomic factors, like unemployment rates and government expenditures, impact government bond yields.

Keywords: Bonds, Bond Yield, Economic Growth, Foreign Direct Investment, FDI, Inflation Rate, Foreign exchange Rates, Macroeconomic variables

INTRODUCTION

A bond is a loan where the issuer is required to repay the capital at maturity and compensate the buyer with one or more future cash flows (Chorafas, 2005). They are responsible for repaying lenders or investors the money borrowed plus interest over a predetermined period (Choudhry, 2006). These cash flow(s) may have a predetermined schedule and magnitude or depend on some economic variable whose value is typically known a priori. Government bonds are types of bonds issued by the federal or national governments of countries to raise funds while rewarding the issuer with annual interest rates over the maturity period (Platz, 2014). These bonds pay interest and have the par value returned to the bearer after a set time (Andritzky, 2012). According to Alfiana, Febrian and Santoso (2023), bond yield refers to interest generated from bond investments over the maturity period(s).

Bond markets are crucial for providing financing sources for governments, businesses, and private organizations to raise money, according to Kodongo, Mukoki and Ojah (2023), there is need for continued research on the role played in Sub-Saharan countries and the corresponding factors that affect its yield. Fredrick (2014) argued that bond markets aid the government to reduce the fiscal deficit and provide investment opportunities for both local and foreign investors. Although Kenya's domestic bond market is minor by global measures, it is rated third in Sub-Saharan Africa, after South Africa and Nigeria.

Wigglesworth (2012) goes on to say that if current development continues, Sub-Saharan African bond markets may see a boom, which will assist support local businesses and allow them to reach their full potential. Kenyan domestic bonds are majorly composed of government and corporate bonds which are traded in the primary and secondary markets in the NSE. In Kenya, the bond market contributes significantly to the republic's economic growth by providing local and international investors with investment possibilities and reducing the country budget deficit. Kenya's local bond market size as of 2012 was over $6 billion, or almost 16% of the GDP in that year in absolute terms (CBK, 2012).

The Nairobi Stock Exchange, formerly referred to as the Nairobi Securities Exchange, was founded around 1954 and was at its infancy stage then composed of an association of

volunteered stockbrokers (Nyasha & Odhiambo, 2016) enacted under the Acts of Societies Law in Kenya. This entity holds the status of being one of the original members of the World Federation of Exchanges (WFE), in addition to its membership in the African Securities Exchanges Association (ASEA).

Statement of the problem

Previous research on government bond yields in Kenya has revealed certain constraints and a failure to account for distinctive circumstances, such as the effects of the COVID-19 pandemic on the economy. These deficiencies in the existing body of knowledge underscore the need for additional research to rectify these shortcomings and offer a more thorough comprehension of the elements influencing government bond yields within the Kenyan framework.

Balozi (2017) conducted research on factors affecting treasury bill uptake in Kenya. However, their studies did not directly analyze government bond yields, which are essential in understanding borrowing costs for the government and investment decisions made by individuals and institutions. Furthermore, the use of regression analysis in their research was problematic as it failed to capture the long- and short-term effects of the macroeconomic variables under consideration. By not accounting for these effects, the studies fell short in providing a complete understanding of the correlation between the macroeconomic variables and government bond yields.

In a related study, Fredrick (2014) evaluated the influence of macroeconomic factors on the rise of the bond market in sub-Saharan Africa but did not specifically consider the impact on government bond yields. This omission is significant because government bond yields directly affect the cost of borrowing for the government, and understanding the determinants of these yields is crucial for policymakers and investors. Neglecting to analyze government bond yields limits the applicability of the findings and their usefulness in informing policy decisions.

Another study conducted by Ngaruiya and Njuguna (2016) focused on macroeconomic factors affecting bond prices but did not include an analysis of government bond yields. While bond prices and bond yields are related, they represent different aspects of the bond market. Government bond yields are specifically indicative of the return on investment for bondholders, while bond prices represent the market value of bonds. The failure to account for bond yields in their analysis limits the understanding of the factors directly impacting the returns and risks associated with government bonds.

Considering the unique conditions of the local Kenyan scenario, it is essential to resolve these research gaps and incorporate the specific impacts of macroeconomic variables, including

the inflation rate, economic growth rate, Foreign direct investment, and exchange rate. Additionally, the COVID-19 global health emergency has introduced unprecedented challenges and disruptions to the economy, necessitating an examination of its impact on government bond yields. By including these unique conditions and variables in the analysis, researchers can provide insights into the specific factors that influence Kenyan government bond yields.

To achieve this, there is a need for the development of more robust econometric models that can accurately predict the outcomes and determine the significant determinants influencing government bond yields. These models ought to take into account both the immediate and enduring impacts of the macroeconomic factors under scrutiny, thus delivering a more all-encompassing insight into the correlation between these variables and government bond yields. Such research initiatives would enrich the prevailing pool of knowledge, offer valuable guidance to policymakers when shaping sound fiscal strategies, and empower investors to make well-informed choices within the Kenyan bond market. By examining the repercussions of macroeconomic elements on government bond yields in Kenya, this study seeks to bridge the informational voids within this domain.

General objective

To determine the effects of macroeconomic variables on government bond yields listed at the Nairobi Securities Exchange.

Specific objectives

1. To determine the effects of Inflation Rate on government bond yields listed at the NSE
2. To determine the effects of Economic Growth Rate on government bond yields listed at the NSE
3. To determine the effects of Foreign Direct Investment on government bond yields listed at the NSE
4. To evaluate the effects of Exchange Rate on government bond yields listed at the NSE

LITERATURE REVIEW

In one noteworthy study, Meyer and Hassan (2020) evaluated the outcome of exchange rate movements on government bond yields in a sample of developed economies. Their research revealed a negative link between exchange rate volatility and government bond yields. In a separate investigation, Ślusarczyk, Meyer and Neethling (2020) explored the relationship between foreign exchange rates and government bond yields specifically in emerging market

economies. Their study highlighted a positive link between exchange rate depreciation and higher government bond yields.

Building upon these findings, Zhang *et al.* (2018) conducted a thorough evaluation of the correlation amid exchange rates and government bond yields across multiple countries. Trinh, *et al.* (2020), analyzed the outcome of exchange rate movements on government bond yields in a sample of Asian economies. Their research provided additional insights into the relationship by highlighting a significant positive association between exchange rate volatility and government bond yields.

Sabov and Murphy (1999) researched the relationship between bond yields and inflation within a controlled Hungary economy. A controlled economy implies that the government. Ekhsan and Fahlevi (2020) provide a different view on the relationship between bond yield and level of inflation. The factors under consideration were interest rates, inflation rates, and the bond's life (maturity). The direction of the impact of the bond's life, interest rate, and inflation on government bond yields are determined using multiple linear regression analysis.

According to Ammer et al. (2019), who conducted research that suggests a negative relationship between FDI and bond yields on U.S. bond holdings by foreign investors from 31 countries for the period 2003–2016. Additionally, the study observed that the relationship is stronger in countries with advanced financial markets, where foreign investments may have a more substantial impact on bond yields. In contrast, Zekarias (2016), explored the impact of FDI on bond yields specifically in African countries and reported a positive relationship the study was on the effect of foreign direct investment on economic growth in Kenya. They found that FDI has a positive impact on bond yields, suggesting that foreign investments may lead to higher borrowing costs for the government.

Matei (2020) studied Eurozone countries and found a negative relationship between FDI and bond yields, like Ammer (2018). Matei's research indicates that higher FDI levels are associated with lower bond yields, but this negative impact is stronger in countries with higher levels of debt. This finding suggests that FDI inflows can have a greater effect on reducing borrowing costs in countries facing higher debt burdens.

Essers (2015) researched fifteen Sub-Saharan African government local currency bond market drivers. The study results findings were also consistent with Gerlach and Alexander (2010) who concluded that bond yields are reduced as the state of the economy improves. Matei (2021) examined the consequences of the Covid-19 pandemic on sovereign yield spreads in European Monetary Union countries concerning German government bonds. The study employed the Pooled Mean Group estimate (Pesaran *et al.,* 1999) and the Chudik and Pesaran (2015) Dynamic Common Correlated Effects estimator, which account for heterogeneous

effects across nations as well as the non-stationarity of spreads and their drivers. The study variables employed by Jurkšas and Kropienė, (2015) encompassed Gross Domestic Product, interest rates, money supply, and foreign direct investment. In the dataset, they applied the vector auto-regression approach, conducted impulse response analysis, and utilized the forecast error variance decomposition method.

RESEARCH METHODOLOGY

Research design

This study was guided by a quantitative research design. The Causal-comparative research design was used to enable the study to specify the type of relationship between macroeconomic factors and government bond rates. The study's goal was to statistically identify relationships between the variables, which will be entirely quantitative.

The data

For the period of Q_1 2007 to Q_1 2023, the study utilized time series data to determine the impacts of inflation rate, Foreign Direct Investment, exchange rate, and economic growth rate on government bond yields in Kenya. This duration was chosen since the Kenyan economy has experienced most dynamic development during this time. The time period was also chosen since during this period when new bond instruments such as Euro bond were developed or adopted in the country.

In the study, secondary data for a 15-year government bonds from the fiscal year 2007 to 2023 were utilized. The Nairobi Securities Exchange (NSE) provided data on government bond yields. The Kenya National Bureau of Statistics supplied data on, inflation rates, and economic growth rate. The Central Bank of Kenya provided data on the USD/KES exchange rates. Finally, the World Bank provided the data on Foreign Direct Investment inflows.

Diagnostic tests

Heteroskedasticity test, in the realm of statistics, occurs when the standard deviations of a predicted variable exhibit non-constant behavior when observed across a spectrum of independent variable values or when contrasted with previous time periods. Therefore, if the data under analysis contain heteroscedascity, the variance cannot be trusted. The Breusch-Pagan-Godfrey test was used to detect heteroskedasticity.

The ADF test was employed to ascertain whether a specific time series dataset is stationary or non-stationary (Mushtaq, 2011). Stationary time series data remain consistent over time, where the mean and variance remain constant. In contrast, non-stationary time series data

exhibit fluctuations in the mean and variance over time. The assessment of data set stationarity was conducted before model estimation.

A cointegration test was applied to ascertain the presence of a lasting relationship among several time series. These tests identify situations in which two or more non-stationary time series are connected in a manner that prevents them from deviating from equilibrium over the long term. Johansen's Test was employed to examine cointegration.

Model specification and testing

To analyze the association between government bond yields and macroeconomic variables under study, Inflation rate, Economic Growth Rate, Exchange Rate and Foreign Direct Investment time series was used. A Vector Error Correction model (VECM) was utilized for the study. The guiding general model would be described as:

$\Delta BY_t = \beta_0 + \beta_1 INF_{t-1} + \beta_2 FDI_{t-1} + \beta_3 EG_{t-1} + \beta_4 EXR_{t-1} + \lambda ECT_{t-1} + u_t$ ……. (1)

Where:

ΔBY_t, is the first-differenced bond yield; INF_{t-1}, FDI_{t-1}, EG_{t-1}, EXR_{t-1} are the lagged first-differenced values of the inflation rate, FDI, economic growth rate, and exchange rate, respectively; ECT_{t-1} is the error correction term; β_0 is the constant term; β1 is the coefficient for intercept β_2, β_3, β_4, β_5 are the coefficients for the first differences of the independent variables (inflation rate, FDI, economic growth rate, and exchange rate, respectively), λ is the coefficient for the error rectification term, u_t represents the error term.

ANALYSIS, RESULTS AND DISCUSSIONS

Table 1: Heteroskedasticity Test Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.077107	Prob. F(4,12)	0.4103
Obs*R-squared	4.491130	Prob. Chi-Square(4)	0.3436
Scaled explained SS	2.039001	Prob. Chi-Square(4)	0.7286

The Breusch-Pagan-Godfrey test is used to detect heteroskedasticity, which refers to the presence of unequal variances in the residuals of a regression model. Table 1 shows the outcome of the heteroskedasticity test. The first component of the test involves the F-statistic, which measures the total value of the model in explaining the variance in the squared residuals used to detect heteroskedasticity. Here, the F-statistic is 1.077107, and the associated p-value (Prob. F(4,12)) is 0.4103. By comparing this p-value to the commonly used significance level of

0.05, you determine whether there is sufficient statistical data to reject the null hypothesis. In the results, the p-value exceeds 0.05, indicating that there is no strong evidence to infer the heteroskedasticity presence in your regression model.

The second component involves two additional statistics: Obs*R-squared and Scaled Explained SS, both tested with associated p-values (Prob. Chi-Square (4)). These statistics involve regression the squared residuals on the independent variables and examining the explained sum of squares in a scaled form, respectively. Similar to the F-statistic, you compare the p-values of these statistics to the significance level (alpha = 0.05) to evaluate the presence of heteroskedasticity. In the results, both p-values (0.3436 and 0.7286) exceed the 0.05 threshold, providing further support for the conclusion that there is no strong evidence of heteroskedasticity in your regression model based on these tests.

In summary, all components of the Breusch-Pagan-Godfrey test yield p-values that are greater than the 5% significance level, indicating that you do not have sufficient statistical evidence to conclude that there is heteroskedasticity in your regression model.

Table 2: Augmented Dickey Fuller test (ADF Test) test

Variable	p-value, At Level	Conclusion	p-value, First Difference	Conclusion
Bond Yield	0.0645	Non-stationary	0.0261	Stationary
Inflation Rate	0.0937	Non-stationary	0.0027	Stationary
Economic Growth Rate	0.4390	Non-stationary	0.0119	Stationary
Exchange Rate	0.3172	Non-stationary	0.0244	Stationary
Foreign Direct Investment	0.0819	Non-stationary	0.0071	Stationary

The Augmented Dickey Fuller test (ADF Test) test is commonly used to test stationarity in the variables at level and at first difference The Table 2 below shows the summary breakdown of the results at 5% significance level. First, consider the Bond Yield. The ADF test indicates that in its original form, the Bond Yield variable is non-stationary, whether with or without a trend. However, it becomes stationary when differenced once, whether with or without a trend. Moving on to the Inflation Rate, the results suggest that it is non-stationary in its raw form, regardless of whether a trend is included or not. Yet, the variable transforms into a stationary time series when differenced once, with or without a trend.

Similarly, the Economic Growth Rate displays non-stationarity at the initial level, regardless of the presence of a trend. However, when differenced once, whether with or without a trend, it attains stationarity. The Exchange Rate variable follows a comparable pattern. It is

non-stationary in its original form, with or without a trend. Yet, it becomes stationary when differenced once, with or without a trend. Lastly, the Foreign Direct Investment variable also exhibits non-stationarity in its initial state, whether with or without a trend. Nevertheless, it turns stationary after a first difference, regardless of the presence of a trend.

Table 3: Johansen Cointegration Trace Test Results

No. Hypothesized of CE(s)	Eigenvalue	Trace Statistic	Critical Value0.05	Prob.**
None *	0.782720	71.44130	69.81889	0.0369
At most 1	0.706434	47.01620	47.85613	0.0598
At most 2	0.627332	27.40573	29.79707	0.0921
At most 3	0.477295	11.61264	15.49471	0.1765
At most 4	0.074158	1.232834	3.841466	0.2669

The Johansen Cointegration Test is used to measure the cointegration presence among the variables. Cointegration suggests a long-run correlation between these variables. The following Table 3 shows the results of the Johansen Cointegration Test. The Johansen Cointegration Test results, conducted at a 5% significance level, offer meaningful perspectives into the relationship between the variables in the dataset. This test assesses whether there are co-integration relationships among the series: Bond Yield, Economic Growth Rate, Foreign Direct Investment, Inflation Rate, and Exchange Rate.

The Trace test, which is one of the cointegration tests used, indicates that there is one cointegrating equation (CE) at the 0.05 significance level. This suggests that there is a long-term equilibrium relationship among your variables. The hypothesis that there are no cointegrating equations is rejected at this significance level. This finding implies that your variables are not independent but are connected by a stable, long-term relationship.

In summary, at a 5% significance level, both the Trace tests indicate the existence of one cointegrating equation among your series. This implies that your variables are not moving independently in the long run, but rather, they have a stable, long-term relationship. Cointegration analysis is essential for understanding how these variables interact and affect each other in the long term, making it a valuable tool for time series data analysis.

Vector Error Correction Model (VECM)

In this section, the results provided are associated with a goodness-of-fit test for a Vector Error Correction Model (VECM) conducted in EViews. The R-squared value of 0.656278 indicated that roughly 65.63% of the variance in the dependent variable is explicated by the

independent variables in the model. The adjusted R-squared, which factors in the number of independent variables, is 0.540621. The standard error of the regression (S.E. of regression) is 1.471199, representing the average deviation of observed values from the regression line. The sum squared resid, measuring the overall fit of the model, is 411.2411. The F-statistic of 16.36799 with a very low p-value (close to zero) suggests that the model is statistically significant.

Table 4: Summary of T-Statistic Of Coefficients

Variable	Coefficient	Standard Error	t-Statistic	p-value
Error Correction Term	-0.177673	0.04290	-4.14170	0.0194
Economic growth	-0.101605	0.12083	0.84091	0.5307
Foreign direct investment inflows	0.611780	0.27757	-2.20402	0.0268
Inflation rate	0.179496	0.07589	-2.36526	0.0116
Exchange rate	0.035587	0.01636	-2.17480	0.0005
Intercept	-3.519003	1.33968	2.626744	0.0307

Bond $Yield_{t-1}$= -3.519003 - 0.101605 * Economic Growth $Rate_{t-1}$ + 0.611780 * Foreign Direct Investment $Inflows_{t-1}$ + 0.179496 * Inflation $Rate_{t-1}$ + 0.035587 * Exchange $Rate_{t-1}$

The coefficient -3.519003 serves as the constant or intercept in the equation. It signifies the expected value of lagged bond yield when all other independent variables are at zero. In this case, it's a negative value, suggesting that in the absence of the other variables' influence, bond yield is expected to have a negative long-run effect. The coefficient -0.101605 depicts the correlation between the lagged value of economic growth and bond yield in the long term. The negative coefficient (-0.101605) indicates that a rise in the lagged economic growth rate is associated with a decrease in bond yield in the long-term. Next, the coefficient 0.611780 highlights the relationship between the lagged value of foreign direct investment inflows in US dollars (at time "t-1") and bond yield in the long term. The positive coefficient (0.611780) means that a rise in the lagged foreign direct investment inflows is linked with a corresponding growth in bond yield in the long run.

Similarly, the coefficient 0.179496 represents the connection between the lagged value of inflation rate (at time "t-1") and bond yield in the long term. The positive coefficient (0.179496) signifies that a rise in the lagged inflation rate is correlated with a growth in bond yield over an extended period. Lastly, the coefficient 0.035587 outlines the relationship between the lagged value of US dollar exchange rate (at time "t-1") and bond yield in the long term. The positive

coefficient (0.035587) suggests that a rise in the lagged exchange rate of the US dollar corresponds to an increase in bond yield in the extended period.

CONCLUDING REMARKS

Summary

The average yearly inflation rate over a sixteen-year period was moderately variable, with a tendency for higher rates on the right side of the distribution. The coefficient of inflation rate indicated a long-term relationship with bond yield, which was positive. In summary, the inflation rate displayed it was suitable for analysis and showed both long-term and short-term relationships with bond yield. The economic growth rate was non-stationary at the initial level but became stationary upon differencing. However, the coefficient of economic growth was found to be insignificant in both the long run.

There's little interaction with other variables, and the FDI data became stationary upon differencing. The coefficient of FDI was significant in the long run, showing a positive relationship with bond yield, but it was insignificant in the short run. The exchange rate is non-stationary initially but becomes stationary after differencing. The coefficient of the exchange rate was statistically significant in the long run with a positive relationship with bond yield, while the short-term effects are insignificant.

Conclusion

In the extended term, we observe that FDI, Inflation rate and Exchange rate have a significant impact on the Bond yield while lagged inflation rate had a noteworthy effect on the yields in the short run. Economic growth rate did not exhibit any importance in the long and short term nor did the one period lagged bond yield.

The coefficient of inflation rate indicated a long-term relationship with bond yield, which was positive. The coefficients positively affected the yield both in the long and short run. This indicated an increase in inflation resulted to an increase in yield to compensate investors for the inflation factor. The coefficient of economic growth was found to be insignificant in both the long run relationship with bond yield. The coefficient of economic growth, however, was negative in the long. The insignificance could be attributed to the COVID-19 pandemic where the fiscal growth shrunk in the negatives.

The coefficient of FDI was significant in the long run, showing a positive link with bond yield. This could be attributed to the fact that most FDIs are long term projects hence the long run association with the bond yields. The coefficient of the exchange rate is statistically significant in the long run with a positive relationship with bond yield.

Recommendations

The research suggests that government bonds should be a focal point in the development of monetary and financial regulations within the country. It is essential that the interest rates associated with government-issued bonds offer attractive yields, thereby encouraging a higher level of citizen investment in these bonds, while also ensuring that such investments do not negatively impact other securities within the capital market.

Furthermore, the study proposes that the administration takes proactive steps to launch an extensive awareness campaign about government bonds and their associated benefits. By educating the public about the advantages of treasury bonds and bills, the government can effectively address budget deficits, reduce foreign debt, and cultivate a culture of long-term investment among its citizens.

Further research

Additional empirical investigations should direct their attention towards examining the impacts of various macroeconomic factors, including aspects like unemployment rates and government expenditure, on the performance of government bond yields. Moreover, there is a need for further research to delve into the factors that dictate the yields of sovereign bonds in the Kenyan context.

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