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# Evaluation of The Determinants of Domestic Bonds in Ghana

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**ABSTRACT**

The study sought to examine the determinants domestic bonds in Ghana using secondary data. The researcher used the Government of Ghana bonds issued in 2013 to 2017 and has not matured by 31st December 2019. A sample of 6 Government of Ghana bonds which have been on the secondary market for at least two years with a tenor of at least three years was used by the researcher. Based on the stationary and the existence on cointegration vectors, the study investigated long and short run effects using ARDL (1,0,1,1,1,1) and ARDL (1,2,2,2,2,2) Error Correction Models respectively. The E-Views version 11 was used to conduct the analysis. It was found that GDP had a long run insignificant positive effect on Ghana Government Bond Prices, but a short run significant positive effect on Ghana Government Bond Prices. The second major finding was that Exchange Rate had a significant positive effect on Ghana Government Bond Prices in the long run, but this significant effect was negative in the short run. Thirdly, it was revealed that inflation had a significant negative effect on Ghana Government Bond Prices both in the long and short run. Risk Free Rate of Return had a significant negative effect in the long run but had insignificant effect in the short run. Monetary Policy Rate had significant positive effects in the long and short run. It was concluded that increases in Exchange Rate, Gross Domestic Products and monetary policy led to corresponding increases in the prices of government bonds while increases in Inflation, and Risk Free Rate of Return led to a decrease in the prices of Government bonds. In the short run, an increase in Exchange Rate and Inflation leads to a decrease in bond prices while an increase GDP, Risk Free Rate of Return and Monetary Policy Rate leads to a corresponding increase in bond prices. It is recommended that investors consider inflation, GDP, exchange rate, Risk Free Return and Monetary Policy, among other factors, when making decisions on the position to take in a bond as it determines bond prices. Policymakers should aim at working to achieving low inflation and exchange rate figures as that will increase bond prices and make it more attractive to foreign investors. It is also important that policy makers understand and manage effectively risk free bonds and the monetary policy as they have significant effects on the prices of government bonds.



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# 1. Introduction

## 1.1. Background Of the Study

Since trading began on Ghana Fixed Income Market in August 2015 (Agyeman-Duah, 2019), the market has experienced significant growth despite being an emerging market. According to data posted on Central Securities Depository Limited (2017), "the Government of Ghana issued 5 bonds in 2015 specifically two three-year tenor bonds and three five-year tenor bonds. The market size grew further to 9 bonds as at 31st December 2016, 19 bonds as at the end of 2017 and 27 bonds as at 31st December 2018." To curb excessive inflation before the Ghana Fixed Income Market was established in May 2015, the Bank of Ghana issued Bank of Ghana and Government of Ghana bonds with maturities of 2, 3, and 5 years (Bank of Ghana, 1994). However, the issuance of 5-year bonds was halted by the central bank in 1994.

There are currently around thirty sovereign bonds denominated in local currency, two sovereign bonds denominated in foreign currency, and various business and quasi-government bonds on the market. As of the end of June 2019, the Government of Ghana had issued five sovereign bonds, expanding the market. Foreign participation of the bond market has been on the rise since Bloomberg reports that the majority of the country's bondholders are foreign pension funds through its E-Bond trading and market surveillance system. Ghana has enjoyed a stable economic growth with a peak of 11.11% in its GDP recorded in the second quarter of 2017 and a trough of -1.6% recorded in the third quarter of 2015 (GSS, 2019). However, Ghana has been highly dependent on external funding which makes the country vulnerable to external shocks. Hence Ghana's economy is open and highly exposed to external shocks such as fall in prices of cocoa, gold and crude oil.

Upon attaining the lower-middle-income economy in 2010 according to one of the world's largest funder namely the World Bank, the government's reliance on bond issuance to augment its budget expenditure heightened as foreign aid declined. Bond issuance has numerous advantages as it helps in stabilizing the country's exchange rate as foreign entities seek for the Ghanaian cedi to participate in bond issuance. Issuance of bonds supplements domestic savings which are then used in financing public sector investments which will eventually lead to domestic capital market development. Bond issuance also relieves government from reliance on bank financing from abroad which will also lead to divestiture in external financing (Das, Papaioannou, & Polan, 2011).

Prior reports on bond prices in the bond market mainly concentrated on established and mature countries, with less research emphasis on developing and emerging economies/markets, which is aligned with academic literature. Where the bond market is based on developing markets, it is typically on a geographical level rather than a country-by-country basis (African Development Report, 2011; Kapingura & Makhetha-Kosi, 2014).. It is argued that a more effective way of finding solution to the development of the local bond market is to identify the major determinants of bond prices. The present study tends to focus on the macroeconomic determinants of bond prices with focus on government bonds.

According to the International Monetary Fund (2019), Ghana's bond market has been described as one of the frontier markets. Ghana's bond market is regulated by Ghana Stock Exchange through Ghana Fixed Income Market headed by Augustine Simmonds, The Bank of Ghana, The Security and Exchange Commission and Central Securities Depository. Regulators and policymakers have embarked on implementing programmes to strengthen the market. The growing relevance of the Ghanaian bond markets due to increasing market openness continue to underpin the strengthening of trade relationships between Ghana and the outside world.

Without a question, macroeconomic factors influence any bond market (whether developed or emerging) (Nkwede, 2020). These macroeconomic trends poses threats to the bond market, both directly and indirectly. The effects and challenges posed by these macroeconomic variables have prompted a whirlwind of scholarly discussion. (Mu, Phelps, & Stotsky, 2013), for example, argue that exchange rate volatility has a countervailing impact on bond market growth.

The problem with the bond market despite its growth is the lack of conclusiveness on the determinants of bond prices on the secondary market. Researchers like (Bhole & Mahakud, 2009; Hofmann, Shim, & Shin, 2020; Ngaruiya & Njuguna, 2016) have carried out some research on bond markets and bond prices but none of them focused on the Ghanaian bond market. As a result, it may be impossible to provide a satisfactory answer to the question of what drives bond market growth in emerging markets from a macroeconomic or institutional perspective until a study on the determinants of bond prices in the bond market that is country specific and variable specific is conducted. In light of this, the current study's motivation is to look into the factors that affect bond prices with a focus on Ghanaian government bonds. It specifically attempted to measure the effects of the GDP, exchange rates, and the consumer price index on the prices of Government of Ghana secondary market bonds.

## 2. Literature Review

### 2.1. Bonds And Secondary Market

A bond is simply a contract between a lender known as the investor and a borrower known as the issuer. A bond according to Elton-Chalcraft, Hollander, and Prescott (2014) is an IOU which states that the issuer owes the investor a certain amount for a specific period. (Nkwede, 2020; Nyantakyi-Frimpong, Arku, & Inkoom, 2016) also defines a bond as a long-term debt instrument in which the issuer, owes the holders a debt and is obliged to pay the interest during the lifetime of the instrument and repay the principal at a later date, termed the maturity.

The issuance of bonds is usually done by corporations, municipals and sovereign states. Features of a bond include principal termed as Face Value, coupon known as interest or returns and days to maturity (Jones & Egley, 2007). Face Value of a bond is the amount due to the investor at maturity of the bond (i.e., when the term or life of the bond ends) Coupon of a bond is the interest or returns or profit that the investor earns on the bond. Coupons are paid twice a year on the Face Value of the bond (Jones & Egley, 2007). Days to Maturity/Years to Maturity refers to the number of years that is left for the bond to mature. Elton-Chalcraft et al. (2014) states that yield and price are inversely related. Price is the value that a bond is sold on the secondary market. It is marked to 100. Principal or amount of a bond on the secondary market is not equal to its face value because of accrued interest. A bond is said to accrue interest from the day that it was issued due to changes of prevailing interest rate on similar Treasury securities. The interest rate on the prevailing interest rate on similar treasuries cannot be stable as a result of the time value of money which measures the value of money concerning inflation (Golinelli & Rovelli, 2005).

### 2.2. Gross Domestic Product

The estimated total value of a country’s goods and services produced by its resident citizens over a particular period is its gross domestic product. Goods produced, such as beverages and food and services offered like delivery services, consultation service etc. in the country over a particular period (Brezina & Zhao, 2012). According to Dornbusch and Fischer (1994), net demand for domestic production is made up of four components: consumption, industry investment, government purchases of goods and services, and international demand. Due to this, the best measure of economic performance according to Mankiw (2006) is the gross domestic product. Since economic growth is measured in terms of a rise in the nation's economy, gross domestic product is often used to measure a country's economic output. The gross domestic product only includes completed products and services, which are those that are used by their end buyer and are not used as inputs into other goods. Measuring intermediate goods and services would allow a country's economic operation to be double-counted. As a result, Reddy (2012) contends that this differentiation distinguishes transactions between individuals and businesses from GDP.

### 2.3. Consumer Price Index (CPI)

Ghana Statistical Service (2015) defines consumer prices index (CPI) as a measure of the change over time in the prices of goods and services. CPI reflects the percentage change (annual) in prices of items and services. Consumer prices index measures price

levels of items and services acquired by the household for consumption. The Ghana Statistical Service (2015) as its base year in performing these calculations. The institution takes into account prices levels of food and non-food items, alcoholic and non-alcoholic beverages, recreation and culture, clothing and footwear, transportation fares, household equipment and routine maintenance, furnishings, housing, gas, electricity, water, and other fuels subgroup, and miscellaneous goods and services.

Sigalla et al. (1997) indicate that CPI is one of the most closely used statistics. Hence, it is a leading indicator in determining the economic health of a nation where high CPI may indicate economic instability as it indicates inflationary trends of the economy (Sigalla and Wayne 1994).

Adjustments in CPI have also been identified to have a direct impact on the pocket and books of many individuals (Sigalla and Wayne 1994). The theory of the cost-of-living index, according to Sigalla and Wayne (1994), is the conceptual foundation of the Consumer Price Index. Konus, a Russian economist, is credited with establishing the theory. This theory is based on the premise that economic actors (consumers or producers) are maximizing their actions (International Labour Organization, 2014). The cost-of-living theory is a philosophy focusing on a person's desires for certain goods and services, as well as the costs at which they can be purchased (Sigalla and Wayne 1994).

### 2.4. Exchange Rate (EXR)

Eichengreen, Rose, and Wyplosz (1994) state that the exchange rate refers to the amount with which one currency will be exchanged for another. It simply means how much one currency worth in another currency. O'sullivan and Sheffrin (2003) state a vital determinant of the level of trade of a particular country is the exchange rate. This is critical to a free market economy. O'sullivan and Sheffrin (2003) also state that exchange rates impact the real return of an investor's portfolio. O'sullivan and Sheffrin (2003) state that a flexible exchange rate system is monetary where the exchange rate is determined by supply and demand. The Foreign Exchange Market determines exchange rates (O'sullivan & Sheffrin, 2003). Since the foreign exchange market is made up of various types of buyers and sellers from various continents, it is open 24 hours a day, except on weekends, when trade starts at 20:15 GMT on Sunday and finishes at 22:00 GMT on Friday (Ngaruiya & Njuguna, 2016). A strong currency which is one of the signs of a strong economic performance tends to lead foreign investors to invest their capital in that economy. A nation with such positive characteristics would lure investment dollars away from countries with higher political and economic risk. An economically risky nation may suffer a lack of faith in its currency as a result of, for example, political instability, allowing capital to flow to more prosperous countries' currencies (Mohan & Wilding, 2009).

## 3. Theoretical Review

### 3.1. Currency Crises Theory

Following the currency crises in the 1990s, many debates have gone on concerning the pros and cons of fixed and floating exchange rate regime from the political and exchange rate perspectives. The focal point of these debates and theoretical reviews have been the ability of an exchange rate regime to withstand periodic financial emergencies. The state's susceptibility to currency instability under multiple exchange-rate theocracies has been thoroughly addressed and the findings have been extensively illustrated in numerous literatures. One of the citations on exchange rate fluctuations notes that the strategy sometimes referred to as the first-generation model of Krugman (1979) describes the currency crisis as the unavoidable result of structural disparities or unstable policy stances. This school of thought considers the exchange rate system to be a critical component of the border policy package, and it believes that the process will only be maintained if it does not interfere with other monetary and fiscal goals. External disparities are often suggested as a function of expansionary monetary policies paired with a fixed exchange rate (Krugman, 1979).

While local credit development over money demand growth would contribute to a gradual yet irreversible reduction of foreign funds under a fixed exchange rate regime, which will eventually damage the currency, contributing to a speculative currency attack.

On the other hand, a floating mechanism can lead to substantial exchange-rate volatility, especially in countries where financial structures are not well established and foreign exchange markets are weak. Flood and Rose (1995), Rose (2000), Klein and Shambaugh (2004) contend that floating exchange rates are highly volatile. Thus in a few cases, such excess uncertainty will curtail foreign trade. Flexible exchange-rate systems would increase risk levels by improved exchange-rate volatility, create moral hazards to the poorly governed financial sector, and further improve the nation's vulnerability to currency crises (McKinnon, 2000). Set exchange rates would prompt lower hazard expenses, which means investors will be more averse to raise their dollar shortages. The middle of the road system of controlled drifting was likewise worth investigating in the light of these issues connected to the previously mentioned plans. Ohno (1999) presumed that changing to a crawling stake component could be fitting for this situation, as it fuses the advantages of both fixed and variable trade rates. The middle of the road system likewise offers adaptability when the nation is affected by capital flights. Even though the moderate system isn't a panacea and is viewed as more calamity than the previous frameworks at one or the flip side of the conversion scale structure range (Fischer, 2001). Crawling peg method is presumed to have been unreliable, so both fixed-rate and free-floating schemes have gained confidence amongst professionals. Thus, Haile and Pozo (2006) argue that non-coupled pegs could contribute to currency speculation, possibly increasing the likelihood of a currency collapse.

Despite their worries about the currency crisis, Stiglitz (2002) insists that countries should choose between a fixed, floating, or medium exchange rate system in general. While neither fixed nor flexible prices can be blamed for the crisis, capital market liberalization, in conjunction with macroeconomic and "bail-out" policies, makes countries more vulnerable to disruptions and, as a result, currency crises. Kaminsky and Reinhart (1999) conclude that currency crises are gradually associated with financial fragility, and Eichengreen et al. (1994) have been tested for popular global shocks or market contagion. Haile and Pozo (2006) acknowledge that the actual exchange rate mechanism has no impact on determining currency crises. Nor is it distinguished between different exchange-rate regimes in addition to increasing susceptibility to financial instability. Eichengreen et al. (1994); Kaminsky and Reinhart (1999) argue that monetary crises are caused by economic policy and some dysfunctional exchange-rate policies instead of by exchange-rate regimes. The key question, which remains a source of contention and is especially contentious, what kind of exchange rate leads to the occurrence of a currency recession.

## 3.2. Impossible Trinity Theory

According to this trilemma, each nation's policy system can only have two of the three characteristics: (1) an open capital market (free capital movement across borders), (2) an independent monetary policy, and (3) a fixed (pegged) exchange rate.

Historically, varying variations of the other three elements have governed the world's monetary processes at different periods. Under the classic 19th-century gold standard, large trading nations showed the advantages of unregulated capital transfers and the security of a fixed connection of the currency to gold. Many states have abandoned capital mobility under the Bretton Woods plan in order to preserve both fixed exchange rates and fiscal independence. Today, the framework that concedes fixed exchange rates for capital portability and floating exchange rates have gotten mutually represented by major modern districts. As far as the impossible trinity standard, under the setting of raised unfamiliar capital versatility, a steady swapping scale empowers policymakers to follow a self-sufficient money related strategy. Be that as it may, if the homegrown policymakers can't utilize it, some opportunity of money related strategy should be relinquished to the adjustment of imports from different countries. Likewise, Christl (2006) demonstrates that the compromise among money related freedom and exchange rate steadiness can be affected by different contemplations, for example, national bank autonomy, regulatory capacity, and the intricacy and liquidity of the unfamiliar trade market.

Many of the countries affected by the crisis have tightened their exchange rates. From the trilemma point of view, crises are a sign that open capital markets, monetary freedom and pegs are irreconcilable and that “bipolar vision” or “two corner solutions” are the only realistic alternatives for these nations. Eichengreen et al. (1994) are one of the

first proponents of the "Hollowing the Centre" or "bipolar vision" theory that only a two-corner hard peg" and "full float" strategy is possible in the sense of high capital mobility. With the intensified pattern of financial consolidation and innovation, capital management efficiency may also be minimized, the traditional trinity problem is usually separated into two choices or monetary policy – exchange rate stability trade-off.

### 3.3. Empirical Review

According to Keleş (2016), emerging market economies have been the primary drivers of global growth. Keleş (2016) states that investing in emerging economies local currency debt instruments is a way of benefiting from high returns that the economies offer. According to Hofmann et al. (2020), investors are looking for ways to reduce exposure to vulnerabilities stemming from foreign currency debt as a result of an emerging market crisis of the 1990s, hence the growth in EME's local currency between markets. Comprehending underlying fundamentals of the Emerging market economies (i.e., EMEs) provides critical information of the associated risk since according to Hofmann et al. (2020), foreign participation in some EMEs local currency bond market is as high as 40%.

Carstens and Shin (2019) link-local currency yields invariably bond prices to exchange rate as Hollman and Pearce (2022) posit that exchange rates are important components of financial conditions that influence investor risk-taking. This is because investors hold assets in dollars which is more sensitive to bond price changes, hence local currency appreciation tends to magnify returns and vice versa. O'sullivan and Sheffrin (2003) emphasize that exchange rate impacts real return of an investor's portfolio. When bond prices rise as a result of yield falling below coupon, the local currency tends to appreciate against the dollar. Hence (Squawk, 2013) suggests that currency risk occurs when investors purchase a bond that is denominated in foreign currency. Global Investor (2013) notes that exchange rate affects bond prices as Njuguna (2017) note that central banks may increase interest rate as a result of controlling the exchange rate between a struggling currency and others. This will increase the yield of bonds and conversely lower bond prices.

AFME Finance for Europe (2013) suggests that currency exchange rate movements can also lead to inflation. Inflation takes away the value of investment returns over time, hence, forces the investor to work to maintain existing purchasing power. An investor holding a bond with fixed-rate coupon and face value at maturity, inflation negatively impact on the interest that coupon pays. Inflation and interest rate move hand-in-hand. Hence as the inflation rate rises, interest rates (or yields) will rise too hence negatively affecting bond prices.

The aim of Fredrick (2014) research was to look into the impact of a few macroeconomic variables on the growth of Kenya's bond market. To assess the influence of macroeconomic variables on bond market growth, researchers used a causal research design. The macroeconomic factors affecting the bond market's development were modeled using secondary data. The Kenyan bond market was covered in its entirety. Descriptive and regression analysis were used to examine the results. The significance of the interaction was calculated using the T-test. The study discovered that bank scale, exports, and fiscal policy had little influence on bond market growth, while the exchange rate, interest rate, and GDP per capita had a positive impact. Economic size as calculated by GDP at purchasing power parity, on the other hand, had a negative effect. The exchange rate, interest rate, GDP per capita, and GDP at purchasing power parity were all found to have an effect on bond market growth.

Hoffman et al. (2019) suggest that there is a positive correlation between exchange rates and local sovereign bond price in emerging market economies. Hence exchange rate is an important component of financial conditions that influence investors in taking positions in Emerging Market Economy local denominated currency bond. Hoffman et al. (2019) used panel data of 20 emerging market economies mainly Chile, China, Columbia, the Czech Republic, Brazil, Hungary, India, Israel, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, Turkey and Thailand from January 2013 to January 2019. The results showed that currency appreciation of emerging market economies increases the bond price that is lowering credit risk spread.

### 3.4. Conceptual Framework

Figure 1 illustrates the relationship between the variables employed in this study. It first looked at the effect of a gross domestic product on bond. The effect of exchange rate on bond price was also depicted in the framework. And finally, the effect of the consumer price index on the bond price was also shown.

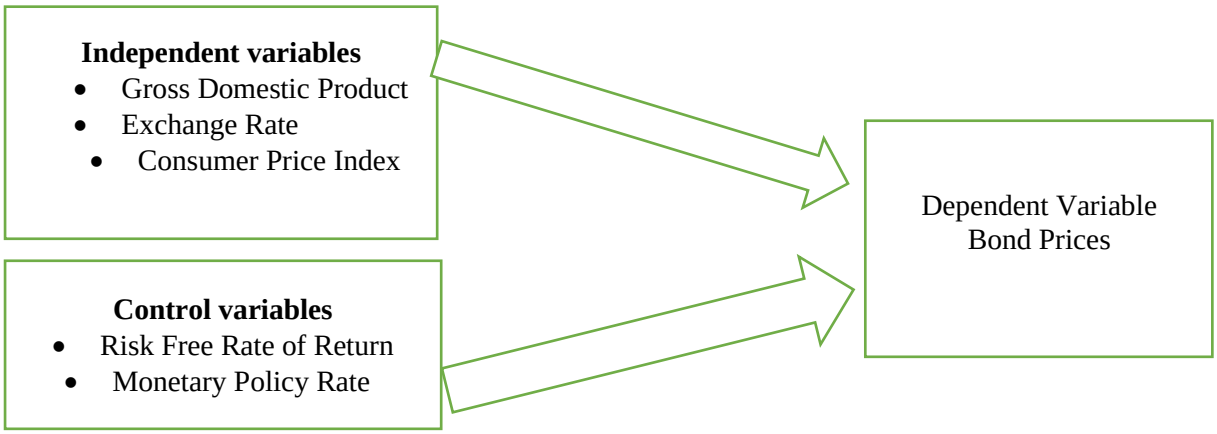


***Figure 1: Conceptual Framework***

## 4. Methodology

### 4.1. Research Design

Leavy, Hourigan, and Carroll (2017) indicates that the quantitative design is used to determine the kind and type of relationship that exists between two variables. Concerning this study, a qualitative model enabled the researcher to deduce the type of relationship which exists between Gross Domestic Product, Consumer Price Index, Exchange rate and Government of Ghana secondary market bond prices. Descriptive and inferential statistics were used by the researcher to determine the level of impact of the relationships. Quantitative research design facilitates objective facts regarding a phenomenon as data has already occurred. The choice of this research design is as a result of the inability of the researcher to tamper with the variables since they hitherto exist and they cannot be manipulated.

### 4.2. Data and Data Collection Procedure

Quarterly secondary data were used in the research. Quarterly secondary market bond prices were provided by Bloomberg LLP since Bloomberg is one of the two key trading platforms approved by the Bank of Ghana for secondary market trading of Government of Ghana bonds. Quarterly USD/GHS exchange rate was obtained from the Bank of Ghana while Quarterly Gross Domestic Product and Consumer Price Index were obtained from the Ghana Statistical Service. Quarterly data obtained span from 2015 through to 2018. Secondary data was used in the research due to its nature.

### 4.3. Data Processing and Analysis

E-Views was used to conduct the analysis. This was used to extensively investigate and determine the type of relationship between Gross Domestic Product, Exchange rate, Consumer Price Index and Government of Ghana secondary market bond prices. Summary of findings was depicted in tables.

### 4.4. Model Specification

It is often debated that macroeconomic factors affect activities on the secondary bond market. Kaps and Lamberson (2009) posit that the way changes in one factor affects the behaviour of the other factors can be described with a function. Regression, specifically

multiple regression was used by the researcher. The model that the researcher used was in this form:

$$GHGBP = \beta_0 + \beta_1 EXR_t + \beta_2 CPI_t + \beta_3 GDP_t + \beta_4 RFRR_t + \beta_5 MPR_t + \mu_t \quad (1)$$

Where,
GHGBP represents Ghana Government Bond Price
EXR represents Exchange Rate
CPI represents Consumer Price Index
GDP represents Gross Domestic Product
RFRR represents Risk Free Rate of Return
MPR represents Monetary Policy Rate
$\beta_0$ and $\mu$ respectively represent constant term and an error term
$\beta_1$, $\beta_2$, and $\beta_3$ represent the beta coefficient of the regression equation.

**Table 1**
***Variable Description, Measurement and Expected Sign***

| Type of variable | Variable | Sign |
|---|---|---|
| Independent | Ghana Government Bond Price (GHGBP) | + |
| Dependent | Exchange Rate (EXR) | - |
| | Consumer Price Index (CPI) | - |
| | Gross Domestic Product (GDP) | + |
| Control | Risk Free Rate of Return | + |
| | Monetary Policy Rate | + |

## 4.5. Estimation Techniques and Data Analysis

The research used Eviews and SPSS applications to perform the Augmented Dickey-Fuller and Philip-Perron tests, as well as cointegration. Also, Jarque-Bera test was employed to test for the existence of normality, while Brusah-Godfrey LM test was adopted to test the existence of serial correlation. Breusch-Pagan-Godfrey test was also adopted to test heteroscedasticity misspecification in the model respectively. Moreover, Serial correlation, heteroscedasticity, normality, functional form, and stability measurements like cumulative sum (CUSUM) and cumulative sum of squares are only a few of the diagnostic tests that were used.

# 5. Results and Discussions

## 5.1. Descriptive Analysis

Table 1 presents summary statistics of the variables of study: Ghana Government Bond Price, Exchange Rate, Gross Domestic Product, Consumer Price Index, Risk Free Return, and Monetary Policy Rate for the period from 2000 to 2019 using mean observation, minimum observation, and maximum observation and Standard Deviation (SD). GHGBP reported a minimum of 4.57 and a maximum observation of 4.69, an average score of 4.62, and standard deviation of 0.0275. The same interpretation is applicable for all other variables.

**Table2**
***Descriptive Statistics***

| Variables | N | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| GHGBP | 20 | 4.62 | 0.0275 | 4.57 | 4.69 |
| CPI | 20 | 15 | 6.82 | 7.13 | 32.9 |
| GDP | 20 | 23.9 | 0.913 | 22.3 | 24.9 |
| EXR | 20 | 4.81 | 0.00546 | 4.8 | 4.82 |
| RFRR | 20 | 18.7 | 5.54 | 8 | 27 |
| MPR | 20 | 20.1 | 8.46 | 8.97 | 41 |

From Table 2 the mean score for GHGBP is 4.62. This mean score has a degree of variability measured using standard deviation of 0.0275. The minimum score recorded for GHGBP is 4.57 and the maximum is 4.69, suggesting that GHGBP within the stipulated period ranges from 4.57 to 4.69. The mean score for the variable, CPI is 15.00. This mean score has a degree of variability measured using standard deviation of 6.82. The minimum score recorded for CPI is 7.13 and the maximum observation is 32.9, suggesting that CPI

from 2000 to 2019 ranges from 7.13 to 32.9. GDP reports an average score of 23.9 within the period of 2000 to 2019. This average score has a degree of variability measured using standard deviation of 0.913. The minimum score recorded for GDP is 22.3 and the maximum is 24.9, suggesting that it ranges from 22.3 to 24.9 within the period of 2000 to 2019.

EXR reports an average score of 4.81 within the period of 2000 to 2019. This average score has a degree of variability measured using standard deviation of 0.005. The minimum score recorded for EXR is 4.8 and the maximum observation is 4.82, suggesting that it ranges from 4.8 to 4.82 from 2000 to 2019. RFRR reports an average score of 18.7 within the period of 2000 to 2019. This average score has a degree of variability measured using standard deviation of 5.54. The minimum score recorded for RFRR is 8.00 and the maximum is 27.00, suggesting that within the stipulated period it ranges from 8.00 to 27.00. MPR reports an average score of 20.10 within the period of 2000 to 2019. This average score has a degree of variability measured using standard deviation of 8.46. The minimum score recorded for MPR in Ghana is 8.97 and the maximum is 41.0, suggesting that it ranges from 8.97 to 41.0 from 2000 to 2019.

## 5.2. Stationarity and Unit Roots Analysis

The study conducted the unit root test with intercept using Augmented Dickey-Fuller (ADF) test both at level I (0) and at first difference I(1) as well as Philip-Peron test both at ordinary level and first difference. This enables the study to determine whether the variables are stationary at level I (0) or at first difference I (1).

**Table 3**
***Unit Root Test (Level)***

| Variables | ADF stat | 1% critical level | 5% critical value | 10% critical value |
|---|---|---|---|---|
| GHGBP*** | -5.8839 | -3.9204 | -3.0656 | -2.6735 |
| EXR** | 3.1126 | -3.9204 | -3.0656 | -2.6735 |
| GDP | -1.6318 | -3.8315 | -3.0300 | -2.6552 |
| CPI | -2.4339 | -3.9592 | -3.0810 | -2.6813 |
| RFRR | -2.1634 | -3.8574 | -3.0404 | -2.6606 |
| MPR | -2.3445 | -3.8315 | -3.0300 | -2.6552 |

**Table 4**
***Unit Root Test (First Difference)***

| Variables | ADF stat | 1% critical level | 5% critical value | 10% |
|---|---|---|---|---|
| GDP*** | -3.980 | -3.8574 | -3.0404 | -2.6605 |
| CPI*** | -8.2149 | -3.8574 | 3.0404 | -2.6606 |
| RFRR** | -3.7264 | -3.8574 | -3.0404 | -2.6606 |
| MPR*** | -4.9460 | -3.574 | -3.0404 | -2.6606 |

The rejection of the null hypothesis (H 0) indicates from Table 4.2 above, (*), (**) and (***) that the time series component is non-stationary and has a unit root at 10 percent, 5 percent and 1 percent significance stage. If the absolute value of the time series variable test statistics is higher than 10% or 5% or 1% criical values, the analysis rejects the null hypothesis ($H_0$) that the time series variable is non-stationary or has unit roots; otherwise the null hypothesis ($H_0$) would not be dismissed by the study. Only GHGBP and EXR are stationary at level I (0) at 1% critical level and 5% level respectively, as seen in Table 2 from the ADF test. However, taking their first variations, as seen in Table 3, all other variables (GDP, CPI, RFRR and MPR) are stationary at either 1% critical level, or 5 % critical level.

**Table 5**
***Philips-Perron Unit Root Test (Level)***

| Variables | ADF stat | 1% critical level | 5% critical value | 10% |
|---|---|---|---|---|
| GHGBP** | -3.7718 | -3.8315 | -3.0300 | -2.6552 |
| EXR** | -3.5037 | -3.8315 | -3.0300 | -2.6652 |
| GDP | -1.8171 | -3.8315 | -3.0300 | -2.6552 |
| CPI* | -2.6884 | -3.8315 | -3.0300 | -2.6552 |

| | | | | |
|---|---|---|---|---|
| RFRR | -1.5231 | -3.8315 | -3.0300 | -2.6552 |
| MPR | -2.3267 | -3.8315 | -3.0300 | -2.6552 |

From Philip Peron Test result shown in Table 5 and Table 6, variables such as GHGBP, CPI and EXR are stationary at I (0) at 5%, 5% and 10% respectively as shown in Table 5. However, other variables become stationary at either 1% or 5% critical value upon taking their first differences as shown in Table 6 below.

**Table 6**
***Philips-Perron Unit Root Test (First Difference)***

| Variables | ADF stat | 1% critical level | 5% critical value | 10% |
|---|---|---|---|---|
| GDP*** | -3.8980 | -3.8574 | -3.0404 | -2.6606 |
| RFRR** | -3.7530 | -3.8574 | -3.0404 | -2.6606 |
| MPR*** | -4.8863 | -3.8574 | -3.0404 | -2.6606 |

## 5.3. Bound Testing Cointegration Approach

The study used Pesaran, Shin, and Smith (2001) bound testing approach to test for the presence of a long-run equilibrium relationship between the variables of the study. Table 7 presents the bound testing co-integration results using both F-bound and t-bound for identifying the presence of cointegration vectors.

**Table 7:**
**Bound Test Results**

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| F-statistic | 9.810467 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |
| t-Bounds Test | | | | |
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -18.79300 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

The analysis will reject the null hypothesis ($H_0$) if the F-statistic and t-statistic for the first difference I(1) regressor are greater than the critical values, and will refuse to reject the null hypothesis ($H_0$) if the F-statistic and t-statistic for the Level I(0) regressor are less than the critical values. The test is considered inconclusive if the F-statistic and t-statistic fell between the lower bound I (0) and the upper bound I (1).

As shown in Table 4.6, the F-statistics of 9.81 is greater than the critical values for I(1) regressors. As a result, the study denies the null hypothesis and concludes that the variables GHGBP, EXR, GDP, CPI, RFRR and MPR have cointegration vectors/long-run equilibrium relationships. The analysis will now estimate the Autoregressive Distributed Lag ARDL (1, 2, 2, 2, 2, 2) error correction model to look at the short- and long-term effects of Exchange Rate, GDP, Consumer Price Index, Risk Free Rate of Return, and Monetary Policy Rate on Ghana Government Bond Price.

## 5.4. Results of the Long Run Relationship

Since the results of the cointegration test show that a long run equilibrium relation exists, the long and short run parameters for the defined model are determined using ARDL (1, 1, 0, 1, 1, 1). The models' long run coefficients are stated in Table 8.

The long-run coefficient of Consumer Price Index is -0.007, indicating a long-run negative relationship with Ghana Government Bond Price. This estimated value of the coefficient of -0.007 is significant at the 1% level as the P-value of 0.008 associated with the t statistics of -3.55 is less than the significant level of 0.01. The null hypothesis is rejected. The coefficient implies that, for every 1% increase in Consumer Price Index,

Ghana Government Bond Prices decrease by 0.007% in the long run. This also means that the Consumer Price Index has a statistically important negative long-run impact on Ghana Government Bonds. In the short term, this major negative effect is also real. Interest rates increase as a result of inflation, and bond prices decline as a result. There is no question that low inflation acts as an attraction to borrowers and encourages the demand for fixed income securities (Nkwede, 2020).

**Table 8**
***Estimated Long run Results***

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 28.15853 | 18.94607 | 1.486246 | 0.1755 |
| GHGBP(-1)* | -1.497501 | 0.371774 | -4.027990 | 0.0038 |
| EXR(-1) | -4.268394 | 3.950953 | -1.080345 | 0.3115 |
| CPI** | -0.007493 | 0.002109 | -3.552204 | 0.0075 |
| GDP(-1) | -0.027088 | 0.023401 | -1.157513 | 0.2805 |
| RFRR(-1) | 0.000169 | 0.002475 | 0.068296 | 0.9472 |
| MPR(-1) | 0.003432 | 0.001854 | 1.851375 | 0.1013 |
| D(EXR) | 10.38149 | 5.134061 | 2.022082 | 0.0778 |
| D(GDP) | 0.040685 | 0.046074 | 0.883026 | 0.4030 |
| D(RFRR) | -0.005206 | 0.002579 | -2.019098 | 0.0782 |
| D(MPR) | 0.007485 | 0.002607 | 2.870846 | 0.0208 |

For Exchange Rate, it has a long run coefficient of 10.38 with a P-value of 0.08. The estimated value of the coefficient is statistically significant at 10% since the p-value associated with the t statistics of 2.02 is greater than 0.1. The null hypothesis is rejected. The coefficient implies that, for every 1% increase in Exchange Rate, Ghana Government Bond Price increases by 10.38% in the long run. This further implies that there is a statistically significant positive long-run effect of Exchange Rate on Ghana Government Bond Price. This confirms the finding of Hoffman et al. (2019) that there is a positive correlation between exchange rates and local sovereign bond price in emerging market economies. However, Exchange Rate has a significant negative effect on Government of Ghana Bond Prices in the short run. A pegged or relatively fixed exchange rate promotes bond market development because it can motivate foreign investors to demand for more bonds (Nkwede, 2020). No doubt, it could lead to higher participation in the bond market (Mu et al., 2013).

GDP also revealed a positive relationship with Ghana Government Bond Price as indicated by the coefficient of 0.04. The estimated value of the coefficient is insignificant as the p-value of 0.40 for the t statistics is greater than the significant level of 0.05 and even 0.1. The null hypothesis is thus accepted. The coefficient of 0.04 implies that for every 1% increase in the GDP, Ghana Government Bond Price increases by about 0.04%. This further implies that there is a long run statistically insignificant positive effect of GDP on Ghana Government Bond Price. Similarly, in the short run, an increase in GDP significantly leads to a corresponding increase in the Government of Ghana Bond Prices in the short run.

Risk Free Rate of Return has a negative impact on Ghana Government Bond, as shown by the -0.005 coefficient. Since the p-value of 0.08 for the t statistics is less than the significant level of 0.1, the estimated value of the coefficient is significant at the 10% level. As a result, the null hypothesis is ruled out. The coefficient of -0.005 indicates that every 1% increase in the Risk Free Rate of Return results in a 0.005 % decrease Ghana Government Bond. This also means that the number of Risk Free Rate of Return has a statistically important negative impact on Ghana Government Bond Price in the long term. In the short term, however, Risk Free Rate of Return has a significant positive effect on Ghana Government Bond Prices.

Monetary Policy Rate revealed a positive effect on Ghana Government Bond Price as indicated by the coefficient of 0.007. The estimated value of the coefficient is significant at 5% level as the p-value of 0.02 for the t statistics is less than the significant level of 0.05. The null hypothesis is thus rejected. The coefficient of 0.007 implies that every 1% increase in Monetary Policy Rate leads to about 0.007% proportionate increase in Ghana Government Bond Price. This further implies that there is a long run statistically significant

positive effect of Monetary Policy Rate on Ghana Government Bond Price. Similarly, Monetary Policy Rate has a significant positive effect on the Ghana Government Bond Prices.

## 5.5. Results of the Short Run Relationship

Since the results of the cointegration test show that a long run equilibrium relation exists, the long and short run parameters for the chosen model are estimated using ARDL (1, 1, 0,1,1,1). The model's long-run coefficients are presented in Table 9.

**Table 9**
***Estimated Short Run Results***

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -1.094516 | 0.058017 | -18.86546 | 0.0337 |
| D(EXR) | -1.375060 | 2.091575 | -6.394731 | 0.0988 |
| D(EXR(-1)) | 2.376710 | 3.984864 | 5.113527 | 0.1229 |
| D(CPI) | -0.013211 | 0.000695 | -18.99816 | 0.0335 |
| D(CPI(-1)) | -0.008185 | 0.000618 | -13.25187 | 0.0479 |
| D(GDP) | 0.171861 | 0.013122 | 13.09764 | 0.0485 |
| D(GDP(-1)) | 0.065605 | 0.007591 | 8.642221 | 0.0733 |
| D(RFRR) | 0.000464 | 0.000542 | 0.857213 | 0.5488 |
| D(RFRR(-1)) | -0.008372 | 0.000735 | -11.38434 | 0.0558 |
| D(MPR) | 0.014137 | 0.000716 | 19.73810 | 0.0322 |
| D(MPR(-1)) | 0.011277 | 0.000834 | 13.52853 | 0.0470 |
| CointEq(-1)* | -3.682427 | 0.195947 | -18.79300 | 0.0338 |
| R-squared | | | | 0.8955 |
| Adjusted R-squared | | | | 0.8874 |
| F-statistic | | | | 122.791 |
| Prob(F-statistic) | | | | 0.0000 |

With regard to the Exchange Rate from Table 8, there exists a negative relationship with Ghana Government Bond Price as indicated by a coefficient of -1.38. The t statistics of this coefficient has a probability value of 0.099 less than 0.1 significant level, indicating that the p-value of the coefficient is statistically significant at the 10% level. The null hypothesis is rejected. This means that increasing percentage of Exchange Rate by 1% decreases Ghana Government Bond by around 1.38. In the short term, there is evidence that the exchange rate has a substantial negative effect on the price of Ghana Government Bonds. Similarly, central banks can raise interest rates as a result of regulating the exchange rate between a struggling currency and others, according to Njuguna (2017). Bond rates will climb as a result, and bond prices will decline.

With regard to the Consumer Price Index, there exists a negative relationship with Ghana Government Bond Price as indicated by a coefficient of -0.01. The t statistics of this coefficient has a probability value of 0.034 less than 0.05 significant level, indicating that the p-value of the coefficient is statistically significant at the 5% level. The null hypothesis is rejected. This means that increasing percentage of Consumer Price Index by 1% decreases Ghana Government Bond by around 0.01%. In the short term, the Consumer Price Index has a substantial negative effect on the price of Ghana Government Bonds, according to data. Since inflation decreases the value of capital, a high rate of inflation in the economy encourages many investors to divert their surplus funds away from bond portfolios and into other savings and projects (Musa, Natorin, Musova, & Durana, 2020).

Regarding GDP and Ghana Government Bond Price, a short-run positive effect exists as indicated by the coefficient of 0.17. The t statistic of this coefficient has a P-value of 0.048, which is less than 0.05 and even 0.1, meaning that the p-value of the coefficient is statistically significant at 5% level. The null hypothesis is shown to be false. The coefficient of 0.17 implies that for every 1% increase in GDP, Ghana Government Bond Price proportionately increases by about 0.17%. There is evidence to suggest that GDP has a significant short run positive effect on Ghana Government Bond Price. This finding is consistent with that of Fredrick (2014) who found that GDP per capita had a positive effect on bond prices.

Risk Free Rate of Return reveals a short-run positive effect on Ghana Government Bond Price as indicated by a coefficient of 0.0005. This implies that for every 1 % increase in Risk Free Rate of Return, Ghana Government Bond Price increases by 0.0005%. The p-value for the t statistics of this coefficient is 0.55 which is greater than 0.1, implying that the estimated value of the coefficient is statistically insignificant. The null hypothesis is accepted. Therefore there is enough evidence to suggest that there exists a short run positive and insignificant effect of Risk Free Rate of Return on Ghana Government Bond Price. However, at lag 1, there is a negative effect of Risk Free Rate of Return on Ghana Government Bond Price as indicated by a coefficient of -0.008. The effect is now significant at 10% level.

Monetary Policy Rate reveals a short-run positive effect on Ghana Government Bond Price as indicated by a coefficient of 0.01. This implies that for every 1% increase in Monetary Policy Rate, Ghana Government Bond Price also increases proportionately by about 0.01%. The estimated value of the coefficient has a p-value of 0.032, which is less than 0.05, meaning that the estimated value is statistically significant at 5% level. The null hypothesis is the one that is rejected. As a result, there is some evidence to conclude that Monetary Policy Rate has a short-run positive and significant impact on Ghana Government Bond Price.

As seen in Table 9 above, the R-squared value of 0.896 shows that changes in independent variables explains about 90% changes in Ghana Government Bond Price. The adjusted R-square of 0.89 shows that the number of independent variables accounts for around 89% of the change in the dependent variable, Ghana Government Bond price. Accordingly, this means that the approximate ARDL (1, 2, 2, 2, 2, 2) has excellent predictive power. The F-statistic is 122.79 and the F-statistics p-value is 0.000, suggesting that the overall results are statistically significant.

## 5.6. Diagnostic Test

To ensure that the estimated models are consistent and devoid of any econometric problems, the study further conducts various diagnostics and stability tests. The results from the stability and diagnostic tests are reported in Table 10.

**Table 10**

***Diagnostic and Stability Test Results***

| **Test** | **F-statistic** | **p-value** |
|---|---|---|
| Breusch-Godfrey Serial Correlation LM Test | 0.5543 | 0.5885 |
| Breusch-Pagan-Godfrey Heteroskedasticity | 1.1360 | 0.3868 |
| Jarque- Bera Normality Test | 0.09831 | 0.9520 |
| CUSUM | STABLE | STABLE |
| CUSUMQ | STABLE | STABLE |

Since the F-statistic of 0.55 is not statistically important in the model (p-value>0.05), the Breusch-Godfrey Serial Correlation LM test shows that there is no serial correlation among the variables. For the GHGP model, the Breusch-Pagan-Godfrey test for heteroscedasticity yielded a statistically insignificant F-statistic of 1.14 (p-value>0.05), meaning that there is no heteroscedasticity among the error terms. The study discovered proof that the sequence in the model is normally distributed (p-value>0.05) using the Jarque-Bera normality test. The model's stability is also shown by the rate of Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMQ) tests.

## 6. Conclusions

It is concluded that in the long and short run, an increase in inflation leads to a proportionate decrease in the prices of government of Ghana bonds. It is established that, in the long run, increase in Risk Free Rate of Return significantly results in a decrease in prices of Ghana government bonds, and vice versa, but in the short run its increase insignificantly leads to a corresponding increase in the prices of government bonds. As regards monetary policy, an increase in the rate of monetary policy significantly leads to a corresponding increase in the prices of government bonds in the short and long run.

## 6.1. Recommendations

- Based on the findings and conclusions of this study, it is recommended that investors consider inflation, GDP, exchange rate, Risk Free Return and Monetary Policy, among other factors, when making decisions on the position to take in a bond as it determines bond prices.
- Policymakers should aim at working to achieving low inflation and exchange rate figures as that will increase bond prices and make it more attractive to foreign investors.
- It is also important that policy makers understand and manage effectively risk free bonds and the monetary policy as they have significant effects on the prices of government bonds.
- Lastly, it is suggested that other researchers delve into the relationship between macroeconomic variables and bond prices of corporate bond on the secondary market. Other researchers could investigate the exchange rate and bond prices using daily data.

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