FACTORS INFLUENCING BOND MARKET LIQUIDITY IN KENYA.

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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This Research Project has been submitted for examination with my approval as the Supervisor.

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ABSTRACT

This study aimed to determine the factors influencing bond market liquidity in Kenya using the Vector Error Correction Model. This paper investigates the factors influencing bond market liquidity in Kenya from 2010 to 2021. We employ a combined approach utilizing Vector Error Correction (VEC) on monthly data. The VECM framework allows us to capture the dynamic interrelationships between various factors and bond liquidity. It is especially suitable for use on cointegrated multivariate time series data. Our research explores the influence macroeconomic factors. Macroeconomic factors encompass variables like bank lending interest rates and foreign exchange rates.

By utilizing this comprehensive approach, the study aims to provide a more nuanced understanding of how various elements contribute to Kenya's bond market liquidity. The findings can be valuable for policymakers, market participants, and researchers seeking to enhance the efficiency and stability of the Kenyan bond market.

The findings suggest that previous bond market turnover, interest rates and stock market index are strong significant predictors of current bond market turnover. The foreign exchange rate is also a significant indicator of current bond market turnover. However, the other economic indicators, Inflation (CPI) and Repo rate show no predictive power in this model. The model explains a moderate portion of the variability in bond turnover, and the overall model is statistically significant. These results can inform financial analysts and policymakers about the key factors influencing bond turnover and guide further investigation into other potential predictors.

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List of Abbreviations

CD- A certificate of deposit

CBK- Central Bank Of Kenya

CDSC- Central Depository Settlement Corporation

CMA- Capital Markets Authority

ICMA- The International Capital Market Association

KASIB- Kenya Association of Stockbrokers and Investment Banks

KNBS- The Kenya National Bureau of Statistics

GDP- Gross Domestic Product

NSE- Nairobi Stock Exchange

USD- United States Dollar

Chapter One: Introduction

1.1 Background of the study

Corporations and governments all over the world issue debt securities to secure public financing on both long term and short-term basis. These debt securities are usually bonds as claimed by Ross (1998). A bond is a debt instrument that is tradable and is used to raise funds for both short-term investments (when their maturity is less than a year) and long-term investments (with maturities of one year or more). According to the ICMAIn August 2020, the total value of outstanding bonds in global markets was estimated to be around $128.3 trillion (USD equivalent). This highlights the bond market's dynamic nature, as noted by Grishchenko et al. (2015) who described it as a time-varying investment channel.

The debt capital market is where bonds are usually traded, and buyers of bonds are typically lenders who are only entitled to receive an interest rate. Primary and secondary markets can be used to categorize the debt capital market. The primary market is where a borrower initiates a new bond issue to raise money from investors directly. Although the interest rates can be fixed or variable, all securities traded on both markets have one thing in common: they are all for a defined term. The secondary market facilitates the exchange of previously issued bonds between diverse participants, including investment managers, hedge fund operators, government institutions, and other commercial entities. Investors in the main market have access to liquidity through the secondary market.

The primary bond market assists in performing a dual purpose of concurrently enhancing investment and saving habits. The secondary market in reverse lays

the groundwork for future capital issue price discovery according to Sorensen & Whitta-Jacobsen (2010). But the primary bond market remains a key factor in capital generation and business investment. The sustainability of the primary market, which influences the liquidity of the secondary market, is a key aspect in its overall development as demonstrated by Messani and Andriansyah (2014).

By encouraging capital formation for potential investors and producers who need capital to meet their investment prospects, it also fosters information linkage and helps the capital market allocate resources more effectively. There are different varieties of bonds that are traded on these debt capital markets. In Kenya, they are prominently the corporate bonds and government bonds. Corporate bonds are financial instruments through which businesses borrow funds by issuing and selling them to investors to secure capital for their operations. A company may issue a bond for a number of reasons, such as to raise money for operating costs, funding for growth and expansion, or finance for corporate acquisitions.

Corporate bonds have the significant feature of allowing for capital raising without reducing firm ownership: unlike stock issuance, which grants equity ownership, investors in bonds do not acquire any interest in the company issuing the bond. According to Oji (2015), a company is still required by law to pay interest on its bonds and to refund investors' money in the event of financial difficulties—a duty that shareholders are not subject to. Government bonds offer an opportunity for investors to contribute to government finances by loaning money at a predefined interest rate. This provides governments with a way to fund infrastructure projects, new initiatives, or other needs. In return, investors receive a guaranteed return paid out regularly.

D'Souza et. al (2006) emphasized the significance of the bond market, particularly its function in the transfer of savings within an economy. Bonds,

typically exhibiting lower volatility and risk compared to stocks, can provide more stable and predictable returns when held until maturity. Their interest rates are often higher than those offered by bank savings accounts, Certificates of Deposit, and money market accounts. By letting companies focus on their competitive advantages in production, the bond market helps to reduce domestic financial concerns. Williams (2005) stresses how crucial it is for the bond market to be liquid in addition to its importance to offer financial resources for the growth of an economy.

A market with high liquidity allows investors to easily buy or sell assets (like bonds) without significantly impacting the price. In the context of bonds, this translates to the ability to quickly sell a bond without having to drastically reduce its selling price. Low liquidity can create market turmoil and amplify financial shocks. Conversely, a well-functioning, liquid market acts as a buffer, absorbing these shocks and promoting stability, as shown by research from Adrian, Fleming, and Vogt (2017). For corporate bonds specifically, their liquidity directly affects the ability to execute large trades at minimal cost. Studies have revealed a strong link between a bond's liquidity and its overall risk and trading costs within the corporate bond market. The liquidity of a corporate bond plays a crucial role in facilitating large, low-cost asset transactions without causing substantial price fluctuations. Researchers have discovered that systematic liquidity risk and the cost of securities in the corporate bond market are strongly related. They also found that yield spreads, which notably widen during periods of market volatility, can be considerably impacted by illiquidity. Bonds with AAA ratings are more resilient to financial hardship than other bonds.

Regarding the measurement of liquidity in financial markets, there is no consensus. However, CGFS (1999) states that the major measures of liquidity are the quote size , trading volume,benchmark yield curve ,number of market makers , bond trading turnover, bid-ask spread, volatility , average normal

market size and frequency . The state of the market determines which liquidity measure is best.

1.2. Bond Markets In Kenya

1.2.1 History of Bonds in Kenya

The origins of the Kenyan bond market trace back to the 1980s when the government first utilized treasury bonds as a means of financing budget deficits. But in 2001, when the government reintroduced treasury bonds, the Kenyan bond market saw a turnaround. Since 2001, there has been a disproportionately greater number of bond offerings and a corresponding increase in market activity. Government officials in Kenya have worked hard to keep interest rates on Treasury securities stable, increase the average maturity of the country's debt by switching from short-term Treasury bills to longer-term Treasury bonds, and create a yield curve that can be used as a benchmark for pricing corporate bonds.

At the end of June 2004, the percentage of Treasury bonds with a maturity of five years or longer climbed from 25.7% to 42.2% of all outstanding bonds. The percentage of bonds with a maturity of ten years or longer increased from 1.7% to 4.6% of all outstanding bonds in the same period. The goal for the government is to maintain this success and broaden the maturity profile in order to shift its fixed income portfolio from short- to long-term securities. It is important to acknowledge the important role that the banking industry plays as the largest holder of outstanding Treasury bonds, followed in that order by "others," insurance firms, parastatals, and building societies. Together, these investors assist the government in achieving its financial goals, therefore protecting their interests is in everyone's best interest.

Compared to the Treasury bond market, Kenya's corporate bond market has historically seen less trading activity. The development of this market was

hindered by several challenges, including information asymmetry among potential issuers, a volatile and high-interest rate environment, the lack of a yield curve for pricing long-term instruments, and the crowding-out effect caused by the government's domestic debt.

1.2.2 Trading Systems and Regulatory Framework

The call auction technique is used to establish the bond price for securities traded on the Nairobi Stock Exchange (NSE) . The limit order is the primary order type used at the NSE for trading bonds. Kenya's secondary market for corporate and treasury bonds is Licensed stockbrokers who operate as middlemen and as agents facilitate trading at the NSE. The Fixed Income Securities Board is a distinct board where bonds on the Kenyan bond market are exchanged. Bonds that periodically make partial principal repayments are sold at the subsequent minimal nominal value. The daily relevant reference interest is shown on the Fixed Income Securities Board at the start of the trading session when the bonds have a floating rate of interest. The regulations further provide that no bond may be traded within three working days of the principal redemption.

Prior to the change, the NSE only had one listing market segment with strict eligibility and listing standards. The NSE regulatory structure has changed in the post-reform era, resulting in the split of the market into four separate market groups, each with unique eligibility and listing requirements. A corporate entity must be incorporated under the Companies Act, be limited by shares, and have a minimum share capital of Ksh. 50 million and have Ksh. 100 million in net assets or a guarantee in order to list on the NSE and issue bonds.

The issued bonds shall be freely assignable to third parties. The issuer had to have released audited, unqualified financial statements that complied with international accounting standards on a going concern basis at the time the

bonds were issued. The issuer ought to have generated a profit in two of the three years before the issue and ought not to be in violation of any loan covenant with relation to maximum debt capacity. The organization's three-year ratio of money earned from activities to total debt should not be lower than 40% at the time it announces its desire to issue bonds. The business entity should also produce a clear certificate from the appropriate regulatory body for banking and insurance companies, in addition to reporting to the Exchange the suitability of directors and Management.

1.3 Statement of the problem

Ngugi and Agoti (2012) discovered that the bond market has continued to be a crucial tool for raising money for long-term projects, particularly infrastructure development, and they also emphasized the importance of high levels of liquidity, efficiency, and low volatility for the development of financial markets.

By regional standards, Kenya is now viewed by many global investors as a sophisticated technology market. A number of FinTech businesses that offer solutions for access to finance, healthcare, and agriculture have sprung up as a result of M-PESA's success. More recently, it sparked the creation of M-AKIBA, launched in June 2017, it is a platform enabling retail investors to buy Government bonds for as little as KES 3,000 on their mobile phone.

The Kenyan government released the M-Akiba retail infrastructure bond in an effort to increase financial inclusion for economic growth. It is a creation of the Kenyan government's National Treasury, which is handled by the Central Bank of Kenya (CBK), in association with KASIB, the CDSC, the NSE, and the mobile network operators. New and ongoing government infrastructure development projects will be funded with the proceeds from the bond. The M-Akiba bond also seeks to improve Kenyans' habit of saving and investing.

Market liquidity refers to the capacity of a market to facilitate the buying or selling of an asset without causing a substantial change in its price. The ability of a bond to be sold quickly without having to significantly lower its price is referred to as bond market liquidity. Lack of liquidity can create a chaotic market environment and amplify shocks. On the other hand, Adrian et. al (2017) found that a deep and robust market can assist with absorbing shocks and preserving stability.

Due to this increased access and subscription to bonds, their liquidity and the factors affecting it should be better understood to protect investors and therefore shield from the economic effects.

Nyongesa (2012) set out to identify the variables that affect bond market turnover and, consequently, liquidity. The findings revealed that key factors of bond liquidity were bank lending interest rates, foreign currency rates, domestic debt, and saving interest rates. Information dissemination and lowering the minimum investment amount in bonds are two policy recommendations made by Ngugi and Agoti (2009) in an effort to reverse the clear negative trends and allow the market to assume its proper role in promoting the Kenyan financial sector to rapid development. With changes in various policies involving capital markets since Nyongesa's study and the introduction of a platform that eases retail investor participation in the bond market, this study seeks to determine whether this has any effect on the bond market's liquidity.

1.4 Research Objectives

The study's primary goal is to identify the factors impacting Kenya's bond market liquidity.

In particular, the study aimed to identify the influence of macroeconomic factors on liquidity:

i. Interest rates on bond market liquidity in Kenya

ii. Inflation rate on bond market liquidity in Kenya

iii. Foreign exchange rate on bond market liquidity in Kenya

iv. Stock Indices on bond market liquidity in Kenya

v. Monetary Policy on bond market liquidity in Kenya

1.5 Significance of the Research

The study is useful in giving the government, investors, Central Bank of Kenya, and other researchers additional information on the factors affecting liquidity in the Kenyan bond market, which will also assist them make educated decisions on bonds and the growth of the bond market.

The information is also crucial for formulating relevant and important policy choices that will keep the bond market liquid, balance the needs of lenders and borrowers and support financing through investment choices with the goal of improving the market's mobilization of savings in order to promote and sustain economic growth.

Chapter Two: Literature Review

2.1 Introduction

This section delves into the existing literature surrounding factors that influence bond market liquidity within the Kenyan context. We will provide a critical analysis of the various theoretical frameworks and econometric models employed by prior research in this domain. Our focus will be on dissecting the methodologies and theoretical underpinnings utilized to understand the dynamics of Kenyan bond market liquidity.

2.2 Theoretical Framework

In order to bring equilibrium in an economy's financial system, liquidity is crucial. The factors that influence how firms decide to finance their operations as well as the impacts these decisions have on the rest of the economy can be used to explain financial system equilibrium (in the debt market). The theories that follow examine these concerns.

2.2.1 Information Asymmetry

The primary reason individuals choose to entrust their money to financial intermediaries, rather than lending or investing directly, is the risk arising from information asymmetry between the fund provider and recipient. In such situations, a seller typically has more knowledge about the item being sold than the buyer, just as a borrower is more aware of their financial condition and prospects than a lender. When information asymmetry exists, two types of risks emerge: adverse selection, which occurs before the funds are borrowed or invested, and moral hazard, which arises after the financial transaction.

A key aspect of risk management is deciding to whom to contribute more of your money, according to Frank and Goyal's (2008) theory of anti-selection. The theory supports the notion that resources ought to be allocated to lower an investor's level of loss risk. By promoting the right use of borrowed funds

for the intended purpose of ensuring that interest and principal are paid on time, Frank and Goyal (2008) emphasize the problem of risk. They contend that doing so will help investors create more money. According to the idea, information asymmetry on the credit histories of users, future users of financing, and the price of funding raises the level of risk exposure, which has a negative impact on investment decisions.

2.2.2 Trade-off Theory

According to Trade-off theory, the best combination of debt and equity is the one found at the balance between the possibility of financial distress and the interest tax shields available. Kraus and Litzenberger (1973) state that the best leverage reflects a balance between the tax shield from debt and the costs of bankruptcy.

Myers (1984) stated that a company that employs the trade-off theory sets a target capital structure and then gradually moves towards the target. The target is established by balancing the interest tax shields against the likelihood of insolvency. This theory suggests that there exists an optimal debt-equity ratio for which there is an optimal amount of debt. As debt increases, the tax shield attributable to the interest payments increases value to the firm to a point at which the cost of financial distress exceeds the additional value from borrowing.

2.2.3 Pecking-Order Theory

The pecking order theory states that there is a preferred order in which a company chooses to finance its activities. This usually begins with the use of internal funding in the form of retained earnings when they are sufficient, and the use of debt and equity financing when the internal cash flow is insufficient. The reason for the preference of internal cash flow as the source of financing is due to the lack of fees and costs attached to the use of retained earnings.

According to Myers (1984), debt, convertible securities, preferred stock, and common stock are favoured in that order as external sources of financing. This is so as to reduce the agency cost of equity. It seeks to reduce the negative market reaction to the news of a new equity issue.

The main assumptions about management in the theory are that they seek to keep information about the company's performance and earnings private from external entities. The second is that they act in the best regard of the existing shareholders. The limitations present in this theory are that since the theory does not discuss issues such as agency cost, financial distress, taxes and security issuance costs, then it ignores the issues that may result from managers' lack of market discipline.

2.2.4 Liquidity Theory of Asset Pricing

According to Hennessy and Josef (2009) "Liquidity Theory of Asset Prices", an investment transaction frequently occurs because someone either has money to invest or needs to raise money. An imbalance can exist for many months between the quantity of money waiting to be invested and the amount that is needed to be raised in the economy as a whole. Markets respond appropriately, moving upward or downward as necessary in the direction of equilibrium. People get optimistic when a market is increasing, and pessimistic when a market is declining. Investors start acting like a crowd as a result of this. Herd mentality supports understanding the subsequent periods of success followed by periods of failure.

The information asymmetry between the various market participants, the capital structure and covenants attached, the cost and advantages of borrowing, the debt maturity structure, and the availability of cash for such investments all affect how liquid a market is. As a result, the aforementioned theories serve as the study's theoretical foundation by providing a critical analysis of the pertinent domains.

2.2.5 Theoretical Overview

According to Hennessy and Josef (2009) "Liquidity Theory of Asset Prices", the market's investment activity is driven by the availability of funds for investments or the need to raise cash. There must be a platform for matching the parties because there is always an imbalance in the economy between capital owners and users. Investors must decide based on the information at hand and their own level of risk tolerance limits in order for a balance to be achieved. The investors choose their investments based on the relative importance of the financing source as well as a trade-off between costs and advantages. As a result, the examination of factors influencing liquidity in this study is based on the idea that in order to improve decision-making, information symmetry is essential.

2.3 Empirical Framework

Most studies on bond market liquidity have typically concentrated on either a single aspect of liquidity or multiple liquidity measures that encompass various characteristics. Many studies use the bid-ask price spread as a primary indicator of liquidity (Bao, Pan, and Wang, 2008), while others employ multidimensional liquidity metrics. However, to accurately capture the diverse characteristics of liquidity, it is necessary to apply distinct liquidity metrics (Fernandez, 1999). Batnyam, Lkhagvajav, and Gan-Ochlr (2008) conducted a time series analysis to assess bond market liquidity, concluding that monetary policy influences bond market growth, which in turn impacts liquidity. Time series data were used to examine the key elements of a liquid market.

Flemming (2003) explained metrics such as trade volume, its frequency, quotation size, price effect coefficients, deal sizes, bid-ask spread and on-the-run yield spread using descriptive statistics such as mean, median, variance, and standard deviations. He comes to the conclusion that the bid-ask spread is a tool for evaluating and monitoring liquidity by showing the relationship

between the various liquidity metrics utilising comparative liquidity measures, such as correlation analysis and principal component analysis. Quote size, trade size, and the on-the-run/off-the-run yield differential, on the other hand, are only moderate proxies for market liquidity, according to his analysis, as these variables had less correlations with periods of reported measures of price effect, the bid-ask spread, and insufficient liquidity.

According to Ngugi and Agoti (2009), the expansion of the bond market is significant in terms of securing long-term funding for Kenya's governmental and private sectors. They highlight volatility, efficiency, and liquidity as being essential to the growth of a bond market. They conclude that microstructure factors affect bonds differently depending on the category by using descriptive statistics used to explain the measurements of liquidity. They used the terms: average, standard deviation, median, maximum, minimum, skewness, kurtosis, and likelihood. They also establish that liquidity is higher in the government bond market than the market for corporate bonds. In general, they judge that treasury bonds have performed better in the examined microstructure.

Eke, Adetiloye, and Adegbite (2020) tried to determine whether there is a functional link between the real sector output of the fourteen African nations with functional bond markets and complete data. Real gross domestic product per capita, corporate bond issuance, industrial output, corporate bond turnover, financial literacy, electricity use, and institutional quality were some of the variables that were modified for use. The study examined both the short- and long-term correlations among the various variables using unit roots to supplement the Toda-Yamamoto non-causality and cointegration technique. Prior to the market information, it was anticipated that money allocation and bond issuance would lead to capital raising. However, the analysis finds that neither corporate bond issuance nor corporate bond turnover results in an increase in industrial output. The impact of financial education is

progressively being seen in the bond markets, according to a significant short-term result. The study accepted the null hypothesis for the vast majority of the long-term correlations. This suggests that the investing public does not take in the value of market information, which could account for the gradual thinning and shallowing of the African corporate bond market. However, it has been discovered that the consequences of liquidity signalling have a long-term impact on the institutional quality of regulation.

Schneider, Lillo, and Pelizzon (2016) extracted three distinct metrics for liquidity depending on trading costs and market member's desire to trade in order to determine whether sovereign bond market liquidity in Italy has changed. By comparing the fluctuation in the various liquidity indices to one another and by linking the strength of rapid deteriorations in various liquidity indices, they examine the relationship between the liquidity indices of bonds of different maturities. They discovered that the variance in liquidity is categorized by maturity. his structure was discovered to be constant across the observation period. Using the second method, they discover that when the market is less liquid, the risk of spillover from illiquidity, or the likelihood that deteriorations in liquidity spread across different bonds, is higher. As a conclusion, their paper offers a novel method for quantifying illiquidity risk and spillover of illiquidity risk, which can be used as additional input by policymakers to control the bond yield curve. It may be possible to prevent the spread of illiquidity and market dysfunction by focusing on the weakest link in the illiquidity chain.

2.3.1 Factors influencing Bond Liquidity.

Das et al. note that the government bond market is mostly influenced by news events related to macroeconomic conditions or public information, in contrast to the stock and corporate bond markets. He and Nasser (1999) assert that macroeconomic factors impact bond market liquidity, in line with Das et al. (2003). He and Nasser (1999) argue that investors are now more concerned

with general patterns than with the specifics of individual companies . Because stocks and bonds are competing investment options, investor money moves between markets as a result of shifts in macroeconomic conditions and market conditions.

Some of the factors influencing bond market liquidity include:

2.3.1.1 Interest rates

According to Davis (1999), changes in interest rates have a significant impact on the decision to buy fixed-income instruments. This means that if interest rates rise as a result of tighter monetary policy, it is likely to cause a financial crisis, which could ultimately lead to liquidity breakdowns, particularly in the security markets. Bond prices increase when interest rates are low and decrease when interest rates are high. The risk that changes in interest rates could lower (or raise) the market value of a bond you hold is referred to as interest rate risk. The longer you hold a bond, the higher the risk related to interest rate fluctuations. This affects the liquidity of the bond since investors would therefore prefer to hold bonds for shorter time periods in preference of liquidity.

2.3.1.2 Exchange rates

Ngabirano (2016) predicts that a rise in foreign exchange rates will improve the secondary bond market's liquidity. Foreign investors may shift their bond holdings back to their home nations due to fluctuations in foreign exchange rates.According to Longei and Ali (2017), a stable exchange rate affects the bond market since it affects the trade balance and the monetary and fiscal policies of the nation.

2.3.1.3 Inflation rates

Kang and Pflueger (2013) assert that when unemployment is high, an increase in inflation in an economy increases the cost of living for the majority of consumers in developing countries. Consumers switch their resources from

security market investment to consumption in instances when inflation rates rise. Because there is less demand for bond securities, fewer bonds are being traded on the bond market, which in-turn lowers the liquidity of the bonds.

2.3.1.4 Stock Indices

He and Nasser (1999) noted that multiple studies have found a negative correlation between the long-term rate on government bonds and the values of US and UK stocks.

2.3.1.5 Monetary Policy

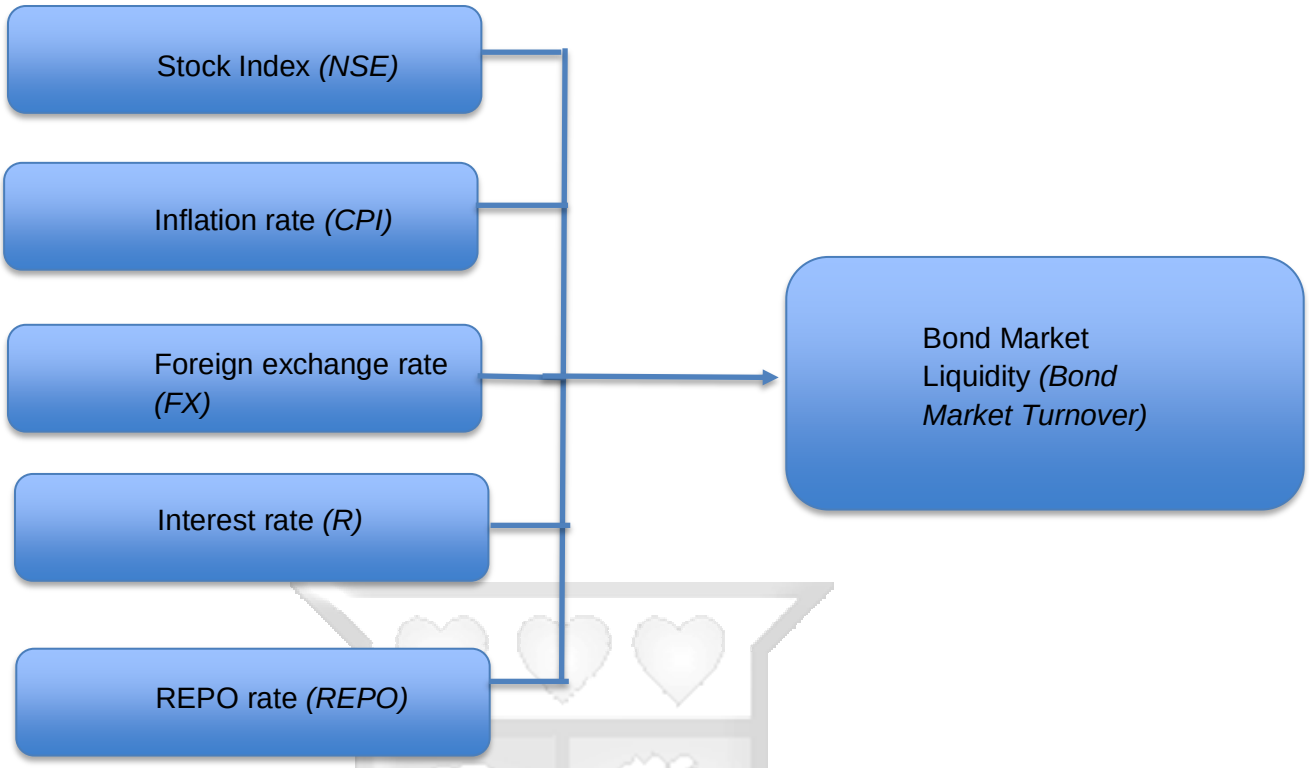
Bond prices will decline if inflation increases to the point that the monetary authorities are forced to raise the repo rate. This will raise yields. This is expected to reduce bond market liquidity, establishing a negative relationship with it.

2.4 Conceptual Framework

As presented in the figure below, the dependent variable in the study (bond market liquidity) is influenced by predictor variables derived from the above literature.

Liquidity = (Stock Indices, Inflation Rate, Foreign Exchange Rate, Interest rate, Repo rate

Figure 1: Figure showing the conceptual framework showing the relationship between variables.


Stock Index (NSE)
Inflation rate (CPI)
Foreign exchange rate (FX)
Interest rate (R)
REPO rate (REPO)
Bond Market Liquidity (Bond Market Turnover)

Chapter Three: Methodology

3.1 Introduction

This chapter presents the study's methodological framework. We will discuss the chosen research design, the target population for data collection, the methods employed for data acquisition, and the specific data analysis techniques utilized to investigate the factors influencing Kenyan bond market liquidity.

3.2 Research Design

The best research type to describe the factors influencing bond market liquidity is the descriptive type of research specifically utilizing quantitative research design. According to Mugenda & Mugenda (2003), the goal of quantitative research is to correlate the variables under investigation in order to provide additional knowledge about a study subject.

Creswell (2003) states that quantitative research relies on a representative sample of the population to derive statistically significant conclusions about the broader population. This study examined macroeconomic factors influencing bond market liquidity over a 12-year period.

3.3 Population and Sampling

Polit and Hungler (1999) define a population as the complete set of individuals who meet specific criteria, representing the broader group relevant to the study and from which generalizations can be made. The target population includes the bond market turnover of the bonds traded on the secondary bond market in Kenya, as well as the data on inflation, stock index, US/Ksh exchange rate, interest rates and the Repo Rate used in Kenya.

A sample, according to LoBondo-Wood and Haber (1998), is a component or subset of the research population that is chosen to participate in a study and serves as a representative of the research population. Due to the small size of

population the study used all the bonds traded for the period 2010 to 2021 for our sample.

3.4 Data Collection

The data for the Bond Market Turnover was collected from the Capital Markets Authority annual reports from the subsequent years. The stock index data was collected from historical information from the Nairobi Stock Exchange. The data on inflation (CPI), Foreign exchange rate between USD/Ksh, Interest rates(91-day T-Bill rate) and The Repo- rate were collected from the Central Bank of Kenya's database. The data was sampled from 2010 through 2021 on the above variables.

3.5 Data Analysis

Based on the literature reviewed, descriptive analyses can be utilized to support the determination of the factors influencing bond market liquidity in Kenya. The data was analyzed using measures such as mean, frequency, percentage and standard deviation. The data was examined via the use of regression analyses in Eviews, SPSS and Excel.

The overall regression model was as follows;

The proposed regression model is;

$BML_t = \beta_0 + \beta_1 NSE_t + \beta_2 CPI_t + \beta_3 FX_t + \beta_4 R_t + \beta_5 REPO_t + \varepsilon$

Where,

BML_t = The bond market liquidity, gauged by monthly secondary bond market turnover in period t

NSE_t = The stock index measured as monthly NSE 25 price in period t

CPI_t = The inflation rate measured as monthly CPI in period t

FX_t = The USD/KSH exchange rate measured as monthly exchange rate in period t

R_t = The interest rate measured as monthly 91- day T-bill rate in period t

$REPO_t$ = The Repo rate measured as monthly repo rate in period t

β_0 = Constant

$B_1 - \beta_5$ = The regression coefficient associated with the independent variables.

3.5.1 Model Specification

Multivariate time series refers to time series data involving multiple time-dependent variables. Each variable is influenced not only by its own past values but also by the past and present values of other variables. Models for multivariate time series analysis include vector autoregression (VAR) and vector error correction models (VECM). These models capture the dynamic interaction and feedback between the multiple time series variables.

A Vector Error Correction Model (VECM) is a type of vector autoregression model, suitable for use on cointegrated multivariate time series data. Its primary aim is to estimate the speed at which variables return to equilibrium after a shock. While some statistical procedures require data to follow a normal distribution, VECM does not necessarily demand this. VECM deals with long-term relationships (cointegration) among variables, and normality isn't a strict requirement for this. If the variables are cointegrated, even if their distribution is not normal, VECM could still be a fitting choice.

3.5.2 Diagnostic Tests

Diagnostic tests are conducted to assess the significance of the model. This study examined multicollinearity, normality, and heteroskedasticity. The presence of multicollinearity was analyzed to determine whether two or more independent variables in the multiple regression model exhibited a high degree of correlation. If these variables are closely related to each other, it may be difficult for a model to try and separate out the individual effects. Variance Inflation Factor (VIF) measures the extent of increase in variance due to multicollinearity. A VIF of 1 means that there is no multicollinearity, but a VIF

greater than 1 and less than 5 is acceptable. If the VIF is greater than 5, it signifies that multicollinearity is present.
Tolerance is the reciprocal of the Variance Inflation Factor (1/VIF). If its value is less than 0.2 or 0.1, there might be multicollinearity in the model.

Testing for normality is important because many statistical procedures rely on the assumption that the data being analyzed is normally distributed. If data is not normally distributed, other types of models may be more appropriate. If we apply techniques assuming normality on non-normal data, it can lead to bias and inefficiency in the estimators.

The Kolmogorov-Smirnov (KS) Test compares the cumulative distribution function (CDF) of your data with the CDF of a theoretical normal distribution. The CDF represents the probability of a data point falling below a certain value. The KS test calculates the maximum difference between the two CDFs. Larger differences indicate a greater deviation from normality.

The Shapiro-Wilk (SW) Test exploits the specific characteristics of a normal distribution. It calculates a statistic based on how well the data aligns with these characteristics. The SW test considers how closely the expected order statistics (theoretical values) of a normal distribution match the actual order statistics (sorted values) of your data.

Choosing Between the Tests, for small samples ($n \leq 50$): The Shapiro-Wilk test is generally preferred due to its higher power. For larger samples ($n > 50$): Both tests are applicable. The KS test might be a good choice for its versatility, but the SW test remains a strong option for its robustness to outliers.

Heteroskedasticity refers to a situation in regression analysis where the variance of the error term is not constant across all levels of the independent variables. The standard errors of the coefficients are biased when

heteroskedasticity is present, leading to incorrect results of hypothesis tests (t-tests, F-tests) and confidence intervals, which may not be accurate or reliable. Heteroskedasticity might also indicate that we are missing an important variable that, if included, could result in a superior, correctly specified model. The Breusch-Pagan test is employed to assess the presence of heteroscedasticity in a regression model. The test is based on the following hypotheses:

• Null Hypothesis (H0): The model exhibits homoscedasticity (residuals are uniformly distributed with constant variance)

• Alternative Hypothesis (HA): The model displays heteroscedasticity (residuals have unequal variance)

If the test's p-value is smaller than the chosen significance level (e.g., $\alpha = 0.05$), the null hypothesis is rejected, leading to the conclusion that heteroscedasticity is present in the regression model.

Autocorrelation refers to the similarity between a series of observations of a variable at different points in time, compared to the similarity between observations at different lags (time differences). In simpler terms, it measures how much a variable is correlated with itself over time. Autocorrelation helps us understand if the past values of a variable influence its future values. There are three main types of autocorrelation:

- Positive Autocorrelation: If past values tend to be followed by similar values (e.g., high temperatures followed by more high temperatures), there's positive autocorrelation.
- Negative Autocorrelation: If past values tend to be followed by opposite values (e.g., a rainy day followed by a sunny day), there's negative autocorrelation.
- No Autocorrelation: If past values have no bearing on future values, there's no autocorrelation.

The Durbin-Watson (DW) test is a statistical tool used to detect the presence of autocorrelation at lag 1 in the residuals (errors) of a linear regression model.

The test produces a statistic called the Durbin-Watson statistic (DW statistic), which ranges from 0 to 4. Here's how to interpret the value:

- 2: This indicates no significant autocorrelation. This is the ideal scenario where the errors are not related to each other over time.
- Values below 2: This suggests positive autocorrelation. In this case, a positive error term (overestimation) tends to be followed by another positive error term, and vice versa (negative error followed by negative error).
- Values above 2: This suggests negative autocorrelation. Here, a positive error is likely to be followed by a negative error, and vice versa.

Chapter Four: Empirical Results

4.1 Introduction

This chapter presents a summary of the main findings from the data analysis, including both quantitative analysis and correlation analysis, to explore the relationships between the study's variables. Employing multivariate regression analysis on data spanning 2010 to 2021, the study examines the influence of various variables including the stock market index, inflation rate, foreign exchange rate, interest rate, and repo rate

4.2 Descriptive Statistics

Table 4.1 indicates that the average turnover during the period is Kshs. 44,757,986,111.11, with a minimum of Kshs. 12,000,000,000 and a maximum of Kshs. 118,190,000,000. The standard deviation is Kshs. 21,240,606,992.90. The mean Stock index for the period is 3590.51 with the minimum of 1738.68 and the maximum of 5491 with a standard deviation of 1027.09. The mean CPI for the period is 6.857 with the minimum of 3.18 and the maximum of 19.72 with a standard deviation of 3.44.

The mean Foreign exchange rate for the period is 95.75 with the minimum of 75.786 and the maximum of 112.91 with a standard deviation of 9.85469. The mean interest rate for the period is 8.27 with the minimum of 1.6 and the maximum of 21.65 with a standard deviation of 3.248 mean REPO Rate for the period is 6.019 with the minimum of 0 and the maximum of 18.89 with a standard deviation of 4.2950.

Table 1: Descriptive Statistics of the study variables

	Bond Turnover (Billions)	*Stock Index*	*CPI*	*Exchange rate 1 Usd/Ksh*	Interest Rate %	*REPO RATE %*
Mean	44.75798611	3590.516667	6.857708333	95.75778472	8.270493056	6.01993007
Standard Error	1.770050583	85.59118387	0.287039634	0.821224689	0.270672655	0.359170506
Median	38.95	3732.34	5.99	100.761	8.035	6.4
Mode	23	4788	4.14	100.61	6.9	0
Standard Deviation	21.24060699	1027.094206	3.444475605	9.854696271	3.248071861	4.295054558
Sample Variance	451.1633854	1054922.509	11.86441219	97.11503859	10.54997081	18.44749366
Kurtosis	0.780092869	-0.925239395	4.24216084	-1.285357945	4.587272671	0.491600666
Skewness	1.015589615	-0.214480897	2.091015093	-0.271423917	1.422851769	0.447587625
Range	106.19	3752.32	16.54	37.124	20.05	18.89
Minimum	12	1738.68	3.18	75.786	1.6	0
Maximum	118.19	5491	19.72	112.91	21.65	18.89
Sum	6445.15	517034.4	987.51	13789.121	1190.951	860.85
Count	144	144	144	144	144	143
Confidence Level(95.0%)	3.498845177	169.1874254	0.567389005	1.623308436	0.535036525	0.710012204

4.2.1 Correlation Test

Testing for correlation enables us to identify whether there is a statistical relationship existing between two or more variables. This information can suggest potential cause-and-effect relationships to investigate further. The correlation coefficient, denoted as r, varies between -1 and 1.

An r value of 1 signifies a perfect positive correlation, where an increase in one variable is directly associated with an increase in the other.

An r value of -1 indicates a perfect negative correlation, where an increase in one variable is directly linked to a decrease in the other. Stock Index and CPI: Their correlation is -0.004, indicating a very weak and negative relationship between the two. This suggests that changes in the stock index do not significantly affect the consumer price index or vice versa. Stock Index and Exchange rate (USD/KSH): There's a strong negative correlation of -0.72 between the two variables. This demonstrates that as the value of the Kenyan shilling against the US dollar rises (exchange rate decreases), the stock index tends to decrease, and vice versa. Stock Index and Interest Rate %: Their correlation coefficient is 0.077, indicating a weak positive relationship.

This means that increases in the stock index are somewhat associated with increases in interest rates, but the relationship isn't strong. Interest Rate % and CPI: The correlation is 0.61, suggesting a moderately strong positive relationship. This implicates that as the interest rate increases, consumer prices also tend to rise. Interest Rate % and REPO RATE %: The correlation is 0.52,

indicating a moderate positive relationship between the two. This suggests that when the interest rate rises, the REPO rate also tends to increase.

REPO RATE % and CPI: The correlation is 0.25, indicating a weak positive relationship. This means that increases in the REPO rate are somewhat associated with increases in the consumer price index. Exchange Rate (USD/KSH) and Interest Rate %: The correlation is 0.01, suggesting almost no linear relationship between the exchange rate and the interest rate. Interest Rate % and REPO RATE %: The correlation is 0.52, suggesting a moderate positive relationship between the interest rates and the REPO rates.

Table 2: Correlation coefficients

	Stock Index	*CPI*	*Exchange rate 1 Usd/Ksh*	*Interest Rate %*	*REPO RATE %*
Stock Index	1				
CPI	-0.004039774	1			
Exchange rate 1 Usd/Ksh	-0.720742098	-0.117505749	1		
Interest Rate %	0.076599351	0.607480647	0.012482541	1	
REPO RATE %	0.032052371	0.249675689	0.111207624	0.520084947	1

4.3 Diagnostic Tests

Conducting these preliminary tests allows us to confidently proceed with the analysis, knowing that the data meets the necessary assumptions. If assumptions are violated, we can seek appropriate remedies - such as data transformations, using a different statistical test, or adjusting the model to account for the violation.

4.3.1 Normality Test

4.3.1.1 Skewness and Kurtosis Test

If we apply techniques assuming normality on non-normal data, it can lead to bias and inefficiency in the estimators. Therefore, to determine the quality of normality, we use the descriptive statistics. In the output table, we look at the

skewness and kurtosis values. In a normally distributed data set, skewness should be about 0, and kurtosis should be close to 0. The given data depicts the Kurtosis and Skewness of six variables - Bond Turnover, Stock Index, CPI, Exchange Rate (USD/KSH), Interest Rate, and REPO RATE.

Bond Turnover:

The kurtosis (0.780092869) - This refers to platykurtic, indicating a distribution is flatter than a normal distribution (lighter tails, fewer outliers). Skewness (1.015589615) - Positive skewness suggests that the distribution is asymmetrical.

Stock Index:

Kurtosis (-0.925239395) - Negative value suggests that the distribution is even flatter than a normal distribution, with light tails or less extreme values (Platykurtic). Skewness (-0.214480897) - Negative skewness refers to the distribution being skewed to the left, with majority of the data values being greater than the mean.

CPI:

Kurtosis (4.24216084) - A high positive kurtosis value indicates a distribution with heavy tails and a sharp peak compared to a normal one, suggesting there could be more extreme values or outliers (Leptokurtic). Skewness (2.091015093) - A high positive skewness depicts that the distribution is positively skewed, with most of the data values falling to the left or below the mean.

Exchange Rate (USD/KSH):

Kurtosis (-1.285357945) - Negative kurtosis, which is platykurtic, indicating lighter tails or fewer extreme values and a distribution flatter than a normal distribution. Skewness (-0.271423917) - Negative skewness, suggesting that the distribution is skewed to the left, or most of the values are above the mean.

Interest Rate:

Kurtosis (4.587272671) - High positive kurtosis indicates a leptokurtic distribution, which has heavier tails or more outlier values compared to a normal distribution. Skewness (1.422851769) - The skewness is positive, indicating that the distribution is positively skewed, with most values falling below the mean.

REPO RATE:

Kurtosis (0.491600666) - Positive kurtosis, but less than 3 (which usually is the kurtosis for a normal distribution), indicates a flatter distribution with lighter tails (Platykurtic). Skewness (0.447587625) - Positive skewness indicates the distribution is skewed to the right, i.e majority values are less than the mean.

Table 3: Skewness and Kurtosis.

	Bond Turnover (Billions)	*Stock Index*	*CPI*	*Exchange rate 1 Usd/Ksh*	Interest Rate %	*REPO RATE %*
Kurtosis	0.780092869	-0.925239395	4.24216084	-1.285357945	4.587272671	0.491600666
Skewness	1.015589615	-0.214480897	2.091015093	-0.271423917	1.422851769	0.447587625

4.3.1.2 Shapiro-Wilk and Kolmogorov-Smirnov tests

Table 4.0 below reveals that the significance values (Sig.) for both the Kolmogorov-Smirnov and Shapiro-Wilk tests are all below the 0.05 significance level, suggesting the rejection of the null hypothesis of normality. This indicates that the distribution of bond turnover, stock index, CPI, exchange rate (USD/KSH), interest rate, and REPO rate are not normally distributed. Further analysis may require the use of data transformation techniques or non-parametric methods in light of the failure of the data to meet the assumptions of inferential statistics where normality is required.

Table 4:Tests of normality

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Bond Turnover (Billions)	0.114	144	0	0.926	144	0
Stock Index	0.088	144	0.008	0.956	144	0
CPI	0.23	144	0	0.751	144	0
Exchange rate 1 Usd/Ks	0.224	144	0	0.914	144	0
Interest Rate %	0.176	144	0	0.845	144	0
REPO RATE %	0.14	144	0	0.921	144	0
a Lilliefors Significance Correction						

4.3.2 Stationarity Test

The Augmented Dickey-Fuller (ADF) test is a technique in statistics used to assess whether a time series is stationary. Stationarity, in the context of time series analysis, implies that the statistical properties of the underlying process remain unchanged over time. The test operates under the assumption that the time series is an autoregressive process.

The Augmented Dickey-Fuller (ADF) unit root test was applied to examine the stationarity of the variables in the study. Stationarity is a crucial concept in time series analysis, signifying that the properties of the series remain consistent over time.

By comparing the ADF test statistic with the critical values:

- If the ADF statistic is less than the critical value, the null hypothesis (H_0) is rejected, indicating that the data is stationary.
- If the ADF statistic is greater than the critical value, the null hypothesis (H_0) is not rejected, suggesting that the data is non-stationary.

Figure 3: Figure showing results from the ADF test.

Stationarity Test - Log Bond Turnover			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.709344	0.0000
Test critical values:	1% level	-4.023506	
	5% level	-3.441552	
	10% level	-3.145341	
Stationarity Test - Log CPI			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.848258	0.0000
Test critical values:	1% level	-4.028496	
	5% level	-3.443961	
	10% level	-3.146755	
Stationarity Test - Log Exchange Rate			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.332795	0.0652
Test critical values:	1% level	-4.023975	
	5% level	-3.441777	
	10% level	-3.145474	
Stationarity Test - Log Interest Rate			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.468167	0.0025
Test critical values:	1% level	4.029041	
	5% level	-3.444222	
	10% level	-3.146908	
Stationarity Test - Log Repo Rate			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.050464	0.0000
Test critical values:	1% level	-4.023506	
	5% level	-3.441552	
	10% level	-3.145341	
Stationarity Test - Log Stock Index			
t-Statistic Prob.*			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.977664	0.6081
Test critical values:	1% level	-4.023975	
	5% level	-3.441777	
	10% level	-3.145474	

For the Augmented Dickey-Fuller (ADF) Test, the null hypothesis posits that the time series contains a unit root, implying stationarity at levels.

The ADF test yields a test statistic and a p-value:
Test Statistic: A negative value suggests evidence against the null hypothesis.
p-value: A low p-value (typically less than 0.05) indicates strong evidence against the null hypothesis, implying that the time series is stationary.

For the variable "Bond Turnover," the ADF test results indicates stationarity. This is supported by the Augmented Dickey-Fuller test statistic of -6.709344 which is less than the test critical values at all levels.

For the variable "Stock Index," the ADF test results indicate non-stationarity. This is supported by the Augmented Dickey-Fuller test statistic of -1.977664 which is greater than the test critical values at all levels.

For the variable "Inflation," the ADF test results indicate stationarity. This is supported by the Augmented Dickey-Fuller test statistic of -5.848258 which is less than the test critical values at all levels.

For the variable "Exchange Rate," the ADF test results indicate non-stationarity at levels. This is supported by the Augmented Dickey-Fuller test statistic of -3.332795 which is greater than the test critical values at the 1% and the 10% level. The ADF test statistic of -3.332795 is however less than the test critical value at the 5% level.

For the variable "Interest Rate," the ADF test results indicate stationarity. This is supported by the Augmented Dickey-Fuller test statistic of -4.468167 which is less than the test critical values at all levels.

For the variable "Repo Rate," the ADF test results indicate stationarity. This is supported by the Augmented Dickey-Fuller test statistic of -8.050464 which is less than the test critical values at all levels.

The stationarity ensures that the statistical features of the data are predictable in the future, which contributes to the reliability of any future predictions or inferences based on the data.

4.3.4 Cointegration Test

Cointegration between two or more time series variables signifies a long-term equilibrium relationship, even though short-term fluctuations may occur. This is a way of modeling long-run relationships in economic datasets where non-stationary data are present. Cointegration is also important because it is a prerequisite for a valid Vector Error Correction Model (VECM) or Vector Autoregression (VAR) model, some types of multiple time series models that can be used when dealing with non-stationary or stationary variables that are cointegrated.

The test indicates the presence of 3 cointegrating relationships at the 0.05 significance level, it means that, in the long run, there are three distinct linear combinations of your variables (Bond Turnover, Stock Index, CPI, Exchange rate, Interest Rate, REPO Rate) that move together. These variables are not just correlated but are bound by a long-run equilibrium relationship. Correlation and cointegration are not the same. Correlation assesses the linear relationship between two variables, whereas cointegration determines whether a linear combination of these variables is stationary, indicating a long-term equilibrium relationship.The implications are:

1. Long-Run Equilibrium: There are three stable long-term relationships in the system that restrict how the variables interact with each other. This suggests that despite short-term fluctuations, these variables will tend to return to a long-run equilibrium.

2. Error Correction Model (ECM): Cointegration implies the possibility of an Error Correction Model (ECM) being used. The ECM adjusts short-term dynamics to reflect long-term equilibrium relationships.

Given that there are 3 cointegrating relationships, you can specify the model using a Vector Error Correction Model (VECM). The VECM is used when you have cointegrated variables because it includes both the short-term dynamics (through lagged variables) and the long-term equilibrium relationships (through the cointegration vectors).

Table 5: Cointegration Test

Sample (adjusted): 2010M05 2021M12
Included observations: 140 after adjustments
Trend assumption: Linear deterministic trend
Series: LOG BOND TURNOVER LOG CPI LOG EXCHANGE RATE USD KSH LOG INTEREST RATE L...
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.287179	135.1182	95.75366	0.0000
At most 1 *	0.235160	87.72462	69.81889	0.0010
At most 2 *	0.179786	50.19229	47.85613	0.0297
At most 3	0.089042	22.44575	29.79707	0.2744
At most 4	0.064807	9.389576	15.49471	0.3306
At most 5	6.63E-05	0.009280	3.841465	0.9229

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.287179	47.39358	40.07757	0.0063
At most 1 *	0.235160	37.53233	33.87687	0.0175
At most 2 *	0.179786	27.74654	27.58434	0.0477
At most 3	0.089042	13.05617	21.13162	0.4471
At most 4	0.064807	9.380296	14.26460	0.2559
At most 5	6.63E-05	0.009280	3.841465	0.9229

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LOG_BOND...	LOG_CPI	LOG_EXCH...	LOG_INTER...	LOG_REPO...	LOG_STOCK_INDEX
3.082559	3.865135	0.740036	-8.045826	4.359713	4.488408
-4.826578	-5.279836	-7.359732	-2.156649	1.111849	-4.076669
6.455705	-3.281672	7.923494	2.160053	-2.664079	7.365106
-2.294695	5.410008	21.96831	-6.509100	-1.261472	4.012421
-0.221393	0.900544	-33.10143	-0.209006	-0.190132	-6.699970
0.859827	0.368469	-0.221450	-1.275825	-0.106385	-6.707843

Unrestricted Adjustment Coefficients (alpha):

D(LOG BO...	-0.038581	0.038937	-0.042303	0.009781	0.005933	-0.000313
D(LOG_CPI)	-0.002347	0.017922	0.014129	0.001176	0.002830	0.000133
D(LOG_EX...	0.001101	0.000331	0.000374	8.42E-05	0.000880	-3.15E-05
D(LOG_INT...	0.017361	-0.000648	-0.003552	0.010521	-0.000197	0.000109
D(LOG RE...	-0.083539	-0.053097	0.041166	0.057303	0.036115	0.000104
D(LOG_ST...	-9.18E-05	-0.001604	-0.002128	-0.002303	0.003079	9.01E-05

4.3.5 Multicollinearity Test

The assessment of multicollinearity was carried out to determine if the explanatory variables in the multiple regression model are highly correlated to each other. When variables are closely related, it can be challenging for the model to distinguish the individual effects.

Variance Inflation Factor (VIF) is a metric used to quantify the amount of intensity in the variance due to the presence of multicollinearity. If VIF equals 1, there's no presence of multicollinearity. However, a VIF value between 1 and 5 is typically seen as acceptable. If VIF surpasses 5, it implies substantial multicollinearity.

Tolerance, essentially the inverse of VIF (1/VIF), is another measure used. If the tolerance value falls below 0.2, or even 0.1, it could indicate the presence of multicollinearity in the model.

As evidenced in the table below, all the variables returned $0 < VIF < 5$, inferring that multicollinearity is not present. Specifically, Stock index VIF = 2.2903, CPI VIF = 1.749, Exchange rate VIF = 2.353, Interest rate VIF = 2.135, REPO Rate VIF = 1.415

Table 6: Multicollinearity Variance Inflation Factor

Variable	VIF	Tolerance
Stock Index	2.290313633	0.436621424
CPI	1.748707213	0.571851018
Exchange Rate	2.353080061	0.424974915
Interest rate	2.134929879	0.468399459
Repo Rate	1.414560657	0.706933276

4.3.6. Autocorrelation.

The Durbin-Watson statistic is also shown in the summary table below with a value of 1. 076 plays an essential role in determining the positive autocorrelation test of a regression model. In this case it refers to the statistical

quantification of the level of independence between residuals of a regression model; this signifies whether there exists a parallel between the residuals and in this case, parallelism means having a high correlation between the residuals.

The value of the statistic varies between 0 and 4, with a reading close to 2 denoting that there is minimal autocorrelation, meaning that the residuals are not correlated with each other and show randomness.

In the summary of the provided model, the Durbin-Watson value is 1.076 which lies below the adopted threshold value of 2 implying the potential of having positive autocorrelation. This suggests that there could be some non-random structure in the residuals that the model does not account for, and this could lead to bias in the estimate of parameters and in the standard deviations. It is therefore prudent to exercise care in interpreting the beta values and regression model significance.

Table 7 :The Durbin-Watson Statistic

Model Summary				
R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.500a	0.25	0.222	18.73042	1.076
a Predictors: (Constant), REPO RATE %, Stock Index, CPI, Interest Rate %, Exchange rate 1 Usd/Ksh				
b Dependent Variable: Bond Turnover (Billions)				

VAR models are useful when you have multiple interrelated time series with potential autocorrelation. They perform regression of each variable on its own lagged values as well as the lagged values of all other variables within the system. VAR models capture the dynamic relationships between the variables, considering how past values of each variable influence the current values of all variables.

However, you would use VECM in the presence of autocorrelation in your time series data because:

•It allows you to model the long-term equilibrium relationships between variables, while also accounting for short-term adjustments.

•It helps correct for autocorrelation by incorporating error correction terms, which adjust the model to the long-term relationships and correct deviations in the short run.

•It reduces potential residual autocorrelation by ensuring the model structure captures both the short-term dynamics and the long-term equilibrium.

Thus, the VECM not only helps deal with autocorrelation but also provides a more robust and theoretically sound framework when dealing with cointegrated time series data.

4.3.7 Heteroskedasticity Test

Heteroskedasticity in regression analysis occurs when the variance or standard deviation of the error term, or residuals, varies across different levels of the independent variables. The Breusch-Pagan Test is used to detect heteroskedasticity. If the coefficients in the squared residuals regression are statistically significant (usually based on a p-value), it suggests heteroskedasticity is present.

The results indicate the presence of heteroskedasticity. This implies that the Vector Error Correction Model (VECM) may be preferred in use to model the relationship between bond market liquidity and the macroeconomic variables.

Table 8: Breusch-Pagan Test

LM (Observed value)	42.740
LM (Critical value)	3.841
DF	1
p-value (Two-tailed)	**<0.0001**
alpha	0.05
Test interpretation:	
H0: Residuals are homoscedastic	
Ha: Residuals are heteroscedastic	
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.	

4.3.8 Model Selection

The selected model is the Vector Error Correction Model (VECM). VECM improves model specification by explicitly considering both short-term fluctuations and long-term equilibrium.

By including the cointegration relationships in the model, VECM better captures the underlying data structure, making the residuals more likely to be white noise (i.e., no autocorrelation), which is a desirable property in time series modeling.

In a system of cointegrated variables, there are potential endogeneity and feedback effects, where the variables influence each other over time. A simple autoregressive model (e.g., VAR) might fail to capture these interdependencies correctly if it does not account for cointegration.

VECM is specifically designed to handle these feedback loops and endogeneity by including both short-term changes (first differences) and long-term relationships (cointegration terms), thereby reducing the chance of autocorrelation in the residuals.

Model Specification:

In a VECM, the dependent variable is modeled using both the first differences of the independent variables (for short-run dynamics) and the error correction term (ECM) from the cointegration relationship (for long-run adjustment).

The general form of the VECM is:

$$\Delta \text{BMT}_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} \Delta \text{BMT}_{t-i} + \sum_{i=1}^{p} \gamma_{1i} \Delta \text{SI}_{t-i} + \sum_{i=1}^{p} \delta_{1i} \Delta \text{Inflation}_{t-i} + \sum_{i=1}^{p} \lambda_{1i} \Delta \text{FXR}_{t-i} + \sum_{i=1}^{p} \theta_{1i} \Delta \text{IR}_{t-i} + \sum_{i=1}^{p} \omega_{1i} \Delta \text{RR}_{t-i} + \alpha_2 \text{ECM}_{t-1} + \epsilon_{1t}$$

Where;
BMT= Bond Market Turnover
SI= Stock Index
Inflation= CPI
FXR= Foreign Exchange Rate
IR= Interest Rate
RR= Repo Rate
ECM= Error Correcting Model

4.3.9 Regression Analysis

A regression analysis of the dataset provides insights into predicting the "Bond Turnover" variable and the factors that affect its value.

The cointegrating equation and long run model from the Vector Error Correction Estimates can be simplified as below:

ECT_{t-1}= (1.000*LgBMT* – 1.697879*LgCPI* + 0.9384301*LgFX* + 3.902638*LgIR* – 2.502751*LgRR* + 0.319004*LgSI* – 5.018052)

The short run model can be simplified as:

$\Delta lgBMT_t = 0.009583 - 0.002046ECT_{t-1} – 0.267972\Delta lgBMT_{t-1} + 0.022027\Delta lgCPI_{t-1} – 4.418279\Delta lgFX_{t-1} + 0.581183\Delta lgIR_{t-1} + 0.020685\Delta lgRR_{t-1} + 1.556143\Delta lgSI_{t-1}$

Where:

- $\Delta lgBMT_{t-1}$ = First difference of the log of BMT (dependent variable)
- ECT_{t-1}= Error correction term from the long-run relationship (lagged one period)
- $\Delta lgCPI_{t-1}$ = Change in the log of Consumer Price Index (inflation) (lagged one period)
- $\Delta lgFX_{t-1}$ = Change in the log of Foreign Exchange Rate (lagged one period)
- $\Delta lgIR_{t-1}$ = Change in the log of Interest Rate (lagged one period)
- $\Delta lgRR_{t-1}$ = Change in the log of Repo Rate (lagged one period)
- $\Delta lgSI_{t-1}$ = Change in the log of Stock Index (lagged one period)

This can be interpreted as:
The constant term is equal to +0.009583. This represents the base value or drift in ΔlgBMTt when all explanatory variables are zero. A small positive value suggests an inherent upward trend.
The Error Correction Term has a coefficient of -0.002046 which shows how quickly deviations from the long-run equilibrium are corrected. Since it is negative, it confirms that Bond market Turnover moves towards equilibrium when there is a shock. However, the small magnitude suggests a very slow adjustment to deviations.
The lagged change in bond market turnover has a coefficient of -0.267972. The negative sign means that if bond market turnover increased in the previous

period, it is likely to decrease in the current period. This suggests short-run mean reversion that is, temporary fluctuations correct themselves over time.
Lagged Change in CPI has a coefficient of +0.022027. A positive relationship between changes in CPI (inflation) and Bond market turnover. Inflation has a small impact but suggests that an increase in inflation leads to a slight increase in Bond market turnover.
Lagged Change in Exchange Rate has a coefficient of -4.418279. There is a strong negative impact of exchange rates on Bond market turnover. If exchange rates increase, Bond market turnover decreases significantly. This suggests a significant inverse relationship between FX and BMT.
Lagged Change in Interest Rate has a coefficient of +0.581183. There is a positive impact of interest rates on Bond market turnover. An increase in interest rates leads to an increase in bond market turnover by 0.581183.
Lagged Change in Repo Rate has a coefficient 0.020685. This has a positive but weak impact. Indicates that an increase in repo rates slightly increases bond market turnover.
Lagged Change in Stock Index has a coefficient of +1.556143. This is a positive and strong impact. It suggests that when stock markets perform well, bond market turnover increases, possibly due to increased financial activity.

Our key takeaways are that for:
Short-Run Dynamics:

- BMT is negatively impacted by past changes in itself.
- Inflation (CPI) has a small positive impact, meaning money supply might increase slightly with rising prices.
- Exchange rates have a strong negative impact.
- Stock market performance has a strong positive impact, suggesting a link between financial markets and money supply.

Long-Run Adjustment:

- The small error correction coefficient (-0.002046) indicates that deviations from equilibrium correct very slowly.

Our model fit can be confirmed using the metrics:
Multiple R-Squared: The R-squared value is 0.561924, meaning that approximately 56% of the variability in bond turnover is explained by the model. This indicates a moderate fit.
Adjusted R-Squared: The adjusted R-squared value is 0.518144, which adjusts for the number of predictors in the model. This value is slightly lower than the R-squared, suggesting that some predictors may not be contributing much to the model.

Table 9: Table showing the Vector Error Correction Model Estimates

Sample (adjusted): 3 144
Included observations: 142 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LOG_BOND_TURNOV	1.000000
LOG_CPI(-1)	-1.697879 (0.67401) [-2.51906]
LOG_EXCHANGE_RAT	0.938430 (3.26627) [0.28731]
LOG_INTEREST_RATE(	3.902638 (0.77034) [5.06609]
LOG_REPO_RATE(-1)	-2.502751 (0.34923) [-7.16656]
LOG_STOCK_INDEX(-1)	0.319004 (0.99020) [0.32216]
C	-5.018052

Error Correction:	D(LOG_BON	D(LOG_CPI)	D(LOG_EXC	D(LOG_INT	D(LOG_REP	D(LOG_STO
CointEq1	-0.002046 (0.02227) [-0.09184]	-0.007335 (0.00734) [1.01256]	-0.000508 (0.00082) [0.62117]	-0.023966 (0.00730) [-3.28207]	-0.237835 (0.04311) [5.51725]	-0.000214 (0.00259) [-0.08251]
D(LOG_BOND_TURNO	-0.267972 (0.08045) [-3.33097]	-0.000464 (0.02652) [-0.01751]	0.001203 (0.00295) [0.40720]	-0.091147 (0.02637) [-3.45602]	-0.432744 (0.15569) [-2.77949]	0.002015 (0.00935) [0.21543]
D(LOG_CPI(-1))	0.022027 (0.25318) [0.08700]	0.261096 (0.08346) [3.12849]	-0.002782 (0.00930) [-0.29921]	0.179638 (0.08300) [2.16429]	0.095105 (0.48998) [0.19410]	-0.045059 (0.02943) [-1.53080]
D(LOG_EXCHANGE_R	-4.418279 (2.21850) [-1.99157]	0.357660 (0.73129) [0.48908]	0.335359 (0.08147) [4.11654]	0.582582 (0.72729) [0.80104]	1.043628 (4.29344) [0.24308]	-0.205198 (0.25792) [-0.79558]
D(LOG_INTEREST_RA	0.581183 (0.22895) [2.53845]	0.102936 (0.07547) [1.36393]	-0.006814 (0.00841) [-0.81052]	0.196415 (0.07506) [2.61688]	-0.617306 (0.44309) [-1.39318]	-0.020242 (0.02662) [-0.76045]
D(LOG_REPO_RATE(-1	0.020685 (0.04544) [0.45518]	0.010339 (0.01498) [0.69024]	-0.000397 (0.00167) [-0.23775]	-0.021873 (0.01490) [-1.46824]	-0.158390 (0.08795) [-1.80101]	-0.003092 (0.00528) [-0.58527]
D(LOG_STOCK_INDEX(	1.556143 (0.74057) [2.10127]	-0.386975 (0.24412) [-1.58520]	-0.052618 (0.02719) [-1.93486]	-0.013623 (0.24278) [-0.05611]	-0.941370 (1.43322) [-0.65682]	0.125117 (0.08610) [1.45318]
C	0.009583 (0.01479) [0.64772]	-0.000935 (0.00488) [-0.19172]	0.000678 (0.00054) [1.24788]	8.17E-05 (0.00485) [0.01685]	0.004137 (0.02863) [0.14448]	-0.001473 (0.00172) [-0.85614]

R-squared	0.561924	0.417451	0.549832	0.472732	0.393611	0.58492
Adj. R-squared	0.518144	0.471350	0.305420	0.43741	0.361934	0.409309
Sum sq. resids	4.006628	0.435351	0.005403	0.430598	15.00626	0.054155
S.E. equation	0.172917	0.056999	0.006350	0.056687	0.334645	0.020103
F-statistic	3.698590	2.547608	3.373699	7.178756	12.42574	1.189265
Log likelihood	51.83000	209.4182	521.0544	210.1976	-41.92675	357.4041
Akaike AIC	-0.617324	-2.836876	-7.226119	-2.847854	0.703194	-4.921185
Schwarz SC	-0.450798	-2.670350	-7.059594	-2.681328	0.869719	-4.754659
Mean dependent	0.000750	0.000309	0.001181	0.000478	0.005106	-0.001975
S.D. dependent	0.184136	0.059148	0.006713	0.064801	0.418939	0.020197

Determinant resid covariance (dof adj.)	4.85E-16
Determinant resid covariance	3.43E-16
Log likelihood	1319.373
Akaike information criterion	-17.82215
Schwarz criterion	-16.69811
Number of coefficients	54

4.3.10 Discussion of Findings

The regression analysis is based on 144 observations from monthly data examining the independent variable in relation to the explanatory variables. With an R-squared value of 0.5619 and an adjusted R-squared of 0.5181, the model explains a moderate proportion of bond turnover, reflecting its impact on bond market liquidity.

The variables included in the VEC results have t-statistics that can be interpreted to determine their significance.

If the absolute value of the t-statistic > the critical value of 1.96 for a 95% confidence level, you can reject the null hypothesis that the coefficient is zero. This suggests that the variable has a statistically significant impact on the dependent variable.

Table 10: Table showing the VEC T-Statistic Significance

Variable	Absolute value of T-statistics	Significance
Past Bond Market Turnover, BMT	|3.33097|	Highly significant, |3.33097|>1.96
Foreign Exchange Rate, FX	|1.99157|	Moderately significant, |1.99157|>1.96
Stock Index, SI	|2.10127|	Highly significant, |2.10127|>1.96
Inflation, CPI	|0.08700|	Not significant, |0.08700|<1.96
Interest Rates, IR	|2.53845|	Highly significant, |2.53845|>1.96
Repo Rate, RR	|0.45518|	Not significant, |0.45518|< 1.96

The VEC results indicate that previous bond market turnover, interest rates and stock market index are strongly significant predictors of current bond market turnover. The foreign exchange rate is also a significant indicator of current bond market turnover. However, the other economic indicators, Inflation (CPI) and Repo rate show no predictive power in this model.

Ngongesa (2012) examines the factors influencing liquidity in Kenya's secondary bond market. The study uses time series data and applies a multivariate Ordinary Least Squares (OLS) regression model to explore the relationships between bond market liquidity and various macroeconomic variables, including interest rates, inflation rates, exchange rates, and other relevant economic indicators. The analysis identified several key factors that

significantly affect the liquidity of Kenya's secondary bond market. Higher interest rates are associated with reduced bond market liquidity, as they increase the cost of borrowing and may deter investment in bonds. Elevated inflation rates negatively impact bond market liquidity, possibly due to the erosion of bond value and investor purchasing power. Volatility in exchange rates adversely affects bond market liquidity, likely due to increased uncertainty and risk for investors, particularly foreign participants. The development and efficiency of market infrastructure, including trading platforms and regulatory frameworks, play a crucial role in enhancing bond market liquidity.

Kapingura (2015) probed the factors influencing bond market liquidity in South Africa over the period from 1995 to 2009. The study utilized the Johansen cointegration test and the Vector Error Correction Model (VECM) to examine the long-term relationships between various macroeconomic variables and bond market liquidity. The results indicated a negative correlation between inflation and bond market liquidity, implying that higher inflation rates lead to a decrease in liquidity. An increase in the repo rate negatively impacts bond market liquidity, indicating that higher borrowing costs reduce trading activity. Greater volatility in exchange rates was associated with reduced bond market liquidity, likely due to increased uncertainty deterring investment. A negative relationship was observed, implying that as the stock market becomes more attractive, investors may shift funds away from bonds, reducing bond market liquidity. A positive impact on bond market liquidity was identified, highlighting the importance of foreign investors in enhancing market activity.

Ngabirano (2016) investigated the factors influencing the performance of corporate bonds within the Kenyan financial market. The research employed a multiple regression analysis to assess the impact of selected independent variables on the performance of corporate bonds. They found that there is an inverse relationship between interest rates and corporate bond performance. Higher interest rates tend to decrease bond prices, leading to lower performance. Elevated inflation rates negatively impact bond performance by eroding the real value of fixed interest payments, making bonds less attractive to investors. Exchange rate volatility poses a risk to investors, particularly foreign investors, leading to reduced demand for corporate bonds during periods of instability. Positive GDP growth correlates with improved corporate bond performance, as a robust economy enhances corporate profitability and creditworthiness. Prudent fiscal policies that promote

economic stability and growth contribute positively to corporate bond performance by fostering a favourable investment climate.

Obeng and Obeng (2019) examined the macroeconomic factors influencing the development of sovereign bond markets across 26 African emerging economies. The authors utilized a dynamic panel data approach within the Generalized Method of Moments (GMM) framework. The study highlighted several key macroeconomic factors driving the development of sovereign bond markets in emerging African economies. Higher inflation rates are found to negatively impact bond market development, underscoring the importance of maintaining low and stable inflation to foster market growth. An increase in domestic debt levels positively correlates with bond market development, suggesting that a well-managed domestic debt strategy can enhance market depth. Elevated external debt levels are associated with a negative effect on bond market development, highlighting the need for sustainable external borrowing practices. Higher GDP at PPP is positively linked to bond market development, indicating that larger economies with greater economic output tend to have more developed bond markets. Improved fiscal balances contribute positively to bond market development, emphasizing the role of prudent fiscal management in market growth. A higher level of exports is positively associated with bond market development, suggesting that economies with robust export sectors may experience more advanced bond markets.

Hongmei (2021) focuses on determining how different macroeconomic variables impact the performance of the bond market in Kenya. The model employed in the study is a multiple regression analysis to examine the relationship between several independent variables (macroeconomic factors which were Interest Rates, Money Supply, Exchange Rates, Inflation Rates and Equity Market Performance) and a dependent variable (bond market performance). In this case, the bond market performance is measured by metrics such as bond turnover, the volume of bonds traded, and market depth. The study concluded that interest rates and money supply are the most important macroeconomic factors influencing the development of the bond market in Kenya. He also found that exchange rate stability could be critical to attracting investment into bonds, especially for foreign investors. There was a negligible effect of inflation and equity market performance.

Chapter Five: Conclusion

5.1 Findings

The analysis in this research allows a deeper understanding of the bond market liquidity in Kenya regarding various factors such as stock index, inflation rate, foreign exchange rate, interest rate, and repo rate. After analyzing the data retrieved from the years 2010 up to 2021 the following conclusions have been made in reference to the relationship between those variables and how they affect the liquidity of bond markets.

The findings suggest that previous bond market turnover, interest rates and stock market index are strong significant predictors of current bond market turnover. The foreign exchange rate is also a significant indicator of current bond market turnover. However, the other economic indicators, Inflation (CPI) and Repo rate show no predictive power in this model.

The model explains a moderate portion of the variability in bond turnover, and the overall model is statistically significant. These results can inform financial analysts and policymakers about the key factors influencing bond turnover and guide further investigation into other potential predictors.

5.2 Conclusion

This paper offers a thorough evaluation of the macroeconomic determinants of bond market liquidity in Kenya and specifically states that bond market liquidity in Kenya is heavily dependent on several macroeconomic factors.

The study aimed to assess the impact of various macroeconomic factors on bond market liquidity in Kenya, focusing on interest rates, inflation, foreign exchange rates, stock indices, and monetary policy.

Here's how the findings relate to these objectives:

1. Interest Rates on Bond Market Liquidity:
    - Objective: The study's objective to determine the influence of interest rates on bond market liquidity found a highly significant impact in this model.
    - Conclusion: Interest rates were significant predictors of bond turnover.

2. Inflation Rate on Bond Market Liquidity:
    - Objective: The study's objective to assess the influence of inflation on bond market liquidity found a weak impact on the relationship in this model.
    - Conclusion: The Consumer Price Index (CPI), representing inflation has a weakly significant impact on the bond market liquidity in this model.

3. Foreign Exchange Rate on Bond Market Liquidity:
    - Objective: The study's objective to evaluate the effect of foreign exchange rates on bond market liquidity found a moderately significant impact in this model.
    - Conclusion: The exchange rate significantly influences bond turnover.

4. Stock Indices on Bond Market Liquidity:
    - Objective: The study's objective to determine the influence of stock indices on bond market liquidity showed a highly significant impact.
    - Conclusion: The stock was a significant predictor of bond turnover.

5. Monetary Policy on Bond Market Liquidity:

- Objective: The study's objective to assess the impact of monetary policy on bond market liquidity found a weakly significant impact on the relationship in this model.
- Conclusion: The REPO rate, representing monetary policy, has a small impact on the bond market liquidity in this model

5.3 Recommendations for Policy

Based on the findings, several recommendations are proposed:
Market participants need to cultivate knowledge on the role of historical data in forecasting the market. Relating autocorrelation to the dynamics of the bond market can help investors make more informed decisions and better address the risks of investing.

Economic policy makers should factor in all the highlighted relationships while making policies. For example, the currency stabilization measures would have impacts on the stock indices and bond market liquidity because there is a strong correlation between the two.

Sophisticated investors should embrace the risk management measures that address a company's exposure to macroeconomic changes. The analysis on the relationship between interest rates, exchange rates, and inflation and bond market liquidity is helpful in investment risk management as it helps the investors to identify risks they face.

There should be a close regulatory control on the bond market not only from the defined key variables perspective. That would mean maintaining interest and exchange rates in a way that supports liquidity in the market and keeps investors' confidence high.

5.4 Limitations

This study examined the macroeconomic environment and the performance of Kenya's bond market over the period from 2010 to 2021. Consequently, the findings may differ from those of studies conducted in other countries or at a later time.

The model might not capture all relevant factors influencing bond market liquidity. The study recommends including foreign markets, and geopolitics in future research.

Events like the COVID-19 pandemic and U.S. interest rate hikes could introduce external shocks that are difficult to capture using VECM.

5.5 Suggestions for Further Research

Some of the specific variables that may be in the future examine the possible impact on bond market liquidity are the government fiscal policies, foreign markets and geopolitics. Additional variables could also help in better explanations of the factors that influence bond market liquidity.

Check how global economic shocks and external factors (e.g., U.S. interest rate hikes, global recessions) impact Kenya's bond market.

Studying alternative Determinants of Bond Market Liquidity such as explore the role of green bonds and sustainable finance in shaping market liquidity.

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