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Examining the Reaction of the Nigerian Bonds Market to Changes in the Monetary Policy Stance: A Markov Switching -Vector Autoregression Approach

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Abstract

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Corresponding author Zainab Said Suwaid zssuwaid.sce@buk.edu.ng Tel: 08037043666 This paper examines the reaction of the bonds market to changes in the monetary policy stance. From the first quarter of Q1:1990 to Q4:2023 using MS-VAR model. Findings from the study shows a positive connect between interest rate and the bond yield in the market, that is, as interest rates increase, the yield on Treasury bills in regime 1 also tends to increase, although marginally while in regime 2, the response of Treasury bills to Interest rate is much larger and takes on both signs. Overall, the model suggests that the response of Treasury bills to Interest rate is nonlinear and regime-dependent, which underscores the importance of considering the state of the economy when analyzing the impact of interest rates on Treasury bills. Financial innovation is therefore required to improve the financial market which is a viable and important sector for economic growth, is the suggested policy tool.

1. Introduction

Volatility in financial markets, particularly stock markets, is an issue that concerns government policymakers, market analysts, corporate managers, and economists. During the 1980s new financial markets bond and stock were developed around the world, and exchanges introduced futures and option contracts on interest rates, stock indices, and foreign exchange rates. These markets experienced impressive growth until the crash of stock markets around the world in October 1987. Serious questions were raised following the crash concerning volatility in financial markets and the role of the new financial futures and options. As a result, a number of reforms for financial markets were proposed such as the financial structure reforms, monetary policy reforms, foreign exchange reforms, liberalization of capital movement and capital market reforms, some of which have been instituted. During the period when financial markets were experiencing dramatic growth, and asset price volatility was becoming more noticeable, economists were reexamining the efficient markets hypothesis-the theory that states that financial markets always price securities correctly.

Interestingly, interest, over the past four decades, the interdependence between stock markets and monetary variables has attracted the attention of many economists and financial experts in both developed and developing countries (Hassan, 2017). Theoretically, this link is intuitively clear due to the importance of monetary variables in explaining a company's cash flows and the overall systematic risk. Given that stock prices are the discounted present value of expected future cash flows, thus any anticipated or unanticipated arrival of new information about inflation, interest rate, exchange rate and other monetary variables will disturb stock prices by affecting expected dividends, discount rates or both (Arnold & Vrugt, 2006). Depending on this fact, it is logical to claim that the conditional variance (volatility) of current stock returns is a function of the conditional variance of expected future cash flows and discount rates as well as the conditional covariance between them. Provided that both expected cash flows and discount rates are determined by monetary variables, it is unsurprisingly that changes in monetary variables uncertainty triggers a proportional reaction in current stock returns volatility (Poon & Granger, 2003). Studies by (Durham 2003, 2005) showed that the relationship between monetary policy and stock market return is historically unstable and time-varying. However, there is not much done in the literature analyzing how and why the relationship varies over time. Is it possible that the time-varying response of stock return to monetary policy depends on drastic changes in monetary regimes or on the phases of the stock market being in a bull or bear market.

The Short-term interest rates alone have only limited direct effects on the economy. Interest rates which determine savings and investment decisions and therefore have a stronger impact on the economy typically have longer maturities. In order to impact the economy, monetary policy impulses must therefore first be transmitted from the money market to the capital market. The money market and the capital market are linked by expectations. Neglecting transaction costs and risk premiums, the expectations theory of the term structure views the long-term interest rate as an average of the short-term interest rates expected to prevail until the maturity of the respective bond. Although current short-term interest rates have some effect on longer-term bond yields, the expectations theory of the term structure tells us that it is primarily expected future short-term interest rates which determine bond yields. In practice, due to uncertainty about the future evolution of short-term interest rates and due to time-varying risk premiums, the longer the maturity, the weaker the link between current short-term rates and long-term rates. Therefore, in practice, a central bank would often find it difficult to guide longer-term interest rates to a level commensurate with what it considers to be the optimal monetary policy stance.

There are reasonable body of literature explaining the monetary policy and bonds markets such as Ajie and Nenbee (2010), Okpara (2010), Abaenewe & Nduglu (2013), Adeniji (2018) and Osakwe & Chukwunulu (2019) supported that money supply and interest rate (the proxy for monetary policy) had short-run significant effects on stock prices in Nigeria. Monetary policy is responsible for creating a stable macroeconomic environment for economic prosperity, achieving these objectives depends on whether or not monetary policy actions permeate the real sector of the economy (Laopodis 2013). Channels through which monetary policy permeates the real sector of the economy are the debt instruments (i.e., interest rate) or asset prices particularly the stock prices

(Mishkin, 2001). Laopodis (2013) found that monetary actions can propagate the real sector if they are properly transmitted into the macroeconomy through the various channels; notably the interest rate channel, consumption channel, and wealth effect channel.

Most African countries have been plagued with economic challenges over the years, in the face of many, and frequent changes in monetary and other macroeconomic policies, raising the question of whether monetary policy is making the desired economic impact or not, especially with regards to the financial market. Views on whether monetary policy is making an economic impact are many and varied. The monetarists strongly believe that monetary policy exert a greater impact on economic activity arguing that unanticipated change in the stock of money affects output and growth i.e., the stock of money must increase unexpectedly for the central bank to promote economic growth (Adeolu et al, 2012). Despite the apparent interaction between monetary policy and the stock market in literature, the existence of a single consistent empirical framework that describes the nature of the relationship across different economies and different monetary regimes remains an issue (Laopodis, 2013). Interestingly, Sesan et.al. (2018) findings showed that there is a strong and positive relationship between monetary policy shocks and stock market price volatility in Nigeria using ARDL and EGARCH. However, only interest rate, among the monetary policy variables examined, is significant in explaining the stock market price volatility in both the short and long run, while money supply (M1) is significant only in the short run. Heuristically,

Osakwe and Chukwunulu (2019) showed that money supply and exchange rate fluctuation have significant positive effect on stock market price movement, while Interest rate has an insignificant negative effect on stock market price movement. The overall results show that monetary policy variables significantly determine the stock market performance movements in Nigeria. It is pertinent to examine the reaction of the bond market to changes in monetary policy stance. This may be the missing link on the variant of the monetary policy inability to exact its main targets. Following the introductory section, this study is further divided into four other sections. In Section 2.0 extant conceptual, theoretical and empirical literature were reviewed while the methodological framework upon which the empirical investigation would be conducted was provided in Section 3.0. In section 4.0, estimations of empirical model were undertaken and findings were discussed while conclusions were reached and policy suggestions were proffered in section 5.0.

2. Literature review

2.1 Conceptual literature

Monetary policy is a deliberate action of the monetary authorities to influence the quantity, cost and availability of money credit in order to achieve desired macroeconomic objectives of internal and external balances. The action is carried out through changing money supply and/or interest rates with the aim of managing the quantity of money in the economy. Monetary policy has been defined as a combination of measures designed to control the supply of money and credit conditions in an economy (Okigbo, 2008). The major objective of monetary policy for most central banks is the attainment of price stability. An associated objective is stable growth with full employment (accompanied by stable long-term interest and real exchange rates). In pursuit of the objective of price stability and its accompanying objectives, central banks recognize the existence of conflicts amongst the objectives and the need for trade-offs. The monetary transmission mechanism describes how policy-induced changes in the nominal money stock or the short-term nominal interest rate impact real variables such as aggregate output and employment (Ireland, 2005). It is the process through which monetary policy

decisions affect the economy in general and the price level in particular. The transmission mechanism is characterized by long, variable and uncertain time lags (ECB, 2023). According to this study, monetary policy is a set of actions taken by a country's central bank to control the money supply and interest rates. The goal of monetary policy is to achieve broader economic objectives, such as: Price stability: Keeping inflation low and stable. Economic stability: Contributing to a stable economy Predictable exchange rate: Maintaining stable exchange rates with other currencies.

Reszat (2008) viewed financial market as a specialized market that is responsible for channeling financial resources from the surplus units (savers) to the deficit units (those who need additional funds) to carry out some forms of economic activities. It is made up of financial institutions that receive financial resources from the surplus units of the economy in the forms of savings and transfer them to the deficit units through lending activities. This study sees financial Markets as any place or system that provides buyers and sellers the means to trade financial instruments, including bonds, equities, the various international currencies, and derivatives. Financial markets facilitate the interaction between those who need capital with those who have capital to invest.

Brunnermeier and Pedersen (2009) define the bond market (also debt market or credit market) is a financial market in which participants can issue new debt, known as the primary market or buy and sell debt securities known as the secondary market. This is usually in the form of bonds, but it may include notes, bills, and so on for public and private expenditures. This study sees bond market is a place where investors can buy and sell debt securities, such as bonds, that are issued by governments or corporations. It's also known as the credit market or debt market.

2.2 Theoretical literature

2.2.1 The expectations hypothesis

To see what the EH implies for the joint behaviour of long and short interest rates, let R_t denote the yield to maturity of a bond that matures in *n* periods, r_t the yield on a one-period instrument, \emptyset_t a term premium, and E_t the expectations operator, conditional on information available at time *t*. In the empirical work below the long rate applies typically to tenyear bonds and the short rate to three-month securities. The yield on long bonds can be decomposed into a weighted average of expected future short-term rates and a term premium.

$$R_t \equiv \sum_{i=0}^{n-1} w_i E_t r_{t+1} + E_t \phi_t, \qquad 1$$

Where;

$$w_i \equiv g^i (1-g)/(1-g^n)$$

and $g \equiv (1 + \overline{R})^{-1}$ where \overline{R} denotes the mean level of the long interest rate in the sample. Equation (2.4) states that the long interest rate equals the weighted sum of the expected future one-period rates.

As shown by Shiller (1979) and Shiller, Campbell and Shoenholtz (1983), the need for the weights arises from the fact that couponcarrying bonds are used: since coupon bonds derive a large part of their value from payments made in the near future, it is appropriate to weight expected near-term one-period rates relatively heavily in equation (2.4).

Three aspects of the weighting scheme deserve comment. First, the weights follow a truncated Koyck distribution and sum to unity. Second, the weights are linked to \overline{R} : if the mean level of interest rates were to rise, the weights attached to one-period rates in the near term would rise and the weights attached to one-period rates further in the future would fall. To understand the reasons for this, it should be recalled that the linearisation underlying equation (2.4) assumes that new bonds are issued at par, so that the coupon rate equals the yield to

maturity. An increase in the level of interest rates should thus be interpreted as an increase in the part of the returns that stems from coupon payments, which in turn shortens the duration of the bond. Third, if pure discount bonds were used, so that the coupon rate was zero,g = 1 and $w_i = \frac{1}{n}$.

Subtracting the short interest rate from both sides of equation (2.4) yields the following expression for the spread between long and short interest rates

$$\sum_{i=0}^{n-1} w_i E_t r_{t+1} - r_t = R_t - r_t + E_t \phi_t$$
 2

Which can be rearranged to yield;

$$(1-g^n)^{-1}\sum_{i=1}^{n-1} (g^i - g^n) E_t \Delta r_{t+1} = R_t - r_t + E_t \phi_t$$
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Equation (2.6) plays a critical role in what follows. To interpret it, recall that under the EH, $E_t \phi_t$ is constant. In that case, the term spread, $R_t - r_t$ is a direct measure of expected changes in short-term interest rates between time period t + 1 and t + n + 1.

In practice, however, movements in risk premia seem to be more important in affecting the exchange rate (Fama, 1984). Fama also finds, on average, high yielding currency tends to appreciate rather than depreciate. Clarida et al. (2009) and Brunnermeier et al. (2008) have also documented the correlation between market's assessment of risk and return to currency speculation. If market's perception of risk is more (or less) sensitive to monetary policy during crisis, then a different relationship between monetary policy and exchange rates can be expected.

There are many ways a crisis can change the effect of policy on the exchange rate. One is through liquidity. Brunnermeier and Pedersen (2009) present a model where initial losses can lead to "liquidity spiral" of funding problems for traders, forced sales, prices that deviate from fundamentals and further margin calls. In a similar environment, a negative monetary policy shock (a fall in interest rates) can have standard first round effects of a depreciation of the home currency. But if tight funding conditions cause margin calls for speculators taking long positions in the home currency and other participants are unable to raise funds to move against the change—then there can be a second-round depreciation and hence a larger effect of monetary policy during crisis.

A closely related mechanism is that high-bid ask spreads during crisis may make it more difficult for market participants to take advantage of deviations from fundamental prices. Bid-ask spreads in foreign exchange markets widened markedly during the global financial crisis. For example, the spread of the Australian dollar widened to 3.5 times its pre-crisis level as "risk retrenchment and the unwinding of leveraged position generated one-sided markets" Debelle (2009). Burnside et al. (2006) report that deviations from UIP can become unprofitable to take advantage of relative to the risk taken due to buy-sell spreads in the foreign exchange markets, and the effect of order flow on spreads. Hui et al. (2009) report that the close relationship between the futures price of foreign exchange and interest rate differences across countries covered interest parity was disrupted during the crisis. While it is difficult to know whether this makes monetary

policy more or less effective, it suggests that mechanisms linking exchange rates and interest rates work differently during the crisis.

Theoretical and empirical works have established that financial time series such as stock market data are found to exhibit some common characteristics often referred to as stylized facts. These stylized facts include fat tails, volatility clustering, leverage effects, long memory and co-movement in volatility. Fat tails, also called heavy tails, implies leptokurtic distributions which captures the density of the distribution towards the tail areas. High frequency financial time series tends to have a fourth moment (kurtosis), which is higher than the normal value of 3 and makes normality assumption inappropriate for such series. Volatility clustering is an indication of persistence in past shock. It implies that prolonged period of low volatility is followed by prolonged period of high volatility. According to Black (1976), leverage effect implies that price movements are negatively correlated with volatility. Long memory is also an indication of persistent volatility and evidence of near unit root behavior of the conditional variance process. Basically, a unit root and long memory process are two distinctive approaches to modeling this fact. Lastly, co-movement in volatility arises when looking at two or more different markets. It suggests that big movements in one financial time series are matched by other big movements from a different market.

The trends of transactions in the bonds market is shown in figure 1



Figure 1. Plot Total Value of Transactions

Source: Researcher's illustration using data from CBN Statistical Database, 2023

The All-Share Index (ASI) of the Nigerian Stock Exchange has also witnessed growth over the years with of course observed volatility clustering which is a common feature of financial data. There are basically two most striking decline in the ASI from the period 1985 to 2018. The two periods were 2009 and 2016 (NSE, 2018). The extreme volatility of stock market (the ALSI) in 2009 could be attributed to the 2008/2009 global financial crisis, during which the value of equity securities in Nigeria recorded a significant drop due to capital reversal of

NGN113.0 billion by foreign portfolio investors (CBN, 2010). Again, after peaking in 2015, the NSE All Share Index (NSE ASI) began to retreat to negative territory as total foreign inflow dropped drastically in 2016 due to loss of confidence in the implementation of an announced free floating FX regime; weak corporate performance; and 2nd consecutive quarter of negative economic growth in the period resulting in the economy entering into a recession. Accordingly, the market witnessed the lowest levels of foreign portfolio and domestic trading activity post the global financial crisis, with a Y-O-Y decline of 69.79% and 56.79% respectively. This trend is consistent with the inverse correlation observed between the value traded on the NSE's equity market and the spread between the parallel and interbank FX market rates suggesting that both domestic and foreign investors seek stability in monetary policy (NSE, 2016). The value of transactions has also witnessed steady growth over the years with observed decline in 2009 and 2016 which could be attributed to the same factors as above.

2.3 Empirical literature

The empirical literature on the nexus between bond market and monetary policy stance is already proliferated with studies targeted area, while a few other studies combined panel of countries without recourse to the specificity of their trading status. The first category includes studies conducted by Ivrendi and Guologlu (2014); Yoshino et al. (2014); Xin (2014); Yang and Hamori (2014); Baig et.al (2015); Pennings et al (2015); Ahmad et.al (2016); Hasan and Zaman (2017); among others. For the second category, Santos et.al (2017); Atis & Deniz (2018); Lee et al. (2020); Tchereni & Mpini (2020); Si et al (2021) are few of the recent studies. While Lee & Lee (2023) assessed the causal linkages among U.S. monetary policy uncertainty (USMPU), equity market volatility, and China's stock price index over the period from January 1994 to August 2021. The study applied Granger causality in quantile analysis. The results of the study indicate that equity market volatility and China's stock price dynamics play little role in affecting USMPU. Altogether, the empirical evidence obtained for these studies showed that all the empirical findings focused on the stock market with only two using the Markov Switching models.

A few other studies conducted in Nigeria include Ajie and Nenbee (2010); Abaenewe & Ndugbu (2012); Babajide and Lawal (2015); Akani et al (2016); Adeniji (2018); Aliyu and Wambai (2018); Lawal et al (2018); Osakwe & Chukwunulu (2019). Posits that monetary policy has a very high determining influence on stock market performance which implies that monetary policy can be used to control stock market activities in Nigeria, Aliyu (2021). What can be infer from most of these studies is that financial market in Nigeria mainly focused on the stock market aspect of the financial market and the methods used were basically VAR, OLS and VECM. Another perceived shortcoming of the studies reviewed is the use of annual data except for a few. However, this study employs monthly and quarterly data.

3. Methodology

The period of investigation for this study spanned 1990Q1 to 2023Q4 Published time series data which give numerical values about the variables under study will be collected from relevant secondary sources which include; National Bureau of Statistics (NBS) publications, Nigeria Stock Exchange (NSE). Publications, World Bank and International Financial Statistics (IFS), and Central Bank of Nigeria (CBN) Annual Reports and Statistical Bulletin (various issues).

Hamilton (1989) Markov-Switching (MS) autoregressive time series models have emerged as an interesting alternative to describe specific features of the business cycle. Consequently, a growing number of empirical works have employed regime switching models in order to capture nonlinearities and asymmetries which are present in many macroeconomic variables (Goodwin, 1993; Boldin, 1996; Krolzig, 1996, Garcia and Perron 1996, Krolzig and Toro, 2000, Kim, Nelson, and Startz 1998).

The basic specification of the Markov Switching model assumes that deviations of dependent variable from its mean follow a p-th order autoregressive process:

$$\begin{aligned} \Delta y_{t} - \mu (s_{t}) &= \alpha_{1} (\Delta y_{t-1} - \mu (s_{t-1})) \\ &+ \dots, \alpha_{2} (\Delta y_{t-p} - \mu (s_{t-p})) + \varepsilon_{t} \end{aligned} \qquad 4 \end{aligned}$$

The errors ε_t is assumed to be independently and identically distributed (iid) with zero mean constant variance σ^2 , while the mean of the process μ dependent on a latent variable s_t . Since the dependence implies that different regimes are associated with different conditional distributions of y_t . The latent variable s_t reflects the state of the business cycle (in the case of two regimes "expansion" and "contraction"). The autoregressive parameters of model (3.1) can be function of the state s_t in the markov chain:

$$\Delta y_t - c (s_t) = \alpha_1(s_t)\Delta y_{t-1} + \dots + \alpha_p(s_t) + \varepsilon_t 5$$

If s_t takes one of the M different values represented by the integers 1, 2. . .M, equation 3.2 represents a mixture of M autoregressive models. In the case of two regimes, model 3.1 describes ''falling'' state for example, if $s_{t=1}$ as well as rising state when $s_{t=2}$ in the y_t variable.

Regime 1 is classified as an economy in recession and can be represented as:

$$\Delta y_t - c_1 (s_t) = \alpha_{11} \Delta y_{t-1} + \dots + \alpha_{p1} \Delta y_{t-p} + \varepsilon_t \qquad 6$$

Regime 2 is classified as an economy in expansion and can be represented as:

$$\Delta y_t - c_2 (s_t) = \alpha_{12} \Delta y_{t-1} + \dots + \alpha_{p2} \Delta y_{t-p} + \varepsilon_t 7$$

The latter process is an ergodic Markov chain with a finite number of states, which is defined by the transition probabilities.

$$\rho_{ij} = \rho_r(s_t=j / s_{t-1}=i), \quad \sum_{i=j}^M \rho_{ij} = 1$$
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For $\forall ij = 1..., M$. More precisely, it is assumed that s_t follows an ergodic M - state markov process with an irreducible transition matrix.

However, constant or fixed transition probabilities are too restrictive to explain stock market performance. Hence, an extension of Hamilton 1989 allows for time-varying transition probabilities as explain by Filardo 1994 and Diebol et al, 1999. The Markov Switching model with time varying transitional probabilities has an advantage over the fixed transition probabilities with respect to flexibility. For example, it can recognize systematic changes in the transition probabilities before and after turning points. It captures more complex temporal persistence and allows for expected duration to vary across time.

The Markov model applied allows for volatility to differ across regimes so that the model can capture the time-varying volatility in stock markets, which is a significant stylized fact in financial markets. In this context Filardo 1994 model is incorporated.

$$P_{i_{j,t}} = P_r[R_t = j/R_t = i, Z_{t-1}]$$

=
$$\frac{exp(\lambda_{i,j,0} + Z'_{t-1}\lambda_{i,j,1})}{1 + exp(\lambda_{i,j,0} + Z'_{t-1}\lambda_{i,j,1})}$$

$$i = 1, 2..., M; j = 1, 2..., M - 1$$

and
 $P_{i,j,m,t} = P_r[R_t = M / R_t = i, Z_{t-1}] = 1 - \sum_{j=1}^{m-1} P_{i,j,t,j} = 1, 2; ..., M$

M is the number of regimes, and R_t is a first-order Markov variable. Z_t is a vector of the economic variables explaining the transition from one regime to the other. The study adapts Filardo (1994), time-varying probabilities to examine the impact of oil price shocks on stock market performance as governed by two different regimes where switches between them are based on a probability process.

Regime 1:

$$P_r\left[R_t = \frac{1}{R_{t-1}} = 1\right] = \frac{exp(\lambda_{10} + \sum_{j=1}^n Z'_{t-1} \lambda_{1j})}{1 + exp(\lambda_{10} + \sum_{j=1}^n Z'_{t-1} \lambda_{1j})}$$
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Regime 2:

$$P_r\left[R_t = \frac{2}{R_{t-1}} = 2\right] = \frac{exp(\lambda_{20} + \sum_{j=1}^n Z'_{t-1} \lambda_{2j})}{1 + exp(\lambda_{20} + \sum_{j=1}^n Z''_{t-1} \lambda_{2j})}$$
11

Where, $P_r[R_t = 1/R_{t-1} = 1]$ is the probability of remaining in low stock performance regime, given that the previous regime is characterized by a low and high stock performance and $P_r[R_t = 2/R_{t-1} = 2]$ represents the probability

of high stock performance regime preceded by a low and high stock performance.

3.1 Markov Switching VAR The model of the study is specified as:

$$TB = \alpha_{0,Rt}^{\circ} + \beta_{1,Rt}^{\circ} IR_{t-1} + \beta_{2,Rt}^{\circ} NEXRATE_{t-1} + \beta_{3,Rt}^{\circ} IIP_{t-1} + \varepsilon_{t,Rt}$$
 12

Where:

 $\begin{array}{l} TB_{t-1} = Treasury \ Bills\\ NEXRATE_{t-1} = Nominal \ Exchange \ Rate\\ IR_{t-1} = Interest \ Rate\\ IIP_{t-1} = Index \ of \ Industrial \ Production\\ R_t = Regime \ at \ time \ t\\ \alpha = Exponential \ Factor\\ \beta = Beta \ coefficient \ for \ explanatory\\ variable \ i \ at \ regime\\ R_t\\ where \ i \ goes \ from \ 1 \ to \ 2\\ \varepsilon_t = Residual \ vector\end{array}$

Treasury bill (T-Bill) is measured as a short-term government debt obligation backed by the government or the CBN with a maturity of one year or less. These securities are widely regarded as low-risk and secure investments. The 3-month Treasury bill will thus be used in this study. Nominal Effective Exchange Rate on the other hand **is** the trade-weighted Nominal Effective Exchange Rate (NEER) indices for Nigeria represent the value of the Naira in terms of a weighted basket of currencies. The weights represent the relative importance of each currency to the Nigerian economy. In other words, it represents the share of each of the selected countries in Nigeria's total trade. Therefore, the NEER index measures the average change of the Naira's exchange rate against all other currencies. Inter interest rate is used as a

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proxy for the monetary policy stance in this study. Industrial Production Index: The Industrial Production Index (IPI) is a monthly economic indicator measuring real output in the manufacturing, mining, electric and gas industries, relative to a base year (2010 for Nigeria).

4. Results and discussion

The result of the descriptive statistics presented in table 1 shows evidence of significant variations as shown by the huge difference between the minimum and maximum values for all variables except for M2 which has lesser variation. The study utilised skewness, kurtosis and Jarque-Bera statistics to test for normality of the data series. The skewness test indicates that some of the variables are negatively skewed while some are positively skewed. The EXRATE is the least skewed among the variables which implies that information in the variables has a long tail in the negative direction. From the kurtosis statistics, the study observed all variables are leptokurtic which portrays the asymmetry of the distribution. Jarque-Bera statistic is the most encompassing normality test which further reinforced the earlier tests by showing that the study can reject the null hypothesis of normality for all the variables because as seen the test statistic for all variables is not close to zero. The average for the variables is greater than the standard deviation except for TBILLS and REALGDP. This indicates that all observations are closer to the mean with the exception of TBILLS and REALGDP. It is important to mention that the descriptive statistics only provides a historical background for the behavior of the time series data as such information obtain cannot be used to make a general inference.

Table 1. Descriptive statistics							
	TB	INTR	EXCHRATE	IPI			
Mean	35.69793	15.56273	95.88996	789075.6			
Median	13.69000	99.84167	99.84167	808961.5			
Maximum	194.2623	30.23000	205.590	2172111			
Minimum	0.306667	7.598570	7.598570	144817.3			
Std.dev	45.72672	57.55625	57.55625	534635.2			
Skeweness	1.7713	-0.000729	-0.000729	0.606660			
Kurtosis	5.300630	2.086669	2.086669	2.716830			
Jarque-bera	95.16476	4.448939	4.448939	8.279084			
Probability	0.00000	0.108125	0.108125	0.015930			

Sources: Authors' Computations

The result of the Markov Regime Switching Vector Autoregressive model is presented in the table below with regimes 1 and 2. In regime 1, the lag of EXR does not significantly affect EXR, but the lag of INTR significantly affects INTR. Also, IPI is significantly affected by its own lag,

likewise TBILLS. In regime 2, the lag of EXR has significant effect on EXR, the lag of INTR and TBILLS significantly affects INTR and TBILLS respectively. However, in regime 2, the lag of IPI has no significant effect on IPI.

	EXR	INTR	IPI	TBILLS
	Regime 1			
EXR	-0.091594	0.039631	0.012600	-0.296773
	0.089911	-0.016370	0.044979***	0.480864*
INTR	0.049874	0.314451***	-0.026513	0.181618
	-0.026418	-0.099722*	-0.034147*	0.172339
IPI	-0.497264	-0.082379	0.331882***	-1.549933
	-0.018609	-0.040726	0.303272***	-0.742943
TBILLS	0.004089	0.005837	-0.001207	0.032541
	-0.031729	-0.004078	-0.004478	-0.191977***
	Regime 2			
EXR	0.266071	-0.022061	-0.196279***	0.040623
	-0.292650*	-0.455660***	-0.122149***	-2.317704***
INTR	3.472016*	4.850983***	0.370991	34.84559***
	2.760051***	2.841508***	0.296267***	9.457741***
IPI	-8.313372	20.87022***	3.114773	241.7897***
	-6.014751	-23.71886***	-2.572213	-258.3308***
TBILLS	-0.311227	-0.530682***	-0.110245***	-1.852058***
	0.022649	0.159866	0.101857***	3.188203***

Table 1. VAR Estimation

Sources: Authors' Computations.

4.1 Transition matrix

The constant Markov transition probabilities for sample 1990Q1 to 2021Q4 is presented below. Note that $P(i,k) = P(s(t)) = k|s(t_{-1} = i)$ Where row = i and column = k

$$P_{ij} = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} = \begin{bmatrix} 0.919250 & 0.080750 \\ 0.646469 & 0.353531 \end{bmatrix}$$

Hence
$$P_{11} = 0.919250, and P_{22} = 0.353531$$

Where; $P_{11} + P_{12} = 1, P_{21} + P_{22} = 1$

Constant expected durations:

Sources: Authors' Computations

The transition probabilities matrix shows the likelihood of transitioning from one state to another. In this case, there are two states, state 1 and state 2. State 1 may represent a low or stable monetary policy stance, while state 2 may represent a high or volatile monetary policy

stance. The rows represent the current state, while the columns represent the next state. The constant transition probabilities indicate that the probability of remaining in the same state is high, with a 0.919250 probability of staying in state 1 and a 0.353531 probability of staying in state 2. The probability of transitioning from state 1 to state 2 is low, with a 0.080750 probability, while the probability of transitioning from state 2 to state 1 is relatively higher, with a 0.646469 probability.

The expected durations indicate the average number of periods that an observation will remain in a particular state before transitioning to the other state. The expected duration for state 1 is 12.38396, meaning that an observation in state 1 is expected to remain in that state for around 12 periods before transitioning to state 2. The expected duration for state 2 is 1.546865, indicating that an observation in state 2 is expected to stay in that state for around 1.5 periods before transitioning to state 1. Overall, this transition probabilities summary suggests that there is a high likelihood of remaining in the same state, with relatively low probabilities of transitioning between the two states. The expected durations provide some information about the timing of these transitions, suggesting that observations in state 1 are likely to remain in that state for longer periods than observations in state 2.

4.2 Markov Switching Smoothed Regime Probabilities

The probabilities indicate the likelihood of each state occurring at each quarter, and the values are smoothed to provide a more stable representation of the state probabilities. From the chart, it can be inferred that State 1 is the dominant state, as it occurs with a probability close to 1 in most quarters. The probability of being in state 1 (P(S(t)=1)) is generally higher than the probability of being in state 2 (P(S(t)=2)) for most of the quarters. In general, the probabilities

appear to be relatively stable over time, except for fluctuations in 1998, 2021 and a sudden drop in 2002.



Sources: Authors' Computations

4.3 Impulse Response Functions

It appears that Regime 1 response of TBILLS to INTR is relatively small and generally positive, although the values are close to zero. This suggests that as interest rates increase (INTR), the yield on Treasury bills (TBILLS) in Regime 1 also tends to increase, but only slightly. For example, when interest rates increase by 1 basis point (0.01%), the yield on TBILLS in Regime 1 increases by approximately 0.0009 basis points on average. However, it's important to note that these values may vary based on other factors and cannot be used as a definitive predictor of TBILLS response to INTR in Regime 1. The Regime 2 response of TBILLS to INTR shows a significantly different pattern compared to the Regime 1 response. In Regime 2, the response of TBILLS to INTR is much larger and can be positive or negative. For example, in period 2, the response is 2.151774, which is much larger than any of the responses in Regime 1. This indicates that in Regime 2, changes in the interest rate have a much greater impact on TBILLS.

Overall, the model suggests that the response of TBILLS to INTR is nonlinear and regimedependent, which underscores the importance of

Regime 1 Response of DLOG(TBILLS) to DLOG(INTR) Cholesky One S.D. (d.f. adjusted) Innovation

Figure 2 Sources: Authors' Computations

4.4. Diagnostic checks

The test for serial correlation and the stability test is presented in table 2 and 3. From the graph above, no root lies outside the unit circle as such the VAR satisfies the stability condition. From the table below, probability is greater than 0.5

Table	2:	Sta	bility	' Test
-------	----	-----	--------	--------

Root	Modulus	
0.841051	0.841051	
0.617565	0.617565	
0.579516	0.579516	
0.239302	0.239302	
0.169797	0.169797	

Q-Stat

14.82565

22.19511

Sources: Authors' Computations

Table 3 Serial Correlation

Lags

1

2

considering the state of the economy when analysing the impact of interest rates on TBILLS.



and the rule states that if probability is less than 0.5 there is serial correlation and if probability is greater than 0.5 there is no serial correlation. Therefore, in this case since probability is greater than 0.5 there is no case of serial correlation.

Inverse Roots of AR Characteristic Polynomial



Prob.*

0.6107

df

25

* test is valid only for lags larger than the VAR lag order. df is degrees of freedom for (approximate) chisquare distribution. Sources: Authors' Computations

Adj Q-Stat

14.94426

22.43258

Prob.*

0.6245

4.5 Discussion of Findings

In alignment with the study's objective which is to examine the reaction of the Nigerian bond market as a component of the financial market to changes in the monetary policy stance. Using the Markov Switching Vector Autoregressive framework, the study analyzed the reaction of bond market to changes in monetary policy stance. The empirical findings suggest that in regime 1, the lag of EXR does not significantly affect EXR, but the lag of INTR significantly affects INTR. Also, IPI is significantly affected by its own lag, likewise TBILLS. In regime 2, the lag of EXR has significant effect on EXR, the lag of INTR and TBILLS significantly affects INTR and TBILLS respectively. However, in regime 2, the lag of IPI has no significant effect on IPI. This is partly in line with the study of Wang et al. (2022), He and Wang (2012).

From the results, it is seen that interest rate shock has significant effect on CPI (inflation) and FEXR (proxy for the derivatives market). This impliedly means that inflation and forwards exchange rate is largely determined by changes in the monetary policy this can further be reinforced through the various monetary policy transmission channels. It has been the tradition of the CBN to concentrate on one channel of transmission of the monetary policy which is the interest rate channel, in effort to further strengthen the impact of the monetary policy into the overall well-being of the financial market other channels of transmission must be utilized. Looking at the results of the transmission mechanism, there is a need for financial innovation so as to improve the financial market which is a viable and important sector for economic growth.

5. Conclusion and recommendation

This study examined the reaction of the Nigerian bond market as a component of the financial market to changes in the monetary policy stance Using Markov Switching Vector Autoregressive model from q1:1990 to 2023:q4. Findings from this study suggest that their a positive connect between interest rate and bond yield in the market, that is, as interest rates increase (INTR), the yield on Treasury bills (TBILLS) in regime 1 also tends to increase, although marginally. In regime 2, the response of TBILLS to INTR is much larger and takes on both signs. Overall, the model suggests that the response of TBILLS to INTR is nonlinear and regime-dependent, which underscores the importance of considering the state of the economy when analysing the impact of interest rates on TBILLS. In line with these findings, it is suggested that regulatory agencies should minimize interventions in the market during crisis, instead allow market forces to even out the fluctuations. Because such interventions calm the volatility within a shorter time thereby not having a lasting effect.

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