



Application of Stochastic Systems on Central Bank of Nigeria Recapitalization Impact: Regime-Switching Analysis

Amadi, Innocent Uchenna^{1*} and Azor Promise Andaowei²

¹Department of Mathematics/ Statistics Captain Elechi Amadi polytechnic, Rumuola Port Harcourt.

²Department of Mathematics/ Statistics, Federal University Otuoke, Bayelsa State.Nigeria.

*Corresponding Author

Amadi, Innocent Uchenna

Article History

Received: 10.03.2026

Accepted: 21.05.2026

Published: 27.06.2026

Abstract: This system extends Geometric Brownian Motion (GBM) to two correlated assets with constant initial prices captures co-movement via correlation. Results show that common shocks create co-movement, while bank-specific components and ρ determine the degree of divergence and systemic risk. Existence and uniqueness of a strong solution is proved using multidimensional SDE theory, yielding explicit solutions for. The system is used to quantify diversification benefits and joint tail risk within the banking sector. This section models the joint future share price dynamics of Access Bank and First Bank using a 2-asset coupled GBM framework. Finally, we present graphical results which represent the behavior of the economic investments and discuss the effect of the relevant parameters.

Keywords: GBM, Correlation, Share Price, Coupled Stochastic Systems, Access Bank and First Bank.

This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/) (CC BY-NC 4.0)

1.1 Introduction

In March 2024, the Central Bank of Nigeria announced a new minimum capital base requirement for commercial banks, triggering a structural shift in the Nigerian banking sector. Such policy directives do not merely change drift or volatility; they create distinct regimes with different risk and return characteristics before and after the announcement. Stochastic systems with regime-switching are well suited to model this behavior because they allow parameters and initial conditions to change at a known or estimated switching time. In the context of CBN recapitalization, the pre-regime reflects market expectations under the old capital rules, while the post-regime captures investor revaluation, capital raising activities, and altered systemic risk. This study applies a coupled multi-asset stochastic differential equation system with piecewise initial conditions to quantify the impact of the recapitalization on major Nigerian banks. The regime-switching framework captures both the

immediate jump effect at and the subsequent evolution under correlated Brownian drivers. The results provide insight into how regulatory policy propagates across banks, how diversification benefits change across regimes, and how risk managers can stress-test portfolios under policy uncertainty.

Though, stock market prices have been examined in a wide manner by many scholars. For instance, [1] studied the stochastic analysis of stock market price model, and result showed that the proposed model is efficient for the production of stock prices. In a similar manner [2] studied the stochastic analysis of stock market expected returns. Their results of comparing the variances of four different stocks indicated that stock1 is the best among the stocks of diverse companies, which is consistent with the work of [3]. Also, [4] considered a stochastic analysis of stock market expected returns and growth-rates. In trying to stochastic model [5] considered the stability analysis of stochastic

Cite this article:

Amadi, I. U., and Andaowei, A. P., (2026). Application of Stochastic Systems on Central Bank of Nigeria Recapitalization Impact: Regime-Switching Analysis. *ISAR Journal of Science and Technology*, 4(6), 41-48.

model for stock market prices and did analysis of the unstable nature of stock market forces applying a new differential equation model that can impact the expected returns of investors. While [6] suggested in their study, some analytical solutions of stochastic differential equations with respect to Martingale processes and discovered that the solutions of some SDEs are related to other stochastic equations with diffusion part. On the other hand, [7] looked at the numerical techniques of solving stochastic differential equations. Their results showed that if the discretization value N is increasing, the Euler-Maruyama and Milstein techniques were closed to exact solution. Also, [8] worked on the stability of both analytical and numerical solutions for non-linear stochastic delay differential equations with jumps and they observed that the compensated stochastic methods inherit stability property of the correct solution. [9] studied the solution of differential equations and stochastic differential equations of time varying investment returns and obtained precise conditions governing asset price returns. The proposed model showed an efficient and reliable multiplicative inverse trend series. As if that is not enough, [10] studied stochastic model of the fluctuations of stock market price and obtained precise conditions for determining the equilibrium price. On the other hand [11] examined the stability behaviors of stochastic differential equations (SDEs) driven by time changed Brownian motions. In another dimension [12] studied stochastic methods in practical delineation of financial models and suggested useful delineation of asset stock price and volatility.

Nevertheless, portfolio managers assume diversification within the banking sector reduces risk. Few studies quantify inter-bank correlation using SDEs for Nigerian Stock Exchange (NSE) but no SDE-based evidence on whether Access and First Bank provides diversification benefits. Finally no existence and uniqueness of solution were considered. The aim of this paper is to model the joint movement of Access and First Bank and assess diversification effectiveness within the banking sector ; which extends the works of [13] and [14] respectively. This novel idea was not considered by the previous efforts.

This paper is prescribed as follows: Section 2.1 presents the mathematical preliminaries, Results and discussion are seen in Section 3.1 and paper is concluded in Section 4.1.

2.1: Mathematical Preliminaries

At this juncture we present few basic definitions as touching this dynamic area of study, hence we have as follows:

Definition 1: Probability space: This is a triple $(\Omega, \mathcal{F}, \mathbb{P})$ where Ω represents a set of sample space, $\mathcal{F}$ represents a collection of subsets of Ω , while $\mathbb{P}$ is the probability measure defined on each event $A \in \mathcal{F}$. The collection $\mathcal{F}$ is

a σ -algebra or σ -field such as $\Omega \in \mathcal{F}$ and $\mathcal{F}$ is closed under the arbitrary unions and finite intersections. Hence it is called probability measure when the following condition holds.

$$(i) \quad P(A) \geq 0 \text{ for all } A \subset \Omega$$

$$(ii) \quad P(\Omega) = 1$$

$$(iii) \quad A, B \subset \Omega, A \cap B = \emptyset \text{ then } P(A \cup B) = P(A) + P(B)$$

Definition 2: A σ -algebra is a set $\mathcal{F}$ of subsets of Ω with the following axioms:

$$(i) \quad \emptyset, \Omega \in \mathcal{F}$$

$$(ii) \quad \text{If } A \in \mathcal{F}, \text{ then } A^c \in \mathcal{F}$$

$$(iii) \quad \text{If } A_1, A_2, \dots \in \mathcal{F}, \text{ then } \bigcup_{k=1}^{\infty} A_k, \bigcap_{k=1}^{\infty} A_k \in \mathcal{F}$$

Clearly $A^c := \Omega - A$ is the complement of A .

Definition 3. Stochastic process: A stochastic process $X(t)$ is a relations of random variables $\{X_t(\gamma), t \in T, \gamma \in \Omega\}$, i.e, for each t in the index set T , $X(t)$ is a random variable. Now we understand t as time and call $X(t)$ the state of the procedure at time t . In view of the fact that a stochastic process is a relation of random variables, its requirement is similar to that for random vectors.

Definition 4. Random Walk: There are different methods to which we can state a stochastic process. Then relating the process in terms of movement of a particle which moves in discrete steps with probabilities from a point $x = a$ to a point $x = b$. A random walk is a stochastic sequence $\{S_n\}$ with $S_0 = 0$, defined by

$$S_n = \sum_{k=1}^n X_k$$

where X_k are independent and identically distributed random variables

Theorem 1.1: (Ito's formula) Let $(\Omega, \mathcal{B}, \mu, \mathcal{F}(\beta))$ represents a filtered probability space $X = \{X, t \geq 0\}$ and an adaptive stochastic process on $(\Omega, \mathcal{B}, \alpha, \mathcal{F}(\beta))$ having a quadratic variation (X) with SDE defined as follows:

$$dX(t) = g(t, X(t))dt + f(t, X(t))dW(t)$$

$t \in \mathfrak{R}$ and for $u = u(t, X(t)) \in C^{1 \times 2}(\Pi \times \square)$

$$du(t, X(t)) = \left\{ \frac{\partial u}{\partial t} + g \frac{\partial u}{\partial x} + \frac{1}{2} f^2 \frac{\partial^2 u}{\partial x^2} \right\} d\tau + f \frac{\partial u}{\partial x} dW(t)$$

Applying theorem 1.1 in equation (3.2.12) solves the SDE with the following solution below:

$$S(t) = S_0 \exp \left\{ \sigma dW(t) + \left(\alpha - \frac{1}{2} \sigma^2 \right) t \right\}, \forall t \in [0, 1]$$

2.1.1 Problem Formulation

Here, we consider a short and long trading period where so many decisions will be faced by investors on how to minimize loss and maximize profit. So, at every time intervals investors receives wages and fully characterized by fluctuations due to the hazards of the environments. Investors' anticipations regarding stock returns and asset valuations will adhere to certain metrics. Hence, we have two-asset correlated constant Geometric Brownian Motion model, the joint dynamics of Access Bank and First Bank market efficiency with constant initial prices.

$$dS_t^{(1)} = \mu_1 S_t^{(1)} dt + \sigma_1 S_t^{(1)} dW_t^{(1)} \quad (1.1)$$

$$dS_t^{(2)} = \mu_2 S_t^{(2)} dt + \sigma_2 S_t^{(2)} dW_t^{(2)} \left(\rho dW_t^{(1)} + \sqrt{1 - \rho^2} dW_t^{(2)} \right) \quad (1.2)$$

$$S_0^{(1)} = A_0, S_0^{(2)} = B_0 \quad (1.3)$$

where $S_0^{(1)}, S_0^{(2)}$ represents independent initial prices of Access and First, μ_1 represents drift coefficient of Access Bank, σ_1 represents volatility coefficient of Access Bank, μ_2 represents drift coefficient of First Bank, σ_2 represents volatility coefficient of First Bank, ρ represents correlation, $W_t^{(1)}, W_t^{(2)}$ represents independent Brownian Motions and t represents time.

2.1.2 Method of Solution

The investment equation consist of a system of variable coefficient problem whose solutions are not trivial. We apply Theorem 1.1 in solving from (1.1), let $f(S_t^{(1)}, t) = \ln S_t^{(1)}$ and taking the partial derivatives yields:

$$\left\{ \frac{\partial f}{\partial S_t^{(1)}} = \frac{1}{S_t^{(1)}}, \frac{\partial^2 f}{\partial S_t^{(1)2}} = -\frac{1}{S_t^{(1)2}}, \frac{\partial f}{\partial t} = 0 \right\} \quad (1.4)$$

According to Ito's theorem gives:

$$df(S_t^{(1)}, t) = \sigma_1 S_t^{(1)} \frac{\partial f}{\partial S_t^{(1)}} dW_t^{(1)} + \left(\mu_1 S_t^{(1)} \frac{\partial f}{\partial S_t^{(1)}} + \frac{1}{2} \sigma_1^2 S_t^{(1)2} \frac{\partial^2 f}{\partial S_t^{(1)2}} \right) dt \quad (1.5)$$

Substituting (1.4) into (1.5) gives the following:

$$df(S_t^{(1)}, t) = \sigma_1 S_t^{(1)} \frac{1}{S_t^{(1)}} dW_t^{(1)} + \left(\mu_1 S_t^{(1)} \frac{1}{S_t^{(1)}} + \frac{1}{2} \sigma_1^2 S_t^{(1)2} \left(-\frac{1}{S_t^{(1)2}} \right) + 0 \right) dt \quad (1.6)$$

simplifying gives

$$= \sigma_1 S_t^{(1)} \frac{S_t^{(1)}}{S_t^{(1)}} dW_t^{(1)} + \left(\mu_1 \frac{S_t^{(1)}}{S_t^{(1)}} - \frac{1}{2} \sigma_1^2 \frac{S_t^{(1)2}}{S_t^{(1)2}} \right) dt \quad (1.7)$$

$$= \sigma_1 S_t^{(1)} dW_t^{(1)} + \left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) dt$$

$$df(S_t^{(1)}, t) = \left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) dt + \sigma_1 dW_t^{(1)} \quad (1.8)$$

Integrating (1.8) from 0 to t gives

$$\int_0^t d \ln S_t^{(1)} = \int_0^t df(S_t^{(1)}, u) = \int_0^t \left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) du + \int_0^t \sigma_1 dW_t^{(1)} du \quad (1.9)$$

$$\ln S_t^{(1)} - \ln S_0^{(1)} = \left(\mu_1 u - \frac{1}{2} \sigma_1^2 u \right) \Big|_0^t + \left(\sigma_1 dW_t^{(1)} u \right) \Big|_0^t$$

$$\ln \left(\frac{S_t^{(1)}}{S_0^{(1)}} \right) = \left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) t + \sigma_1 dW_t^{(1)}$$

Taking the ln of the both sides gives

$$S_t^{(1)} = S_0^{(1)} \exp \left(\left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) t + \sigma_1 dW_t^{(1)} \right) \quad (1.10)$$

This gives the general solution of the SDE. To find the particular solution

$$S_0^{(1)}(t) = A_0, \quad ,$$

$$\Rightarrow S_0^{(1)} \exp \left(\left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) t + \sigma_1 dW_t^{(1)} \right) = A_0$$

$$S_0^{(1)} = A_0$$

$$S_0^{(1)}(t) = A_0 \exp \left(\left(\left(\mu_1 - \frac{1}{2} \sigma_1^2 \right) t + \sigma_1 dW_t^{(1)} \right) \right) \quad (1.11)$$

From (1.2), let $f(S_t^{(2)}, t) = \ln S_t^{(2)}$ and taking the partial derivatives yields:

$$\left\{ \frac{\partial f}{\partial S_t^{(2)}} = \frac{1}{S_t^{(2)}}, \frac{\partial^2 f}{\partial S_t^{(2)2}} = -\frac{1}{S_t^{(2)2}}, \frac{\partial f}{\partial t} = 0 \right\} \quad (1.12)$$

According to Ito's theorem gives:

$$df(S_t^{(2)}, t) = \sigma_2 S_t^{(2)} \frac{\partial f}{\partial S_t^{(2)}} (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t + \left(\mu_2 S_t^{(2)} \frac{\partial f}{\partial S_t^{(2)}} + \frac{1}{2} \sigma_2^2 S_t^{(2)2} \frac{\partial^2 f}{\partial S_t^{(2)2}} \right) dt \quad (1.13)$$

Substituting (1.12) into (1.13) gives the following:

$$df(S_t^{(2)}, t) = \sigma_2 S_t^{(2)} \frac{1}{S_t^{(2)}} (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t + \left(\mu_2 S_t^{(2)} \frac{1}{S_t^{(2)}} + \frac{1}{2} \sigma_2^2 S_t^{(2)2} \left(-\frac{1}{S_t^{(2)2}} \right) + 0 \right) dt \quad (1.14)$$

simplifying (1.14) gives

$$= \sigma_2 S_t^{(2)} \frac{S_t^{(2)}}{S_t^{(2)}} (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t + \left(\mu_2 \frac{S_t^{(2)}}{S_t^{(2)}} - \frac{1}{2} \sigma_2^2 \frac{S_t^{(2)2}}{S_t^{(2)2}} \right) dt \quad (1.15)$$

$$= \sigma_2 S_t^{(2)} (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t + \left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) dt$$

$$df(S_t^{(2)}, t) = \left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) dt + \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t \quad (1.16)$$

Integrating (1.16) from 0 to t gives

$$\int_0^t d \ln S_t^{(2)} = \int_0^t df(S_t, u) = \int_0^t \left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) du + \int_0^t \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) du \quad (1.17)$$

$$\ln S_t^{(2)} - \ln S_0^{(2)} = \left(\mu_2 u - \frac{1}{2} \sigma_2^2 u \right)_0^t + \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) dW_t \Big|_0^t$$

$$\ln \left(\frac{S_t^{(2)}}{S_0^{(2)}} \right) = \left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) t + \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)})$$

Taking the ln of the both sides gives

$$S_t^{(2)} = S_0^{(2)} \exp \left(\left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) t + \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) \right) \quad (1.18)$$

This gives the general solution of the SDE. To find the particular solution

$$S_0^{(2)}(t) = B_0 \Rightarrow S_0^{(2)} \exp \left(\left(\mu_2 - \frac{1}{2} \sigma_2^2 \right) t + \sigma_2 (\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}) \right) = B_0$$

$$S_0^{(2)} = B_0$$

$$S_0^{(2)}(t) = B_0 \exp\left(\left(\mu_2 - \frac{1}{2}\sigma_2^2\right)t + \sigma_2\left(\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}\right)\right) \quad (1.19)$$

Combining (1.11) and (1.19) gives complete solution of the systems

$$S_0^{(1)}(t) = A_0 \exp\left(\left(\mu_1 - \frac{1}{2}\sigma_1^2\right)t + \sigma_1 dW_t^{(1)}\right) \quad (1.20)$$

$$S_0^{(2)}(t) = B_0 \exp\left(\left(\mu_2 - \frac{1}{2}\sigma_2^2\right)t + \sigma_2\left(\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}\right)\right) \quad (1.21)$$

2.1.3 Correlated Constant GBM-Access Bank and First Bank Assumptions

1. $S_t^{(1)}, S_t^{(2)} > 0$ a.s
2. $\mu_1, \mu_2, \sigma_1, \sigma_2 > 0$ $\rho \in (-1, 1)$ constants.
3. $S_0^{(1)} = S_{0,1}^{(1)}$ $S_0^{(2)} = S_{0,2}^{(2)}$ constants.
4. $W_t^{(1)}, W_t^{(2)}$ independent Brownian motions

Theorem 1.2:(Existence and Uniqueness of the solution)

Following assumptions 1-4, therefore, we model the stock.

$$dS_t^{(1)} = \mu_1 S_t^{(1)} dt + \sigma_1 S_t^{(1)} dW_t^{(1)}$$

$$dS_t^{(2)} = \mu_2 S_t^{(2)} dt + \sigma_2 S_t^{(2)} dW_t^{(2)} \left(\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)} \right)$$

with piecewise $S_0(t)$ has unique strong solution.

$$S_t^{(1)}(t) = S_0' \exp\left(\left(\mu_1 - \frac{1}{2}\sigma_1^2\right)t + \sigma_1 dW_t^{(1)}\right)$$

$$S_t^{(2)} = S_0^*(t) \exp\left(\left(\mu_2 - \frac{1}{2}\sigma_2^2\right)t + \sigma_2\left(\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)}\right)\right)$$

Proof: write in vector form $dS_t = \text{diag}(\mu) S_t + \text{diag}(S_t) \Sigma dW_t$

where $\Sigma \Sigma^T$ is the covariance matrix. The functions $a(S) = \text{diag}(\mu) S$ and $b(S) = \text{diag}(S) \Sigma$ are Lipschitz because $\|\text{diag}(x) - \text{diag}(y)\| \leq \|x - y\|$. Positive definiteness of $\Sigma \Sigma^T$ ensures non-degeneracy. Hence existence and uniqueness follows from standard multidimensional SDE theory. On each interval $[0, t]$ and $[t, T]$ the SDE has constant coefficients.

At $t = t$, we define $S_t^{(i)} = S_0, 2^{(i)}$ which ensures continuity of the solution in distribution. For the vector $S_t = (S_t^{(1)}, S_t^{(2)})^T$, the drift vector $a(t, s)$ and diffusion matrix $b(t, s)$ satisfy:

$$\|a(t, s) - a(t, y)\| + \|b(t, x) - b(t, y)\| \leq k \|x - y\|.$$

Thus global Lipschitz holds. By multidimensional SDE theorem, unique strong solution exists.

3.1 Results And Discussion

Analysis of Two-Asset Correlated Constant GBM Model: Models joint movement of Access and First Bank under market efficiency with parameter values.

$$\begin{cases} S_t^{(1)} = S_0^{(1)}(t) \exp\left(\mu_1 - \frac{1}{2}\sigma_1^2\right)t + \sigma_1 W_t \\ S_t^{(2)} = S_0^{(2)}(t) \left(\exp\left(\mu_2 - \frac{1}{2}\sigma_2^2\right)t + \sigma_2 \left(\rho W_t^{(1)} + \sqrt{1-\rho^2} W_t^{(2)} \right) \right) \end{cases}$$

$$S_0^{(1)}(t) = 18, \mu_1 = 0.15, \sigma_1 = 0.30, W_t^{(1)} = 1, t = 1, \mu_2 = 0.12,$$

$$\sigma_2 = 0.25, W_t^{(2)} = W_t^{(1)} = 1, t = 1, \rho = 0.5, S_0^{(2)}(t) = 22$$

$$S_0^{(1)}(t) = A_0 \exp\left(\left(\mu_1 - \frac{1}{2}\sigma_1^2\right)t + \sigma_1 dW_t^{(1)}\right)$$

$$S_0^{(2)}(t) = B_0 \exp\left(\mu_2 - \frac{1}{2}\sigma_2^2\right)t + \sigma_2 \left(\rho dW_t^{(1)} + \sqrt{1-\rho^2} dW_t^{(2)} \right)$$

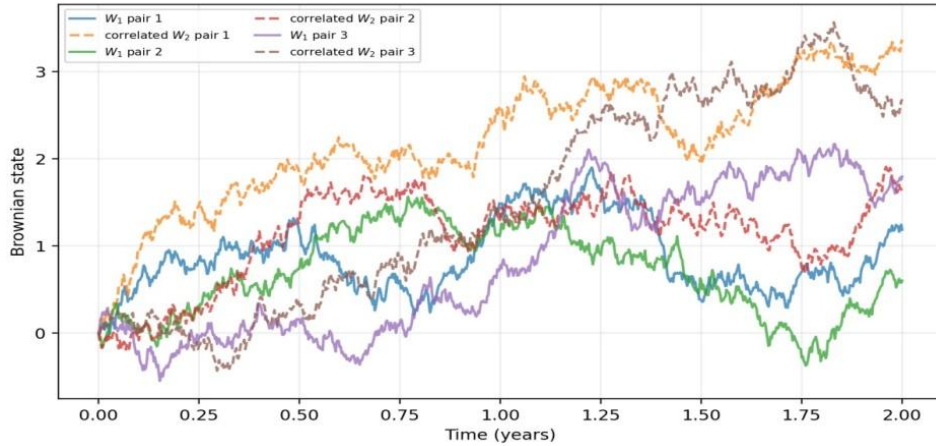


Figure 1: Correlated Brownian drivers for Model .

Figure 1 shows that the second stochastic driver partially follows the direction of the first while retaining an independent component. The two correlated Brownian drivers show moderate co-movement between Access Bank and First Bank share prices. Common shocks are transmitted through the shared Brownian motion component, reflecting

joint exposure to CBN policies and market sentiment. However, the independent component ensures the second price process does not mirror the first exactly. This captures how systemic events link both banks, while bank-specific risks keep their paths distinct.

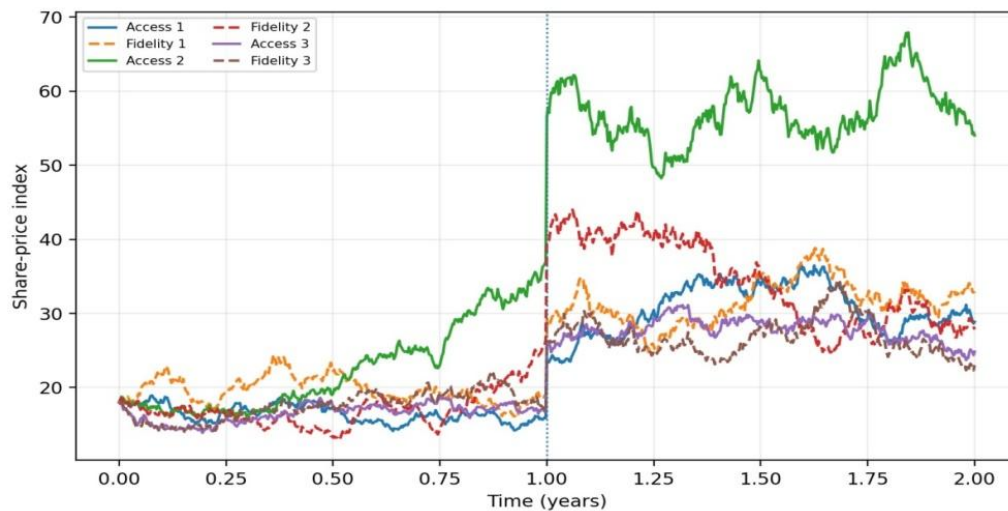


Figure 2: Sample Paths for the Two-Bank Regime Model

The simulated paths in Figure 2, show initial horizontal co-movement for Access1 with First Bank1, and Access2 with First Bank2, indicating joint response to common market factors. Over time, Access Bank 2 diverges and moves horizontally upward, suggesting a positive bank-specific

shock. This implies that while Access and First Bank tend to move together in the short run, idiosyncratic factors can cause divergence later. Thus, portfolio diversification between them is possible despite correlation.

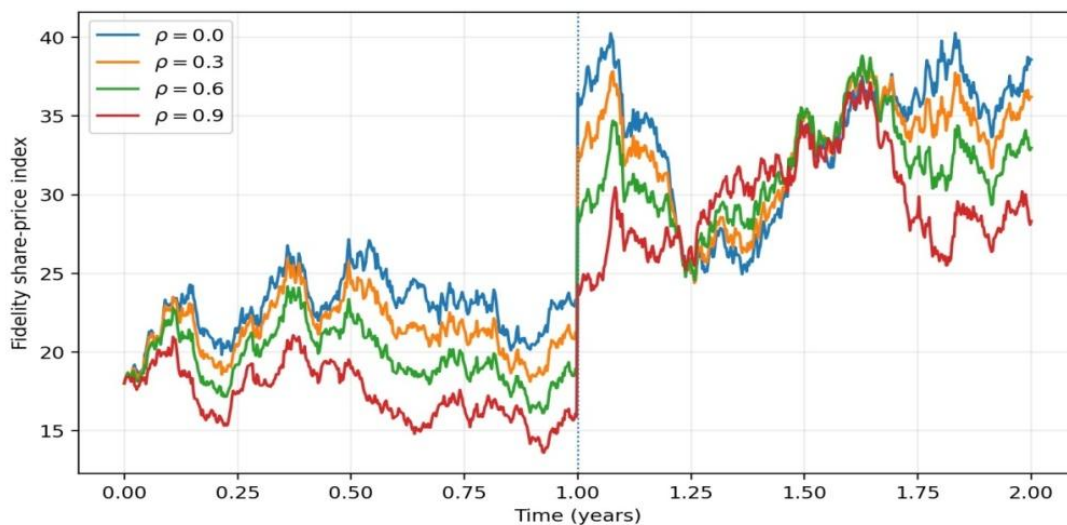


Figure 3: Sensitivity of Model to the Correlation Coefficient.

As can be seen in Figure 3, exhibits a visible level discontinuity around $t = 1$. This jump is not generated endogenously by the diffusion; it comes from the imposed change in the deterministic level from 18 to 27. The result may be interpreted as an intervention-type recapitalization shock.

The sensitivity plot confirms that correlation ρ primarily controls the degree of co-movement between Access Bank and First Bank. As ρ increases, the second asset inherits a larger share of the first Brownian driver, making the price paths more synchronized. When ρ is low, independent shocks dominate and the banks move more separately. This

shows that systemic risk rises with correlation, but reducing ρ through different business exposures can improve diversification benefits. However, a value near zero produces weak instantaneous co-movement, while a value close to one makes the stochastic components move much more similarly.

4.1 Conclusion

Existence and uniqueness under positive definite covariance ensures the model is well-posed. The analysis shows that significantly reduces diversification benefits, with joint declines reflecting exposure to common market factors.

Volatility drag can dominate drift, causing portfolio decay. The conclusion is that intra-sector diversification is insufficient and that sector rotation or options hedging is required. This system provides a quantitative basis for portfolio construction in the NSE banking sector. Finally, in the next study, we shall be looking at three coupled systems of SDEs and its further implications in financial markets.

References

1. Adeosun, M. E, S.O and Ugbebor, O.O (2015). Stochastic Analysis of stock market price model; A case study of the Nigerian stock Exchange (NSE). WSEAS transactions on mathematics.
2. Osu and Amadi (2022). A stochastic Analysis of stock market price fluctuations for capital market. Journal of Applied Mathematics and computation.6(1);85-95
3. Ofomata, A. I. O; Inyama, S.C., Umana, R.A. and Oname, A. (2017). A stochastic model of the dynamic of stock price for forecasting. Journal of Advance in mathematics and computer science. 25(6); 1-24, Articlono: JAMCS;38014,ISSN:2456-9965.
4. Amadi, I.U; Igbudu, R. and Azor, P.A. (2022). Stochastic Analysis of the impact of Growth-Rates on stock market prices in Nigeria. Asian Journal of economics Business and Accounting 21(24):9-21
5. Davis, I., Amadi, I.U. and Ndu, R.I. (2019). Stability Analysis of stochasdtic Model for stochastic Market prices international Journal of Mathematical and computational methods.VOL.4, ISSN:2367-895x
6. Farnoosh, R, Razazadeh, H; Sobhani, A and Behboud, M. (2015). Analytical solutions for stochastic differential equations via Martingale processes. Math sci. 9(2), 87-92.
7. Bayram, M; partal, T. and Buyukoz, G.S. (2018). Numerical Methods for simulation of stochastic differential equations Advanced in difference equations a springerop journal.
8. LI, Q. and GAN, S. (2012). Stability of Analytical and Numerical solutions for Nonlinear stochastic delay differential equations with jumps. Hindawi Publishing corporation abstract and applied analysis VOL.2012, Article ID: 831082.
9. Amadi, I.U. and Anthony, C. (2022). stochastic Analysis Of Asset price Returns for capital market Domain international Journal of Mathematical and statistics studies,VOL.10.NO.3.PP.28-38.S
10. Osu, B .O. (2010) . A stochastic Model of the variation of the capital market price international journal of trade, economics and finance, VOL .1 NO 3. 2010-023X.
11. WU, Q. (2016). Stability of stochastic differential equation with respect to time-changed Brownian motions. Tufts university, department of mathematics, 503 Boston Avenue, Medford,MA .02155,USA,
12. Adewole, Y.O. (2016). A Stochastic formulation for asset stock delineation and interpretation viz Euler Maruyama method. Journal of multi disiplinary Engineering science and technology (JMEST). VOL, 3, issue 7 ISSN:2458-9403.,
13. Nwobi, F.N and Azor, P.A (2022).An Empirical Approach for the variation in Capital Market Price Changes. *International journal of Statistics and Mathematics*, Vol. 8(1), 164-172.
14. Amadi, I.U and Okpoye , O.T (2022). Application of Stochastic Model in Estimation of Stock Return rates in Capital Market Investments. *International journal of Mathematical Analysis and Modelling*, Vol.5 issue 2, 1-14.
15. Higham, D.J. (2004). *An introduction to financial option valuation: Mathematics, Statistics and computation*. Department of Mathematics, University of Strathclyde, Cambridge University Press.
16. Wilmott, P., Howison, S. and Dewynne, .J. (2008). *Mathematics of Financial Derivatives*. Cambridge University press, New York.
17. Hull, J. C. (2012). *Option, Futures and other Derivatives* (eighth Edition). Prentice Hall, Boston Columbus Indianapolis, New York San Francisco.