TEST OF THE GLOSTEN-MILGROM INFORMATION ASYMMETRY MODEL OF MARKET MICROSTRUCTURE IN THE NIGERIAN BANKING SECTOR

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Obomeile Cyril[1]
Okhumaile Selena Idowu[2]
Philip Shakede Sanni[3]
[1]Department of Accounting and Finance,
College of Management and Social Sciences
Glorious Vision University (Formerly Smauel Adegboyega University)
Ogwa, Edo State, Nigeria
Email: cymek2003@yahoo.com
[2]Department of Banking and Finance, School of Financial Studies, Auchi Polytechnic, Auchi, Edo State, Nigeria
[3]Department of Accounting and Finance, Glorious Vision University
Ogwa, Edo State, Nigeria

Abstract

The trading of securities in the stock market is guided by various models used by investors and traders. However, market efficiency is often hindered by factors such as asymmetric information and transaction costs. Price discovery remains a challenge, especially in markets lacking transparency and efficient structures. This study examines the applicability of the Glosten-Milgrom model of market microstructure in the Nigerian banking sector, focusing on how uninformed traders can overcome price discovery challenges. The model was applied to stock prices from thirteen (13) deposit money banks for May 30th and 31st, 2022. The findings reveal that the model accurately predicted stock prices for six (6) banks, challenging the random walk hypothesis. For the remaining seven (7) banks, the model demonstrated that the next day's stock price could be slightly higher or lower than the current day's price. Based on these findings, it is recommended that future research explore the applicability of other market microstructure models to further enhance price discovery and reduce information asymmetry in Nigeria's securities market.

Keywords: Market microstructure, asymmetric information, security price, dealers puzzle, market makers.

Introduction

The increasing focus on market microstructure research is driven by significant structural, technological, and regulatory advancements that continue to reshape global securities markets. Since its introduction by

Garman (1976), market microstructure has remained a critical area of study in economics and finance. At its core, market microstructure seeks to understand how stock markets function, the rules and processes governing securities trading, and the formation of asset prices. Additionally, it addresses challenges posed by asymmetric information between buyers and sellers in dynamic stock market environments. Essentially, it examines the securities exchange process, with market makers playing a vital role in facilitating transactions.

Market microstructure (MM) seeks to explain how pricing information for securities is processed in financial markets, including the regulatory mechanisms that govern these markets. This contrasts with the Efficient Market Hypothesis (EMH) (O'Hara, 1987; O'Hara, 1995; Aigbovo & Osamwonyi, 2018). O'Hara (1995) and Madhavan (2000) challenge the assumptions of EMH, arguing that market frictions prevent prices from fully reflecting all available information. Madhavan (2000), Aigbovo and Osamwonyi (2018), as well as Edewor, Omorose, and Eghosa (2020), suggest that EMH and market microstructure represent two sides of the same coin. While EMH asserts that stock prices incorporate all available market information, MM argues that asset prices may not fully reflect information due to market frictions.

In developing economies like Nigeria, numerous empirical studies have explored how inventory models and information asymmetry models aid investors and market participants in predicting stock prices for the next trading day. Notable studies in this area include Nevmyvaka (2005), Madhavan (2000), Osamwonyi, Igbinosa, and Aigboduwa (2011), Kehinde, Ishmael, and Moruf (2012), Eguavoen (2016), Ogbeide and Umana (2017), Igbinovia (2019), Osifo and Okuwhere (2018), Aigbovo and Osamwonyi (2018), Ogieva and Chijuka (2018), and Kasimu and Igbinadion (2019). However, many studies, including Osamwonyi et al. (2011), Eguavoen (2016), and Aigbovo & Osamwonyi (2018), have primarily applied the Glosten-Milgrom model to securities outside the banking sector, leaving a significant gap in the literature. In developing economies, empirical tests of models that mitigate information asymmetry remain limited, particularly in the banking sector. Addressing this gap is crucial, as asymmetric information continues to drive market frictions across both financial and non-financial sectors in Nigeria.

Given this gap, the present study aims to apply the information asymmetry model within the Nigerian banking sector. Specifically, it seeks to empirically examine the market microstructure model of asymmetric information using stock market data. The goal is to provide insights that can help uninformed investors make more informed and strategic trading decisions.

Market Microstructure

O'Hara (1995) defines market microstructure as the study of the processes and outcomes involved in asset exchanges governed by explicit trading rules. Spulber (1996) offers a broader perspective, describing it as the study of intermediation and exchange institutions. Similarly, Madhavan (2000) characterizes market microstructure as the process through which investors' latent demands are transformed into prices and trading volumes. Asmar and Ahmad (2011) define market microstructure as the study of trading mechanisms and regulations that facilitate trade. Trading mechanisms refer to the methods through which securities are transacted, influenced by factors such as market type, price discovery, order execution, and transparency levels. The National Bureau of Economic Research (NBER) expands on this by defining market microstructure as a field that integrates theoretical, empirical, and experimental research on the economics of security markets. This includes analyzing the role of information in price discovery, measuring and managing liquidity, assessing transaction costs, and evaluating their implications for efficiency, welfare, and market regulation. A key takeaway from these definitions is that market microstructure is fundamentally influenced by trading mechanisms and regulatory frameworks (Aigbovo, Ozekhome, & Isibor, 2017).

Market Regulation and Rules of Procedure

Market regulation encompasses the rules governing securities trading, established by securities markets to oversee various aspects of the trading process. These rules define order priority, tick size, spreads, listing requirements, trading units, price thresholds, trading status, short selling, and off-market trading (Aigbovo et al., 2017). The interaction between investors, brokers, and dealers within an exchange is shaped by these regulations, which also dictate the trading mechanisms in place. Markets establish the sequence in which existing limit orders and dealer quotes are executed against incoming market orders. For instance, some markets prioritize orders offering the best price first, followed by those submitted earlier at the same price. While price priority is a common practice, many markets adjust secondary priority rules to accommodate large transactions. In cases where multiple competing markets operate under distinct procedural rules, uniformity across markets is not required. Under such conditions, price priority typically prevails, as market orders seek the best available price. However, time priority at each price level does not necessarily hold across markets. Harris (1991) highlighted that time priority becomes meaningless when the tick size (the minimum allowable price variation for a security) is very small. Tick size is usually set by the exchange on which a security is

traded and is closely linked to the exchange's regulatory framework and procedural rules.

Market Makers

The role of market makers in the securities market is crucial, as they provide liquidity and facilitate continuous trading by bridging the timing gap between buy and sell orders. Often referred to as suppliers of liquidity, market makers hold a central position in stock trading and price formation (Ogbeide & Umana, 2017; Aigbovo et al., 2017). Market makers are unique in the securities market because they determine the bid-ask spread, making them key liquidity providers. They quote two prices; the bid price, (at which they are willing to buy securities) and the ask price, (at which they are willing to sell securities). The difference between the bid and ask prices represents the market maker's spread, which determines their profit or loss in the trading process (Ogbeide & Osamwonyi, 2021). Under competitive market conditions, the bid-ask spread serves as an appropriate return, compensating market makers for the risk assumed while providing immediate liquidity.

Just as kingmakers influence leadership in communities, market makers shape price determination and liquidity in the securities market. While their role is largely passive, they adjust the bid-ask spread in response to changing market conditions to maintain stability. Market makers operate in two key capacities; as specialists in continuous auction markets, where stocks are quoted and as dealers in the over-the-counter (OTC) market, where stocks are unquoted.

Ultimately, market makers ensure price stability, liquidity, and continuity in stock trading by facilitating transactions when buy and sell orders do not arrive simultaneously. Their commitment to maintaining liquidity makes them indispensable in the securities market, as they help prevent price volatility and ensure smooth market operations.

Market Transparency

Market transparency refers to the ability of market participants to observe and access information about the trading process. Just as electoral observers monitor elections to ensure fairness and credibility, market participants assess transparency in financial markets (Agbadua, Obomeile & Ohiokha, 2022). A market is considered transparent when high-quality and comprehensive information about current and past prices, quotes, market depth, trading volumes, and participant identities is readily available to the public. Transparency ensures that traders can access real-time data on trade execution prices and available quotes. Highly transparent markets provide

extensive information both before and after trades occur, fostering market efficiency, investor confidence, and fair price discovery.

Network Externality Puzzle

Variations in real-world trading systems give rise to the network externality puzzle, which refers to the persistence of market fragmentation despite compelling arguments for market consolidation. Consolidation involves centralizing buyers and sellers within a unified market structure, allowing them to execute trades at a common bid-ask price.

However, the network externality puzzle emerges because different markets remain disconnected, failing to share price quotes and order flow information. This lack of integration leads to inefficiencies, preventing optimal price discovery and market transparency (Aigbovo et al., 2017).

Anonymity and Trader Identity

Anonymity and trader identity are key aspects of market transparency. While some traders prefer to remain anonymous, others seek recognition depending on their trading strategies and market roles. For instance, dealers often prefer identifiability to establish and maintain their market reputation. In contrast, institutional investors, who typically possess superior information, opt for anonymity to avoid influencing price movements that could negatively impact their trading positions (Aigbovo et al., 2017).

Sunshine Trading

Sunshine trading is a market microstructure concept where traders disclose pending orders in advance. Liquidity traders who preannounce their order sizes can benefit from lower trading costs, as transparency can attract counterparties and reduce price impact. Conversely, traders who cannot preannounce their orders often face higher trading costs due to adverse selection, as market participants may adjust prices based on anticipated order flow, leading to less favorable execution prices.

The Dealer Puzzle

In every market, especially continuous markets, dealers serve a crucial role in bringing buyers and sellers together for intermediation. In limit order markets, where trades occur either with designated dealers or without intermediaries, the dealer puzzle arises when the presence of dealers influences market efficiency.

Similarly, in exchange markets, the dealer puzzle exists when market makers are relied upon as intermediaries instead of traditional dealers. Since market makers significantly impact price formation and discovery, their

engagement in trading can affect security pricing, liquidity, and overall market dynamics in various ways.

Asset Price Formation and Discovery

A defining feature of a continuous market is the presence of bid and ask prices, which determine the levels at which trades occur. The bid price represents the amount a buyer is willing to pay for a financial asset, while the ask price is the amount a seller is willing to accept. This can be viewed as the cost paid to a dealer or market maker for assuming an unwanted position and efficiently disposing of it. The bid-ask spread is the difference between the bid and ask prices set by a dealer or market maker (Ogbeide & Osamwonyi, 2021). This spread reflects the cost of trading, market liquidity, and transaction costs. A wider spread typically indicates higher trading costs and lower liquidity, whereas a narrower spread suggests lower costs and higher liquidity. The bid-asks spread serves as compensation to dealers or market makers for providing liquidity and absorbing risk. Market illiquidity can be measured by the time required to complete a trade at an optimal price. The spread varies across asset classes—while it is narrow for actively traded stocks, it tends to be wider in less liquid markets, such as real estate (Aigbovo et al., 2017; Edewor et al., 2020). A central issue in market microstructure research is identifying the determinants of bid-ask spreads and explaining why they vary across different securities and market conditions.

Determinants of the Bid-Ask Spread and the Glosten-Milgrom Model

Security value is generally assumed to consist of two components: private value and common value. Private values are unique to individual investors and are typically known to them when making trading decisions. In contrast, common values are the same for all market participants but are only realized after a trade has occurred. The common value component reflects the securities expected cash flows, often represented by the present value of these cash flows or its resale value. On the other hand, the private value component arises from differences in factors such as investment horizon, risk exposure, financial endowments, and tax considerations.

The bid-ask spread is influenced by several factors, including order handling costs, noncompetitive pricing, inventory risk, options, and asymmetric information. These factors are not mutually exclusive and can coexist within the market. As liquidity providers, dealers who ensure market continuity incur order handling costs, which cover labor and capital expenses associated with providing quote information, order routing, execution, and clearing. Additionally, suppliers of immediacy (those who

buy at the bid price or sell at the ask price) take on inventory risk, for which they must be adequately compensated.

Placing a bid or an ask grants the rest of the market an option to trade based on new information before the bid or ask can be adjusted to reflect that information. This necessitates a deviation from the consensus price to account for the cost of such an option. When asymmetric information exists, some investors are better informed than others. The person placing a firm quote for a bid or ask is at a disadvantage compared to investors with superior information. Informed investors will sell at the bid if they possess information suggesting a lower future price, and they will buy at the ask if they have information indicating a higher future price. In the Nigerian Exchange Group (NGX), the bid-ask spread is currently capped at a maximum of 5% (Osamwonyi et al., 2011).

The bid-ask spread can be determined using the Glosten-Milgrom model. This model illustrates the spread by assuming that an asset can have one of two possible values: a high value (V^H) or a low value (V^L), each occurring with equal probability. Informed investors, who know the asset's true value, are present with probability π. Assuming risk neutrality; informed investors assign a value to the asset based on its actual worth at: $A = (V^H + V^L)/2$. The ask price A is then the expected value of the asset conditional on trade at the ask price: $A = V^H\pi + A(1-\pi)$. The bid is: $B_F = V^L\pi + A(1-\pi)$. Since informed investors trade at the ask price or bid price only if they believe the asset value is $V^H(V^L)$, the ask price exceeds the bid price. The bid-ask spread, is given by $A - B = \pi(V^H - V^L)$. Where: V^H= the high value of an asset; V^L = the low value of the same asset and π = probability of informed investors' presence.

The bid-ask spread depends on the probability of encountering an informed trader and the degree of uncertainty regarding the asset's value. Glosten and Milgrom demonstrate that prices evolve over time as a martingale, incorporating the information revealed by each trade. However, their model does not fully address the speed at which prices converge to informational efficiency.

Models commonly used in Testing Market Microstructure

A model is a formalized way of doing things under specific assumptions which must not be violated (Osamwonyi et, al, 2011). There are two principal models of market microstructure testing. These are the inventory model and asymmetric information model.

Inventory Model

In the inventory model, the trading process functions as a matching problem, where market makers manage imbalanced risk by adjusting prices

to balance supply and demand over time. The key factors influencing this process are the market maker's inventory position and the uncertainty surrounding order flow. Market makers achieve inventory control by adjusting their bid and ask quotes to address imbalances in buy and sell orders.

Theoretical examinations of inventory models were first conducted by Garman (1976), Stoll (1978), Amihud and Mendelson (1980), and Ho and Stoll (1981). Additionally, Roll (1984), Hasbrouck (1991), Huang and Stoll (1997), and Madhavan, Richardson, and Roomans (1997) have applied the inventory model to analyze the time-series behavior of prices and quotes.

Asymmetric Information Models

The asymmetric information model primarily concerns the interaction between informed and uninformed traders in the pricing of securities. It aims to provide market participants with transparent pricing information. Several researchers have tested variations of the information asymmetry model, with each adaptation being named after its developers. Notable examples include the Copeland and Galai (1983) model, the Glosten-Milgrom (1985) model, the Easley-O'Hara (1987) model, and the O'Hara (2003) model. Each of these models has distinct characteristics in the context of security price trading.

For instance, Glosten and Milgrom (1985) expanded upon the Copeland and Galai (1983) model of asymmetric information. According to the Glosten-Milgrom model, dealers and uninformed investors determine the correct price by observing the order flow. This model enables investors to anticipate the next day's price, thereby significantly reducing the degree of asymmetric information. The ultimate goal is to enhance market liquidity and minimize transaction costs.

Research Methodology

This study adopted exploratory and ex-post facto research designs. Data on the daily share prices of deposit money banks were obtained from the Cashcraft Nigeria Limited website for April 2022 to facilitate empirical testing. The Glosten-Milgrom information asymmetry model was adapted to examine price formation and the price discovery process in the stock market. This model removes the pains of the uninformed (ignorant) traders in the price discovery process in the market, and contributes to order flow and market transparency (Ogbeide & Umana, 2017). The Glosten-Milgrom information asymmetry model assumes that an asset can take on two possible values, namely, a high value (V^H) and a low value (V^L), with equal probability. Informed investors who know the correct value are presented

with probability π. Assuming risk neutrality, informed investors value the asset at;

$$A = \frac{V_H + V_L}{2}$$

Where;

- $A = V_{\pi}^{H} + a(1-\pi) = ask\ price$
- $B = V_{\pi}^{L} + a(1-\pi) = bid\ price$

The bid price model shows how the informed traders can buy stocks only if they believe the asset value is $V^H + V^L$. This is also similar to the ask price model. The investor can only have a fore knowledge of the next day price in the stock market through the bid – ask-spread price model express as:

$$A - B = \pi(V^H - V^L)$$

Where;

V^H = the high value of an asset

V^L = the low value of the same asset

π = probability of informed investors.

The model enables investors to gain prior knowledge of stock prices for deposit money banks, thereby reducing information asymmetry between buyers and sellers. Its effectiveness depends on the probability of encountering an informed trader and the degree of asset value uncertainty. However, while the model offers a means of anticipating market movements, it does not fully address the speed at which prices achieve informational efficiency. To test its ability to reduce information asymmetry, the probability of informed investors in the market is set at 50%, following the approach of Ogbeide & Umana (2017). This helps determine the likelihood of an investor predicting the next day's stock price. To experiment with this, the population of the study consisted of the listed deposit money banks in Nigeria. A sample of thirty (13) banks were selected in the study using simple random sampling method. These banks have readily available stock market data, making them practical choices for empirical analysis. The analysis utilized the high and low stock prices from two consecutive trading days, May 30th and May 31st, 2022. By analyzing price changes over two trading days, the study can evaluate the extent to which past prices influence future prices, aligning with the Glosten-Milgrom model.

Selected Deposit Money Banks

S/n	Banks
1	Access Bank Plc
2	Fidelity Bank Plc
3	First Bank of Nigeria Plc
4	First City Monument Bank Plc
5	Guarantee Trust Bank Plc
6	Jaiz Bank Plc
7	Stanbic IBTC Bank Plc
8	Sterling Bank Plc
9	Union Bank of Nigeria Plc
10	United Bank for Africa Plc
11	Unity Bank Plc
12	Wema Bank Plc
13	Zenith Bank Plc

Sources: Researchers Compilation, (2025)

Empirical Analysis

In this section, the data collected are analyzed using the Glosten-Milgrom information asymmetry model as described earlier. This analysis provides insights for investors and retail traders on how to stay informed about security prices in the market and mitigate the adverse effects of information asymmetry during transactions. The analysis is outlined below:

Table 1: Testing the Glosten-Milgrom Information Asymmetry Model on Stock Prices of Deposit Money Banks in Nigeria

S/N	Company	$\pi(v^H - v^L)$	$v^L - \pi(v^H - v^L)$	Predicted price
1	First Bank of Nigeria plc	0.50 (₦11.90-₦11.25) = ₦0.32K	₦11.25k – ₦0.32k = ₦10.93	₦10.93k
2	Union Bank of Nigeria Plc	0.50(6.25 – 6.25) =0.00	6.25-0.00= 6.25	6.25
3	Zenith Bank Plc	0.50(23.80 – 23.45)= 0.18	23.90-0.18= 23.90	23.72
4	Fidelity Bank Plc	0.50(3.40 – 3.25) = 0.08	3.45- 0.08= 3.37	3.37
5	Access Bank Plc	0.50(5.16 – 4.80) = 0.00	3.52 – 0.00= 3.52	3.52

6	First City Monument Bank Plc	0.50(3.50 – 3.50) = ₦0.00	₦0.00 - ₦0.00 = ₦0.00k	₦0.00k
7	Guaranteed Trust Bank Plc	0.50(23.90 – 22.55) = ₦0.01	23.20 – 0.68 = 22.52	₦22.52
8	United Bank for Africa Plc	0.50(7.95 – 7.75) = 0.10k	7.95 – 7.75= 0.20	0.20
9	Stanbic IBTC Bank Plc	0.50(34.00 – 33.50) = ₦0.25	₦33.50 - ₦0.25 = ₦33.25k	₦33.25k
10	Unity Bank Plc	0.50(22.55 – 22.55) = ₦0.00	22.55– 0.00 = 22.55	₦22.55
11	Sterling Bank Plc	0.50(1.51- 1.42) = 0.05k	₦1.42 - ₦0.05 = ₦1.37k	₦1.37k
12.	Jaiz Bank Plc	0.50(1.05 – 0.98) = 0.04	₦1.05 - ₦0.04 = ₦1.01k	₦1.01k
13.	Wema Bank Plc	0.50(0.90 – 0.82) = 0.04k	₦0.82- ₦0.04 = ₦0.78k	₦0.78k

SOURCE: Authors computation 2025

The analysis from the table above indicates that banks' stock prices exhibited a random walk movement between May 30th and 31st, 2022. This suggests that the stock price trend over the past two to four days provides useful insights into the expected price for the current or next trading day. Consequently, past stock prices serve as a valuable tool for predicting future prices. For example, if the closing prices of Zenith Bank PLC over successive days on the Nigerian exchange group were **₦43, ₦44, ₦45, ₦46, and ₦47,** the **random walk theory** suggests that the next day's closing price is more likely to be **₦48 than ₦46**. In essence, stock prices approximate a random walk, resembling the unpredictable movements of a drunkard, as they fluctuate without a clearly defined pattern. Since the next day's stock price remains uncertain due to information asymmetry, investors can mitigate this uncertainty by applying the Glosten-Milgrom model of information asymmetry.

The analysis in the table above suggests that an uninformed investor can reasonably estimate tomorrow's stock price by comparing the closing stock prices of May 30th and May 31st, 2022. If the previous day's closing price closely aligns with today's price, it reduces the information asymmetry experienced by investors in the stock market. In other words, investors can predict the next day's stock price based on today's closing price using the

Glosten-Milgrom model of information asymmetry. By applying this model, the next day's stock prices for Union Bank Plc, Zenith Bank Plc, Fidelity Bank Plc, GT Bank Plc, Stanbic IBTC Bank Plc, and Sterling Bank Plc were successfully predicted. This implies that investors could further predict the stock price for June 1st, 2022, using the closing stock price of May 31st, 2022, demonstrating the model's potential in stock price forecasting.

By utilizing this model, today's closing stock price can be used to estimate tomorrow's price with a higher degree of accuracy, thereby challenging the widely accepted random walk theory proposed by Eugene Fama. This finding challenges the strict interpretation of the random walk theory by implying that information asymmetry can lead to predictable stock price movements, at least in the short term. This study contributes to the literature by bridging the gap between the random walk theory and information asymmetry models. It also provides empirical evidence from Nigeria's stock market, a developing economy where market inefficiencies and frictions may lead to deviations from pure randomness. The findings suggest that if informed investors can leverage past stock prices to predict future prices, thereby challenging the strict Efficient Market Hypothesis (EMH), then short-term trading strategies such as momentum trading may be effective. Additionally, the results indicate that the Nigerian stock market may not be fully efficient, as price movements partially reflect historical trends, creating opportunities for arbitrage. Lastly, investors can apply the Glosten-Milgrom model to mitigate information asymmetry in stock trading, enabling them to make more informed and risk-adjusted decisions.

However, it is important to note that while the model provides insights into potential stock price movements, it should not be considered a benchmark for consistently outperforming the market, as the stock market inherently exhibits random walk behavior. This is so because the stock market at all times always exhibit a random walk movement. The model is not a source of market prophecy to investors. With the model, the investors are informed that the next day's stock price could be priced high or low but, but cannot be exactly predicted with precision even though it looks like having it so. Additionally, the analyses above point out that it is quite difficult to arbitrarily fix of stock prices in the stock market. It also shows the propensity for insider trading and other trade manipulation to be easily detected in the financial market so as to restore investors' confidence. With the above results, investors can meaningfully predict what price expectation will look like in the market and thus promote efficiency in the market.

Conclusion and Recommendations

The literature suggests that detecting and quantifying information asymmetry in financial markets is a complex challenge. Since information

asymmetry allows one party to possess superior knowledge over another, often leading to adverse selection, it is crucial to explore ways to mitigate this issue. One possible approach is enabling uninformed investors to anticipate stock prices by leveraging prior day prices as a guide for forecasting future prices.

To illustrate this concept, this study adopts the Glosten and Milgrom (1985) model of information asymmetry, which provides a framework for understanding how price formation occurs in markets with asymmetric information. The findings suggest that the Glosten-Milgrom model of information asymmetry can help uninformed investors and traders predict stock prices, providing them with some foreknowledge of the next day's prices in the Nigerian stock market with a degree of precision. While the model reflects elements of the random walk theory, it also minimizes the impact of asymmetric information in the market. Notably, the model accurately timed the next day's stock prices for six deposit money banks in the Nigerian Stock Market, demonstrating a significant probability of predicting stock prices based on prior-day data. This underscores the model's ability to mitigate the adverse effects of information asymmetry on traders and investors. As Karlan and Zinman (2008) highlight, while information asymmetry is significant in theory, its identification and quantification remain difficult, particularly in emerging markets.

This study has made a significant contribution to knowledge by demonstrating how uninformed investors in the Nigerian stock market can gain insights and anticipate next day's stock prices, albeit with slight variations from prior prices. It stands out as one of the few empirical studies that examine how uninformed investors or traders can be assisted in predicting stock prices, allowing them to better time the market and potentially profit from price movements in the Nigerian banking sector. Since this study has made a significant contribution to price formation and discovery in the financial market, it is recommended that future researchers test the Glosten-Milgrom model in other sectors of the Nigerian economy. Additionally, future studies should explore the applicability of alternative models to further enhance price discovery and mitigate information asymmetry in the securities market.

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