Non-monotonicity of risk-expected return trade-off in pricing of equity securities: the case of premium board of Nigerian Stock Exchange

Peter Ngozi Amah
Department of Finance, Faculty of Management Sciences, University of Lagos, Akoka Yaba, Nigeria

Received 28 February 2023
Revised 4 April 2023
1 August 2023
26 September 2023
12 December 2023
Accepted 2 January 2024

Abstract

Purpose – A stylized fact in finance literature is the belief in positive relationship between *ex ante* return and risk. Hence, a rational investor, by utility preference axiom can only consider committing fund in asset which promises commensurate higher return for higher risk. Questions have been asked as to whether this holds true across securities, sectors and markets. Empirical evidence appears less convincing, especially in developing markets. Accordingly, the author investigates the nature of reward for taking risk in the Nigerian Capital Market within the context of individual assets and markets.

Design/methodology/approach – The author employed *ex post* design to collect weekly stock prices of firms listed on the Premium Board of Nigerian Stock Exchange for period 2014–2022 to attempt to answer research questions. Data were analyzed using a unique M Vec TGarch-in-Mean model considered to be robust in handling many assets, and hence portfolio management.

Findings – The study found that idea of risk-expected return trade-off is perhaps more general than as depicted by traditional finance literature. The regression revealed that conditional variance and covariance risks reveal minimal or no differences in sign and sizes of coefficients. However, standard errors were also found to be large suggesting somewhat inconclusive evidence of existence of defined incentive structure for taking additional risk in the market.

Originality/value – In terms of choice of methodology and outcomes, this research adds substantial value to body of knowledge. The adapted multivariate model used in this paper is a rare approach especially for management of portfolios in developing markets. Remarkably, the research found empirical evidence that positive risk-expected return trade-off, as known in mainstream literature, is not supported especially using a typical developing country data.

Keywords Risk-return, Trade-off, Conditional variance, Conditional covariance, Random walk, Equity pricing

Paper type Research paper

1. Introduction

The traditional view on preference ordering framework in the capital market is founded on the belief of investor rationality and one key expectation here, which is taken as fundamental to finance theory, is the positive relationship between the first and second moments of returns distribution. Notwithstanding that this framework, rooted in the landmark works of Markowitz (1952), Sharpe (1963, 1964), Lintner (1965), and Fama (1965) among others have shaped the way finance people think, emerging empirical evidence appears to question the monotonous belief of positive risk-expected return trade-off in traditional literature of asset pricing.

IIMBG Journal of Sustainable Business and Innovation
Vol. 2 No. 1, 2024
pp. 43-59
Emerald Publishing Limited
2753-4022
DOI 10.1108/IJSBI-02-2023-0003

Several recent studies have come up with findings that appear to suggest that investors do not necessarily demand positive premium in other to assume higher risk in the market (Amah, 2011; Hong, Nguyen, Pham, Truong, & Cong Nguyen, 2019; Liu, Su, Wang, & Yu, 2021; Jo, Chen & Yang, 2023; Cotter & Salvador, 2022; Zhao & Wen, 2022). While a number of authors found robust negative pay-off in the relationship (Zhao & Wen, 2022; Jo, Chen, & Yang, 2023), others found that nature of relationship between the variables is conditional on time, portfolio approach, risk proxy used for investigation, asset classes and sector (Amah, 2011; Liu *et al.*, 2021; Lee, Lee, & Kim, 2022; Cotter & Salvador, 2022; Shivaprasad, Geetha, Raghavendra, Kishore, & Matha, 2022). Certain issues and inconsistencies are very obvious from these studies and the research findings. Firstly, the belief in the monotonous positive trade-off between risk and expected return as widely held in the traditional literature cannot be sustained. Secondly, the explanations offered by authors for inconsistency in the research results are perhaps equally as varied as the contradictory findings. However, we can conveniently summarize them into methodological issues and specific notions of risk in the preference ordering framework, out of which certain research gaps have been identified. On the former, most of the studies were either carried out with univariate model specifications or based on implicit assumption of random walk process of price formation. The variance of return residuals in most price process is now known to be variable or heteroskedastic (Engle, 1982). This introduces non-linearity in models of asset pricing rendering any such specifications defective for analysis. Hence, any study that purports to show a certain risk-return trade-off without accounting for heteroskedasticity in the return generating process needs some re-consideration. Also, just a few of the cited studies used measures of risk that incorporates influences of many assets (Barroso & Maio, 2023; Zhao & Wen, 2022; Amah, 2011). Univariate analysis has limited practical appeal for portfolio management since investors and fund managers rarely invest in just one asset. Finally, asset pricing literature is replete with empirical studies of most advanced markets and Asian economies. Studies based in developing markets of sub-Sahara Africa appear scanty. With increasing global importance of these markets, understanding their risk-return behavior is a critical gap that needs to be filled. This paper is designed to help fill these gaps and contribute to the body of knowledge.

Theoretically, it implies a distortion of what is generally known about random walk of the price process and hence, the preference ordering framework; and practically, it leads economic agents to make counter-intuitive asset allocation decisions that throw up prices of doubtful signal to potential investors in the market. This discourages flow of investments into the market.

For markets that desire new investments, particularly developing markets, the state of play requires some more clarity beyond what is available in contemporary literature.

More research effort is therefore required to de-construct the theoretical and empirical question of relationship between the variables for informed policy choices and practical portfolio management in these markets. More precisely, research is required to answer the question of whether investors typically receive positive payoff for taking higher risk in the market.

1.1 Research objectives

In view of the empirical anomalies, a critical opening has been created in the body of knowledge for re-examination of regularity of positive risk/expected return trade-off. Accordingly, the broad goal of this paper is to investigate what appears to be a stylized fact that an investor will receive higher reward for taking higher risk using Nigerian data. In specific terms, the study objectives are to:

(1) Determine the nature of trade-off relations between the measure of conditional variance risk and expected return;

(2) Determine the nature of pay-off between conditional covariance risk and expected return and

(3) Establish whether differences exist in the nature of the above trade-off relations among economic sectors.

To achieve these objectives, a more robust model framework that incorporates stylized patterns of price volatility, Multivariate Vec Garch, will be used to analyze data collected for the period 2014 to 2022.

1.2 Outline of the paper

The rest of the paper is organized as follows; in section two, the authors briefly examine relevant literature on different mean-variance models analyzed within random walk and heteroskedasticity frameworks with empirical evidence. Section three outlines methodological issues including sample design, model specification, data diagnostics and methods of analysis. In section four, the authors present data and analysis of results, including discussion of findings, while section five contains conclusion, policy implications and recommendations.

2. Literature review

In the literature of asset pricing, there exists numerous specifications of return generating process, with each model dwelling essentially on the key risk factors or forms that motivate changes in price.

Two clearly discernible model frameworks, the Random Walk (RW) and Auto-Regressive Conditional Heteroskedasticity (ARCH) theories are reviewed in this study. The conceptual specification used is however based on the multivariate variant of auto-regressive conditional heteroskedasticity to explain risk/expected return tradeoff in a portfolio environment. However, we consider a clear understanding of random walk theory necessary for proper interpretation of the results.

2.1 The random walk theory

An economic time series is said to follow a random walk (RW) process if successive changes in the random variable assume irregular pattern and conforms to a Brownian motion process (Osborne, 1959). The framework is used to represent the environment for theories of financial time series behavior in which expectations of residuals can be modeled in the following dynamics:

(1) $E(Y_{i,t+1}|\Omega_t) \approx E(Y_{i,t+1})$, conditional expectation of variable, Y. is equivalent to its un-conditional expectation.

(2) $E(\varepsilon) = 0$, expected value of stochastic term is zero

(3) $E(\varepsilon_i^2) = \varepsilon^2$, variance of the stochastic variable is constant or homoscedastic.

(4) $E(\varepsilon_t \varepsilon_{t+1}) = 0$, auto-correlation of stochastic terms is zero.

These are powerful concepts that motivated most of the market equilibrium theories and dominated what has come to be regarded as normative framework of market behavior. The basic idea of independence of successive changes of random error variable implies that no easily identifiable patterns can be observed in the financial time series.

The implication of RW theory is that merely analyzing historical trend in the random variable cannot be a sufficient guide to understand and predict future behavior. On the other hand, technical analysis is rendered useless as a portfolio approach. If the Random Walk process holds, it implicitly means that all relevant information are fully and instantaneously compounded in the market prices and the market, by definition, is efficient. Such a market is expected to be operationally and allocationally efficient.

It should be noted that the more in-efficient a market is, the greater the departure of prices thrown up by such a market from random walk. The idea behind efficient market theory is the speed at which the market processes the relevant information, reflects them on prices, and reverts to equilibrium. In a perfect market, this process is instantaneous, thereby, making it possible for prices to conform to random walk. Following this, a number of equilibrium models of return emerged in finance literature to explain and predict behavior of risk and return in the market.

The dominant, normative preference ordering framework may be captured under the traditional mean-variance choice criteria associated with Markowitz (1952), Sharpe (1964) and Lintner (1965) among others exemplified in this paper by what is arguably the key asset pricing model in finance –the Capital Asset Pricing Model. This framework, from which virtually all subsequent theories were derived, boils down to the thinking that an individual's decision to arrange his consumption plan is exclusively spanned in the return-risk space represented by mean return and non-diversifiable variant of risk.

2.1.1 The capital asset pricing model (CAPM). The CAPM is a logical out-growth of the mean-variance paradigm of Markowitz (1952, 1959) and Sharpe (1963) which has grown to be the most popular but controversial price generating dynamics in finance. An extension of the market model, it is generally credited to Sharpe (1964), Lintner (1965) and Mossin (1966). The model states that equilibrium return expected on a security is a linear function of its systematic risk or beta, measured by the standardized covariance between the security and market returns. In other words, asset risk premium depends, not on the total risk of the asset, but rather on the relationship of the asset to the overall market. This would appear to provide the right perspective to the portfolio problem faced by investors who typically invest in more than one asset.

$$E\,(R_i) = R_f + \{(E\,(R_m) - R_f\}\beta_i \tag{1}$$

where $E(R_i)$ = Expected security return

R_f = Risk free return

$E(R_m)$ = Expected market index return.

β_i = Beta of the security.

Conceptually this model implies that, in equilibrium, every asset must be priced to lie along the linear upward sloping curve with intercept, R_f, and slope, $E(R_m) - R_f$. The beta, expressed as σ_{im}/σ_m^2, therefore measures the quantity of risk that is priced by the market, where σ_{im} is covariance between asset and market returns while σ_m^2 is variance of market return. This is the only risk the investor would be expected to be rewarded for, or pay to avoid in the market. It is recognized as the non-diversifiable contribution to security riskiness and would determine the appropriate risk-return trade-off. If the market risk premium increases, it implies greater risk aversion in which case investors demand higher returns for a unit of systematic risk. CAPM implies that in tests of asset pricing, total variance is expected to lack significance. This will also be the case with all risk factors unique to the firm. Criticisms of CAPM center largely on reality of the assumptions and anomalous evidence. Perhaps the most profound criticism of CAPM came from Roll (1977). Richard Roll literally wrote off the model, dismissed all previous tests and believes no valid test based on it is even possible in the future. Basically, Roll doubted the identification condition of the market portfolio upon which beta is derived in terms of composition and observability. Some other studies have also challenged the model's intuition with a number of anomalous findings related to size effects, market to book effects, momentum effects and "own variance effects" (Friend, Westerfield, & Granito, 1978; Miller & Scholes, 1972; Banz, 1981; Basu, 1983; De Bondt & Thaler, 1985; Schwert & Seguin, 1990; Fama & French, 1988; Jegadeesh & Titman, 1993; Iyiegbuniwe, 1998; Agha, 2002; Dechow, Hutton, Meulbroek, & Sloan, 2001; Amah, 2008).

Notwithstanding the enormity of the criticisms, it must be pointed out that the model attracted strong support from the early works of Black, Jensen, and Scholes (1972) and Fama and MacBeth (1973) among others. In fact, most efficient market theorists, including Sharpe (1964), believe that what many authors regard as evidence of existence of patterns in financial time series may just be a result of data mining with spurious outcomes. As William Sharpe said, "if you torture data long enough, it will confess to any crime".

And yet a more moderate position is held by others. According to Campbell (2000), "a more reasonable view is that rational models of risk and return describe a long run equilibrium toward which financial markets gradually evolve . . . some deviations from such models can be quickly arbitraged away by rational investors; others are harder to arbitrage and may disappear slowly after a slow process of learning and institutional innovation".

However, despite the criticisms, the intuition behind CAPM remains the guiding inspiration to academic discourse on security pricing and indeed practical portfolio management (Amah, 2008). In fact, it would appear that most of the subsequent theories and models of the subject matter were derived one way or the other from CAPM as authors try to work round the model's assumptions.

Most of the models formulated under the random walk framework assume constant unconditional variance of error term in the mean process. But most financial time series data has been found to yield errors with time varying variance (Engle, 1982). Accordingly, a breakdown of the assumption of homoscedastic returns will be expected to give rise to specification problems and imprecise measures of standard errors. A more relevant theory that incorporates these nuances is required. Hence, the emergence of the Autoregressive Conditional Heteroskedasticity Models.

2.2 Autoregressive conditional heteroskedasticity models

The important theoretical intuition captured in this framework is that variation in volatility of residuals (heteroskedasticity) can be econometrically specified, explained and predicted contrary to the normative theory. A foremost encapsulation of this body of knowledge was articulated in the landmark work of Engle (1982) to the effect that value of variance of random variable (σ_t^2) at any time is conditioned on past history of indefinite series of residuals ($\varepsilon^2{}_t$) in the following dynamics:

$$\sigma_t 2|\Omega_{t-1} = a_0 + \sum_{i=1}^{p} \mathrm{a_i}\varepsilon^2_{\mathrm{t}-1} \tag{2}$$

Clearly, the model is an expression of the influence of past surprises in determination of risk and hence, return generating process. Hence, Engle impliedly considered that magnitude of past unrealized expectations in the price process is directly related to magnitude of returns expected from an investment. Interestingly, under this framework (which assumes variability of variance of residuals), the proposition of positive trade-off is sustained. However, the challenge of appropriate number of series to assure robust estimate of parameters was a big issue in modeling the relationship, just as certain observed volatility patterns cannot be readily analyzed under this body of knowledge. Consequently, Bollerslev (1986) developed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) which technically decomposed volatility into Autoregressive (AR) and Moving Average (MA) components of p and q orders respectively.

$$\sigma_t 2|\Omega_{t-1} = a_0 + \sum_{i=1}^{p} \mathrm{a_i}\varepsilon_{\mathrm{t-1}}^2 + \sum_{j=1}^{q} \beta_{\mathrm{j}}\sigma_{\mathrm{t-1}}^2 \tag{3}$$

This original GARCH specification is able to analyze the tendency of prices to form clusters around innovations in the information process, and also for price fluctuations to witness slow successive decay rate. However, it is blinded to the tendency of prices to respond differently to positive and negative surprises. Where residual term is motivated by unfavorable news, it can be shown to stoke greater volatility in asset prices than relatively good news concerning the asset. Several studies, especially with respect to developed markets agree with this pattern of volatility asymmetry (Kroner & Ng, 1998; Ghysels, Pedro, & Valkanov, 2005). Increasing body of literature, particularly concerning developing markets, has emerged to challenge this intuition of negative asymmetry (Ogum, Beer, & Nouyrigat, 2005; Amah, 2011). In order to incorporate the study of asymmetry, several extensions of Bollerslev's model have been developed and applied in literature with outstanding ones attributed to Nelson (1991), Glosten, Jagannathan, and Runkle (1993), and Zakoan (1994) among others. The model has equally been limited by difficulty in using it to analyze many assets simultaneously, thereby posing serious challenge to application in portfolio management.

2.3 Empirical review

Several authors have investigated the nature of trade-off patterns using the Random Walk and ARCH frameworks with interesting results. While most of the earlier studies, especially focused on developed markets, yielded outcomes that reflect positive relationship between risk and expected return, a number of recent studies have tended to qualify this mainstream view or outrightly suggest a negative pay-off.

Guo & Whitelaw investigated monthly data of S&P 100 Index Option prices and found a positive measure of relative risk aversion which suggests that when controlled for the hedge component, a positive trade-off is guaranteed. What is apparent in this work is that when controlled for certain intervening factors, the normative positive trade-off is sustained. In this case, the authors controlled for risk and hedge components. However, the research did not consider the effect of heteroskedasticity in the price process, just as analysis was only based on developed market data. In a similar vein, Maheu and McCurdy (2007) suggested that time dynamics is required to arrive at optimal result since risk premium is known to be time-varying. Accordingly, the authors employed US equity price data for the period 1840–2006 and found that over the long run, positive trade-off between risk and expected return is to be expected. In a more recent study using US data, Barroso and Maio (2023) looked at the nature of the relationships among sectors and the market as a whole. They found a positive trade-off which is more robust among sectors than the market as a whole. Interestingly, the study was done within the multivariate framework, and the result would appear to be encouraging for portfolio management in practice. Again, the study is based on developed market data only. Other studies with "well-behaved" results include Ludvigson and Ng (2007), Lin (2022).

In another sector-based study, but which investigated 10 Industrial sectors across several ASEAN countries, Hong, Nguyen, Pham, Truong, and Cong Nguyen (2019) found healthcare sector in Vietnam that had "least extreme risk" but earned highest return. In Thailand, the consumer sector showed such outstanding result. This research outcome supports the contrarian view and is consistent with several findings from developing markets. In one rare study within the multivariate framework focused on African market, Amah (2011) investigated the nature of relations between a measure of excess return and conditional covariances and found coefficients that are predominantly negative. The author relied on M Vec threshold Darch model to account for information asymmetry. However, the in-mean specification of the covariance terms only captured covariances with market factor and not those of individual sectors. Jo, Lin, and You (2022) conducted a survey of respondents in US market with investments in wide range of asset classes (including cryptos) to find out if investors receive positive premium for more risk in their portfolios. They found a preponderance of negative trade-off. Inherent in their research outcome is that perception of risk is subjective, and premium placed on investment exposures is equally dependent on nature of individual's asset allocation. As recognized by the authors, the study is largely concentrated on improperly diversified portfolio of assets with high Sharpe ratios. As shown in Table 1, the weight of evidence from recent studies appears to lean towards mixed results where positive or negative payoff is achieved conditional on time, risk and other methodological adjustments (Liu *et al.*, 2021; Lee *et al.*, 2022; Cotter & Salvador, 2022; Shivaprasad *et al.*, 2022; Zhao & Wen, 2022).

3. Research methods

This paper employs ex-post design approach to attempt to answer the relevant research questions and achieve research purposes. It includes collection of observable historical data on securities prices and the market index from which relevant explained and explanatory variables are derived. By judgment, we focus on 7 out of 8 securities listed on the Premium Board of the Nigerian Stock Exchange across Industrial, financial services and energy sectors for eight-year period between April 2014 and March 2022. The telecommunication giant, MTN, the 8th firm listed on the Premium Board, was excluded on account of insufficient data points. Firms quoted on the Premium Board constitute the most significant firms in the market in terms of size, activity and commitment to best corporate governance standards. It is therefore thought that, in addition to the market index, price data on these 7 assets will give a good insight into stylized facts of market attributes and overall direction. The period covered by the empirical investigation saw several events that motivated innovations in the price process including a novel political transition, unusual economic recession, devastating Covid-19 pandemic and associated policy headwinds which fed through asset prices. Using weekly data on market prices, we computed asset returns (R_i) which are inputted into EViews software to derive conditional variances (H_i), conditional covariances (H_{ij}) and residuals (ε_i) series as dependent and explanatory variables. We subsequently adopted the M Vec TGarch-in Mean Model of Amah (2011) to specify the relationships as follows:

$$R_{it} = A_i + B_i R_{it-1} + C_i H_{it} + D_i H_{ijt} + \varepsilon_{it} \tag{4}$$

where $\varepsilon_t \sim N(0, H_t)$

$$H_{it} = M_i + A1_i\, \varepsilon^2_{it-1} + D1_i\, \varepsilon^2_{it-1}.(\varepsilon_{it-1} < 0) + B1_i H_{it-1} \tag{5}$$

$$H_{ijt} = M_{ij} + A1_{ij}\, \varepsilon_{it-1}\, \varepsilon_{jt-1} + D1_{ij}\, \varepsilon_{it-1}.(\varepsilon_{it-1} < 0).\, \varepsilon_{jt-1}(\varepsilon_{jt-1} < 0)_{.} + B1_{ij} H_{ijt-1} \tag{6}$$

Equations (5) and (6) can be looked at as simultaneous generators of two risk dimensions (H_i and H_{ij}) required for estimation of our trade-off relations using equation (4). On *a priori* basis, we expect coefficients C and D of the risk measures to be positive in line with mainstream views of positive trade-off in literature. Before running the regression, we conducted certain diagnostic tests to enable us understand data attributes that may potentially affect estimation procedures and outcomes. We ran system unit root tests using Augmented Dicky–Fuller (ADF) test and the result, as shown in Table 2, shows rejection of null hypothesis of unit roots in the series.

Author(s)	Empirical work done and key objectives	Specific findings	Review/Remarks
Liu, Su, Wang, and Yu (2021)		The authors found a time dependent nature of relationship between market expected return and variance	There is a behavioral component in this relationship when under or over-reaction in price level occurs as a result of shock to some of the risk factors. This questions the idea of unique or objective positive trade-off as generally assumed in mainstream literature
Lee *et al.* (2022)	The key objective of this study is to investigate effect of investor attention on variation of trade-off relations in a market	The study found that the anomaly of negative trade-off reduces as degree of attention declines irrespective of the risk proxy adopted	The authors admitted that negative trade-off found in some recent studies is an anomaly. But this would appear to negate the effectiveness of active strategy as portfolio management approach
Cotter and Salvador (2022)	Using US data for period 1963 to 2017, the authors sought to explain nature of non-linearities found in the price process and the determinants	The authors found that positive trade-off is associated with periods of low volatility, but mostly inverted during periods of great uncertainty in the economy	Does this then follow that research into high- risk economies should be expected to result in anomalous negative relations?
Shivaprasad *et al.* (2022)	The authors looked at risk and premiums of different options strategies on performance (measured by returns)	The research found that more riskier strategies like short straddle and short strangle negatively influenced pay-off while the less-riskier ones like long straddle and long strangle have positive pay-off	If this result holds up to real market behavior, it will obviously help investors in making desired portfolio choices that fit their risk-return preferences
Zhao and Wen (2022)	This research work studied effect of global green gas and environmental sustainability issues on financial markets, with specific focus on how associated policies have induced variation in risks and return	The authors found time-varying risk compensation coefficients. More importantly a statistically significant negative coefficient was found at 1% level of significance	A remarkable thing about this study is that it employed the Garch-M estimation method for analysis. It thus was able to account for structural breaks of positive and negative dimensions arising from policy choices made in the carbon markets
Capiello, Engle, and Sheppard (2006)	The authors went beyond equity to include bonds in search for nature of risk-return relations in the international assets market	The study found bond volatility that is expectedly lower than equity, but with no clear linkage to return	Remarkably, the authors employed price correlation dynamics, but the outcome implies that no definite trade-off pattern could be established

Source(s): Table by the author

Table 1.
Summary of other empirical works

Method				Statistic
ADF – Fisher Chi Square				1236.83
ADT – Choi Z Test				−34.37
Series	**Prob**	**Lag**	**Max Lag**	**Obs**
RA	0.00	0	17	413
RD	0.00	1	17	412
RF	0.00	0	17	413
RL	0.00	0	17	413
RM	0.00	0	17	413
RS	0.00	0	17	413
RU	0.00	0	17	413
RZ	0.00	1	17	412

Note(s): Access Bank return (RA), Dangote Cement return (RD), First Bank return (RF), Lafarge Cement return (RL), market return (RM), Seplat Energy return (RS), UBA return (RU), Zenith Bank return (RZ)
Source(s): Table by the author

Table 2. Null hypothesis: Unit root process

We also ran System Portmanteau test for Autocorrelation up to 12 lags (Table 3) and could not find any evidence to accept null hypothesis of no "arch effects". Among others, this could result in the presence of endogeneity in the system of relationships among variables. Where serial correlation is found in a data series, heteroscedasticity-consistent estimators may be more suitable in analysis of mean-variance models (Giovanis, 2009).

Hence, we utilize the method of Maximum Likelihood to estimate parameters of the Multivariate Vec Threshold Garch model which reveal the nature of trade-off relations between risk and expected return.

4. Data description and analysis

4.1 Descriptive analysis

As shown in Table 4, descriptive analysis of statistics used for our empirical investigation reveals mean weekly return that ranges from −0.0014 for Lafarge Cement to 0.003 achieved

Null hypothesis: no residual autocorrelations up to lag h

Lags	Q-stat	Prob	Adj Q-Stat	Prob	Df
1	254.36	0.00	254.98	0.00	64
2	387.98	0.00	389.25	0.00	128
3	468.51	0.00	470.37	0.00	192
4	548.97	0.00	551.61	0.00	256
5	628.95	0.00	632.57	0.00	320
6	726.44	0.00	731.51	0.00	384
7	820.25	0.00	826.93	0.00	448
8	876.27	0.00	884.06	0.00	512
9	949.26	0.00	958.67	0.00	576
10	1021.14	0.00	1032.33	0.00	640
11	1090.60	0.00	1103.69	0.00	704
12	1152.99	0.00	1167.95	0.00	768

Note(s): *The test is valid only for lags larger than the system lag order
*Df is degrees of freedom for (approximate) chi-square distribution
Source(s): Table by the author

Table 3. System residual portmanteau tests for autocorrelations

Table 4.
Descriptive statistics

	RA	RD	RF	RL	RM	RS	RU	RZ
Mean	0.0021	0.0015	0.0024	−0.0014	0.0009	0.0030	0.0022	0.0018
Median	0.0000	0.0000	0.0000	0.0000	−0.0008	0.0000	0.0000	−0.0019
Maximum	0.1868	0.2567	0.3129	0.4134	0.1690	0.3387	0.3228	0.3254
Minimum	−0.3647	−0.1571	−0.2523	−0.3013	−0.1349	−0.1914	−0.1948	−0.3670
Std. Dev	0.0579	0.0456	0.0694	0.0629	0.0303	0.0633	0.0621	0.0593
Skewness	−0.2764	1.0454	0.9074	0.5768	0.4850	0.8473	0.6646	−0.0686
Kurtosis	7.8760	8.4674	6.6976	9.1823	9.5221	7.2814	7.0774	10.1362
Jarque–Bera	415.3956	591.0421	292.6524	682.2751	750.0045	365.7378	317.2601	878.7883
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	414	414	414	414	414	414	414	414

Source(s): Table by the author

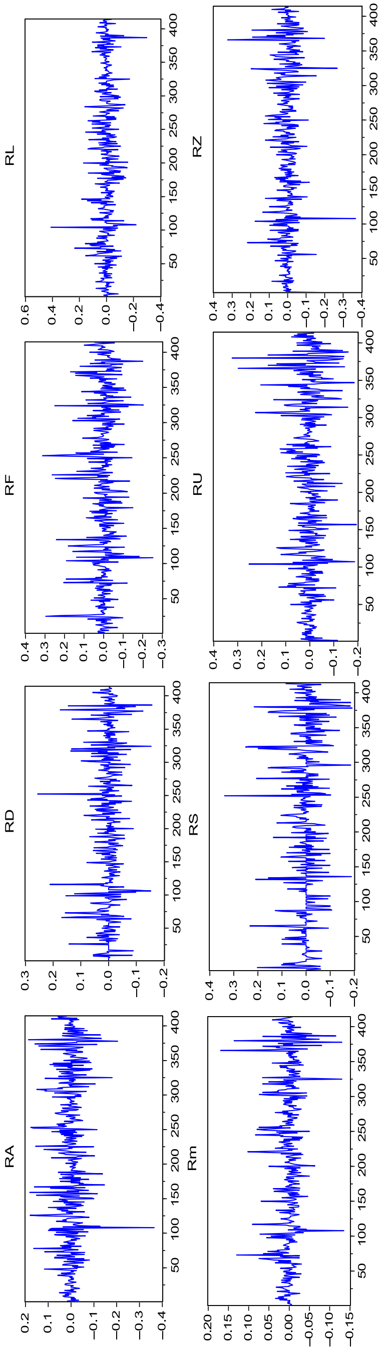
by Seplat Energy. This is equivalent of −7.28% and 15.60% of average annual returns respectively. A further breakdown of the data distribution, and perhaps clearly indicative of nature of risk faced in the market, shows a minimum random return (weekly) of −0.3670 for Zenith Bank and maximum of 0.4134 for Lafarge Cement over the period 2014 to 2022. Not surprisingly, the market index printed the least max-min range from −0.1349 to 0.1690 and standard deviation of 0.0303, reflecting an expectation that while the market portfolio return under-performs most of the individual assets, risk is correspondingly lower. For the individual assets, the mean-maximin-standard deviation statistics are indicative of non-uniform trade-off profiles.

Also, Table 4 shows moderate levels of skewness and leptokurtic form of distribution. This indicates that tail risk, which is associated with high probability of outlier events, may be high. With figures that range from 7 to 10 in a non-normal distribution, this risk is prevalent among all the asset classes, and also clearly evident in the visual representation of fluctuations as shown graphically in Figure 1.

4.2 Findings and discussions

The central issue for empirical resolution in this paper is whether the market offers a mechanism to positively reward investors for taking additional risk in a consistent basis. Simultaneously with the risk generating processes, we ran 8 regressions of returns on conditional variances and covariances of random variables. This was done given the assumption of heterogeneity of return. Ignoring lag terms in the mean equations, we estimated 64 coefficients of the process for evaluation of trade-off relations between risk and expected return. Our findings on risk aversive behavior of investors in the two risk measures are quite revealing.

4.2.1 Pricing of conditional variance risk. The result of regression analysis as shown in Table 5 reveals coefficients of conditional variance risk (H_A, H_D, H_F, H_L, H_M, H_S, H_U, H_Z) with mixed outcomes in sign and magnitude. Out of the eight risk measures, five coefficients relating to Dangote Cement, First Bank, Market Index, Seplat Energy and Zenith Bank yielded positive outcomes in line with what is the prevalent view in the body of knowledge, with substantial sizes ranging from 0.09 (H_Z) to 4.01(H_D). Ordinarily, this is indicative of positive trade-off, meaning that investors expect varying degrees of increase in return for assuming higher level of risk. Ceteris paribus, they obviously have incentive to make more investments in the market. However, all the coefficients are statistically insignificant with very high implied standard errors. For investments in Access Bank, Lafarge Cement and UBA, a different result was obtained from analysis of the price process. Contrary to a prior expectation, their coefficients of conditional variance were found to be negative in the



Source(s): Figure by the author

Figure 1.
Graphical
representation of
volatility patterns of
returns

R_A	Coefficient	Prob	R_D	Coefficient	Prob	R_F	Coefficient	Prob
H_A	−1.6802	0.4041	H_D	4.0144	0.7079	H_F	1.8292	0.5179
H_{AD}	18.8374	0.1452	H_{DA}	4.0390	0.7971	H_{FA}	2.1379	0.5952
H_{AF}	3.3363	0.2284	H_{DF}	0.2770	0.9972	H_{FD}	86.3586	0.1325
H_{AL}	4.6471	0.1416	H_{DL}	2.8863	0.8755	H_{FL}	1.2535	0.8170
H_{AM}	−5.7668	0.3456	H_{DM}	−1.4385	0.9874	H_{FM}	6.1053	0.5606
H_{AS}	4.0594	0.8730	H_{DS}	−21.1824	0.3270	H_{FS}	−8.7660	0.5573
H_{AU}	4.0855	0.3804	H_{DU}	−14.5880	0.8587	H_{FU}	−5.2407	0.4082
H_{AZ}	−1.8511	0.5686	H_{DZ}	6.3393	0.7057	H_{FZ}	−3.6840	0.3221
R_L	Coefficient	Prob	R_M	Coefficient	Prob	R_S	Coefficient	Prob
H_L	−0.8302	0.7709	H_M	1.4787	0.8620	H_S	1.1651	0.6222
H_{LA}	3.1326	0.6535	H_{MA}	0.5376	0.8627	H_{SA}	10.0740	0.8478
H_{LD}	8.4880	0.6008	H_{MD}	44.9305	0.0264	H_{SD}	−29.298	0.3489
H_{LF}	−0.1710	0.9837	H_{MF}	2.8956	0.3657	H_{SF}	7.8380	0.7077
H_{LM}	−2.0852	0.8815	H_{ML}	−5.5098	0.1530	H_{SL}	−2.9146	0.7854
H_{LS}	0.6631	0.9357	H_{MS}	4.0313	0.6806	H_{SM}	13.3791	0.8092
H_{LU}	−1.6364	0.8820	H_{MU}	−3.4993	0.5494	H_{SU}	−26.079	0.4949
H_{LZ}	−0.6510	0.9318	H_{MZ}	−0.8307	0.8214	H_{SZ}	−12.535	0.3024
R_U	Coefficient	Prob				R_Z	Coefficient	Prob
H_U	−3.8281	0.3958				H_Z	0.0907	0.9599
H_{UA}	1.7262	0.7738				H_{ZA}	−2.7723	0.3970
H_{UD}	31.519	0.6216				H_{ZD}	9.9613	0.1890
H_{UF}	0.4477	0.9285				H_{ZF}	−0.0535	0.9850
H_{UL}	−2.3700	0.7190				H_{ZL}	1.4430	0.6966
H_{UM}	10.3934	0.4860				H_{ZM}	7.2467	0.2737
H_{US}	−13.941	0.6783				H_{ZS}	7.0806	0.2173
H_{UZ}	−0.8395	0.8945				H_{ZU}	−6.5210	0.2040

Note(s): R_i are dependent variables while H_i and H_{ij} are explanatory variables in the in-mean equation and the figures are as computed by the authors
Source(s): Table by the author

Table 5. Extracts from regression results of the multivariate Vec threshold GARCH-Mean model

Multivariate Vec GARCH-Mean Model regression. The negative values range in size from −0.83 (H_L) to −3.83 (H_U), showing different degrees of decline in expected return as the measure of total risk increases. On the face of it, this implies that investors should not expect to receive any extra rewards for taking extra risk in shares of Access Bank, Lafarge Cement and UBA; they would rather expect to suffer loss of value by increasing exposure to these assets. This is a form of negative trade-off which obviously is a dis-incentive for additional investments in the market.

4.2.2 How does the market price conditional covariance risk?. We computed coefficients of Conditional Covariance Risk (H_{IJ}) from eight regressions of Multivariate Vec GARCH-Mean Model to test whether a more relevant risk measure for portfolio management will yield better research outcomes. As shown in Table 4, the result was likewise mixed in terms of sign and sizes of the coefficients. Out of 56 coefficients, 31 showed indication of positive trade-off relations fairly spread among the assets investigated. A non-trivial number of 25 coefficients on the other hand returned negative. Interestingly, 55 of the entire coefficients are statistically insignificant, signifying inability to conclusively, on the basis of this research, align strongly with mainstream view on positive trade-off between risk and expected return. In fact, only the parameter associated with covariance between Dangote Cement and the Market Index was positive and statistically significant at 5% level. The stock also returned outlier coefficient sizes in combination with other assets, and hence should be of interest to investors in portfolio risk modeling for optimal return.

4.2.3 Risk-return trade-off across sectors. In terms of sign and statistical significance of coefficients, regression outcomes reported in 4.2.2 and 4.2.3 above did not show any obvious discrimination across assets and sectors under investigation. In all 8 regressions, positive results range between 3 and 5; the same with positive outcomes, while virtually all are statistically insignificant. The one obvious exceptional result in terms of size has to do with covariances involving Dangote Cement (quoted in the industrial sector). The coefficients ranged from a relatively high figure of 8.49 in combination with Lafarge (also in industrial sector) to exceptionally high of 86.36 when combined with First Bank. This appeared to be company-specific as Lafarge stock did not show such exceptional results in combination with other stocks.

4.3 Discussion

From this research, we saw a tendency, though largely inconclusive, for existence of positive pricing of risk in the market, and this is without prejudice to type of risk used as a measure. This is even as a substantial part of outcomes showed negative results. Perhaps of remarkable significance, the evidence of this non-monotonicity can be seen in Table 5 with 5 positive and 3 negative coefficients in regressions involving the market index (R_M). This would seem to challenge certain key pillars or rather assumptions upon which traditional finance theory existed and flourished. As could be seen in our review above, the notion of positive trade-off is well documented in literature. On the flip side, several emerging views and research outcomes in extant literature, especially concerning emerging markets, are not in contradiction to our findings in this paper. For instance, Li and Yanhui (2007) carried out a similar investigation that considered capital markets of 11 Asia-Pacific countries and found what seemed conclusive evidence that the idea of positive trade-off was not prevalent during the period of investigation. Amah (2011) had earlier found compelling evidence of non-monotonous form of risk-return trade-off during the 1998–2008 period, with negative trade-off being dominant when excess return was regressed on conditional covariances. Other budding studies that offer support to our findings here include Alagiede and Panagiotidis (2009), and Capiello *et al.* (2006).

Another remarkable perspective of this study outcome can be seen in the observed similarity in coefficients of conditional variance and covariance terms in our regression. This raises the prospect of beholding a market in which different forms of risk are priced, beyond just the non-diversifiable risk for which investors can expect to be rewarded for. Flowing from the intuition of conventional theory, only risk estimators that compound systematic or market wide factors should be priced by the market. This implies that in regressions of asset pricing involving systematic and unsystematic measures of risk, only the former should be statistically and economically significant. But then, it could be argued that this is a phenomenon of markets that are efficient, whereas most developing markets are known to show attributes of inefficiency. Hence, the findings in this paper constitute a challenge to established view in extant literature.

5. Conclusion

5.1 Summary of findings

Given a review of literature and outcome of empirical research comprised in this study, we feel confident to make some far-reaching inferences and conclusions.

Firstly risk, measured in terms of conditional variance, would appear to exhibit expected return attributes that are not significantly different from conditional covariance. This is the case for sign, sizes and statistical significance of coefficients of the two metrics, and would imply that a typical investor expects to have similar rewards for taking systematic and unsystematic risks.

Secondly, using these measures, the idea of positive risk/expected return relationship, as held in mainstream literature, appears to define dominant investor behavior; however, this by no means precludes existence of negative trade-off in the market. There is therefore what may be termed inconclusive evidence of existence of definite trade-off pattern in the market. This also implies existence of doubts as to the nature of incentive for risk-bearing in the capital market. One consequence is constrained capital inflows into the market as investors respond naturally to what appears as possibility of inappropriate pricing of risk.

Thirdly, no evidence exists to suggest that lack of support for a monotonous trade-off pattern between risk and expected return is limited to specific sectors of the market. This is evidently a phenomenon of the entire market and perhaps underlies some of the peculiar attributes associated with literature of other emerging markets. Some of these attributes relate to information problems, market microstructure and state of regulation. This definitely imposes some challenges to pricing, selection of securities, diversification and optimal choice in the portfolio process.

5.2 Theoretical implications of findings

Theoretically, it implies a distortion of what is generally known about random walk of the price process and hence, the preference ordering framework. This may also mean potential introduction of non-linearity in the efficient frontier (in the presence of capital market) and inverted utility preference function of individual investors. This implies greater complexity in the model of determination of optimal portfolios.

5.3 Practical implications of the findings

If it is not given that investors should expect positive pay-off for assuming more risk in the market, this has enormous challenges and practical implications for policy making and portfolio management, especially for developing markets. Inflow of local and foreign portfolio investment will be negatively affected. This will require policy makers to devise measures to de-risk the market and provide incentives to attract investors. Portfolio Managers are bound to make counter-intuitive or irrational asset allocation decisions that lead to sub-optimal outcomes; and prices thrown up by interaction of buy and sell decisions may not appropriately signal market direction.

5.4 Recommendations

From perspective of extant literature, certain research outcomes in this paper constitute anomalous result inconsistent with optimal portfolio choice and symptomatic of some form of market inefficiency. As a way of stimulating desired trade-off between risk and expected return that promotes optimal investment choice and market efficiency, we make the following recommendations:

(1) In order to reduce uncertainty, regulators should formulate and enforce rules on availability and credibility of information in the market. Situations where financial reports are released out of time, or with lack of accuracy, contributes to anomalous trade-off relationship between risk and expected return. In most under-developed markets, the incentive to default in financial reporting and disclosure requirements is

appreciably high; and strict sanctions are necessary to address the inevitable market failure represented by uncertainty.

(2) High cost of transaction is another factor that constitutes static interference in the market microstructure, constrain ability of investors to intervene in mis-priced situations and distort risk-return relations. Most developing economies operate under very high-cost regime and conscious efforts are required to reduce transaction costs in the capital market.

(3) Lack of depth and breadth in a market presents abnormal scenario of suppressed activity, demand and supply gaps, and hence inability of prices to signal underlying real economic relationships. This is further accentuated by internal market rules or their absence, which enable manipulation of transactions and prices in the market. Greater efforts to open up the markets and expand the scope of public listings and instruments will improve market competitiveness and normalize risk and expected return

(4) Making optimal portfolio choice against the background of findings of negative trade-off suggests that greater diversification may be required to moderate risk levels by investors. Concentration of risk may give rise to outliers of positive or negative returns which yield anomalous patterns of relationship between risk and return.

(5) We found evidence, though inconclusive, of empirical regularity of systematic and unsystematic risk proxies suggesting that they are priced by the market. This suggests that a more holistic approach to risk management is required in building investment models that have optimal properties. Hence, in the determination of appropriate risk-adjusted rate to discount future cashflows, estimators that incorporate total risk should also be considered.

References

Agha, W. O. (2002). The impact of macro-economic variables on returns of investment in the emerging market: The case market of Nigeria (1985-1996). Unpublished PhD Thesis. University of Benin.

Alagiede, P. & Panagiotidis, T. (2009). Modeling stock returns in Africa's emerging equity markets. Discussion Paper Series, ISSN 1791-3144. Greece: Department of Economics, University of Macedonia.

Amah, P. N. (2008). Heteroskedasticity of market returns: A look at the Nigerian stock exchange time series. Unpublished Seminar Paper. August: Department of Finance, University of Lagos.

Amah, P. N. (2011). Multivariate estimator of volatility patterns and risk-return trade-off in the behaviour of equity prices – the Nigerian evidence. Ph.D Thesis. Department of Finance, University of Lagos.

Banz, R. W. (1981). The relationship between return and market value of common stock. *Journal of Financial Economics*, *9*(1), 3–18. doi: 10.1016/0304-405x(81)90018-0.

Barroso, P., & Maio, P. (2023). The risk-return trade-off among equity factors. SSRN, Available from: http://dx.doi.org/10.2139/ssrn.2909085 (accessed 7 February 2023).

Basu, S. (1983). The relationship between earnings yield, market value and return for NYSE common stocks: Further evidence. *Journal of Financial Economics*, *12*(1), 129–156. doi: 10.1016/0304-405x(83)90031-4.

Black, F., Jensen, M., & Scholes, M. (1972). The capital asset pricing model: Some empirical tests. In Jensen, M. (Ed.), *Studies in the Theory of Capital Markets*. New York: Praeger.

Bollerslev, T. (1986). Generalized auto-regressive conditional heteroskedasticity. *Journal of Econometrics*, *31*(3), 307–327. doi: 10.1016/0304-4076(86)90063-1.

Campell, J. (2000). Asset pricing at the millennium. *The Journal of Finance*, *LV*(4), 1515–1567.

Capiello, L., Engle, R., & Sheppard, K. (2006). Asymmetric dynamics in the correlation of global equity and bond returns. *Journal of Financial Econometrics*, *4*, 537–572. doi: 10.1093/jjfinec/nbl005.

Cotter, J., & Salvador, E. (2022). The non-linear trade-off between return and risk and its determinants. Working Paper Number 202203. Dublin: Geary Institute, University College.

De Bondt, W., & Thaler, R. (1985). Does the stock market over-react. *Journal of Finance*, *40*(3), 793–805. doi: 10.1111/j.1540-6261.1985.tb05004.x.

Dechow, P., Hutton, A., Meulbroek, L., & Sloan, R. (2001). Short sellers, fundamental analysis and stock returns. *Journal of Financial Economics*, *61*(1), 77–106, July. doi: 10.1016/s0304-405x(01)00056-3.

Engle, R. (1982). Auto-regressive conditional heteroskedasticity with estimates of variance of UK inflation. *Econometrica*, *50*(4), 987–1008. doi: 10.2307/1912773.

Fama, E. (1965). The behaviour of stock market prices. *Journal of Business*, *38*(1), 34–105. doi: 10.1086/294743.

Fama, E., & French, K. (1988). Permanent and temporary components of stock prices. *Journal of Political Economy*, *96*(2), 246–273. doi: 10.1086/261535.

Fama, E., & MacBeth, J. (1973). Tests of the multi-period two parameter model. *Journal of Financial Economics*, *74*(1), 43–66. doi: 10.1016/0304-405x(74)90008-7.

Friend, I., Westerfield, R., & Granito, M. (1978). New evidence on the capital asset pricing model. *Journal of Finance*, *33*(3), 903–917. doi: 10.1111/j.1540-6261.1978.tb02030.x.

Ghysels, E., Pedro, S., & Valkanov (2005). There is a risk-return trade-off afterall. *Journal of Financial Economics*, *76*(3), 509–548. doi: 10.1016/j.jfineco.2004.03.008.

Giovanis, E. (2009). Application of ARCH-GARCH models and feed-forward neural networks with bayesian regularization in capital asset pricing model: The case of two stocks in Athens exchange stock market. Izmir Bakircay University International Trade and Business. Presented to Economic Research Forum on January 10. doi: 10.2139/ssrn.1325842.

Glosten, L., Jagannathan, R., & Runkle, D. (1993). On the relation between the expected value and the volatility of the nominal excess returns on stocks. *Journal of Finance*, *48*, 1791–1801.

Hong, D., Nguyen, T., Pham, T. T. V., Truong, L. M., & Cong Nguyen, T. (2019). Risk return and portfolio optimization for various industries in the ASEAN region. *Borsa Istanbul Review*, *19*(2), 132–138. doi: 10.1016/j.bir.2018.09.003.

Iyiegbuniwe, W. (1998). Multi-factor asset pricing model for bond valuation. *Nigerian Journal of Management Studies*, *1*, 79–97.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers. *Journal of Finance*, *48*(1), 65–91. doi: 10.1111/j.1540-6261.1993.tb04702.x.

Jo, C., Chen, L., & Yang, Y. (2023). Subjective risk-return trade-off. SSRN, Available from: http://dx.doi.org/10.2139/ssrn.4096443 (accessed 26 November 2023).

Kroner, K. F., & Ng, V. K. (1998). Modeling asymmetric comovements of assets returns. *Review of Financial Studies*, *11*(4), 817–844. doi: 10.1093/rfs/11.4.817.

Lee, J., Lee, K., & Kim, R. (2022). Investor attention and risk-return trade-off. *Finance Research Letters*, *47*(PA). doi: 10.1016/j.frl.2021.102524.

Li, B., & Yanhui, W. (2007). *Risk and return in Asia pacific markets*. UQ Business School, University of Queensland Brisbane.

Lin, P. (2022). Intertemporal risk-return relationship in the housing market. *Journal of Real Estate Research*, *44*(3), 331–354. doi: 10.1080/08965803.2021.2011560.

Lintner, J. (1965). The valuation of risk assets and selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, *47*(1), 13–37. doi: 10.2307/1924119.

Liu, Q., Su, Z., Wang, H. & Yu, J. (2021). Extrapolation of risk-return trade-off. PBCSF.NIFR Research Paper Forthcoming. SSRN, Available from: http://dx.doi.org/10.2139/ssrn.4039296 (accessed 15 November 2021).

Ludvigson, S., & Ng, S. (2007). The empirical risk-return: A factor analysis approach. *Journal of Financial Economics*, *83*(1), 171–222. doi: 10.1016/j.jfineco.2005.12.002.

Maheu, J., & McCurdy, T. (2007). Components of market risk and return. *Journal of Financial Econometrics*, *5*(4), 5605–5670. doi: 10.1093/jjfinec/nbm012.

Markowitz, H. (1952). Portfolio selection. *Journal of Finance*, *1*, 77–91. doi: 10.1111/j.1540-6261.1952.tb01525.x.

Markowitz, H. (1959). *Portfolio selection: Efficient diversification of investments*. New York: John Wiley & Sons Press.

Miller, M., & Scholes, M. (1972). Rate of return in relation to risk: A re-examination of some recent findings. In Jensen, M. C. (Ed.), *Studies in the Theory of Capital Markets* (pp. 47–48). New York: Praeger.

Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica*, *34*(4), 768–783. doi: 10.2307/1910098.

Nelson, D. (1991). Conditional heteroskedasticity in asset returns: A new approach. *Econometrica*, *59*(2), 347–370. doi: 10.2307/2938260.

Ogum, G., Beer, F., & Nouyrigat, G. (2005). Emerging equity market volatility: An empirical investigation of markets on Kenya and Nigeria. *Journal of African Business*, *6*(2), 139–154. doi: 10.1300/j156v06n01_08.

Osborne, M. (1959). Brownian motion in stock markets. *Operations Research*, *7*(2), 145–173. doi: 10.1287/opre.7.2.145, March/April.

Roll, R. (1977). A critique of the asset pricing theory's tests; Part 1: On the past and potential testability of the theory. *Journal of Financial Economics*, *4*(2), 129–176. doi: 10.1016/0304-405x(77)90009-5.

Schwert, G., & Seguin, P. (1990). Heteroskedasticity in stock returns. *Journal of Finance*. *XLV*(4). 1129–1155. doi: 10.1111/j.1540-6261.1990.tb02430.x.

Sharpe, W. (1963). A simplified model for portfolio analysis. *Management Science*, *9*(2), 277–293. doi: 10.1287/mnsc.9.2.277.

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, *XIX*(3), 425–442. doi: 10.1111/j.1540-6261.1964.tb02865.x.

Shivaprasad, S., Geetha, E., Raghavendra, Kishore, L., & Matha, R. (2022). Choosing the right options trading strategy: Risk-return trade-off and performance in different market conditions. *Investment Management and Financial Innovations*, *19*(2), 37–50. doi: 10.21511/imfi.19(2).2022.04.

Zakoan, J. (1994). Threshold heteroskedasticity models. *Journal of Economic Dynamics and Control*, *18*, 931–944.

Zhao, L., & Wen, F. (2022). Risk-return relationship and structural breaks: Evidence from China carbon market. *International Review of Economics and Finance*, *77*, 481–492. doi: 10.1016/j.iref.2021.10.019.

Corresponding author
Peter Ngozi Amah can be contacted at: pamah@unilag.edu.ng