Pricing Higher-Order Moment Systematic Risks in the Nigerian Stock Market: Empirical Analysis from Moment-CAPM, Moment-FF3F and Moment-FF5F

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Abstract: The goal of this research is to evaluate the influence of higher-order moment systematic risks on stock return utilizing Moment-CAPM, Moment-FF3F and Moment-FF5F in the Nigerian stock market. The research sample 90 equities listed on the Nigerian Group of Exchange as of December 2020. The research covers the period of January 2005 to December 2020 and Fama-MacBeth regression was utilized as the estimating approach. Evidence from the outcome demonstrated that coskewness risk has positive substantial influence on return under the three-moment factor CAPM, four-moment FF3F and six-moment FF5F. This shows that the coskewness risk is considerably priced in the Nigerian stock market and this means that coskewness risk demand premium. Also, this conclusion was reinforced by the fact that the incorporation of coskewness risk greatly increases the explanatory capacities of the normal CAPM, FF3F and FF5F models. However, it was discovered that the cokurtosis risk has positive significant influence on return under the seven-moment FF5F whereas the cokurtosis risk has positive negligible effect on return under three-moment factor CAPM, four-moment FF3F. Considering this, the research indicated that larger moment systematic risks are also predictors of asset return in the Nigerian stock market which must be taken into account in risk-return decision making process. Thus, the research indicates that in the process of making investment choice, the investors should retain positive skewness risk factor since it would raise the anticipated return and negative kurtosis which has positive influence on stock return.

Keywords: Higher-Order Moment Systematic Risks; Moment-CAPM; Moment-FF3F; Moment-FF5F

JEL Classification: G12

1. Introduction

The idea that premium components must be accounted for in finance theory was conceived because of the a-priori study that Sharpe carried out in 1964. This research led to the establishment of the concept. This is because premium components have a major effect on stock returns. Stock returns are significantly impacted by premium components. Sharpe was able to illustrate the link between beta, also known as market risk, and return by making use of the Capital Asset Pricing Model, which is also frequently known as the single indexed model (SIM) (CAPM). Merton Markowitz is the one who established the capital asset pricing model (CAPM), and Markowitz's mean-variance portfolio model served as the foundation for it. Markowitz introduced this model in 1952. It makes the assumptions that all investors want to maximize utility and make risk-averse judgements, that all capital markets are efficient and devoid of friction caused by humans, that all assets provide the same rate of return (that is, risk-free

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assets), and that the supply of risk is constant. Additionally, it presupposes that all investors be risk-averse to function. Even though this assumption-based model has some conceptual ambiguity, the theoretical validity of the single-component CAPM is dependent on the mean-variance sufficiency of the data that it creates. This is the case even if the model includes conceptual ambiguity (Rose, 1976). It was vital to the creation of the Capital Asset Pricing Model and its subsequent general adoption that Lintner's (1965) work on preserving a stated trade-off between risk and return when assessing investment possibilities was done (CAPM). Both Black (1972) and Mossin (1966) made important contributions to the theoretical application and implementation of the CAPM in current finance. Black's work was published in 1972, while Mossin's was published in 1966. The beta component is inadequate to explain the variance in asset return, and if it is insufficient to capture a large amount of asset returns, it implies that the capital asset pricing model (CAPM) is appropriate. The market index should also incorporate labor and real estate. Since the actual market portfolio, which is the foundation upon which the CAPM is built, is not viewable, it cannot be proxied by equity alone. Roll (1977) was able to provide data that contradicted the theory by focusing emphasis on these two key components (i.e., CAPM). In addition, in contrast to mean-variance efficiency, it does not necessitate that the anticipated value and variance be inadequate to adequately define the return distribution. This is because it does not require that the expected value be equal to the mean. This is not a prerequisite in any way. When returns do not follow a normal distribution, risk-averse investors will commonly require higher-order assertions as part of their risk assessment. For the idea of systemic risk to be considered important, its detractors would argue that it needs more than simply a connection with the return on the market.

The idea that asset return distributions have a negative skewness and excess kurtosis is supported by a significant body of empirical finance research. This lends credence to the contention that the premise of a normal distribution is routinely violated in practice, which in turn lends credence to the contention that asset return distributions have a negative skewness and excess kurtosis (Aggarwal, Rao & Hiraki, 1989; Beedles, 1986; Lux & Marchesi, 2000). The findings of these investigations led researchers to the conclusion that positive skewed portfolio returns had a greater chance of being positive, but negative skewed portfolio returns have a lesser chance of being so. In addition, the presence of a substantial kurtosis suggests an increased chance of fat tails, which is another term for the potential of outlying events. It is of the highest significance to design portfolio behavior in a manner that considers these two events, which produce greater risk moments. This is because increased risk moments may have a negative impact on portfolio performance. This is because heightened risk periods may sometimes result in unfavorable outcomes. If we try to maximize the performance of our assets by using mean variance and assume that everything is operating normally, it is likely that we could wind up with a portfolio that is subpar.

An extensive body of work has been produced because of research into the factors that impact the anticipated rate of return, and these factors include higher-order instants (Tol, 2015; Naqvi, Mirza, Naqvi, & Rizvi, 2017; Chamadia, Rehman & Kashif, 2021; Vendrame, Guermat, & Tucker, 2022). The information that was available to the researcher suggested that relatively few studies of this sort had been carried out in underdeveloped countries like Nigeria. The primary purpose of this research is to answer the question, "Does the Nigerian stock market meaningfully value higher-order comma-moment systemic risk?" (Yes or no: that is the question). As a direct consequence of the publishing of this paper, the existing body of scholarly work now consists of three more pieces of data than it did before. To begin, we will investigate the Nigerian stock market through the perspective of systematic risks such as coskewness and cokurtosis, as well as how the existence of these risks impacts returns. Specifically, we will look at how the coskewness and cokurtosis measures returns. Second, we will assess the efficacy of the moment-capital asset pricing model (moment-CAPM), the capital asset pricing model (moment-FF3F), and the capital asset pricing model (capital asset pricing model) by contrasting and comparing the outcomes predicted by each of these models (moment-FF5F). Additionally, research was conducted on the systemic risks of coskewness and cokurtosis to assess whether these factors may be leveraged to increase investment returns. As a direct result of this discovery, the remainder of the study will be structured in the following manner: The documentation of the literature review can be found in Section 2, the discussion of the methodology can be found in Section 3, the discussion of the findings can be found in Section 4, and Section 5 includes a summary and the conclusions.

2. Literature Review

Tol (2015) did research to investigate how peak times affected the price of a company's shares as well as the firm's overall growth. We used the Capital Asset Pricing Model, the Capital Asset Pricing Model with Interval Data, and the Fama-Macbeth Regression Estimation Method throughout our inquiry. These models are all used to calculate the worth of financial assets. According to the study's results, although more co-moments improved the model's capacity to represent value stocks, they had little effect on growth businesses. According to the statistics, investors' utility functions seem to have differing effects on the price of growth and value stocks, respectively. Ajibola, Kunle, and Prince (2015) expanded the Capital Asset Pricing Model with more moments to conduct research on the effect of risk factors on the returns of the Nigerian stock market between 2003 and 2011. The Fama-MacBeth approach was used by the researchers behind this study to provide an estimate of the variables of interest. The Fama-MacBeth regression method was utilized to provide a precise estimate for the purposes of this investigation. The study's findings revealed that the coefficient for skewness risk premium was statistically significant. The results, on the other hand, suggested that the coefficients for covariance and kurtosis were not statistically significant. When trying to explain the volatility of stock returns, the kurtosis coefficient should not be used; instead, the covariance and skewness metrics should be used. The kurtosis coefficient cannot be utilized since it does not fulfill the statistical significance criterion. According to the findings of the investigation, the potential for skewness to create damage may be observed in either increasing or declining markets. According to the conclusions of Besther (2016) study, the price of moment assets is substantially higher on the JSE. We used a regression model using cross-sectional data to get a better understanding. To be more exact, coskewness and cokurtosis are priced for portfolios sorted by book equity/market equity (value) as well as portfolios sorted by market equity (size), however conditional coskewness and cokurtosis are valued exclusively for size-sorted portfolios. As a result, we may infer that conditional coskewness and cokurtosis are exclusively priced for size-sorted portfolios. Because of this distinction, we may conclude that conditional coskewness and cokurtosis are only valued for size-sorted portfolios. This suggests that anticipated return and coskewness have a positive connection, whereas expected return and cokurtosis have a negative relationship. According to the findings of this study, larger moment capital asset pricing models resulted in significant price errors for size-sorted portfolios, which might be positive or negative. Statistical significance was not attained for these errors, however, when value-sorted, dual size-value-sorted, or industry-specific portfolios were examined. Researchers Lal, Mubeen, Hussain, and Zubair (2016) discovered that the higher moment (skewness and kurtosis) of the return's distribution was critical for capturing the diversity in average returns. The researchers came to this conclusion after discovering that the higher moment was crucial for capturing the diversity in average returns. The researchers reached these results after seeing that the upper moments of the return distribution were critical for appropriately portraying the variation in average returns (KSE). While we were performing our computations, we relied on the Fama-MacBeth regression technique. It is possible to increase the model's performance by including skewness and kurtosis. This might lead to a rise in the performance of stock prices. Because of the increasing adjusted R square, which expanded as a direct result of the expanding model moments, the larger KSE moments were given more weight. This increase in adjusted R square happened along with the increase in model moments. According to the data, the CAPM model with a greater moment outperformed Sharpe and Linter's baseline CAPM.

Iglesias (2017) explored how the stock market's conduct during peak periods affects the cross section of stock market returns. He was particularly interested in how these returns were altered. The GARCHSK and NAGARCHSK models were used to do the computations required to calculate the observed volatility, skewness, and kurtosis of the markets studied. Multivariate clustering and cross-sectional regression based on the Fama-MacBeth model were both utilized in the study. The results show that returns on equities that are more sensitive to changes in market volatility tend to be lower but returns on stocks that are more sensitive to changes in market skewness and kurtosis are often somewhat higher. This paradox is explained by the fact that skewness and kurtosis are two distinct metrics of the market's return distribution. Various studies have shown that skewness risk in the market relates to a significant negative risk premium. Volatility and kurtosis, on the other hand, have been demonstrated in studies to be less resistant to change and more subject to changes in the empirical setup and variations among sample periods. Man (2017) conducted study on the impact of exceptional events on the financial performance of Vietnamese firms. This research focuses largely on businesses listed on the Ho Chi Minh Stock Exchange (HCMSE), and the Generalized Method of Moments (GMM) estimator was used to analyze skewed panel data collected between 2006 and 2015. (HOSE). The data show that the link between skewness and stock returns has a negative correlation, but the relationship between kurtosis and stock returns has a positive association. There was a statistically significant association between the time periods studied and the types of economic activity and market scenarios observed. This relationship was between the historical periods studied and the market. Naqvi and colleagues looked at broader moments of risk in their 2017 study to develop a mean-variance-skewness-kurtosis-based paradigm for optimizing portfolios. This paradigm is based on the concept that greater levels of volatility relate to bigger times of risk. To get an accurate estimate, the solver integrated into Excel as well as some bespoke Visual Basic for Applications (VBA) code were employed. Given that the PSX has been shown to have a trade-off between returns and other risk dimensions, the study strongly recommends adding them in the optimization framework to avoid making suboptimal decisions and to limit exposure to higher moments of risk. Furthermore, this is done to reduce the likelihood of loss from higher times of risk. As a result, it was determined that neglecting the risk hidden in the skewness and kurtosis of the returns distribution would result in market overpricing, putting investors and the economy at undue risk. Elyasiani, Gambarelli, and Muzzioli (2018) conducted research from 2008 to 2015 to investigate the impact of moment risk premia on stock return cross-sections. Estimation was carried out using, among other statistical approaches, multivariate analysis, a combination of multivariate and four-way analysis, and Fama-Macbeth regression. Conventional risk indicators such as market excess return, size, book-to-market ratio, or momentum could not explain the occurrence of a negative volatility risk premium and a positive skewness risk premium. These indications were unable to provide a sufficient explanation for the phenomena. Furthermore, it was shown that kurtosis risk is not priced in the European market and that there is a positive risk premium that develops proportionately with firm size. This information was obtained from European research. Investors agreed that they should focus their attention on firms with lower market capitalizations.

According to the study's results, the average values of higher-order moments for all firms combined could provide an accurate projection of future market excess returns. To predict future aggregate excess returns, both linear and quantile regression models were applied. The value-weighted and equal-weighted averages of higher and market moments were used as independent variables in this research. When the weights in the markets of two different nations were equalized, it was observed that there is a substantial relationship between skewness and kurtosis. When the sample markets were weighted based on their value-added content, four of the nine showed a significant correlation between skewness and kurtosis. The distribution of conditional quantiles generated using quantile regression shows, among other things, that the relationship between the risk variable and total returns is not constant. The fact that the distribution of conditional quantiles was produced demonstrates this. Higher-order moments were demonstrated to have a very high value in certain markets, but their worth was not taken into consideration in the price structure of other markets. Vendrame, Guermat, and Tucker (2022) investigated if the integration of dynamic and moment extensions may possibly enhance the empirical performance of the initial iteration of the CAPM. The authors used a multivariate GARCH model in conjunction with conditional dynamic correlations throughout the experiment. It has been shown that the conditional version of the higher-moment CAPM performs much better than the unconditional version of the model. According to the findings of the research, applying the four moment CAPM to the years 1926-2021 gave an optimistic total risk premium estimate of 0.67 percent monthly. The solution was discovered by assigning equal weight to each of the four distinct historical eras.

According to empirical literature studies, there hasn't been a lot of research done on the association between higher-order moment systematic risk and stock performance in Nigeria. According to research on the subject, this is the case. Even though they only looked at moment-CAPM, Ajibola et al. (2015) discovered evidence of a link between rising moment and return in Nigeria. Even though they only looked at moment-CAPM, this is the case. Even though they only utilized moment-CAPM data, this was the result. Consequently, the research fills a data gap that has existed up to this point and adds to the little amount of historical information on the Nigerian stock market that has previously been created. As a result of this, the following is what the investigation considers when referring to the "null hypothesis":

The fact that coskewness is not highly appreciated on the Nigerian stock exchange lends credence to Hypothesis 1, indicating that the argument should be accepted. This is because coskewness is not highly appreciated on the Nigerian stock exchange.

Consequently, given that the Nigerian stock market does not adequately represent cokurtosis, hypothesis H02 may be accepted.

CAPM, FF3F, and FF5F are useful in this regard, while Moment-CAPM, Moment-FF3F, and Moment-FF5F are ineffective for comprehending the risk-return relationship in the Nigerian stock market.

The modern portfolio theory serves as the theoretical underpinning for this examination, and it is also used to test the research's underlying assumptions to form conclusions regarding the results. As the concept emphasizes, a combination of a high projected return and a low risk may improve an investor's happiness (utility). This may be done by purchasing an asset that has both traits (variance).

3. Methodology

These stocks constituted the study's population, which was based on an expo-factor research design and contained all 161 companies listed on the Nigerian Stock Exchange in December 2020. The assumption behind this investigation was that the expo-factor would stay constant throughout time. This population was used for the whole of the study. The original sample consisted of 113 shares collected from 113 separate firms. This sample size was reduced to 90 frequently traded stocks using a technique known as purposive sampling, which relied on filters based on the trading frequency of the stocks. Monthly data on stock prices, market indices, the risk-free rate (represented in this instance by the yield on U.S. Treasury bills), ownership shareholdings, market capitalization, book value of equity, profits before interest and taxes, and total assets were utilized for the purpose of this investigation. The decade from 2005 to 2020 is entirely represented by every data point in this collection. Standard & Poor's, the Central Bank of Nigeria, and the Nigerian Group of Exchange, among others, provided the data that was utilized to construct this report (NGX). The Fama-MacBeth approach was employed as the principal method of analysis for the two-stage regression analysis that was performed. As a direct result, the following framework will serve as the foundation for this investigation:

$$R_{i,m(t)} = logP_{i,m(t)} - logP_{i,m(t-1)} \text{...} 1$$

Where $R_{i,m(t)}$ denotes the return on security say (i) and market return say (m) at time t, $P_{i,m(t)}$ represents the current price of security say (i) and current market price say (m) while $P_{i,m(t-1)}$ represents the previous price of security say(i) and the last price market say (m). This method of computing return followed the approach of Gbadebo and Oyedeko (2021), Zubairu and Oyedeko (2017). The Fama-French Five-factor model was specified in both first and second-pass regression. The first-pass regression is specified below.

$$R_{it} - Rf_t = a_i + b_i(Rm_t - Rf_t) + S_i(SMB_t) + h_i(HML_t) + u_i(RMW_t) + v_i(CMA_t) + \varepsilon_{it} \text{..................} 3.2$$

Where: R_{it} -Rf_t is the excess return of the asset over and above the treasury-bill rate. Rm_t - Rf_t is the excess return of the value-weighted index over and above the risk-free rate, SMB_t is the size factor premium, HML_t is the value factor premium, RMW_t is the profitability factor premium, CMA_t is the investment factor premium, a_i is the intercept, b_i is the regression parameter, S_i is the loaded factor of the size, h_i is the loaded factor of the value, u_i is the loaded factor of the profitability, v_i is the loaded factor of the investment and ε_{it} is the residual term. SMB this is the difference of equal weighted average of small stock mimicking portfolios or portfolios with small market capitalisation stocks returns and the big stock portfolios or portfolios with big market capitalisation stocks returns. *HML* is the difference of equally weighted average of high book to market ratio stock mimicking portfolios returns and the low book-to-market ratio stock portfolios returns. RMW is the difference between average stock returns of the robust and weak portfolio. CMA is the difference between Conservative (low investment) and

Aggressive Portfolio (high investment). The two-pass regression is in line with Zhong (2017). This is express in equation 3.3.

$$\widehat{ri} = a_0 + a_1\widehat{\beta}mi + a_2\widehat{\beta}si + a_3\widehat{\beta}hi + a_4\widehat{\beta}ui + a_5\widehat{\beta}vi + wi \quad \text{...} 3.3$$

Where; $\widehat{ri}$ is the individual securities return, $\widehat{\beta}mi$ is market risk, $\widehat{\beta}si$ the size risk factor of individual securities, $\widehat{\beta}hi$ is the value risk factor of individual securities, $\widehat{\beta}ui$ is profitability risk factor of individual securities, $\widehat{\beta}vi$ is the investment risk factor of individual securities, a_2 represents the coefficient of size risk factor, a_3 represents coefficient of value risk factor, a_4 is the coefficient of profitability risk factor, a_5 is coefficient of investment risk factor, a_0 is the intercept and a_1 is coefficient of the market risk. The model can be transformed to co-skewness FF5F by introducing the systematic co-skewness risk and this stated below:

$$\widehat{ri} = a_0 + a_1\widehat{\beta}mi + a_2\widehat{\beta}si + a_3\widehat{\beta}hi + a_4\widehat{\beta}ui + a_5\widehat{\beta}vi + a_6\widehat{\beta}ski + wi \quad \text{...} 3.4$$

Where $\widehat{\beta}ski$ the coskewness risk factor of individual securities is, a_6 represents coefficient of coskewness risk factor. The coskewness is measure as;

$$\beta sk = \frac{Cov\left(R_i,\ R_m^{\ 2}\right)}{E\left[\left(R_m - E\left(R_m\right)\right)^3\right]} \quad \text{..} 3.4b$$

Where; β_{sk} is the sensitivity of asset return to skewness in the market, R_i is the excess return which is (R_i-R_f), R_m^2 is the square of excess market return which is $(R_m\text{-}R_f)^2$ and $E(R_m)$ represents mean of the market return. This measure is in line with the measure of Oyedeko, Zubairu and Samson, (2021). Also, the model can transform to higher moment by introducing systematic co-kurtosis risk and the model is specified below:

$$\widehat{ri} = a_0 + a_1\widehat{\beta}mi + a_2\widehat{\beta}si + a_3\widehat{\beta}hi + a_4\widehat{\beta}ui + a_5\widehat{\beta}vi + a_6\widehat{\beta}ski + a_7\widehat{\beta}kti + wi \quad \text{...............................} 3.5a$$

Where $\widehat{\beta}skt$ the cokurtosis risk factor of individual securities is, represents coefficient of cokurtosis risk factor. The measurement of cokurtosis is in line with the measure of Oyedeko, Zubairu and Samson, (2021) and it is specified as

$$\beta kt = \frac{Cov\left(R_i,\ R_m^{\ 3}\right)}{E\left[\left(R_m - E\left(R_m\right)\right)^4\right]} \quad \text{..} 5b$$

This study sorted the portfolio based on 2x2 which in line with Fama-French (2015), Adaramola and Oyedeko (2022). Data was sorted based on size and book to market ratio, size and operating income, size, and investment. This procedure is summarized in the Table 1.

Table 1. Portfolio Factors and Their Components

Sort Break points Factors and components
2*2 sorts on
Size: Median
SMB = (SH + SL + SR + SW +SC + SA)/6
- (BH+BL+BR +BW + BC+BA)/6
Value: Median
HML= (SH+BH)/2 - (SL +BL)/2
Profitability: MedianRMW= (SR+BR)/2 - (SW +BW)/2
Investment: Median
CMA= (SC + BC)/2 - (SA+ BA)/2

Note: big (B) and low (L) market capitalization, high (H) and low (L) value, robust (R) and weak (W) profitability and conservative (C) and aggressive (A) investment.
Source: Author's Computation, (2022)

4. Results and Discussion

This section presents the descriptive, interpretation of result and discussion of findings. The study starts with estimation of the model and diagnostic tests

Table 2. Descriptive Statistics

Stat	AVR	B	S	H	R	C01	CKT	CSK	ID5F
Mean	0.0140	0.7178	-0.0978	-0.3586	0.1303	0.1803	0.7559	0.6791	0.1656
Med.	0.0110	0.7492	-0.1222	-0.3604	0.1582	0.0879	0.4287	0.5613	0.1324
Max.	0.0925	2.0136	2.0784	9.2819	8.1219	8.6963	8.1652	4.0548	0.7770
Mini.	-0.0067	-0.1992	-4.7910	-12.716	-5.9377	-3.3408	-0.0079	0.0123	0.0470
St.Dev	0.0169	0.4070	0.8074	1.8303	1.2488	1.2702	1.2734	0.7128	0.1243
Skew.	2.7413	0.5007	-1.9355	-1.8597	1.3767	4.1196	4.1012	2.3523	3.1021
Kurt.	12.246	3.5902	14.374	32.637	26.536	28.904	23.031	10.958	13.068
J.Bera	433.32	5.0679	541.32	3345.7	2105.8	2771.0	1757.0	320.5	524.48
Prob.	0.0000	0.0793	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Authors' Computation, (2022).

The results shown in Table 2 shows the average values of average return, and estimated risk premium. It is obvious that average return tends to rise with market premium, profitability premium, investment premium, unsystematic risk, systematic coskewness risk and cokurtosis risk. The size and value premiums, on the other hand, tend to decline during the sampling. The return value ranges from -0.006740 to 0.092572, suggesting that there are patterns for capital losses and gains during the study period in market trading activity. This shows that there are active securities on the market. The market premium has values between -0.199242 and 2.013677. The co-skewness tends to be less volatile than the market at some points in time, but more volatile at other points in time, according to the value premium, which ranges from -4.791040 to 2.078426. This is implied by the fact that the profitability value ranges from -5.937704 to 8.121966. The value of the investment premium lies between -3.340886 and 8.696328. The kurtosis and skewness of the asset return ranges from -0.0079 to 8.1652 and 0.0123 to 4.0548 respectively. The value risk premium is the variable with the highest standard deviation, according to the table, while the average return has the lowest standard deviation. The skewness score shows that all unsystematic risk, as well as systematic risk, profitability risk premium, investment risk premium, and average return, are positively skewed, but size and value risk premia are negatively skewed. Kurtosis scores suggest that the variables are platykurtic in nature and are not normally distributed, as shown by the associated Jarque bera probability values, necessitating the inclusion of a larger moment of return. After defining the properties of the variables in terms of their average return for each portfolio and projected risk premium, the study next conducts a correlation analysis to demonstrate whether or not the variables support the concept of multicollinearity.

Table 3. Correlation Analysis

	B	S	H	R	C01	CKT	CSK
B	1	-0.49643	-0.2753	0.0907	0.4218	0.6215	0.0354
S	-0.4964	1	0.6365	-0.4981	-0.2365	-0.3999	-0.4707
H	-0.2753	0.6365	1	-0.6341	-0.1417	-0.1781	-0.2265
R	0.0907	-0.4981	-0.8341	1	0.2311	0.0571	0.0552
C01	0.4218	-0.2365	-0.1417	0.2311	1	0.7410	0.6155
CKT	0.6215	-0.3999	-0.1781	0.0571	0.7410	1	0.0645
CSK	0.0354	-0.4707	-0.2265	0.0552	0.6155	0.0645	1

Source: Authors' Computation, (2022)

The output of the correlation matrix shows that there is no perfect collinearity among the variables. The highest coefficients of correlation among the variables exist between the cokurtosis risk and investment risk. This is strong but does not indicate perfect collinearity between the variables. Thus, the study refutes the problem of multicollinearity among the variables. The variables can be subjected to further estimation.

Table 4. Higher-Order Moment Systematic Risks in the Nigerian Stock Market Using Moment-CAPM

Variables	**CAPM**	**C0CAPM**	**HMCAPM**
α	0.007386	0.026188	0.023687
	(2.074106)	(0.004081)	(0.004709}
	[0.0410]	[0.0000]	[0.0000]
b	0.009325	-0.052657	-0.039964
	(2.158212)	(0.010034)	(0.015599)
	[0.0336]	[0.0000]	[0.0121]
csk		0.037830	0.026762
		(0.005729)	(0.011890)
		[0.0000]	[0.0269]
ckt			0.000417
	(0.000393)		
			[0.2911]
R^2	0.050270	0.367340	0.375533

Adj- R^2	0.039477	0.352796	0.353749
P(F-Stat)	0.033634	0.00000	0.000000
Diagnostic test			
LM Test	2.834	10.299	1.697592
	[0.0643]	[0.1126]	[0.1323]
BPG Test	1.976	0.007127	0.004143
	[0.1633]	[0.9964]	[0.9996]
JB	314.9738	968.7477	1004.212
	[0.0000]	[0.0000]	[0.0000]

Note: The figures in parentheses () are the standard error and the one in square brackets [] are the probability values.
Source: Author's Computation, (2022)

According to the findings of the estimate, both the alpha value and the systematic risk have a constructive impact that is also statistically significant on the return calculated using the CAPM. This indicates that the intercept, also known as alpha, is considerably different from zero, which is in direct opposition to the CAPM's underlying premise. The conclusion that can be drawn from the observations is that both the slope and risk-return trade-off hypotheses are correct. The coefficient of determination is 0.050270, and the related F-statistics value is 0.033634. As a direct consequence of this, the CAPM model's applicability to the Nigerian stock market is severely limited. The results of the three-moment estimate showed that the alpha value and the coefficient of coskewness risk have a substantial positive influence on return, but the systematic risk has a significant negative effect on return. Considering this, it can be deduced that the systematic and coskewness risks are included into the prices of the stocks traded on the Nigerian stock market. In addition, the coefficient of determination is found to be 0.367340, with a probability of 0.000 being connected with it. This indicates that the model is accurate and that it is feasible to extract generalizations from the data. The outcome of the estimate demonstrates an increase in the value of the adjusted coefficient when compared with the two-moment estimation (CAPM), and this indicates that the incorporation of coskewness risk enhances the explanatory power of CAPM. In addition, the estimate of the four-moment CAPM shows that the coefficient of alpha risk and the coskewness risk have a substantial positive influence on return, but the systematic risk has a large negative effect on return. Additionally, the results of the estimate suggest that the coefficient of cokurtosis risk has a positive influence that is negligible on return. This indicates that the systematic risk and the coskwness risk are both considerably priced in the Nigerian stock market, however the cokurtosis risk is not significantly priced in the Nigerian stock market. The addition of cokurtosis, on the other hand, lends the three-moment CAPM a somewhat more effective capacity for explanation. In addition, the coefficient of determination demonstrates that the model is accurate and that inferences on potential generalizations may be drawn from this accuracy. The research goes on to conduct diagnostic tests to validate the model. These tests demonstrate that erial correlation, heteroskedastic test, and normality test were used to check the effectiveness of the cross-sectional version of the model. Validation of the model was successful. According to the findings of the research, the models' residuals agree with the assumption that there is no autocorrelation. This is because the associated probability values of the statistics are greater than 0.05 for each model. This satisfies the a priori expectation that was derived from the models. Because the probability values of the statistics are greater than 0.05, we may conclude that the assumption of homoscedasticity has not been violated by any of the models. This indicates that the residuals of the models remain the same throughout the course of time. Nevertheless, the normality assumption does not hold true for any of the models since the probability values are more than 0.05 and do not meet the threshold.

Table 5. Higher-Order Moment Systematic Risks in the Nigerian Stock Market Using Moment-FF3F

Moment-FF3F

Variables	FF3F	C0FF3F	HMFF3F
α	0.010949	0.028536	0.027241
	(2.704995)	(0.004151)	(0.004760)
	[0.0082]	[0.0000]	[0.0000]
b	0.003693	-0.057933	-0.048101
	(0.720594)	(0.009885)	(0.020086)
	[0.4731]	[0.0000]	[0.0189]
s	-0.006145	-0.001560	-0.002220
	(-1.355816)	(0.003718)	(0.003912)
	[0.1787]	[0.6758]	[0.5719]
h	0.000340	-0.001701	-0.001476
	(0.188030)	(0.001487)	(0.001546)
	[0.8513]	[0.2558]	[0.3424]
Csk		0.038827	0.024909
		(0.005657)	(0.025365)
		[0.0000]	[0.3289]
Ckt			0.004902
			(0.008707)
			[0.5749]
R^2	0.101208	0.421715	0.423888
Adj- R^2	0.069854	0.394501	0.389596
P(F-Stat)	0.026395	0.000000	0.000000
Diagnostic Test			
LM Test	2.198	1.889995	1.882924
	[0.1173]	[0.0928]	[0.0942]
BPG Test	3.414	1.300375	1.155727
	[0.2010]	[0.2765]	[0.3379]
JB	314.9738	594.1654	593.7116
	[0.0000]	[0.0000]	[0.0000]

Note: The figures in parentheses () are the standard error and the one in square brackets [] are the probability values.

Source: Author's Computation, (2022)

The FF3F results show that the intercept is significant at 5 per cent, whereas the market risk, size risk, and value risk are not significant at 5percent. This implies that in the Nigerian stock market, market risk, size risk, and value risk are not significantly priced. As a result, the Nigerian stock market does not compensate investors for taking such risks. The results also show that market risk and value risk have a positive effect on expected return while size risk has a negative effect. The coefficient of determination of the model is 0.101208 with associated probability value of 0.026395 and this implies that the model is fit and generalization can be deduced. Under the coskewness Fama-French three factor model, the coefficients of alpha value and coskewness risk have positive significant effect on return while the systematic risk has negative significant effect on return. This denotes that coskewness risk is significantly priced in the Nigerian stock market. Also, the result reveals that the size and value risks have negative insignificant effect on return. The adjusted coefficient shows that the introduction of coskewness risk improves the explanatory power of Fama-french three-factor model and the risk is significantly priced in the Nigerian stock market. Also, the coefficient of determination reveals that the model is fit. The estimation of cokurtosis Fama-French three factor model shows that the coefficient of alpha value has positive significant effect on return while the coskewness and cokurtosis risk have positive insignificant effect on return. However, the coefficient of systematic risk has negative but insignificant effect on risk while the coefficients of size and value have negative but insignificant effect on return. The result revealed that the cokurtosis risk is not significantly priced in the Nigerian stock market. In addition, the introduction of cokurtosis does not improves the explanatory power of coskewness Fama-French three-factor model. The model is fit and possible generalization can be deduced. The diagnostic test is used in the study, and it is determined that serial correlation, heteroskedastic test, and normalcy test may be used to assess the utility of the model's cross-sectional version. The analysis shows that the residuals of the models fulfill the condition of no autocorrelation since their associated statistical probability values for each model are larger than 0.05. This corresponds to the models' a priori predictions. Because the statistical probability values are larger than 0.05, the assumption of homoscedasticity is not violated in any of the models. This suggests that the model residuals remain constant across time. However, since the probability values are smaller than 0.05, the normality assumption does not hold true for any model.

Table 6. Higher-Order Moment Systematic Risks in the Nigerian Stock Market Using Moment-FF5F

Variables		**FF5F**			**CoFF5F**			**HMFF5F**	
α		0.0136			0.0318			0.0280	
\	(3.3754)		(0.0044)			(0.0047)			
[0.0011]	[0.0000]			[0.0000]					
b		-0.0019		-0.0735				-0.0411	
(-0.3652)	(0.0122)			(0.0198)					
[0.7159]	[0.0000]			[0.0413]					
s		-0.0008		-0.0022				-0.0043	
(-0.0008)	(0.0049)			(0.0049)					
[0.8881]	[0.6457]			[0.3875]					
h		-0.0040		-0.0006				-5.33E-05	
(-1.0294)	(0.0033)			(0.0032)					
[0.3062]	[0.8541]			[0.9870]					
r		-0.0045		0.0018				0.0018	
(-1.2429)	(0.0032)			(0.0031)					
[0.2173]	[0.5683]			[0.5620]					
c		0.0050			-0.0040			-0.0062	
(3.0941)	(0.0019)			(0.0022)					
[0.0027]	[0.0432]			[0.0061]					
Csk					0.0517			0.0008	
(0.0082)		(0.0261)							
[0.0000]		[0.9742]							
ckt									0.0204
(0.0099)									
[0.0434]									
R^2		0.1936			0.4521			0.4789	
Adj- R^2		0.1456		0.4125					0.4344
P(F-Stat)	0.0024			0.0000				0.0000	
Diagnostic Test									
LM Test	3.0669			9.5839				9.2077	
[0.0519]	[0.1481]			[0.0561]					
BPG Test	13.086			4.6562				7.2886	
[0.1226]	[0.5886]			[0.3995]					
J.B		724.4187		121.5930			53.5643		
[0.0000]	[0.0000]			[0.0000]					

Note: FF5F, CoFF5F and HMFF5F mean Fama-French five-factor, Coskewness Fama-French five-Factor and Higher moment Fama-French Five-factor respectively.

Source: Author's Computation, (2022)

The result of the FF5F estimation shows that the coefficient of alpha is 0.0136 and the associated with a P-value of 0.0011, the threshold of significance is less than 5%. This refutes the intercept's assumption that it should be in equilibrium with the risk-free rate or not diverge significantly from zero. The market systematic risk has a -0.0019 coefficient and a probability value of 0.7159. This suggests that the systemic danger is underestimated. Both the positive risk-return trade-off and the slope hypothesis are debunked. Non-market variables such as size, value, profitability, and investment have co-efficients of -0.0008, -0.0040, -0.0045, and 0.0050, with corresponding probability values of 0.8881, 0.3062, 0.2173, and 0.0027, respectively. This implies that, although investment risk has a significant positive influence on return, size, value, and profitability risks have negative and insignificant impacts. Furthermore, the FF5F coskewness calculation revealed that the coefficient of alpha is 0.0318 with a probability value of 0.0000, which is less than the 0.05 significance level. This disproves the intercept idea. Furthermore, the results show that the systematic risk, size, value, profitability, investment, and systematic coskewness risks all have coefficients of -0.0735, -0.0022, -0.0006, -0.0018, -0.0040, and 0.0517, with corresponding probability values of 0.0000, 0.6457, 0.8541, 0.5683, 0.0432, and 0.0000, respectively. This shows that size and value hazards have insignificant positive influence on return, but systematic risk and investment risk have a significant negative impact. The results also show that, whereas systematic coskewness risk has a significant positive influence on return, profitability risk has a minor positive impact. Under the higher moment FF5F model, the coefficients of alpha, systematic risk, size, value, profitability, investment, systematic coskewness risk, and systematic cokurtosis risk are 0.0280, -0.0411, -0.0043, -5.33E-05, 0.0018, -0.0062, 0.0008, and 0.0204, respectively. These numbers equate to probabilities of 0.0000, 0.0413, 0.3875, 0.9870, 0.5620, and 0.00. This shows that, whereas profitability and systematic coskewness risk have minor beneficial influence on return, alpha value and systematic cokurtosis risk have a significant positive effect. However, the results revealed that systematic risk and investment risk have a significant negative influence on return, but size and value hazards had a minimal impact. Greater moment FF5F has superior explanatory power than FF5F and Co-skewness FF5F, according to the modified co-efficient of determination. Furthermore, the probability of F-statistics is demonstrated to be significant at 5% for each pricing model, demonstrating that the models are significant at 5%. The greater moment FF5F model is therefore preferred in examining the risk-return relationship with an emphasis on systematic risk.

Therefore, diagnostic tests are done to check the model and draw generalizations from the model. Serial correlation, the heteroskedastic test, and the normality test were used to assess the performance of the cross-sectional version of the model. The analysis demonstrates that the residuals of the models fulfill the criteria of no autocorrelation since the corresponding probability values for the statistics for each model are greater than 0.05. This is consistent with what the models projected in advance. The homoscedastic assumption is not violated by any of the models since the probability values of the statistics are greater than 0.05. This implies that the residuals of the model are stable over time. However, since the probability values for each model are less than 0.05, the normality condition is violated.

4.1. Discussion of Findings

Evidence from the result revealed that coskewness risk has positive large effect on return under the three-moment factor CAPM, four-moment FF3F and six-moment FF5F. This shows that the coskewness risk is well priced in the Nigerian stock market and this suggests that coskewness risk is rewarded. This correspond with the findings of Ajibola, et al (2015), Man (2017), Chamadia, et al (2021) among others who showed that coskewness risk is strongly priced in the stock market and it explains the variation in stock return. Also, this result was strengthened by the fact that the introduction of coskewness risk considerably boosts the explanatory powers of the standard CAPM, FF3F and FF5F models. The relevance of this is that three-moment factor CAPM surpasses the CAPM, four-moment FF3F exceed the FF3F model and six-moment FF5F beat the FF5F model. Also, it was observed that the cokurtosis risk has positive big impact on return under the seven-moment FF5F but the cokurtosis risk has positive minimal effect on return under three-moment factor CAPM, four-moment FF3F. This implies that the cokurtosis has mixed impact on return and this matches to the conclusions of Besther (2016), Elyasiani, et al (2018) among others.

5. Conclusion and Recommendation

The purpose of this study is to analyze the effect of higher-order moment systematic risks on stock return employing Moment-CAPM, Moment-FF3F and Moment-FF5F in the Nigerian stock market. The study sample 90 stocks listed on the Nigerian Group of Exchange as of December 2020. The study covers the period of January 2005 to December 2020 and Fama-MacBeth regression was applied as the estimating technique. Evidence from the result revealed that coskewness risk has positive large effect on return under the three-moment factor CAPM, four-moment FF3F and six-moment FF5F. This implies that the coskewness risk is highly priced in the Nigerian stock market and this suggests that coskewness risk demand premium. Also, this finding was strengthened by the fact that the introduction of coskewness risk considerably boosts the explanatory powers of the standard CAPM, FF3F and FF5F models. However, it was observed that the cokurtosis risk has positive considerable impact on return under the seven-moment FF5F while the cokurtosis risk has positive insignificant effect on return under three-moment factor CAPM, four-moment FF3F. In light of this, the study suggested that bigger moment systematic risks are also predictors of asset return in the Nigerian stock market which must be taken into consideration in risk-return decision making process. Thus, the study reveals that in the process of making investment decision, the investors should keep positive skewness risk factor as it would enhance the projected return and negative kurtosis which has positive effect on stock return. One of the shortcomings of the study is that it fails to include Moment-Fama French four-Factor model (Moment-FF4F) within the model estimate. The paper indicates that further researches should be carried out on the influence of higher-order moment systematic risk on return in Nigerian stock market utilizing Moment-FF4F.

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