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Effect of Capital Expenditure on Idiosyncratic Volatility of Stock Returns at the NSE in Kenya

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Abstract:
The Nairobi Securities Exchange (NSE) provides a platform for investors to stake their money for a return, for businesses to raise equity capital and for the government to mobilize resources to attain national development goals and fulfill Vision 2030 development blueprint in Kenya. Despite the importance of NSE both locally and regionally, volatility of stock returns in the market has been a common phenomenon for the past 8 years. This is evidenced by a continuous decline in the NSE 20 share index from 5,406 points in 2014 to 1,672 points in 2022. Studies have shown that at equilibrium, only systematic risk is priced since all the unsystematic risks can completely be eliminated through diversification and therefore do not affect the overall volatility of stock returns. However, empirical evidence shows that investors may fail to hold a fully diversified portfolio, leading to the need for idiosyncratic risk premium in the pricing of stocks, without which idiosyncratic risks will be major contributors to the overall volatility of stock returns at the NSE. Past literature has shown that for investors who do not hold fully diversified portfolios, firm-specific risks associated with high managerial strength, intangible assets, environmental disclosure, firm size, liquidity, dividend policy and cash flow to price all have a significant effect on firm-specific volatility of stock returns. The effects of Idiosyncratic risks associated with capital expenditure on firm-specific volatility of stock returns at the NSE have not been studied previously. This study sought to examine the effect of capital expenditure on firm-specific volatility of stock returns. The Efficient Market Hypothesis, Modern Portfolio Theory and Fama & French three-factor model informed the study. The research employed a quantitative approach with a correlational research design using secondary data. Firms forming the NSE 25 share index formed the target population (N = 25), with annual data for 10 years from 2010 to 2019, yielding 250 data points. Fixed effects dynamic panel data regression model was used to analyse data. The results showed a positive and significant relationship between Capital expenditure (CAPIT: β = 0.024737, p = 0.0000. Earnings Quality, the moderating variable, strengthened and had a positive and significant effect on the overall model and the relationship increasing R^2 from 74.2096% to 85.7798%. The study concludes that capital expenditure (CAPIT) is a significant positive predictor of stock return volatility is recommended that NSE-listed firms should decrease their capital expenditure, use more internal sources of finance and focus more on wealth maximization objectives to reduce the volatility of stock returns. These findings may be useful to policymakers and academia in designing models which capture firm-specific risks in stock pricing to reduce stock return volatility for firms at the NSE.

Keywords: *Capital expenditure, idiosyncratic volatility of stock returns*

1. Introduction

Firm-specific volatility of stock returns is the measure of the level of turbulence of stock returns of listed firms occasioned by the presence of firm-specific risks. Stock return volatility of a specific firm at any given period can be expressed as a function of market shocks, firm-specific risks and volatility in the respective stock in the previous period (Laibon, 2020). Firm-specific risks, also known as Idiosyncratic risks, refer to the risks inherent to a specific firm. At equilibrium, investors can eliminate idiosyncratic risks through diversification, where an investor holds the right mix of stocks, which reduces risk without reducing the return received. This is in line with the modern portfolio theory (Markowitz, 1952) and the Capital Asset Pricing Model (CAPM) concept (Sharpe, 1964; Litner, 1965; Mossin, 1966). Authors such as Hartono (2017) gave support to the Markowitz diversification method as a useful tool in reducing idiosyncratic risk. Merton (1987) and Malkiel and Xu (2006) have posited that the idiosyncratic risk-expected returns relationship is dependent on the extent to which investors hold diversified portfolios. Highly diversified portfolios reduce the amount of idiosyncratic risk incorporated in their expected stock returns and vice-versa.

Numerous studies have shown that 35-50 stocks are required for optimum diversification effect (Bradfield & Munro, 2017; Oyenubi, 2019; Kurtti, 2020 & Raju Agarwalla, 2021). However, investors fail to diversify fully, resulting in

the need for a risk premium in the expected rates of return to compensate for the undiversified risk (Scott, 2015; Rohmat W., & Amrie F., 2021). This implies that both systematic risk and firm-specific risk together affect investors' returns and need to be priced (Mathew et al., 2018; Rasheed et al., 2019; Shahzad et al., 2020).

Numerous empirical studies on the relationship between capital expenditure and the volatility of stock returns have been carried out, albeit with many shortcomings. While Erwei et al. (2020) and Clark et al. (20201) found a positive relation between capital expenditure and volatility of stock returns, Takashi et al. (2022) and Chih et al. (2017) found a negative relationship. They both used R&D as a measure of capital expenditure. The entire capital expenditure of the firm as measured by the capital expenditure ratio, capital expenditure to depreciation ratio or capital expenditure intensity ratio was not considered. These studies also failed to capture asymmetric volatility response to information and time-varying properties of idiosyncratic volatility of stock returns. Some studies, such as Li et al. (2019) and Ching et al. (2022), did not directly link capital expenditure to the volatility of stock returns, while others have omitted firm years with large acquisitions, making them biased. Also, the data used in past studies has been obtained from developed markets outside Africa and it is not yet known whether their results can apply in the frontier markets in Africa, such as the NSE, which are faced with huge capital demands posed by existence of high growth opportunities and high expansionary activities. Thus, the effects of idiosyncratic risks associated with the firm's overall corporate investment, measured by its entire capital expenditure, on the volatility of the firm's stock returns are not yet known.

2. Literature Review

Takashi, Kentaro and Clinton (2022) did a study on whether firm-level productivity predicts stock returns. The results showed that the idiosyncratic total factor productivity positively predicts their future stock returns when relevant risk factors are controlled, together with those in the FF3F model. Interestingly, the study found that Risks associated with research and development (R&D) explain a substantial fraction of the predictive power of firm-level TFP. However, risks associated with the entire capital expenditure were found not to have any predictive power on stock returns. Firms with high productivity were found to trade at a substantive premium compared to firms with low productivity. The study fell short of linking directly the entire capital expenditure of the firms, measured by CAPIT, and the firm's volatility of stock returns. The sampled firms included only Japanese manufacturing firms, which excluded other sectors of the economy, making the study findings biased.

LI, HOU & Zhang (2019) found that idiosyncratic volatility is negatively correlated to the ratio of intangible assets to total assets, which is consistent with the theoretical predictions of the IC model. They further constructed different subsamples by dividing the dataset based on the factors of idiosyncratic volatility and the firm-level ratio of intangible assets to total assets, respectively. In addition, they demonstrated the explanatory power of intangible assets with regard to the idiosyncratic volatility puzzle for firms with idiosyncratic volatility and firms with high intangible asset ratios. This study did not consider the causality effect of IC investments on firm-specific volatility of stock returns. IC does not represent the total capital expenditure of the firms.

The study by Erwei, Dominic, Grant & Wenjuan (2020) showed that the relation between the volatility of R&D expenditure and stock return may be moderated by disruptive adjustment costs, emerge from earnings management, or reflect the actions of managers attempting to control the overinvestment of technocrats. Using a sample of 5,178 publicly listed US firms from 1980 to 2018, they found a negative relation between R&D volatility and return, which is moderated by firm size. They concluded that investors react negatively to the disruptive effect of changes to R&D expenditure, except for small firms. In small firms, the benefit of the governance mechanism of varying R&D expenditure to control overinvestment outweighs the cost of disruption. The study used R&D as a measure of total capital expenditure and also did not relate R&D with stock return volatility. The current study used total capital expenditure as the independent variable and stock return volatility as the dependent variable. The GARCH model was used to capture asymmetric volatility response to information and time-varying properties of idiosyncratic volatility of stock returns.

The study by Ching, Chih, Ruey & Hsin (2022) examined convertible bond issue announcement effects in Korea from 2000 to 2015. Their empirical results showed that convertible bond issues have significantly positive cumulative abnormal returns (CARs) around the announcement. Higher CARs were recorded by firms indicating that capital expenditure was the use of the proceeds of the issue. This indicates that investors react positively to the information about capital expenditure leading to CARs in the short run. In addition, they found that CARs are more likely to be positive for smaller firms where asymmetric information occurs more from the new investment opportunities than from the assets-in-place, which is consistent with the generalized Myers-Majluf model (Myers & Majluf, 1984). This study linked bond issues, capital expenditure and abnormal returns but failed to explain the influence of capital expenditure on the overall volatility of stock returns. The study used qualitative data with regards to capital expenditure and thus, the effect of capital expenditure on volatility of stock returns could not be determined quantitatively. The current study employs a quantitative approach to determining the effect of capital expenditure on the volatility of stock returns at the NSE.

Chih-Chiang and Wei-Peng (2017) examined the impact of research and development (R&D) expenditures on idiosyncratic risk. They focused primarily on R&D expenditures, which is a large and fast-growing corporate capital expenditure aimed at enhancing the firm's innovation capability. The empirical results show that R&D expenditures are significantly and positively associated with absolute idiosyncratic volatility of stock returns for firms. Overall, the adj. R^2 was 50%. This study considered the impact of only research and development expenditure on idiosyncratic risk. The study did not account for asymmetric volatility response to information and time-varying properties of idiosyncratic volatility. The current study measured the total capital expenditure as CAPIT and captured the time-varying properties of idiosyncratic volatility using the GARCH model.

Clark and Shujing (2021) evaluated the moderating effect of growth options on the negative relation between corporate investment and idiosyncratic risk in the absence of agency problems. They sampled all listed firms in CompStat with fiscal years ranging from 1967 to 2017. They eliminated firms with headquarters outside the USA and with format codes 4, 5 and 6. They also eliminated firm–years with large acquisitions. They also excluded firms in financial, utility, and government-regulated industries. The final sample had 124,314 firm–year observations. They found a negative relationship between corporate investments and idiosyncratic risk. Growth options increased the strength of the relationship between investments and idiosyncratic risks. Their results remained robust even after they controlled for managerial risk aversion, suggesting the importance of firms' optimal decisions under uncertainty in explaining the negative relation between corporate investment and idiosyncratic risk. This study omitted firm-years with large acquisitions making it a biased study. Despite the fact that the study posits a strong relationship between corporate investment and idiosyncratic risk, it is not clear to what extent this risk affects the idiosyncratic volatility of stock returns.

The empirical literature on the relationship between capital expenditure and volatility of stock returns shows diverse results. While Erwei et al. (2020) and Clark et al. (20201) found a positive relation between capital expenditure and volatility of stock returns, Takashi et al. (2022) and Chih et al. (2017) found a negative relationship. They both used R&D as a measure of capital expenditure. The entire capital expenditure of the firm as measured by the capital expenditure ratio, capital expenditure to depreciation ratio or capital expenditure intensity ratio was not considered. Other studies, such as Li et al. (2019) and Ching et al. (2022), did not directly link capital expenditure to the volatility of stock returns and also did not capture the element of volatility clustering. Other studies reviewed were qualitative rather than quantitative.

3. Methodology

3.1. Research Design

In the broad sense, this study embraced a quantitative research design. More specifically, the study used a Correlational research design using secondary data sourced from financial statements of companies listed on the NSE and other relevant market data.

3.2. Target Population

The target population for this study comprised firms forming the NSE 25 share index, which were continuously listed during the period 1st January 2010 to 31st December 2019. NSE is the only stock market in Kenya where the listing of companies is done. Firms listed at NSE were considered since they are required by law to publish their annual audited financial reports making the relevant data to be collected authentic and readily available. This study was designed to cover a period of 10 years from 1st January 2010 to 31st December 2019.

3.3. Data Reliability

Reliability refers to the internal consistency of the collected data, allowing the data to maintain some form of internal consistent pattern (Creswell & Plano, 2007). Ascertaining reliability is important as this guarantees consistency or stability of the data even when the test is repeated. Preliminary reliability assurance emanated from the fact that this study used secondary data from audited financial statements prepared in line with Generally Accepted Accounting Principles (GAAPs) (Mule & Mukras, 2015; Kenyanya & Ombok, 2018). According to Field (2000), secondary panel data is considered reliable if it is stationary. Unit root test was conducted using the Levin Lin and Chun (LLC) test to determine whether the variables series were stationary or non-stationary. The LLC test results presented in table 1 below indicate that all variables series are stationary at the first difference (absence of unit roots) both at 1% and at 5% level of significance.

			Cross-	
Method	**Statistic**	**Prob.****	**Sections**	**Obs**
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-36.4174	0.0000	7	1660
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-43.6489	0.0000	7	1660
ADF - Fisher Chi-square	826.520	0.0000	7	1660
PP - Fisher Chi-square	776.686	0.0000	7	1666

Table 1: Panel Unit Root Test Results for the Study Variables
*** Probabilities for Fisher Tests Are Computed Using an Asymptotic Chi-Square Distribution, All Other Tests Assume Asymptotic Normality.*
Source: Research Data, 2023

3.4. Model Specification

The Fama and French Three-Factor Model:

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}(R_{m,t} - R_{f,t}) + s_{i,t}SMB_t + h_{i,t}HML_t + \varepsilon_{i,t}, \quad \varepsilon \sim N(0, \sigma_{i,t}^2) \ldots\ldots (3.11)$$

Where: $R_{f,t}$ is the risk-free rate, $R_{m,t}$ is the market return for period t; $\alpha_{i,t}$ the stock's alpha, or abnormal return at a time t; $\beta_{i,t}$ is the stocks' sensitivity to the market return at a time t; SMB_t and HML_t represent the portfolios' sensitivity to size and value respectively; and s_{it} and h_{it} are the coefficients related to each factor. $R_{i,t} - R_{m,t}$ is the excess return on the

stock i at time t and $R_{m\,t} - R_{f,\,t}$ is the excess returns on the market and $\varepsilon_{i,t}$ are the residual terms relating to security *i* at a time t.

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model:

$$\sigma_{i,t}^2 = \omega + \alpha\varepsilon_{i,t}^2 + \beta\sigma_{t-1}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (3.14)$$

Where: $\boldsymbol{\omega}$ is the intercept, $\boldsymbol{\alpha}$ is the coefficient for the variance of the residual and $\boldsymbol{\beta}$ is the loading on the conditional variance estimate at time t - 1. In the next sub-section, the study details the test framework where firm-specific dispersion is specified as $\boldsymbol{\varepsilon_{i,t}}$ and describes the computation of firm-specific volatility based on $\boldsymbol{\sigma^2_{i,t}}$. The parameters of the GARCH (1,1) process must be non-negative ($\boldsymbol{\omega \geq 0}$, $\alpha \geq 0, \beta \geq 0$) to ensure that $\boldsymbol{\sigma_{i,t}^2}$ is positive for all values of the white noise process $\boldsymbol{\varepsilon_{i,t}}$. The new information at time $\boldsymbol{t}$ is embodied in the ARCH term, the squared residual, $\boldsymbol{\varepsilon_{i,t}^2}$. The carrier of the old information at time ***t-1*** is the GARCH term, $\boldsymbol{\sigma_{t-1}^2}$ (Rachev et al., 2008). The persistence of shocks to volatility becomes greater as the sum ($\boldsymbol{\alpha + \beta}$) approaches unity.

3.5. Empirical Model

A dynamic panel data regression model was employed in this study to assess the effect of capital expenditure, financial gearing, profitability and earnings quality on idiosyncratic volatility of stock returns of NSE-listed firms' securities. Dynamic panel data is autoregressive; it contains one or more lagged effects of the dependent variable on itself. In line with the study of Hsiao (2003), the Panel data contained observations for CAPIT was obtained over a ten-year period for each of the 24 firms.

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 Y_{i,(t-1)} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.15)$$

Where: $Y_{i,t}$ represents the dependent variable which denotes idiosyncratic volatility of stock returns of firm i at time t; i denotes individual firm, i = 1,… 24 while t is the period in years, t = 2010-2019; $X_{i,t}$ denotes a vector of independent variables, $Y_{i,(t-1)}$ denotes one period lag for idiosyncratic volatility for firm I; β_1 and β_2 are specific effects to be estimated, $\beta_0$is a constant term, and ε_{it} is a residual term. The following specific models are derived from the general model:

4. Results

4.1. Correlation Analysis between Capital Expenditure and Volatility of Stock Returns

Pearson's correlation analysis was performed to measure the strength of association between dependent and independent variables.

Included Observations: 240 Correlation		
Probability	**LNSRV**	**LNCAPIT**
LNSRV	1.000000	

LNCAPIT	0.517244	1.000000
	0.0000	-----

Table 2: Correlation Analysis of Capital Expenditure and Volatility of Stock Returns
Source: Research Data, 2023

The results in table 2 show a moderate positive and significant correlation between Capital Expenditure (CAPIT) and firm-specific volatility of stock returns (SRV) (r = 0.517244; p = 0.0000). This implies that a 51.7244% increase in Capital Expenditure by firms listed at NSE results in a corresponding increase of 51.7244% in the volatility of the stock returns, the result, therefore, confirms that firms listed at the NSE could differ in idiosyncratic volatility of stock returns based on the total amount of resources directed towards corporate investments annually.

4.2. Effects of Capital Expenditure on Volatility of Stock Returns amongst Firms Listed at the NSE

To achieve the results for the first objective, a null hypothesis, H_{01}, assuming that Capital Expenditure has no significant effect on the volatility of stock returns among listed firms in Kenya, was formulated. Fixed effects regression analysis was conducted and the results are presented in table 3 below.

Dependent Variable: SRV				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.041688	0.010304	4.045731	0.0001
CAPIT	0.025937	0.004397	5.898765	0
SRV(-1)	0.669195	0.042598	15.70961	0
R-squared	0.62291	Mean dependent var		0.221339
Adjusted R-squared	0.619714	S.D. dependent var		0.120656
S.E. of regression	0.074405	Akaike info criterion		-2.34611
Sum squared resid	1.306532	Schwarz criterion		-2.30247
Log-likelihood	283.3596	Hannan-Quinn criter.		-2.32852
F-statistic	194.9223	Durbin-Watson stat		2.000039
Prob(F-statistic)	0			

Table 3: Effect of Capital Expenditure on Volatility of Stock Returns at the NSE
Source: Research Data, 2023

The results of the regression analysis in table 3 show that capital expenditure is a positive and significant predictor of stock return volatility at the NSE (β = 0.025937, p = 0.0000). This implies that a unit increase in capital Expenditure causes an increase in stock return volatility by 2.5937%. The result of the current study is in line with that of Takashi et al. (2022) and Chih et al. (2017), who found a positive and significant relationship between capital expenditure and stock returns. However, the two studies used R & D as a measure of capital expenditure and also failed to capture the asymmetric volatility response to information and time-varying properties of idiosyncratic volatility of stock returns. The current study analysed the relationship between total capital expenditure, measured by CAPIT, and idiosyncratic volatility of stock returns, measured as the standard deviation of residuals of Fama and French three-factor model. This accounted for market (β), size (SMB) and value (HML) factors. The current study captures all firm-years regardless of the magnitude of new acquisitions incurred in each particular year. Additionally, the current study uses the GARCH model, which allows for volatility clustering, to capture asymmetric volatility response to information and time-varying properties of Idiosyncratic volatility of stock returns.

The reported coefficient of determination (Adjusted R^2) of 0.619714 shows that capital expenditure, measured as Capital Intensity Ratio (CAPIT), together with the one-period lag volatility, will predict 61.9714% of firm-specific stock return volatility with other variables not included in the model predicting the remaining 38.0286%. This is an indication that the model is a good predictor of idiosyncratic volatility using capital expenditure as the independent variable. The result reveals that stocks from firms listed at the NSE could face different levels of volatility based on the proportion of resources allocated and utilized in corporate investment activities. These findings explain why aggregate firm-specific volatility of stock returns can increase even when aggregate market volatility remains the same over time, as posited by the study by Campbell (Campbell, 2001). This makes a strong case for pricing of idiosyncratic risks in the NSE listed firms' stocks since all the firms engage in corporate investment at different levels and at different time periods leading to varying levels of idiosyncratic volatility of stock returns. The resulting model 4.31, showing the Effect of Capital Expenditure on the volatility of stock returns at the NSE, is as follows:

$$SRV = 0.041688 + 0.025937\,CAPIT + 0.669195 SRV_{t-1} + \varepsilon_{i,t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.3)$$

The reported coefficient of determination (Adjusted R^2) of 0.619714 shows that capital expenditure, measured as Capital Intensity Ratio (CAPIT), together with the one-period lag volatility, will predict 61.9714% of firm-specific stock return volatility with other variables not included in the model predicting the remaining 38.0286%. The coefficient of determination measures the quality of the model and its linear approximation. A strong R^2 implies that the model is a good and significant predictor of firm-specific volatility of stock returns.

The hypothesis was tested using the simple linear regression represented in table 3 (above) and determined using its p-value. The acceptance/rejection criterion was that if the p-value is less than 0.05, H_{01} is rejected, but if it is more than 0.05, H_{01} is not rejected. The results in table 3 indicate that there was a positive and significant relationship between capital expenditure and Idiosyncratic Volatility of stock returns among listed firms in Kenya (β = 0.025937; p=0.0000). This was supported by a calculated t-statistic of 5.898765, which is greater than the critical t-statistic of 1.96. The null hypothesis, H_{01}, that Capital Expenditure has no significant effect on the volatility of stock returns among listed firms in Kenya is, therefore, rejected based on the findings. It is, therefore, concluded that capital expenditure has a significant effect on the volatility of stock returns among listed firms in Kenya.

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