

Market Risk and Returns: Evidence from the Nigerian Capital Market

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Abstract: The relationship between markets returns proxied by ‘betas’ and security returns is well established in the relevant extant literature. The objective of this paper is to provide evidence that this relationship holds in the Nigerian Capital Market. The study specifically examines market risk as defined in the Capital Asset Pricing Model (CAPM) as an explanatory variable for security returns in the Nigerian Capital Market. The model was tested with quarterly data for the period 2001 to 2005, using the most capitalized firms in the Nigerian Capital market. The findings confirm a positive linear relationship between market betas and security returns for the sampled Nigerian firms.

Keywords: Betas, capital asset pricing model

INTRODUCTION

The Capital Asset Pricing Model (CAPM) developed independently by many writers such as Sharpe (1964) and Lintner (1965) marks the birth of asset pricing theory. This theory is widely applied today, influencing the decisions of bankers, brokers, government agencies, and millions of investors worldwide. Their work explained how the weighing of risk and reward helps to determine securities prices; and how those prices depend on such factors as tax changes and bankruptcy risk (Showcase, 1997). Markowitz (1952) had focused on how investors use risk and return assessments in forming portfolios. His paper emphasized that diversification is required to obtain the optimal tradeoff between risk and return. Sharpe (1964) built on that work by developing the CAPM which explains how markets incorporate risk in pricing securities.

Before the breakthrough, there were no asset pricing models with clear testable predictions about risk and return. According to Fama and French (2003), “the attraction of the CAPM is its powerful simple logic and intuitively pleasing predictions about how to measure risk and about the relation between expected return and risk”. In about four decades after, the CAPM is still widely used in applications; such as estimating the cost of equity capital for firms and evaluating the performance of managed portfolio (Burton, 1998; Fama and French, 2003).

Most assets that we choose to invest in, financial as well as real have some exposure to risk. Financial theory and common sense tell us that those investments that are riskier require higher risk premium. Post

(Markowitz, 1952) models using risk-return parameters take the view that the relevant risk in an investment should be the risk perceived by a well diversified investor, and that the expected return should be a function of this risk measure ‘beta’. At one end, the capital asset pricing model measures the market risk with a beta (measured relative to a market portfolio), and at the end are multi-factor models that measure market risk using multiple betas estimated relative to different factors. The classical portfolio theory says that investors are risk averse and choose a portfolio with maximum risk adjusted return. Capital Asset Pricing Model (CAPM) gives the relationship between risk and expected return for a security.

Empirical tests of the CAPM in developed countries have had mixed results; security returns do appear to be positively related to their respective measured market ‘betas’, but not in the precise manner implied by the model (Elton and Gruber, 1997). Against this background, the study attempts to examine within CAPM the relationship between market risk proxied by beta and security returns using empirical evidence from the Nigerian Capital Market.

LITERATURE REVIEW

Investors base their investment decision on the expected return and risk of investments (Kevin, 2001). Risk is measured by the variability in returns and investors attempt to reduce that variability through the diversification of their investments. This results in the creation of portfolios from an infinite set of securities or assets. Among the portfolios, some are efficient while some are not. Investors identify the efficient set

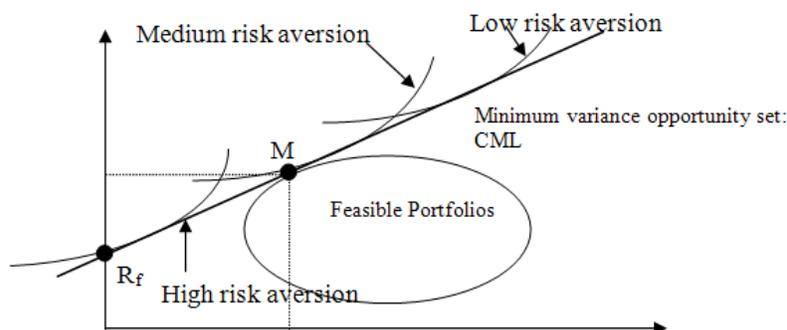


Fig. 1: Optimal combined portfolio choice for a risk averse investor with many risky assets and a risk free asset

of portfolio using the rule of maximizing expected return at a given risk level or minimizing expected risk given a return level. Diversification helps to reduce risk, but even a well-diversified portfolio does not become risk free (Markowitz, 1952; Kevin, 2001). Each diversified portfolio is still subject to variability which is not diversifiable known as systematic risk (beta risk). A rational investor would expect the return on a security to be commensurate with this risk. Thus, the standard CAPM gives the relationship between the expected return and the systematic risk of a security (Sharpe, 1964; Lintner, 1965; Mossin, 1966; Kerr, 1997; Reinganum, 1981; Vuolteenaho, 2002; Stambaugh, 1982; Elton *et al.*, 2007). However, other studies have relaxed the assumptions such as Elton and Gruber (1997), Breeden (1979), Pettit and Stanley (1979); The Arbitrage Pricing Theory of Ross (1976, 1977). Other supporting literature includes Breeden (1979), Osamwonyi and Tebekaemi (2007), Rosenberg *et al.* (1985), Roll (1997), Berk and Green (2004), Brock and Hommes (1998), Chiarella *et al.* (2006), Getmansky (2004), Grinold and Kahn (2000), Jensen (1969) and Litterman (2003).

Summary of the capital asset pricing model: The Capital Asset Pricing Model (CAPM) is an economic model for valuing stocks, securities, derivatives and/or assets by relating risk and expected return. It is an equilibrium model, which describes the pricing of assets as well as derivatives. Van Horne (2004) defines the CAPM Model as an equilibrium model of the trade-off between expected portfolio return and unavoidable risk. Kevin (2001), describes the CAPM Model as the relationship between risk and return established by the security market line.

To derive the CAPM, we start by assuming that all assets are stochastic and follow a normal distribution described completely by its two parameters: mean value (μ) and variance (σ^2). It is also assumed that investors are risk averse and therefore maximize expected utility of his end of period wealth. This is where his subjective

marginal rate of substitution between risk and return (his indifference curve) equals the objective marginal rate of transformation offered by the minimum variance opportunity set. If we now allow unlimited lending and borrowing at the Risk Free rate (RF) in addition to the risky assets, in the absence of market frictions, he will now hold a combined portfolio described by the equations and Fig. 1:

$$\mu_p = R_f + \left(\frac{\mu_m - R_f}{\sigma_m}\right) \sigma_p \mu_p \tag{1}$$

This shows that the new minimum variance opportunity set will be linear in the (μ, σ_p) space and consists of combined portfolios with some fraction of the market portfolio M and the riskless asset. This equation is the capital market line (CML), it prices only efficient portfolios because of homogeneous expectations, perfect market and absence of market frictions. The combined portfolio is described as the two mutual fund theorem.

However, the CML does not price individual assets and inefficient portfolios (investors may hold these in reality). To achieve this, Beta (a measure of non-systematic risk) becomes the appropriate measure of a security risk for every diversified portfolio. With homogenous expectations and unlimited borrowing and lending at risk free rate, all investors will hold the market portfolio and the dimensions of concern are expected return and the Beta. With arbitrage, it can easily be established that all investments and portfolios lie on a straight line in return-Beta space called the Security Market Line (SML) in Fig. 2. The equation below called the CAPM describes the SML:

$$\mu_i = R_f + \beta_i(\mu_m - R_f) \tag{2}$$

and,

$$\beta_i = \frac{\text{Cov}[R_i, R_m]}{\sigma^2_m} \tag{3}$$

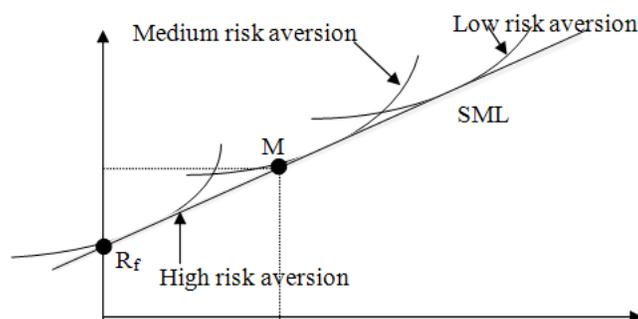


Fig. 2: Security market line

This can be expressed for estimation purposes in terms of excess returns or the two factor zero-beta model.

Osaze (2000) states that the SML “is the expected linear relationship between the return and the systematic risk for a security and the market?”. The security market line provides a standard for project acceptance. If the project return lies above the security market line, then the return is higher than investors could expect to get by investing their funds in the capital market and therefore is an attractive investment opportunity (Berkley *et al.*, 2001). The CAPM holds that investors demand additional expected return (more risk premium) if they are asked to accept additional risk; hence expected return equals the rate on a riskless asset plus a risk premium. It is basically a simple linear relationship. The higher the value of beta, the higher would be the risk of the security and therefore the larger would be the return expected by the investors. In other words, all securities are expected to yield returns commensurate with their riskiness as measured by beta. This relationship is valid not only for individual securities, but is also for all portfolios whether efficient or inefficient. According to Riskglossary (2006),

“We call CAPM a ‘capital asset pricing model’ because, given a beta and an expected return for an asset, investors will bid its current price up or down, adjusting that expected return so that it satisfies the formula. Accordingly, the CAPM predicts the equilibrium price of an asset; this works because the model assumes that all investors agree on the beta and expected return of any asset...”

CAPM can be used for pricing of securities whether underpriced, overpriced or correctly priced. The assumptions of CAPM have been criticized as unrealistic but the model remains a fairly good predictor of return. Since studies have not shown that other asset pricing models are consistent superior, we

continue to use the CAPM, being wary of all the estimation problems. The non-standard CAPM models that relax these assumptions have not empirically performed better.

Empirical tests: Tobin (1958), Sharpe (1964) and Lintner (1965) know like everyone else that investor hold different beliefs, that borrowing rates are typically higher than lending rates and there is credit restriction on the amount that can be borrowed. Thus, they have been criticized for leaving the empirical validation of their conclusions to others. By relaxing the assumptions involved in the derivation of the CAPM, the model has been extended to more general conditions, usually at the expense of simplicity in the structure of equilibrium expected return (Fama and French, 2003; Sharpe *et al.*, 2006). Black (1972) has relaxed the riskless lending and borrowing.

Empirical tests of the CAPM have relied on proxies for the market portfolio. Efforts have been on the ability of the model to capture total systematic risk, the stationarity of beta, and its ability to explain difference in observed and expected returns. Results on test of CAPM based on individual securities have been mixed. CAPM is in terms of investor’s expectations, yet tests used realized ex-post returns. The different between realized and expected return is the residual term that should be zero on average if model is correctly specified. If CAPM is correct, the regression of returns against beta should result in a positive slope equal to the average market risk premium ($R_m - R_f$) and intercept at average R_f . Some tests show larger betas securities have higher rates of return and that the relationship between betas and the returns are linear. Others indicated that the slope was lower than predicted and intercept higher (Elton *et al.*, 2007).

To deal with measurement errors for individual estimates (some too high, some too low), portfolios were adopted. Results indicated that the slope of the relationship between beta and the returns was positive but lower and the intercept less than averaged (Elton *et al.*, 2007). Results indicate that the stationarity of

beta is related to number of securities in the portfolio, the length of period used for beta estimation, length of holding periods for estimating returns, level of beta estimate and structural variations in the market due to stocks and changes in certain company-specific attributes. Our concern here is to test if betas (market risks) significantly affect returns in the Nigerian Capital Market.

MODEL SPECIFICATION AND METHODOLOGY

In estimating CAPM, we define it in the general framework of Campbell *et al.* (1997):

$$Z_t = \alpha + \beta Z_{mt} + \varepsilon_t \tag{4}$$

$$E[\varepsilon] = 0 \tag{5}$$

$$E[\varepsilon_t \varepsilon_t^{\square}] = \Sigma \tag{6}$$

$$E[Z_{mt}] = \mu_m \quad E[(Z_{mt} - \mu_m)^2] = \sigma_m^2 \tag{7}$$

$$\text{Cov}[Z_{mt}, \varepsilon_t] = 0 \tag{8}$$

where,

- Z_t : An (Nx1) vector of excess returns for N assets or portfolios
- β : The (Nx1) vector of Betas
- Z_{mt} : The time period t market portfolio excess return
- α & ε_t : (Nx1) vectors of asset return intercepts and errors

Adopting the Sharpe-Lintner version, the mean return is usually defined as expected excess return and all the elements of the vector α are zero, thus the m is the tangency portfolio. The risk-free security will have the

same return under all possible economic scenarios (Pandey, 1999). Beta is a risk metric employed primarily in the equity markets which measures the systematic risk of a single instrument or an entire portfolio. It is the sensitivity of a stock's return to the return on the market portfolio (Berkley *et al.*, 2001). Sharpe's work suggests that the expected return on a portfolio should increase proportionally with beta. The beta measure has two basic characteristics that we need to keep in mind during estimation. The first is that it measures the risk added on to a diversified portfolio, rather than total risk. Thus, it is entirely possible for an investment to be high risk, in terms of individual risk, but to be low risk, in terms of market risk. The second characteristic that all betas share is that they measure the relative risk of an asset, and thus are standardized around one. The treasury bill rate proxies R_f . The premium of a security is directly proportional to the risk as measured by beta. We note the tendency of Betas to regress toward one as well as the solution techniques of Blume (1975) and Vasicek (1973), but for convenience will report it in another study.

MICROFIT 4.0 statistical software was employed to estimate Sharpe-Lintner version using the proxies of Treasury bill, All-Share Market Index of the Nigerian Stock Exchange, returns on 14 most capitalized firms in 2005 (sourced from the Nigerian Stock Exchange Fact book). The firms were NBL, First Bank, Guaranty Bank, Uniliver, Union Bank, UBA, Nestle, NBC, Oando, Total Oil, Cadbury, Conoil and Mobil Oil, while the three industries were banking, petroleum and breweries. The time frame of the study is limited to the quarterly data covering 2001 to 2005.

Empirical analysis: As stated earlier, the objective of this work is to validate the positive relationship between beta and security returns with the Nigerian Capital Market data. Thus we emphasize the extent to

Table 1: Regression results for the thirteen firm and three industries

Dependent variables	Independent variables	Coefficient	t-statistic	Probability	R ²
R _{t1}	B ₁	-21.4292	-3.4618**	0.003	0.9757
R _{t2}	B ₂	22.7705	2.1383*	0.047	0.8573
R _{t3}	B ₃	24.4296	9.0847**	0.000	0.7490
R _{t4}	B ₄	21.3515	2.3431*	0.036	0.7779
R _{t5}	B ₅	26.6954	4.4725**	0.000	0.2639
R _{t6}	B ₆	13.2475	2.7005*	0.015	0.4975
R _{t7}	B ₇	-0.9450	-0.7029	0.945	0.6802
R _{t8}	B ₈	8.6080	0.5255	0.606	0.9420
R _{t9}	B ₉	25.8150	3.8130**	0.007	0.8846
R _{t10}	B ₁₀	-0.0371	-0.5177	0.611	0.9179
R _{t11}	B ₁₁	-55.4791	-2.1452*	0.047	0.9398
R _{t12}	B ₁₂	-16.2379	-2.1443*	0.047	0.8793
R _{t13}	B ₁₃	169.8290	4.4506**	0.000	0.9245
R _{t14}	B ₁₄	52.3767	0.6512	0.524	0.6343
R _{t15}	B ₁₅	-9.1797	-0.0884	0.931	0.8406
R _{t16}	B ₁₅	52.3767	1.9512*	0.052	0.7143
R _{t17}	B ₁₅	1116.700	3.6122**	0.002	0.9059

*: Significant at 5%; **: Significant at 1%

which the Capital Asset Pricing Model (CAPM) can be used to evaluate expected return and risk in the market. The regression results obtained are reported in the Table 1. It shows the data for the 14 most capitalized firms and the 3 most capitalized industries; i.e. their returns and their respective measured market betas. In the table, R_{i1} to R_{i14} represent the 14 most capitalized firm and R_{i15} to R_{i17} for the three most capitalized industries.

From the table, most of the results confirmed the *a priori* relationship between beta (B) and security returns (Ri). Ten out of 14 firms confirmed significant relationship at 5% level while two out of the three industries also confirmed significant relationships. Moreover, the explanatory power of the model was good; for ten firms, the model had a fit of over 70%. Indeed, only two firms did not describe a fit of above 60% and the three industries had a fit of over 70%. Only five individual firms and one industry were negatively signed; indicating that majority confirmed a positive linear relationship as expected. For the twelve firms and industries with relationships that are significant at 5% significant level, only three are negatively signed, probably because they are not actively traded in the market.

CONCLUSION

In conclusion therefore, empirical evidences significantly indicate that a positive relationship exist between security returns and the measured market betas in the Nigerian Capital market. This implies that CAPM holds in the Nigerian Capital Market. It confirms the results of studies such as Brailford and Josev (1997) and Fama and French (2003) which indicated a linear relationship between returns and betas of portfolio.

Based on the finding from the study, we recommend:

- That investors and portfolio managers should improve the methods they employ in optimizing their portfolios as the market significantly rewards market risk
- That firms and industries must be proactive in diversifying non-systematic risks and creatively responding to market risk
- That effective economic policies are required to continue to enhance the sovereign risk status of the country as well as that of the firms and industries

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