An Analysis of the Relationship between Risk and Expected Return in the BRVM Stock Exchange: Test of the CAPM

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Abstract

One of the most important concepts in investment theory is the relationship between risk and return. This relationship drives the theoretical foundation of many investment models such as the well known Capital Asset Pricing Model which predicts that the expected return on an asset above the risk-free rate is linearly related to the non-diversifiable risk measured by its beta. This study examines the Capital Asset Pricing Model (CAPM) and test it validity for the WAEMU space stock market called BRVM (BOURSE REGIONALE DES VALEURS MOBILIERES) using monthly stock returns from 17 companies listed on the stock exchange for the period of January 2000 to December 2008. Combining Black, Jensen and Scholes with Fama and Macbeth methods of testing the CAPM, the whole period was divided into four sub-periods and stock's betas used instead of portfolio's betas due to the small size of the sample.

The CAPM's prediction for the intercept is that it should equal zero and the slope should equal the excess returns on the market portfolio. The results of the study refute the above hypothesis about the slope and offer evidence against the CAPM for all the sub-period and even for the whole period. The tests conducted to examine the nonlinearity of the relationship between return and betas support the hypothesis that the expected return-beta relationship is linear. Additionally, this paper investigates whether the CAPM adequately captures all-important determinants of returns including the residual variance of stocks.The results demonstrate that residual risk has no effect on the expected returns of stocks for the whole period and the entire sub –periods except for the last period of 2003-2008 which shows that returns are affected by non-systematic risks during that specific period, justifying the fact that the operating activities of the firms have an impact on their stocks returns

Keywords: CAPM, beta, BRVM stock exchange, risk, expected return

1. Introduction

The nature and performance of financial systems in developing countries must be judged in relation to an individual country's level of development. Whether these financial systems are relatively simple or highly complex the primary role of the financial system in any economy is to mobilize resources for productive investment. The financial system provides the principal reasons to transfer funds or savings from individuals and companies to private enterprises, farmers, individuals, and others in need of capital for productive investment. An efficient financial system channels resources to activities that will provide the highest rate of return for the use of the funds. These resources stimulate economic growth; provide enterprises with the ability to produce more goods and services and generate jobs. Well performed and formal financial market offer to investors a variety of short and long term investment instruments by providing qualified financial intermediaries that enable individuals to make reasonable and adequate decisions about the risks and rewards of investing their funds. These instruments package risk and returns effectively so that the investors who wish to participate in a well structured and appropriate market can do so.

Financial risks are a relatively recent phenomenon, evolutionary speaking. The chance that an investment's actual return will be different than expected return includes the possibility of losing some or all of the original investment. Most literature on this subject defines the term "risk" as comprising two elements: First is the probability (or likelihood) of occurrence of a negative event during the lifetime of operation of a facility: Second is the resultant consequence when a negative event has taken place (Rackwitz 2001, Bedica 2000, Recchia 2002).

Despite the fact that many studies have been made regarding the financial markets of developed countries like the United States, very few have been conducted in the case of emerging economies and especially in the area of the WAEMU space. In this sense very few are the studies that focus on the analysis of financial risk of capital markets in West Africa and particularly at BRVM. Most studies on the BRVM capital market are limited to the analysis of market structure and the evolution of different index.

Many studies also revealed the institutional weaknesses and the financial problems facing the BRVM and some approaches of solutions were proposed, but the relationship between risk and returns or more precisely the test of the risk-return relationship on this market are very few. In this order our study is devoted to review the main risks facing the BRVM and analyze the correlation and the inter-dependency between risk and expected return of the different market players.

2. The Empirical Appraisal of the CAPM

Recently the finance discipline has developed much theory about the risk measurement and its use in assessing returns. The two major components of this theory are beta β, takes as a measure of risk, and the CAPM, which uses beta to estimate return.

The CAPM is important because it was the first equilibrium asset pricing model that hinges on mean-variance portfolio selection under uncertainty. It provides the relationship between and investment's systematic risk and its expected return. Therefore, given the general risk-aversion of the market, investments with high levels of systematic risk can be expected to produce a high return, and vice versa. The model is built upon a number of assumptions, some of which are realistic, others of which are not. These assumptions may be divided into two groups about investors and capital markets.

With beta, as the measure of non-diversifiable risk of an asset relative to that of the market portfolio, the CAPM defines the required return on an investment as follows:

$$E(R_i) = r_f + \beta_i \left[E(R_M) - r_f \right]$$

Where β is the measure of risk for asset *i.*

The CAPM can be divided into two parts: The risk-free rate of return, and the risk premium, $\beta_i \left[E(R_M) - r_f \right]$.The risk premium is the amount of return investors demand beyond the risk-free rate to compensate for the investment's non-diversifiable risk as measured by beta. To find the beta, measure of the systematic risk, we write:

$$\beta_i = \frac{Cov(R_i, R_M)}{Var(R_M)} = \frac{\sigma_{iM}}{\sigma_{MM}}$$

According to the capital asset pricing model, the equation (2) can be rewritten to express that the risk premium on individual asset equals its beta time the market risk premium:

$$E(R_i) - r_f = +\beta_i \left[E(R_M) - r_f \right]$$

The usual estimator for β is the OLS estimate from the following linear regression, called the characteristic line.

$$R_{it} - r_{ft} = \alpha_{it} + \beta_i \left[R_{Mt} - r_{ft} \right] + \varepsilon_{it}$$

Where ε_{it} is the error term and α_{it} a constant

3. The WAEMU Space: An Overview

The West African Economic and Monetary Union (WAEMU) was established by the Union Treaty signed at Dakar on January 10, 1994 by the Heads of State and Government of seven countries in West Africa which have in common the use of the CFA currency. The Treaty was effective from the 1st August 1994, after ratification by Member States. On May 02, 1997, Guinea-Bissau became the 8th Member State of the Union.

3.1 The WAEMU Capital Market

The West African Economic and Monetary Union (WAEMU) financial system consists of a relatively new regional stock market, a banking sector and a mesh of microfinance institutions, known as Decentralized Financial Structures (DFS). Despite their relative performance, decentralized financial structures have encountered various development requirements, particularly their inclusion in the financial system and sustainability in a long-term perspective. The

financial market is known as the BRVM (Bourse Regional des Valeurs Mobilières) and has two value weighted indexes that include all the listed firms and the top 10 firms on the market. The Regional Stock Exchange (BRVM), the stock market for the UEMOA region, started operating in September 1998. It is located in Abidjan and has a branch in each capital city of the other member States of the Union. Its main role is to pool and process stock market orders transmitted by brokerage companies (Société de Gestion et d'Intermédiation- SGI) authorized to negotiate securities quoted on the BRVM. As of December 2006, 19 SGIs were registered in the Union with nine located in Côte d'Ivoire. The BRVM is regulated by the CREPMF whose responsibilities include the promulgation of policies and procedures to regulate the BRVM, and the promotion of a regional bond market. In order to list on the BRVM, all bond issues must be guaranteed by an approved financial institution, a development financial institution, a guarantee fund, or the Parent Company. At the end of December 2006, the capitalization of the equity market was XOF 2067 bn whereas the bond market capitalization stood at XOF 489 bn, with XOF 260 bn being government bonds, representing 1.07% of the GDP of the Union. By end-December 2006, 61 securities were listed, including 40 shares and 21 bonds, compared to 57 securities comprising 39 shares and 18 bonds by end-December 2005. Out of the 40 companies that are listed on the Exchange in December 2006, all but four were Ivorian institutions.

The BRVM is equipped with a fully integrated and modern system of trading. The headquarters in Abidjan provides securities quotation and trading services as well as regulation/issuing services.

On Figure 1, we can appreciate the evolution of the BRVM indexes known as BRVM Composite and BRVM 100, from 2000 to 2008 in FCFA.

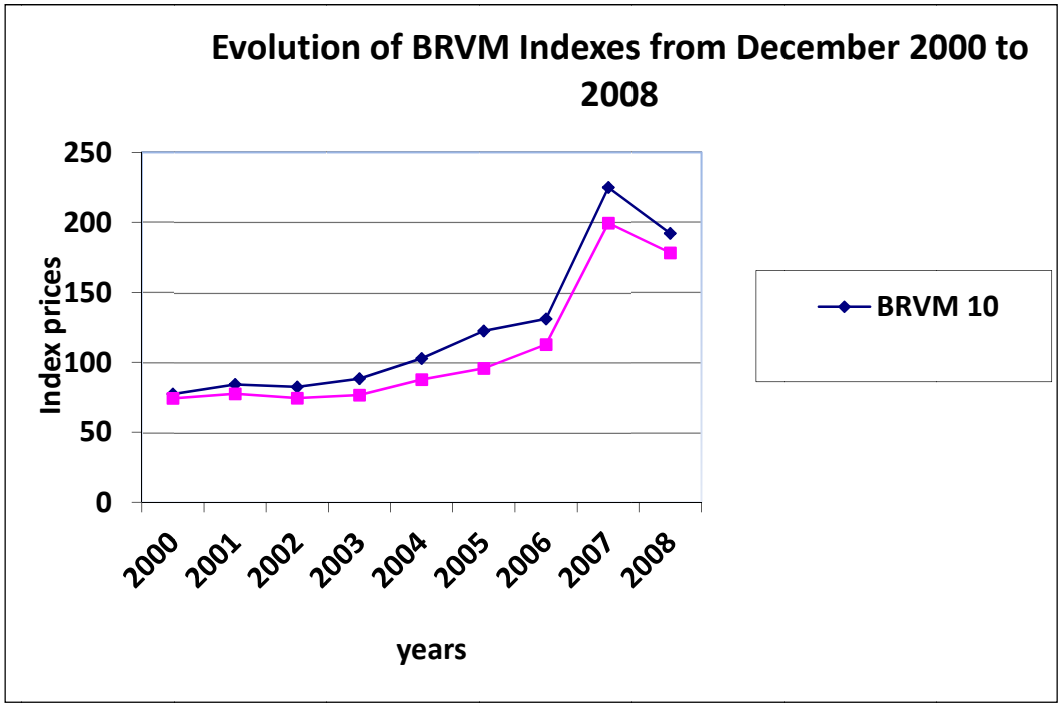


Figure 1. Evolution of the BRVM indexes from 2000 to 2008

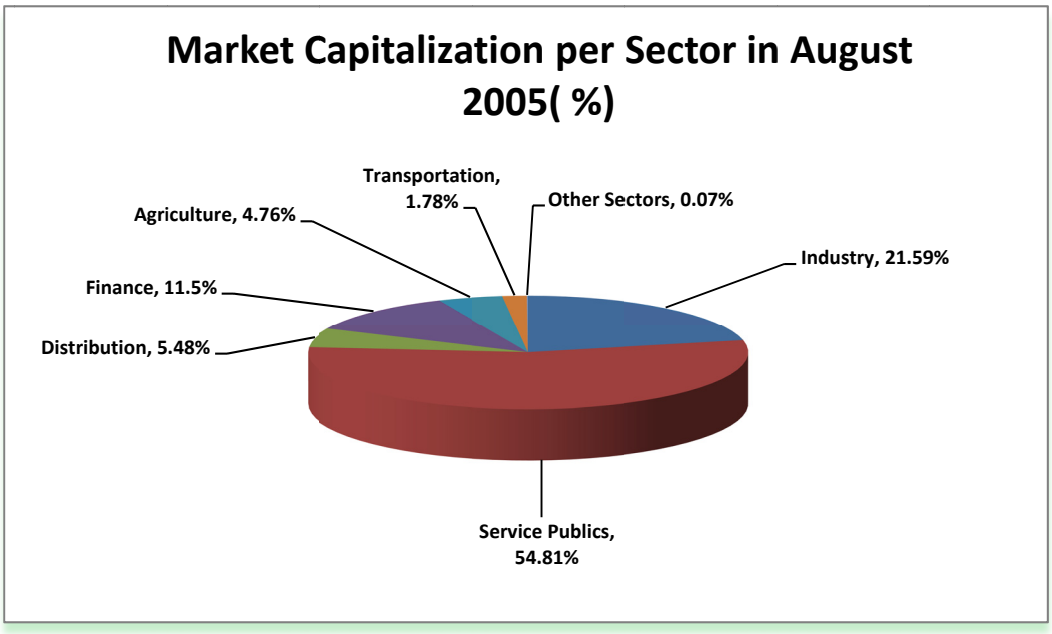
From the year 2000, we can notice a well increment of both the BRVM 10 and BRVM Composite indexes. From respectively 77.27 and 74.76 in 2000, they reached their higher level in 2007 with 224.85 for the BRVM 10 and 199.45 for BRVM Composite, before declining in 2008.

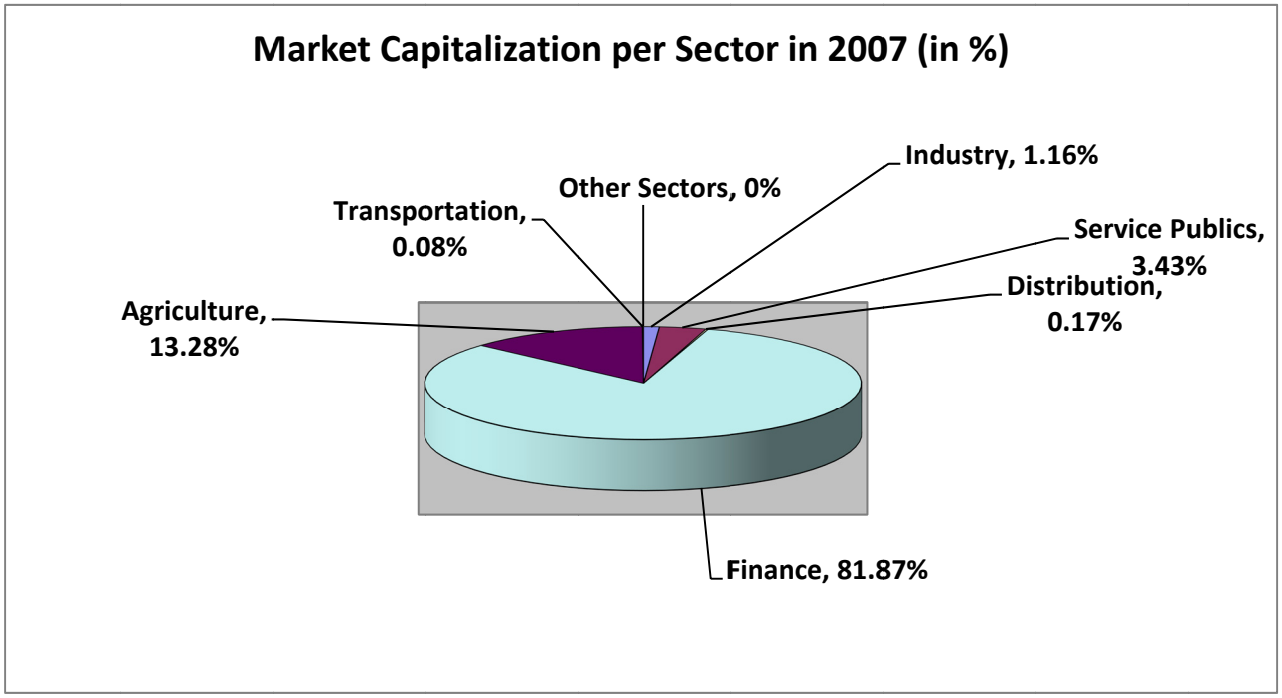
Today, the benchmark index, the BRVM Composite Index, tumbled 0.90% to 135 94. This was underlined by losses in SLBC (7.50% to CFA 198 875), SMBC (6.60% to CFA 21 500) and UNLC (4.61% to CFA 32 005). Others were NTLC, SOBC, SPHC and FTSC. Meanwhile, CIEC and SIVC advanced by CFA 5 each to CFA 16 205 and CFA 8 700 respectively.

Taking into account the Market per sector, we can notice that in 2005 the Service Publics sector had performed very well compare to the other sectors. This improvement was due to the good performance of SONATEL with a total of 41 632 shares exchanged and its meteoric rise over 14 970 FCFA. From 2005 to 2007, the market tendency move drastically with only 3.43 % for the Service Publics and 81.87% for the Finance sector. The sector of finance

"remains the most dynamic sector with 8 012 353 shares traded, representing 81.87% of the total volume of the annual market transactions. This volume is due to the high activity of ETIT (Ecobank) which totalize 7 828 559 shares traded, or 97.71%. The Financial sector continues its growth in year 2008. It totalize the most important traded volume of the market with 30 682 217 shares traded, representing 92.01% of the annual transactions in the market. The sector has been driven by the intense activity of ETIT (Ecobank) with 30 419 575 shares traded.

Figure 2 shows the main characteristics of the market capitalization per sector.





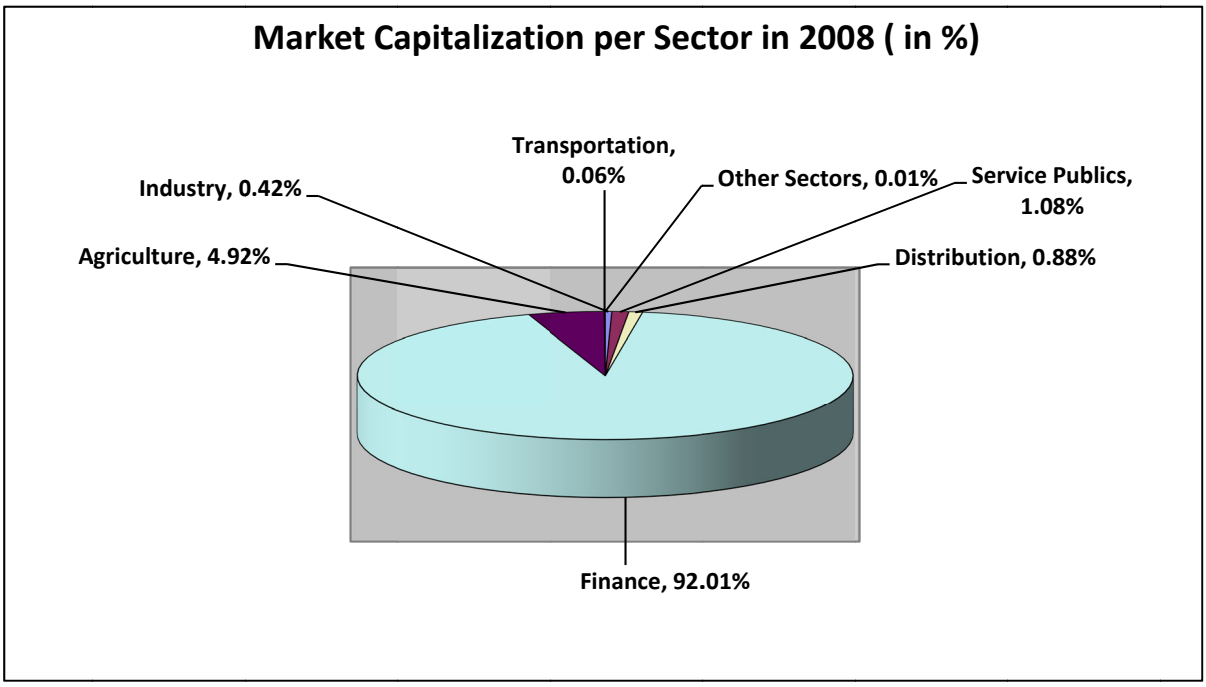


Figure 2. Market capitalization per sector

Source: Revue trimestrielle, www.brvm.org

4. Objective and Significance of the Study

Because investors are risk averse, they will choose to hold a portfolio of securities to take advantage of the benefits of Diversification. Therefore, when they are deciding whether or not to invest in a particular stock, they want to know how the stock will contribute to the risk and expected return of their portfolios.

Our main objective in this paper is to investigate the relationship between the securities portfolio risk and the return on investment of the selected firms in the regional stock market of the West African Economic and Monetary Union called the BRVM and prospect on how this affects their investment decisions. In other words, our objective is to test the Risk –Return relationship on the BRVM market using the CAPM.

Many authors have already search about the concept Risk – Return on different financial markets, and results differ from one to the other, going from a positive to a negative correlation between the two variables according to the model used. But most of these studies have been made in developed countries financial markets and only very few take into account the emerging countries financial markets and especially the WAEMU space one. Based on this remark, it's so important to focus and pay attention on how the concept of Risk – Return is view and measured at the BRVM stock exchange and to analyze the different factors influencing it. That's why this study reveal a so great importance in the area of risk and return analysis in emerging countries and especially in the WAEMU space.

It contributes to the latter literature by examining the relation between expected market returns and risk in the BRVM. It uses data on a frontier market and tests for the risk-returns tradeoff in the BRVM for the first time using the traditional capital asset pricing model (CAPM) of Sharpe and Lintner. Second, it contributes to the literature on this important relation by showing that the risk-returns tradeoff in the BRVM is conform to those found in mature markets. Thirdly it is showing the importance of risk analysis and good securities portfolio strategy formulation in the area of financial investment. Finally based on the findings of this research, the thesis will provide potential researchers with area of future research and study in emerging countries financial markets and the West African Economic and Monetary Union in particular

5. Hypothesis of the Research

H10 Expected stock return has a positive and statistically significant relationship with Risk in the BRVM market

H11 Expected stock return on the BRVM market has a positive but not statistically significant relationship with the measure of systematic risk

H20 Higher/lower risk yield higher/lower expected rate of return on BRVM stock market

H21 The non-systematic risks has no effect on stock's returns at BRVM

H30 expected rate of return and stock's beta are linearly related

6. Theoretical Evidences about the Relationship between Risk and Expected Return

Many investors notice that the stock market is a volatile place to invest their money. The periodic moves can be dramatic, but it is this volatility that also generates the market returns for investors. Volatility is a measure of dispersion around the mean or average return of a security.

For securities, the higher the standard deviation, the greater the dispersion of returns and the higher the risk associated with the investment. Volatility creates risk that is associated with the degree of dispersion of returns around the average. In other words, the greater the chance of lower-than expected return, the riskier the investment.

There is a strong relationship between volatility and market performance. Volatility tends to decline as the stock market rises and increase as the stock market falls. When volatility increases, risk increases and returns decrease. Risk is represented by the dispersion of returns around mean. The greater the dispersion of returns around the mean, the larger will be the drop in the compound return. (The rate of return, usually expressed as a percentage, which represents the cumulative effect that a series of gains or losses have on an original amount of capital over a period of time. Compound returns are usually expressed in annual terms, meaning that the percentage number that is reported represents the annualized rate at which capital has compounded over time).

The work of Markowitz (1952), which developed the basic portfolio theory, described a linear relationship between risk and return, and proved to be useful for portfolio and asset management. Since his work, many other researchers concentrate their work on investigating the relationship between stock returns and volatility for developed markets. Uncovering the relationship between risk and return provides a better understanding of price dynamics and can serve as a guide for building new asset pricing models.

Using Pettengill et al.'s approach, Hodoshima, J. X. Garza-Gomez and M. Kunimura (2000) examined beta-return relationships in Japanese market, by including size, and book to market equity ratio as control variables into their model. The study period goes from the period 1956 to 1995, and included all the stocks listed in the first section of Tokyo Stock Exchange (TSE). The collateralized next day call money rate was used as risk-free rate. As a proxy to the market they used both JSRI (Japanese Securities Research Institute), and EWI (Equally Weighted Index) indices. 20 portfolios formed by taking into account the ranking of the betas were used in regression analyses. They found that data are better explained by making a distinction between positive and negative market risk premiums. It was also found that the company size is significant with a negative coefficient in the unconditional CAPM test and with a positive coefficient in conditional test.

As we mention before in our previous section, the concept of the risk- return relationship has been argue and study in the emerging countries by many researchers, and their findings are quite similar to those from the developed countries with some few differences related to the characteristics of the financial markets and the socio-economical environment of the countries. Many studies have shown that emerging markets are vastly different from those of developed markets in terms of risk, return, and liquidity patterns.

Working on an emerging stock market, Salman (2002) provides empirical evidence to support the positive and linear relationship between risk and return. While studying the Istanbul Stock Exchange, he finds that the CAPM's concept is valid and he believes that both risk and return are integrated in the information provided to the market. Similarly, a positive and significant association between risk and return in the Jordanian Securities Market was found by Omet, Khasawneh and Khasawneh (2002). In the same logic Koutmos, Negakis and Theodossiou (1993) also report a similar finding from the Athens Stock Exchange. They find that the risk premium is positive and significant which means that the returns are positively related to volatility. In a study across eight different industries in Taiwan, Chiang and Doong (1999) discover that the influence of conditional volatility on stock returns is mixed depending on the industry. Nonetheless, only the coefficients with negative signs are found to be significant. Therefore, the negative risk premium suggests that investors are penalized, not rewarded, for holding risky stocks.

Most of the researches on stock returns in emerging markets indicate that they are characterized by high risk and high returns. It also show that they are not really integrated to the developed markets of the World as evidenced by very low correlation with the rest of the World and among themselves (Bekaert and Harvey, 1997). Investor interest in emerging markets exploded during the last decade as a result of the quest for higher returns and further international diversification. Yet little is known about the nature of stock returns in those markets.

It is not surprising that no study about the risk-return relationship is related to the stock exchange market of the WAEMU space because of its relatively recent start point of operation. This leads **N'dri. Konan Léon** to investigate on the relationship between expected stock market returns and volatility in the regional stock market of the West African Economic and Monetary Union called the BRVM. Using weekly returns over the period 4 January 1999 to 29 July 2005 and the EGARCH-in-Mean model, assuming normally distributed and Student's t distribution for error terms, he found that in this market, the expected stock return has a positive but not statistically significant relationship with expected volatility and argue that this volatility is higher during the market booms than when market declines.

7. Empirical Analysis of the Relationship between Risk and Expected Return at BRVM

As we mention before, few studies have been conducted based on the risk-return relationship in the WAEMU space. Those that exist have proved an existence of risks in the market and the positive relation between these risks and the return of the market, using the EGARCH-in-Mean model. In this chapter we will describe the sample data used in this study, and how these data was compiled and organized. Then we will take a look of the research hypothesis and questions. Finally the research methodology will be described together with the justification of the empirical model used.

7.1 Database Construction

7.1.1 Source of Data and Sample Period

Firms in our sample include financial institutions, banks, insurance companies, Service Publics, Agriculture, Industry, distribution and other sectors firms. A sample of about 40 firms is selected from the above mentioned industries and their investment activities studied over the period 2000 to 2008. The firms will be selected from the BRVM stock exchange listed companies and included in the two indexes of the market: the BRVM 10 and the BRVM Composite. Data are selected from the statistical documents for the study period provided by the firms and the stock markets statistics data derived from the annual report publication of public shareholding companies held by the BRVM. All this data are available in the Official Newsletter publication (BOC) of BRVM. These newsletters include data for all listed companies comprised in seven economic sectors as mentioned in the previous chapter. The study period from 2000 to 2008, which is equal to 9 years of accurate data, is adequate for this study. The analysis is based on annual data.

7.1.2 Data of the Study

The data set used in this study is monthly closing prices on the BRVM composite index and the individuals stocks closing prices obtained from the Official Newsletter of the Regional Stock Market (BRVM). The study period ranges from end 2000 to end of 2008. The choice of the BRVM Composite is motivated by the fact that it is composed of all the listed companies, by this way we can have an overlook of the whole market performance and risk trend as well as the well performed firm's one.

7.1.3 Specification of the Database

With the available monthly reports and Official newsletters publications, the database was constructed including all financial figures for all the companies listed at BRVM. Like we identify in the previous chapter, the sample consist of 34 companies of which 13 are industrial, 4 agricultural firms, 4 distribution companies, 7 financial companies, 3public utilities, 2 transportation firms and 1 for other sectors.

The analysis of the risk-return relationship took into account the firms listed on the BRVM stock exchange market for the period 2000 to 2008 based on the criteria that, the firm had to be listed on the market for the whole period under consideration and their share prices available for every month in a specific year. Based on these criteria, 17 firms are selected to build the portfolio that we use for our analysis.

7.2 The Model of the Study

7.2.1 Statistical Analysis

Because samples are small and information is limited, parametric model are not appropriate we use a non parametric linear progression technique for our study. The method will be base on a statistical assessment of risk in financial area.

In this study, the traditional approach of the Capital Asset Pricing Model of Fama and MacBeth's will be use in order to measure the significance of the market risks on the firms expected return. The Capital Asset Pricing Model (CAPM) provides an expression which relates the expected return on an asset to its systematic risk. Systematic risk,

which is also called market risk or undiversifiable risk, is the portion of an asset's risk that cannot be eliminated via diversification. The systematic risk indicates how including a particular asset in a diversified portfolio will contribute to the riskiness of the portfolio.

As an economic theory that describes the relationship between risk and expected return, and serves as a model for the pricing of risky securities, the CAPM asserts that the only risk that is priced by rational investors is systematic risk, because that risk cannot be eliminated by diversification. The relationship between the risk and the expected return in the CAPM is known as the Security Market Line (SML) equation and the measure of systematic risk is called Beta

The CAPM asserts that:

$$R_i = R_f + (R_M - R_F)\beta$$

Where

R_i is the expected return on security

R_f is the risk free rate

$(R_M - R_{F)}$ is the market risk premium

And β is the security's beta

The CAPM is a ceteris paribus model. It is only valid under a special set of assumptions listed below:

- All the investors are risk averse; they will maximize the expected utility of their end of period wealth. Implication: The model is a one period model.
- All the investors use the same expected return and covariance matrix of stock return to form the optimal risky portfolio. That is referred to as homogenous expectations (beliefs) about asset returns. Implication: All the investors use the same information at the same time.
- A fixed risk-free rate exists, and allows the investors to borrow or lend unlimited amounts to the same interest rate.
- There are a definite number of stocks and their quantities are fixed within the one period world.
- There are no market imperfections. Implication: there are no taxes, regulations, or trading costs.

The econometric specification of CAPM model is the following:

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it}$$

This type of model will be estimated with ordinary least squares regression. We assume that the expected value of the error is zero and that it is uncorrelated with the independent variable.

7.2.2 The Econometric Model

Taking into account the variables used for our study and all the factors surrounding the choice of those variables, both the Time series and the Cross sectional specification of the CAPM will be used. The time series specification set as follows is used in the first phase of our analysis.

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it}$$

Where

$R_{it} - R_{ft}$: is the risk premium on i'th stock in period t

α_i : is the alpha coefficient or the intercept

$(R_{mt} - R_{ft})$: is the market risk premium

β_i : is the beta of the stock

ε_{it} : is the error term which is assumed to be random

The time series specification is used in the first phase of our analysis to run the regression between stocks return and the market return in order to determine their specific beta coefficient for each sub –period and for the whole period of 2000 to 2008.

The Cross – sectional specification of CAPM is used in the second phase of our study in order to test the risk- return relation hypothesis at BRVM. The model is specified as follow:

$$R_i - R_f = \gamma_{0t} + \gamma_{1t}\beta_i + \mu_i$$

Where

R_i = Equally weighted average return of stocks.

β_i = Estimate of true β for stock i.

μ_i = Error term which is assumed to be random

7.3 Data Description

Monthly share prices for 17 stocks listed in the BRVM Stock Exchange for the period 2000 to 2008 are used in this study. The main considerations in choosing this sample is that shares must be continuously listed during the period define and shares prices available for every month during a specific year. End of the month share prices are not adjusted to account for cash and stock dividends due to unavailability of data resulting in the underestimation of stock returns. However this is not expected to significantly affect the result of the study.

Stock price returns are calculated using the formula:

$$R_{it} = \ln\left(\frac{P_{it}}{P_{i,t-1}}\right)$$

Where

R_{it} = Return on stock *i*.

P_{it} = Price per share of stock *i* at the end of the month *t.*

$P_{i,\,t-1}$ = Price per share of stock *i* at the end of the month *t-1*.

The computation of the monthly stock market returns $\hat{R}_{mt}$ is as follows:

$$R_{mt} = \ln\left(\frac{P_{mt}}{P_{m,t-1}}\right)$$

Where

R_{mt} = monthly return on the market.

P_{mt} = Value of BRVM Composite price index at the end of the month *t*.

$P_{m,t-1}$ = Value of BRVM Composite price index the at the end of the month *t-1*.

ln (.) is the logarithm operator

All returns are expressed in local currencies and are not adjusted for dividends.

The analysis period of this research extends from January 2000 through December 2008. This period was divided into four 6-year sub-periods. Each sub-period, in turn, was further divided into two 3-year periods being beta estimation periods, and the testing periods. The fact is that, because we have a small sample, we use the stocks individual betas in the same portfolio A rather than dividing the sample into portfolio. Hence, the portfolio formation period and the beta estimation period become one, because we don't have to estimate the portfolio beta anymore since the stocks individual betas are used. All the BRVM stocks available and meeting data requirements in each period were included in the analysis.

1. The first period is: 2000.1.1 – 2005.12.31;
2. The second period is: 2001.1.1 – 2006.12.31;
3. The third period is: 2002.1.1 – 2007.12.31;
4. The fourth period is: 2003.1.1 – 2008.12.31.

In order to avoid the beta's measurement bias, we follow Black, Jensen and Scholes (BJS) method by estimating betas for the last period and used theses in the grouping of the next period so that we mitigate statistical errors from the beta estimation.

Table 1. Beta estimation for each period

	2000-2002	**2001-2003**	**2002-2004**	**2003-2005**
FILTISAC	0.998	-0.017	-0.019	-0.020
NESTLE	0.263	0.001	0.00	0.002
SODECI	1.296	-0.001	-0.005	-0.006
SIVOA	-0.213	-0.006	-0.003	-0.002
SOLIBRA	0.456	0.002	0.001	-0.003
SITAB	0.904	0.007	0.003	-0.001
TRITURAF	0.123	0.098	0.096	0.098
SICABLE	0.168	-0.007	-0.009	-0.008
BICICI	1.178	0.008	0.003	0.003
BOA BENIN	-0.102	-0.001	-0.013	-0.003
CIE	2.127	0.036	0.031	0.028
SONATEL	0.518	0.011	0.022	0.027
SGB CI	2.191	0.02	0.01	0.008
SHELL CI	0.694	0.01	0.004	0.001
SOGB	3.2	0.019	0.008	-0.007
SAPH	0.592	0.004	-0.007	-0.007
UNILEVER	0.055	0.006	0.005	0.002

Because the sample of our analysis is small, we only consider one single portfolio A of 17 stocks, so instead of using a portfolio beta for our analysis, we consider the individual stock's beta includes in the portfolio.

The first phase of our analysis consists of time series regression of 17 companies listed on BRVM Stock Exchange, where stocks return is regressed to the market return in order to determine their specific beta coefficient for each sub -period. The regression model used is showed bellow:

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \mu_{it}$$

Where

R_{it} is the rate of return on asset i (or portfolio) at time t,

R_{ft} is the risk-free rate at time t,

R_{mt} is the rate of return on the market portfolio at time t.

β_i = estimate of β for stock *i*.

μ_{it} = error term which is assumed to be random.

The coefficient αi is the difference between the estimated expected return by time series average and the expected return as stipulated by the CAPM. If CAPM describes expected returns and a correct market portfolio proxy is selected, the regression intercepts of all portfolios or assets should be equal to zero.

The 17 companies are then set to form one portfolio A which is the sample of our analysis

The next phase involves a Fama and Macbeth cross-sectional regression (CSR) of excess return of the stocks in portfolio A on the estimated betas for each sub- period using the regression model as follows:

$$R_{it} - R_f = \gamma_{0t} + \gamma_{1t}\beta_{it} + \mu_{it}$$

Validity of CAPM would be verified when $\gamma_{0t} = 0$, and $\gamma_{1t} \neq 0$.

In order to be sure that all the assumptions surrounding the CAPM test hold, we run some specifics test.

To test for nonlinearity between total stocks returns and betas we use the equation bellow:

$$ri = \gamma_0 + \gamma_1 \beta i + \gamma_2 \beta_i^2 + ei$$

If the CAPM hypothesis hold γ_2 should be equal to zero.

We then examine whether the expected excess return on securities are determined only by systematic risk and are independent of the nonsystematic risk, as measured by the residuals variance. The equation used is set as follows.

$$ri = \gamma_0 + \gamma_1 \beta i + \gamma_2 \beta_i^2 + \gamma_3 \partial^2(e_i) + ei$$

Where

γ_2 is the measure of the potential nonlinearity of the return,

γ_3 estimates the explanatory power of non-systemic risk.

$\partial^2(e_p)$ measures the residual variance of portfolio or stocks return.

If the CAPM hypothesis is true, *γ3* should be equal to zero.

We finally use the t-test In order to statistically test the CAPM.

8. Empirical Test and Results

8.1 Empirical Test for the Period 1 (2000 -2005)

Based on the results obtain for the Period 1, we can estimate that there is a linear relationship between stock's expected returns and its betas. And that non-systemic risk has no effect on the returns, this means that during the period, all the stocks returns are explained only by the systematic or market risks and all the risks related to the firms operations and activities does not affect the returns. The CAPM hypothesis is, however, rejected taking into consideration that estimates of the SML coefficients do not confirm the CAPM hypothesis which assumes that, higher/lower risk yield higher/lower rate of return. According to the set hypothesis the average risk premium should be positive, reflecting that investors who undertake a high risk should yield a greater return. Our result shows a negative sign for the coefficient γ_1, which mean that for this period of time a high risk doesn't necessarily lead to a high return on the BRVM market, fact which is inconsistent with the CAPM predictions Thus, we conclude that CAPM is not fully valid in period 1. Refer to the Table 2.

Table 2. Analysis results for period 1

	coefficients	value	t-value	P-value
Estimation of SML	γ_0	-0.006376913	-0.786161868	0.44401546
	γ_1	-0.003500171	-0.532873494	0.60192711
Test for non- linearity	γ_0	-0.013529915	-1.4644	0.165178
	γ_1	0.021111802	1.169418	0.26176
	γ_2	-0.009025823	-1.45592	0.167473
Test for non-systematic risks	γ_0	-0.01587	-1.38855	0.188302
	γ_1	0.022194	1.176588	0.260455
	γ_2	-0.00959	-1.45793	0.168593
	γ_3	0.239956	0.371184	0.716479

8.2 Empirical Test for the Period 2 (2001 -2006)

Taking into account the results obtain for the Period 2, we can estimate that there is a linear relationship between stock's expected returns and its betas. And that non-systemic risk has no effect on the returns. But the CAPM hypothesis is rejected since the estimates of the SML coefficients does not confirm the fact that higher/lower risk yield higher/lower rate of return. The risk premium for this second period is seen to be equal to 0, which doesn't hold with the theory which predicts that the value should be greater than 0. Thus, we conclude that CAPM is not valid for the period 2. See Table 3.

Table 3. Analysis results for period 2

	coefficients	value	t-value	P-value
Estimation of SML	γ_0	-0.0026714	-0.436815379	0.668467926
	γ_1	0.060646276	0.268126271	0.792254288
Test for non- linearity	γ_0	-0.004	-0.571	0.577
	γ_1	0.452	0.773	0.452
	γ_2	-4.680	-0.728	0.479
Test for non-systematic risks	γ_0	0.001494212	0.161452637	0.874219113
	γ_1	0.563467269	0.9224682	0.373088353
	γ_2	-5.963241763	-0.885512243	0.391965791
	γ_3	-0.394384457	-0.770634282	0.45470193

8.3 Empirical Test for the Period 3 (2002 -2007)

Referring to the results we obtain for the entire hypothesis test during the third period (shows in Table 6), we can estimate that there is a linear relationship between stock's expected returns and its betas. And that non-systemic risk has no effect on the returns, meaning that the stocks returns are only explained by the market risks and that no alternative risks are affecting the returns. But the CAPM hypothesis is rejected since the estimates of the SML coefficients does not confirm the fact that higher/lower risk yield higher/lower rate of returns predicted by the theory. This mean that the investor who undertake a high risk is not sure to consequently get a greater return. This fact is not consistent with the theory, thus we conclude that CAPM is not valid for the period 3. Refer to Table 4.

Table 4. Analysis results for period 3

	coefficients	value	t-value	P-value
Estimation of SML	γ_0	0.005587	1.003322	0.331617
	γ_1	0.139648	0.654521	0.522686
Test for non- linearity	γ_0	0.006667	1.309463	0.211461
	γ_1	1.002785	2.149687	0.049546
	γ_2	-11.0526	-2.03466	0.06128
Test for non-systematic risks	γ_0	0.006113	0.701096	0.495602
	γ_1	0.997022	2.037541	0.062484
	γ_2	-10.9769	-1.92061	0.076987
	γ_3	0.050088	0.07981	0.937604

8.4 Empirical Test for the Period 4 2003 -2008

Based on the above findings, especially on the value of γ_3 , it is obvious that the non-systematic risk has an effect on the stock's returns for this specific period. It means that for this period, systematic risks as well as unsystematic risks affect the stocks returns on BRVM market. Its means that during this period, the firm's stocks returns were affected by other risks than the market risk, which surely comes from the firm's operating activities. But we should notice that beta and the returns are linearly related to each other supporting the non- linearity hypothesis. the SML hypothesis is not confirmed since the high risk investment doesn't procure a higher return. Thus the CAPM is not valid for this period. Refer to the Table 5.

Table 5. Analysis results for period 3

	coefficients	value	t-value	P-value
Estimation of SML	γ_0	0.013363	1.618948	0.126288
	γ_1	0.041199	0.131615	0.897038
Test for non- linearity	γ_0	0.014598	1.721095	0.107247
	γ_1	0.655295	0.804637	0.434481
	γ_2	-7.59512	-0.81839	0.426844
Test for non-systematic risks	γ_0	-0.00102	-0.10595	0.917242
	γ_1	0.695625	0.996024	0.337417
	γ_2	-6.98409	-0.87735	0.396219
	γ_3	1.078698	2.459086	0.028718

8.5 Empirical Test for the Whole Period 2000 – 2008

Taking into consideration the test of the whole period from 2000 to 2008, we found that beta-return relationship is indeed linear with each other and the systemic risk is the only factor that affects the rate of return, which is consistent with CAPM. However, the fact that high/low risk will yield high/low return is not significant during 2000 to 2008 since the estimation of the SML coefficients shows γ_1 not different from zero, is inconsistent with the CAPM. So here we conclude that the CAPM is invalid during the whole period. The results are shown in Table 6.

Table 6. Analysis results for the whole period

	coefficients	value	t-value	P-value
Estimation of SML	γ_0	0.002803562	0.557878	0.585158
	γ_1	0.069651161	0.377584	0.711028
Test for non- linearity	γ_0	0.000825	0.174131	0.864255
	γ_1	0.826731	1.930646	0.074035
	γ_2	-9.13714	-1.92581	0.074683
Test for non-systematic risks	γ_0	0.0083	1.248954	0.233704
	γ_1	1.028993	2.395543	0.032354
	γ_2	-11.4202	-2.39529	0.032369
	γ_3	-0.70135	-1.53548	0.148639

9. Conclusion and Implications

This study aimed to test and examined the validity of the CAPM for the BRVM Stock Exchange. For this purpose, we used monthly stock returns from 17 companies listed on the BRVM stock exchange over the period 2000.1 to 2008. 1. The companies are selected based on some criteria mentioned in the previous chapter to ensure the reliability of our result.

The purpose of the study has been to examine whether the CAPM is valid on the BRVM stock market.

By combining Black, Jensen and Scholes with Fama and Macbeth methods of testing the CAPM, we got the followings results summarize in Table 7.

Table 7. Summary of the results

	Period 1	Period 2	Period 3	Period 4	Whole period
SML	Reject	Reject	Reject	Reject	Reject
Non-Linearity	Support	Support	Support	Support	Support
Non-Systematic risks	support	support	support	reject	support

As mentioned previously, the validity of the CAPM required that all the assumptions and hypothesis be verified. Taking a look of the table 7 and reminding that The CAPM prediction for the intercept is that it should be equal to zero and the slope of SML equals the average risk premium, it is obvious that the findings of the test contradict the above hypothesis and indicate evidence against the CAPM' predictions during each specific period and for the whole period of 2000 to 2008.

The CAPM hypothesis also predicted that the stock expect rate of return has the linear relationship with its systematic risk. The findings of the test are consistent with the above hypothesis and indicate evidence supporting the CAPM prediction for all the sub-periods and during the period 2000 to 2008. Testing the CAPM hypothesis about the non-systematic risk effect on the stock's returns, the prediction expect that there has no relation between the returns and the non-systematic risk at all. The findings of the test do not fully contradict the above hypothesis, except from the period 4 where we found evidence that the stocks return's during that period are affected by other risks than the systematic risks. This shows that the operating activities of the firms have an effect on their stocks returns during this period. But still, the findings of the other sub-periods indicate evidence supporting the CAPM.

Considering the whole period, The CAPM' predictions that stocks with higher/lower risk will yield higher/lower expect rate of return is not confirmed. However, the beta-return relationship is linear with each other and the

non-systemic risk has no effect on the return during the test period. This finding is consistent with the predictions hence the CPAM is not fully invalid.

Relying on the above and taking into consideration all the mentioned assumptions, we conclude that, our empirical study do not fully support the CAPM. Thereby, we assume that CAPM do not fully hold true in the BRVM Stock Market during the period 2000 to 2008.

Based on all the analyses of the theoretical approaches and findings of our study, its obvious that several implications can be point out concerning the validity of the CAPM in the BRVM Stock Exchange.

It is clearly shows that, as applied for the most developed countries like US, Canada and UK, the theoretical approach of the CAPM can also be applied to an emerging capital market such as BRVM and gives strong evidence to support or reject the hypothesis. The result obtained from our analysis implied controversially to the predictions that investors who bear higher risk in the BRVM stock exchange should not necessarily expect a higher return from his investment as well as the risk averse investor for whom the probability to yield a low return by bearing a low risk is not certain. The basic logic behind the capital-asset pricing model is that there is no premium for bearing risks that can be diversified away. Thus, to get a high average long-run rate of return in a portfolio or for a stock, the investor needs to increase the risk level of the portfolio that cannot be diversified away. But since our result shows that high risk don't necessarily yield high return; this logic is no longer applicable in the BRVM capital market. Except for the period four, our findings show that the unsystematic risk has no effect on the stocks returns. Therefore, the fact that the finding of period 4 reveal an impact of non-systematic risks on the return implied that investors on the BRVM market as well as the listed companies themselves should consider some other factors and variables which can possibly affect their return such as the profitability ratios, the dividend policy ratios, the book value etc…. . Despite that for most of the period the non-systematic test confirm the non effect of the unsystematic risk on returns, the result of period four suggest that more variables should be take into account when measuring the risk-return relationship. Our findings however are quiet consistent with other studies but is at odd with the positive and statistically significant risk-return tradeoff prescribed by finance theory.

9.1 Limitation of the Research

Like every scientific work, this study on the risk-return tradeoff has some limitations. The main limitations to be point out are mostly related to the empirical study approach in general and particularly to the data set and the methodology.

As recommended by the CAPM, the market portfolio to be used in this test should combine all the assets in the market. The market for such a portfolio would be the world market. But because it is impossible to have all the assets worldwide bring into one portfolio, market index is used as a proxy and in our case we choose the BRVM Composite.

The results of the tests conducted on data do not appear to clearly reject the CAPM. This does not mean that the data do not support CAPM. As Black [1972] points out these results can be explained by the fact that measurement and model specification errors arise due to the use of a proxy instead of the actual market portfolio. This error could have biased the regression line estimated slope towards zero.

The results about the CAPM test, to be more accurate should be obtained based on an investigation about many stocks grouped into portfolios according to their estimated beta coefficients as suggest by Black, Jensen and Scholes, and portfolio's beta be used for the test. But due to the fact that the sample of our study is too small, individual stock's betas instead of portfolio's beta are used for this study. This fact, like mentioned by some authors could have caused some biases in the estimation of the coefficients because by combining securities into portfolios one can diversify away most of the firm-specific component of the returns, thereby enhancing the precision of the beta estimates and the expected rate of return of the portfolio securities. This approach can mitigate the statistical problems that arise from measurement errors in beta estimates. Furthermore, this small samples and short observation period (2000-2008) may also lead to some measurement errors.

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