Journal of Financial Risk Management, 2022, 11, 220-243
https://www.scirp.org/journal/jfrm
ISSN Online: 2167-9541
ISSN Print: 2167-9533

Risk-Return of Securities in a Developing Market: The Case of the Bourse Regionale Des Valeurs Mobilieres

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How to cite this paper: Essingon, H. N., & Diallo, M. S. (2022). Risk-Return of Securities in a Developing Market: The Case of the Bourse Regionale Des Valeurs Mobilieres. *Journal of Financial Risk Management, 11,* 220-243.
https://doi.org/10.4236/jfrm.2022.111011

Received: February 26, 2022
Accepted: March 28, 2022
Published: March 31, 2022

Abstract

The study of the risk-return relationship of securities is decisive in order to appreciate in particular the attractiveness of a financial market. Using the Asymetric Response Model (ARM), we show that the level of risk taken by investors is insufficiently remunerated on the BRVM market with regard to the risk premium obtained. This result confirms the relevance of the ARM model in developing markets. It also underlines the need to rebalance the risk-return relationship on the BRVM in order to make it more attractive.

Keywords

Risk, Return, ARM, CAPM, BRVM

1. Introduction

The study of the determinants of the choice of investment in financial securities benefits from the historical answer of Markowitz (1952), according to which the interest of an investment must be assessed according to the risk and the return, considered as the two essential factors of the investor's satisfaction. Thus, the return must be correlated to the level of risk in a symmetrical movement. In other words, high risk should be matched by high return and vice versa.

Markowitz's work was extended by Treynor (1962), Sharpe (1964), Lintner (1965), Mossin (1969) and Black (1972), who confirmed the relevance of risk and return as the two determinants of any investment decision on a financial security using the Capital Asset Pricing Model (CAPM). Consequently, the attractiveness of a security on a market will depend on a symmetrical and normal relationship between the risk and return of securities on an efficient financial market.

However, several research studies show anomalies that lead to market inefficiency and, consequently, to the questioning of the CAPM hypotheses. Furthermore, work in behavioural finance (Thaler, 2005) suggests that investors may have a heterodox attitude towards risk due to the existence of over- or under-confidence biases that they may exhibit. This seems to predict an asymmetric relationship between risk and return. The literature appears to have moved from a balanced view of the risk-return relationship to a rather unbalanced approach to their relationship.

In the case of African stock markets, there is little research on the link between risk and return. It focuses mainly on the study of the sensitivity of African stock markets to global economic events and shocks (Aka, 2009; Mandimika 2012; Du Toit, 2015), on the one hand, and on tests of the validity of theoretical models, notably the CAPM, on these markets, on the other (Pamane & Vikpossi, 2014; Janata, 2016). However, the proliferation of financial markets since the 1990s leaves one wondering how attractive they are to local and foreign investors.

While reasons related to the size of the market, the weak stock market culture and the nature of the debt economies are often put forward, few studies have looked at the relationship between the gain obtained by investors, known as the risk premium, and the level of risk incurred by investors in these markets. This paper focuses on the case of the BRVM to examine this relationship. More specifically, we test the consistency between the level of risk taken by investors and the return obtained in return. Because of the low robustness of the CAPM model for the study of risk and return on African markets (Pamane & Vikpossi, 2014; Janata, 2016; Gahé et al. 2017) and more globally on emerging markets (Bakir, 2012), we chose an alternative model to the CAPM, namely the ARM model.

Our main contribution is therefore to provide an answer to the problem of the attractiveness of the BRVM, i.e. we will study whether the use of the market factor alone is decisive in explaining the remuneration of securities. Through this pioneering study in the West African Economic and Monetary Union (WAEMU), we will also demonstrate that remuneration through dividends makes the market less dynamic than remuneration through capital gains.

The rest of the study is organised as follows. Section 2 presents the literature review on the link between risk and return. Section 3 presents the ARM model and the research hypotheses. Section 4 presents the empirical study. Section 5 is devoted to the discussion. Finally, Section 6 concludes.

2. Risk and Return on Securities: A Review of the Literature

In the literature, there are two main currents, one based on a logic of normality and symmetry between risk and return, and the other on the existence of an asymmetry between these two factors.

2.1. Risk and Return on Securities: Normality and Symmetry

The seminal work of Markowitz (1952) established the relationship between risk and return, thus formalising the dilemma faced by investors in financial securities, i.e. whether to obtain a low but certain return or to accept risk in the hope of increasing this return. The higher the risk, the higher the expected return. Thus, this work highlights risk and return as the two determinants of the investment decision and their evolution is considered to be correlated and symmetrical. Moreover, the interest of investing in a financial security should not be evaluated separately but as part of the investor's portfolio as a whole, since the return obtained by the portfolio investor may be higher overall than the specific return of each security in the portfolio. Finally, the overall risk of the portfolio may be lower than that of each of the assets that make it up, thanks to the advantages of diversification.

Based on this risk-return relationship, authors such as Treynor (1965), Sharpe (1964), Lintner (1965), Mossin (1969) and Black (1972) went further and developed a central model that made it possible to describe, from an operational perspective, the way in which this relationship would be established on a financial market in equilibrium. Thus, the CAPM that follows shows that, based on the hypothesis that there are two categories of securities on a market, risk-free securities and risky securities, the overall return on a security or a security portfolio includes the return on the risk-free asset and a risk premium resulting from the investor's choice to compose his portfolio with risky assets. This excess return or risk premium depends on the overall performance of the financial market and the sensitivity of risky securities to changes in this market. Therefore, the CAPM makes it possible to understand the link between risk and return by considering what is happening in the market and in the company. From this perspective, the return is not only linked to the intrinsic performance of the company, but also to the performance of the market.

Empirical tests sought to validate the main results of the Sharpe-Lintner-Mossin and Black (1972) models. These include the linearity of the Security Market Line (SML) equation, the positivity of the market risk premium, its uniqueness as an explanatory variable and finally, the fact that any security uncorrelated with the market portfolio is identical to the risk-free rate. Blume and Friend (1973) developed a procedure for cross-sectional[1] data. Black et al. (1972) constructed a test incorporating time series[2] and Fama and MacBeth (1973) proposed an adaptation of Blume and Friend's test (op.cit.) to panel data. The linearity of the SML is unanimously validated, as is the positive market risk premium. However, conclusions are mixed on the other CAPM results. In a discussion, Huang and Litzenberg (1993), show that empirically it is Black's (1972) version that has been the most successful, even though Roll (1977) proved the untestability of the theoretical implications of CAPM.

[1]This means that the sample is composed of individual stocks whose returns are observed over a single period.

[2]The sample here consists of a set of observations of returns for each asset over a time interval of several periods. In the case of panel data, the average returns of several securities are observed over several periods simultaneously.

Subsequently, Ross (1976) developed the APT (Arbitrage Pricing Theory) model, which is based on the idea that there are no sustainable arbitrage opportunities over time. Indeed, an asset A that is as risky as asset B, but more profitable, would see its demand increase rapidly until its profitability became equal to that of asset B, thus cancelling out any arbitrage opportunities in the future. The other basic assumption is that the expected profitability of a stock can be modelled by a linear function of the various macroeconomic factors or factors specific to the company's sector of activity, weighted according to their impact on the stock, by a "beta" coefficient specific to each factor retained. Empirical studies seek to determine these macroeconomic or sectoral factors. In particular, they highlight the book value/market value ratio (Stattman, 1980; Rosenberg et al., 1985), size (Banz, 1981), the profit/share ratio (Basu, 1983), the turnover/share ratio (Senchack & Martin, 1987), and the debt leverage (Bhandari, 1988). Fama and French (1992) will also develop a model that proposes an original specification of the relationship between risk and return. They argue that return is a function of a systematic risk factor: the market portfolio and two specific risk factors: the book-to-market ratio and the size of the market measured by market capitalisation.

Despite these extensions, these models share a common thread based on the existence of a symmetrical and normal relationship between risk and return on securities in an efficient financial market. Moreover, these models consider the investor as rational and anaesthetised from any belief, ideology or culture other than that of profit maximisation. These conceptions have been challenged by various aspects of inefficiency observed in the markets and by an investor psychology far removed from rational and maximising behaviour.

However, it is difficult to find studies in sub-Saharan Africa, particularly in the WAEMU zone, that have attempted to test the relationship between risk and return. The CAPM, Fama and French models have been tested for their ability to predict fluctuations in securities returns. Soumaré et al. (2013) compare the Fama and French model and the CAPM model on the stocks of 28 companies listed on BRVM for the period July 2001-December 2008. They find that 11 stocks satisfy the CAPM, and 10 validate Fama and French. However, both models failed to explain the variation in returns of at least 60% of the stocks listed on this market. Diallo (2018) confirms this result with 34 companies listed on BRVM over the period September 1998-December 2016 and a daily frequency. We observe the predominance of the CAPM model over the Fama and French models and CAPM with liquidity. Indeed, the coefficient of determination R2 shows that the CAPM model (45.07%) is better than the Fama and French model (27.58%). If we remove the constant, it is 63.55% and 39.79% respectively. Pamane and Vikpossi (2014) examine the CAPM and test its validity on the BRVM market using the monthly stock returns of 17 listed companies for the period January 2000-December 2008. Their results show that residual risk has no effect on expected stock returns for the whole period and sub-periods, except for the last period 2003-2008 which shows that returns are affected by unsystematic risks during this specific period, justifying the fact that firms' operational activities have an impact on their stock returns. Gbenro and Moussa (2019) reject the hypothesis of the efficiency of the BRVM market. Their results suggest the existence of an asymmetric reversion property of the BRVM Composite index and the BRVM 10 index. This means a higher persistence of positive returns than of negative returns or the reverse.

2.2. Risk and Return on Securities: Anomaly and Asymmetry

Many market anomalies have challenged the conclusions of the models of Markowitz (1952), Ross (1976), Fama and French (1992). Indeed, the work of Lo and Mackinlay (1999), Lo et al. (2000) and Shiller (2000) highlights aspects of the dynamics of financial markets and prices that do not support the random walk and efficiency hypothesis of financial markets. Non-zero autocorrelations and successive variations that do not take the same direction constitute deviations from the hypothesis of a stock price following a random walk. The January, size and weekend effects, the predictability patterns based on price/earnings and dividend/price ratios, the under-reaction and over-reaction, and the mean reversion of long-term returns are all arguments that reinforce the questioning of conclusions based on the assumption of the efficiency of financial markets.

The work carried out by behavioural finance (Thaler, 2005) completes this picture of market anomalies because it argues that certain patterns found in the dynamics of financial markets are compatible with psychological feedback mechanisms. These include the followership or imitation effect, which can create serious disruptions in the functioning of the market. These anomalies call into question the efficiency hypothesis considered as one of the pillars of the CAPM (Lakoniskok et al. 1994). In this perspective, alternative models to the CAPM propose an assessment of the relationship between risk and return that takes into account the characteristics of emerging stock markets: 1) higher average returns than in traditional markets; 2) low correlations of returns with developed markets; 3) more predictable returns and higher volatility (Bekaert & Harvey, 1995) leading to problems of excess volatility, relevance of the CAPM and anomalies (size effect, book-to-market, value stocks, etc.).

According to Pedersen and Hwang (2002), when stock returns are abnormal, the CAPM is rejected in favour of the LPM-CAPM to measure risk, performance and stock prices. This is particularly relevant when listed companies are small. LPM[3]-CAPM or ARM models are then credible alternatives to CAPM for estimating the risk and return of stocks in emerging stock markets.

Taking into account the psychological dimensions to explain the behaviour of individuals shows that they do not always seem to use a single measure of risk. Investors seem to favour semi-variance and the probability of loss in their decision making instead of variance (Veld & Veld-Merkoulova, 2008).

[3]Lower partial moment (LPM) is a set of moments that is used to estimate downside risk in finance. Its formula is given by the following integral: $\mathrm{LPM}_n(\tau) = \int_{-\infty}^{\tau} (\tau - R)^n \, dF(R)$.

Empirical studies by Mitton and Vorkink (2007) on the behaviour of individual investors show that they do not (or very imperfectly) diversify their portfolios and that they choose securities with high skewness, even if the variance is also high. This explains why tens of billions are spent each year on gambling, whose expected return is largely negative (but whose skewness is largely positive). Similarly, large sums are spent on insurance contracts against all kinds of risks. Work in behavioural finance thus emphasises that the attitude of individuals to risk depends significantly on the type of risk they face. In other words, it is unrealistic to assume a uniform attitude to risk and an objective assessment of the probabilities of events. Rabin and Thaler (2001) show in this respect that decision making based on maximising the expectation of a concave utility function leads to inconsistent results.

From then on, the limits of the theory of utility expectation (Von Neumann & Morgenstern, 1947) in describing observed behaviour gave rise to the development of "behavioural" alternatives such as rank-dependent utility models (Quiggin, 1982), prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981) or optimal belief theory (Brunnermeier & Parker, 2005). Indeed, three elements have emerged as "problems" for the theory of utility expectation, namely: the idea that decisions are made by calculating the utility expectation on total wealth; the idea that the attitude towards risk is uniform (concavity of the utility function); and finally, the fact that the investor makes a linear evaluation with respect to probabilities.

Because of these limitations, prospect theory offers, for example, an alternative way of calculating utility by taking into account changes in wealth, gains and losses, and not final wealth. This utility calculation can also take into account the subjective distortion of probabilities by individuals. Therefore, the relationship between risk and return on securities may need to be re-examined. Thus, taking into account numerous psychological biases, an investor may accept a level of return that is asynchronous with the level of risk he or she bears, depending on whether he or she is optimistic or pessimistic about the gain or loss.

3. The ARM Model and Research Hypotheses

The CAPM model assumes that the distribution of returns is symmetric. However, **Figure 1** shows us an asymmetric distribution. It shows that the tail of the distribution is spread out on the left side.

We will therefore adopt the ARM model to study the risk-return relationship and test our research hypotheses

3.1. The ARM Model

This model was initiated by Bawa et al. (1981) and is presented as follows:

$$R_i(t) - R_f = \beta_{1i} R_m^-(t) + \beta_{2i} R_m^+(t) + \pi\delta(t) + \varepsilon_i(t) \quad (1)$$

or $R_m^-(t) = R_m(t) - R_f$ when $R_m(t) < R_f$ and zero otherwise

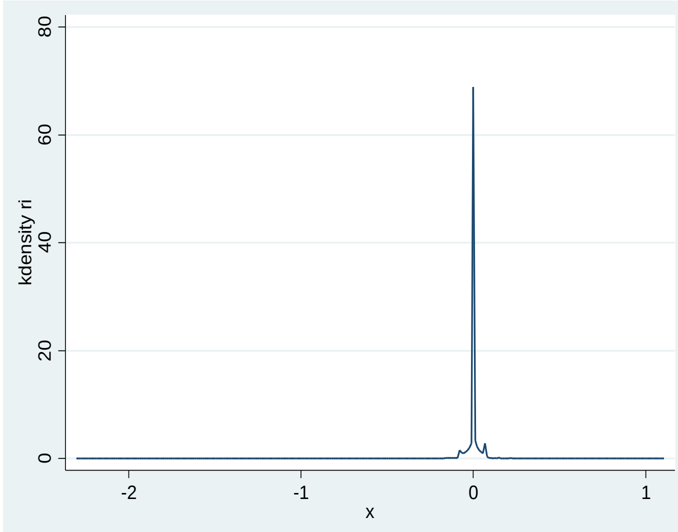

Figure 1. Distribution of returns on listed securities.

$R_m^+(t) = R_m(t) - R_f$ when $R_m(t) > R_f$ and zero otherwise with: $R_i(t)$ the performance of security i in period t; $R_i(t) - R_f(t)$ the yield expectation at time t; β_{1i} the yield response of security i to adverse market performance; β_{2i} is the asset return response to favourable market performance; π captures the asymmetric response of the model; $R_m(t)$ and $R_f(t)$ are, respectively, the market yield and the risk-free rate of return; $\delta(t)$ an indicator variable which is equal to 1 when $R_m(t) > R_f(t)$ and 0 otherwise; $\varepsilon_i(t)$ the serially uncorrelated error term.

The ARM model like the LPM-CAPM is a derivative of the CAPM. Indeed, to distinguish these three models and to situate the ARM model more specifically, we start from the work of Harlow and Rao (1989), then Eftekhari and Satchell (1996). They assume that, when $\pi = \phi(\beta_{1i} - \beta_{2i})$ in (1); where ϕ is the conditional expectation of $R_m^+(t)$ given that $R_m(t) > R_f(t)$, i.e.:

$$\phi = E\left[R_m(t) - R_f(t) \middle| R_m(t) \succ R_f(t)\rangle\right] = \frac{E\left[R_m^+(t)\right]}{\Pr\left(R_m(t) \succ R_f(t)\right)} \quad (2)$$

Using expectations, we can show that Equation (1) is reduced to the LPM-CAPM equation in Bawa and Lindenberg (1977) and that:

$$\beta_{1i} = \hat{\beta}_{LPM} = \frac{CLPM_{R_f}(R_p, R_m)}{LPM_{R_f}(R_m)} = \frac{\sum_{t=1}^{T}\left(R_i(t) - \bar{R}_f(t)\right)\min\left[0, R_m(t) - R_f(t)\right]}{\sum_{t=1}^{T}\left(\min\left[0, R_m(t) - \bar{R}_f\right]\right)^2} \quad (3)$$

The "beta" of the LPM-CAPM therefore gives a risk measure equivalent to the equilibrium risk measure of a model whose assumptions are the same as those of the CAPM, but where volatility is measured by a semi-standard deviation instead of variance as a measure of risk.

$$d\left[\sum_{i=1}^{n}\left(\tau - R_i(t)\right)^2\right]^{\frac{1}{2}} \text{ in which } R_i(t) < \tau .$$

Here τ is the target return, typically as the risk-free rate of return.

Equation (3) replaces the traditional CAPM beta and is a measure of the downside (semi-variance) risk of returns.

As for β_{2i}, it can be analogously interpreted as the response of asset returns to upside market returns.

By posing $\beta_{1i} = \beta_{2i}$ (and thus by (3) also $\pi = 0$) in (2) and taking into account expectations, we find the traditional CAPM where:

$$\beta_{2i} = \hat{\beta}_{\text{CAPM}} = \frac{\operatorname{cov}(R_i, R_m)}{\operatorname{var}(R_m)} = \frac{\sum_{t=1}^{T}\left(R_i(t) - \bar{R}_i\right)\left(R_m(t) - \bar{R}_m\right)}{\sum_{t=1}^{T}\left(R_m(t) - \bar{R}_m\right)^2} \tag{4}$$

3.2. Research Hypotheses

Considering that the CAPM and LPM-CAPM models are only extensions of the ARM model, their difference will however be appreciated as follows: when the distribution of returns is "normal" and symmetrical, the CAPM model is the best adapted. On the other hand, when the distribution of returns is "non-normal" and asymmetrical, we choose either the LPM-CAPM or the ARM, which corresponds to the general hypothesis of our research. We then identify three testable sub-hypotheses.

3.2.1. The Distribution of Excess Returns on Securities Is Asymmetric

The limits of the expected utility theory (Von Neumann & Morgenstern, 1947) shed interesting light on this asymmetric relationship. Indeed, by assuming that investors' attitude towards risk is uniform and leads to a linear valuation, we expect investors' interest in securities to vary. However, the work of Kahneman and Tversky (1979) suggests that investors will evaluate their loss and gain perspective asymmetrically. This is because investors are more sensitive to the risk of loss than to the probability of making a gain. For example, on the BRVM, investors focused on the Société Nationale des Télécommunications (SONATEL) stock. While this may constitute a model stock to attract investors to the market, the consequence is that there is a kind of avoidance effect on other stocks in the market, characteristic of an atypical behaviour of investors, which places them in a situation of overconfidence in this stock and conversely, of underconfidence in the other stocks listed on the market. We can therefore consider that investors in the BRVM have an aversion to loss that leads them to prefer one security to others on the market, justifying sub-hypothesis 1: that there is an excess return on securities that leads to the asymmetric nature of the risk-return ratio on this market.

3.2.2. The Risk to the Investor Is Disproportionate to the Market Risk

The anomalies observed in the stock market by Pedersen and Hwang (2002) lead to the rejection of the CAPM as an explanatory model of the risk-return ratio. This implies that there are factors other than those linked to the market to explain the risk borne by the investor. In this respect, and according to Thaler (2005), the psychological dimension, which emphasises following and imitation, should be considered as a determining factor of investor behaviour, which may then impact on the functioning of the market. In this case, the risk suffered by an investor does not only come from the market, but also includes different dimensions outside the market. They are in particular behavioural because of the numerous psychological biases evoked by behavioural finance, which are also considered to be sources of anomalies in the market. The risk incurred by the investor will therefore be disproportionate to that assessed on the basis of systematic risk factors considered until now to originate from the market. Hence our sub-hypothesis 2, that the risk to the investor is disproportionate to that of the market.

3.2.3. There Is an Indicator Variable that Captures the Direction of the Asymmetry

The implementation of the ARM model requires the characterisation of market returns. To do so, it is necessary to empirically analyse the assumptions that are at the origin of the distribution keys of the market returns. To this end, the maximum likelihood test of the ARM model is carried out, which is broken down as follows:

$$pdf\left(R_i(t) \middle| R_m^-(t), R_m^+(t), \delta(t)\right) = \frac{1}{\sigma\sqrt{2\pi}}\exp\left[-\frac{1}{2\sigma^2}\left(R_i(t) - \beta_{i1}R_m^-(t) - \beta_{i2}R_m^+(t) - \pi\delta(t)\right)^2\right]$$

The second term $pdf\left(R_m^-(t), R_m^+(t), \delta(t)\right)$ requires an appropriate assumption based on the observed distribution of market returns.

The probability density function is also used to explain the normality or non-normality of stock returns on the BRVM. The Mixed Gamma (MG) test, proposed by Knight et al. (1995), captures the asymmetry of downside and upside asset returns. The distribution described by MG is as follows:

$$pdf(x) = \begin{cases} \dfrac{\lambda^{\alpha} x^{\alpha-1}}{\Gamma(\alpha)}\exp(-\lambda x);\ x > 0 \\ 0;\ \text{otherwise} \end{cases} \tag{6}$$

Γ is the Gamma function, $\alpha > 0$; $\lambda > 0$

Under these conditions, Knight et al. (1995) show that the likelihood test can also be written as follows:

$$\begin{aligned} &pdf\left(R_i(t) \middle| R_m^-(t), R_m^+(t), \delta(t)\right) \\ &= \left[pdf\left(R_m^-(t)\right)p\right]^{\delta(t)}\left[pdf\left(R_m^+(t)\right)(1-p)\right]^{1-\delta(t)} \\ &= \left[\frac{p\lambda_1^{\alpha_1}\left[R_m^+(t)\right]^{\alpha_1-1}\exp\left[-\lambda_1 R_m^+(t)\right]}{\Gamma(\alpha_1)}\right]^{\delta(t)} \\ &\times\left[\frac{(1-p)\lambda_2^{\alpha_2}\left[-R_m^-(t)\right]^{\alpha_2-1}\exp\left[-\lambda_2\left(-R_m^-(t)\right)\right]^{1-\delta(t)}}{\Gamma(\alpha_2)}\right] \end{aligned}$$

where: (λ_1, α_1) are parameters that represent the Gamma distribution for favourable market returns; (λ_2, α_2) are parameters that represent the Gamma distribution for unfavourable market returns $R_m^-(t)$; *p* is the probability of the indicator variable $\delta(t)$.

In the case where the distribution of returns is normal, the indicator value would be zero, which is characteristic of the assumption of market efficiency and normality supported by the theory of Markowitz (1952). However, when the distribution of returns is asymmetric, the indicator variable is non-zero and likely to determine the direction of the asymmetry. It is this second case that we retain in sub-hypothesis 3, namely that the indicator variable is non-zero.

4. The Empirical Study

It leads successively to the presentation of the data, on the one hand, and the statistical results and the test on the ARM model, on the other hand.

4.1. The Data

The study covers all companies listed on the BRVM market over the period from 16 September 2013 to 31 December 2019. The database is based on a daily frequency of prices of securities listed on the market as well as on the evolution of the market performance through the BRVM Composite[4] index. Out of a sample of 32 companies, 91% are Ivorian.

The average interest rate on Ivory Coast government bonds is used as the risk-free rate of return for the period (2013-2019). It is 5% on average per annum, i.e. at a daily rate of about 0.019% if one considers that the number of effective market days in a year is 252 days. It is illustrated by the following **Table 1**. (**Figure 2**)

We could also follow the methodology of Gbongué (2019) to improve the use of the risk-free rate in the WAEMU zone. The most relevant approach would then be to use a monthly or annual frequency on our database. This is not the case in this study.

The return on the security and the return on the market are calculated as follows:

$$R_{i,t} = \ln\left(\frac{C_{i,t}}{C_{i,t-1}}\right), \quad R_{m,t} = \ln\left(\frac{I_t}{I_{t-1}}\right)$$

with: $R_{i,t}$ = the return on security *i* over the period *t*[5], $R_{m,t}$ = the market performance at the time *t*, $C_{i,t}$ the price of firm *i* in period *t*; It the BRVM composite index in period *t*.

4.2. Descriptive Statistics

Table 2 gives the following statistics:

[4]The data is available on the brvm or sikafinance website

[5]In our case, dividends are paid mainly at the end of the year, so we exclude dividends from the calculation of returns to avoid having outliers for the last day of December

Table 1. Ivoiry Cost's bond issue rate.

Date	Deadline	Duration	Weighted average interest rate	Amount/million XOF
03/05/2016	04/05/2019	3	5%	61,000
21/04/2016	22/04/2023	7	5.25%	70,000
12/04/2016	11/04/2017	1	4.24%	50,000
17/02/2016	13/02/2018	2	4.72%	60,000
04/11/2015	31/10/2017	2	4.48%	50,000
04/11/2015	31/10/2017	2	4.48%	50,000
14/10/2015	14/10/2022	7	5.85%	100,000
05/08/2015	02/08/2016	1	4.03%	30,000
24/06/2015	21/06/2016	1	3.99%	10,000
11/06/2015	11/06/2025	10	5.99%	100,000
13/01/2015	09/01/2017	3	5.52%	50,000
29/10/2014	29/10/2019	5	5.80%	40,000
16/10/2014	16/10/2019	5	5.80%	40,000
05/08/2014	05/08/2019	5	6%	100,000
14/07/2014	15/07/2017	3	6%	40,000
24/06/2014	21/06/2016	2	5.75%	60,000
28/04/2014	29/04/2022	8	6.55%	100,000
15/04/2014	12/04/2016	2	5.90%	50,000
06/03/2014	07/03/2014	7	6.50%	50,000
25/02/2014	26/02/2021	7	6.50%	250,000
28/03/2013	29/03/2020	7	6.50%	70,000
Weighted average rate on Ivoiry Coast government bonds			**5%**	

Source: BRVM.

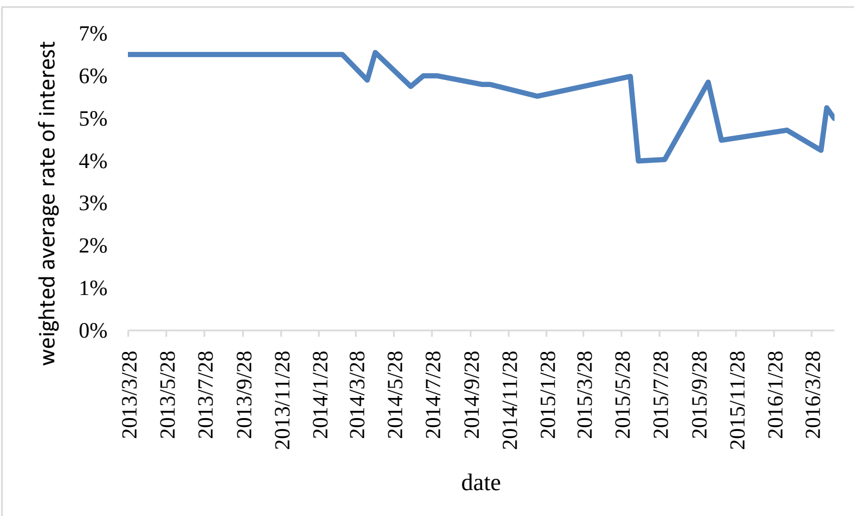

Figure 2. Evolution of the average bond issue rate in Ivoiry Coast.

Table 2. Descriptive statistics.

Frequency	Parameter	Negative risk premium	Negative market return	Positive market return
Daily	Number of observations		49,984	
	Absolute proportion	38,777	26,336	23,552
	Relative proportion	77.58%	52.69%	47.12%
	t-value[6]	−6.5853	−141.9717	125.9184
	Mean	−0.0021905	−0.002807	0.0026455
	Standard deviation	0.0743666	0.0044203	0.0046971
	skewness (0)	−39.44609	−2.5040444	2.86864
	kurtosis (3)	1904.962	11.48958	13.6968
	Jarque-Bera (5.99)	4,378,617.4721	378.65883	178.2749

Source: Author' own calculation from stata software.

Table 2 shows that since the change in listing mode[7] until the end of 2019, the investors' risk premium shows on average a negative balance (−0.21%) with a low standard deviation (0.074), i.e. nearly 78% of our observation on the BRVM market. This result is quite similar to studies conducted on emerging markets where we also observe a high proportion of negative returns. For example, Aksu and Onder (2003) show that 52% of securities have negative returns on Turkish markets. Similarly, according to Ben Naceur and Ghazouani (2007), this proportion is 60% over a period of 5 years on the Tunisian markets.

We also note the low attractiveness of the market characterised by performances close to zero over the whole period. Indeed, the market performance gives the following results:

- The return is on average negative and stands at −0.28% with a low standard deviation of 0.44% or 52.69% of our observation.
- The positive market return is on average 0.26% with a low standard deviation of 0.46% or 47.12% of our observation.

Figure 3 gives us an overview of the distribution of BRVM market returns. This almost zero performance can be interpreted by the low market activity.

The same conclusion can be drawn from the figures (Figures 4-6) on the evolution of returns over time.

The indicator variable gives 22816 situations where the market return is higher than the risk-free rate return, i.e. 45.65% of our observation. Far from the zero value, we deduce that the distribution of the risk premium sends asymmetric signals.

The negative skewness coefficient shows us that the distribution of the risk premium is shifted to the right and that its tail is on the left side, i.e. a negatively skewed distribution. The kurtosis coefficient of the risk premium is large. This is associated with high risk for an investment as it indicates high probabilities of

[6]The t-value is calculated by dividing the average of the daily returns by its standard deviation which is: $\sigma/(T-1)^{0.5}$.

[7]BRVM has changed its quotation system from fixing to continuous trading as of Monday 16 September 2013, after 15 years of operation.

extremely high and extremely low returns. In contrast, market returns show a low kurtosis and indicate a moderate level of risk, as the probabilities of extreme returns are relatively low. The jarque bera chi (2) test is equal to 7.5e+09 greater than 5.99. Therefore, the data do not follow a normal distribution.

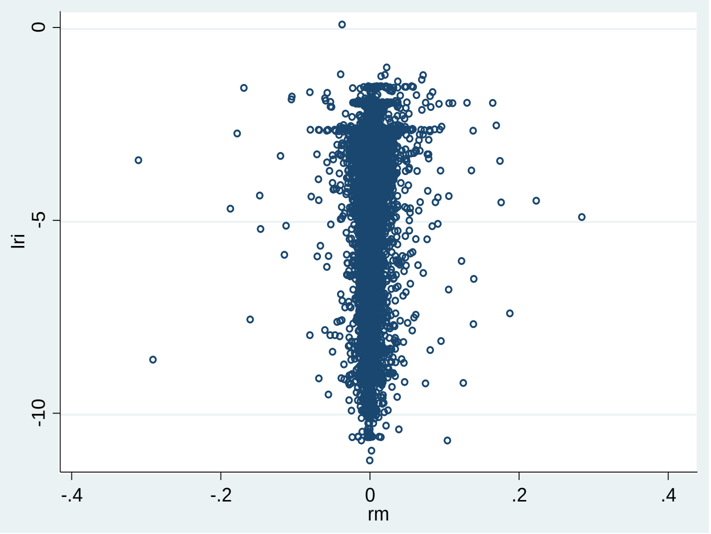

Figure 3. Distribution of market returns.

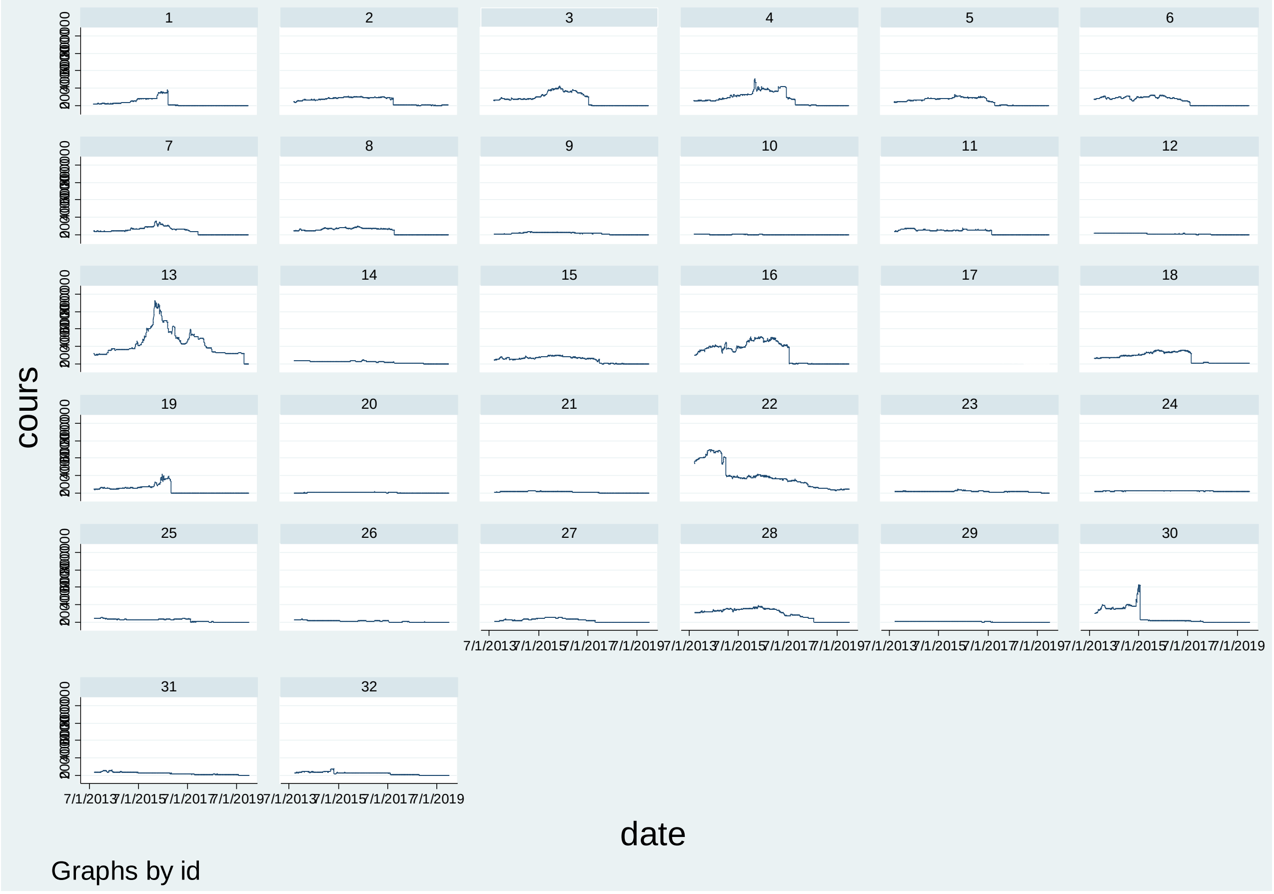

Figure 4. Evolution of prices on the BRVM market.

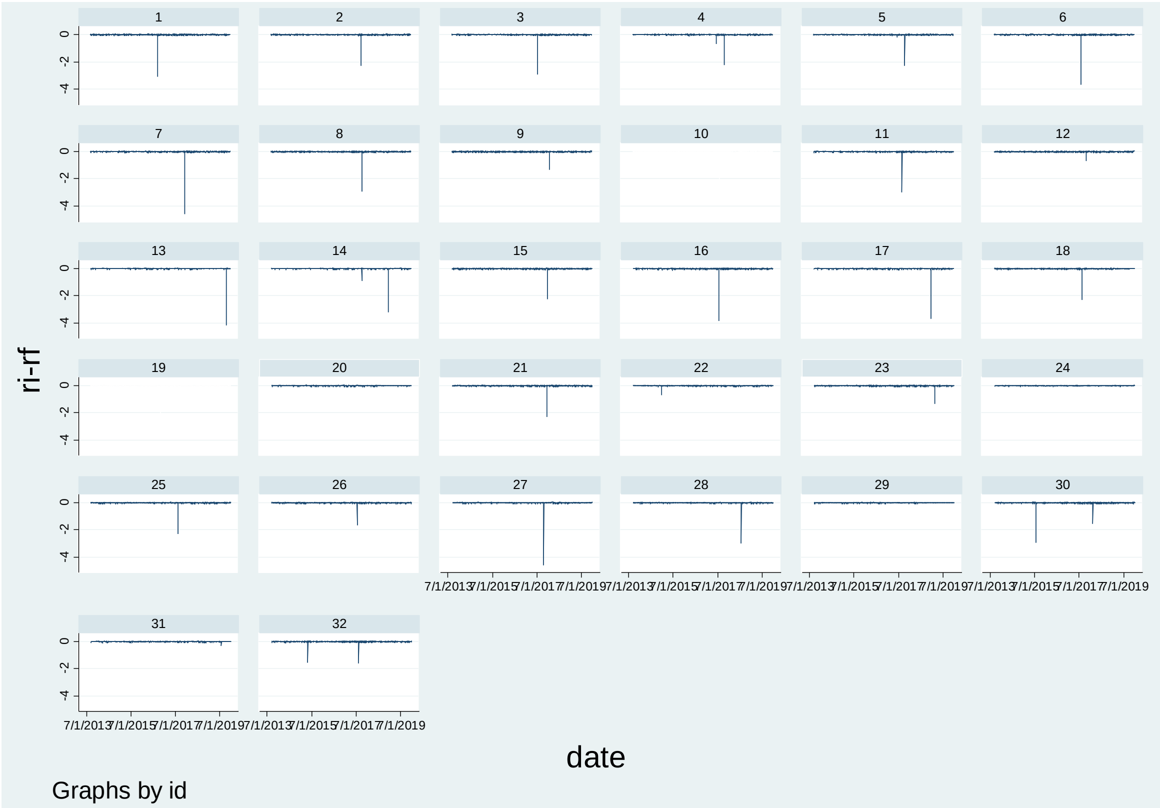

Figure 5. Evolution of risk premiums for securities in the market.

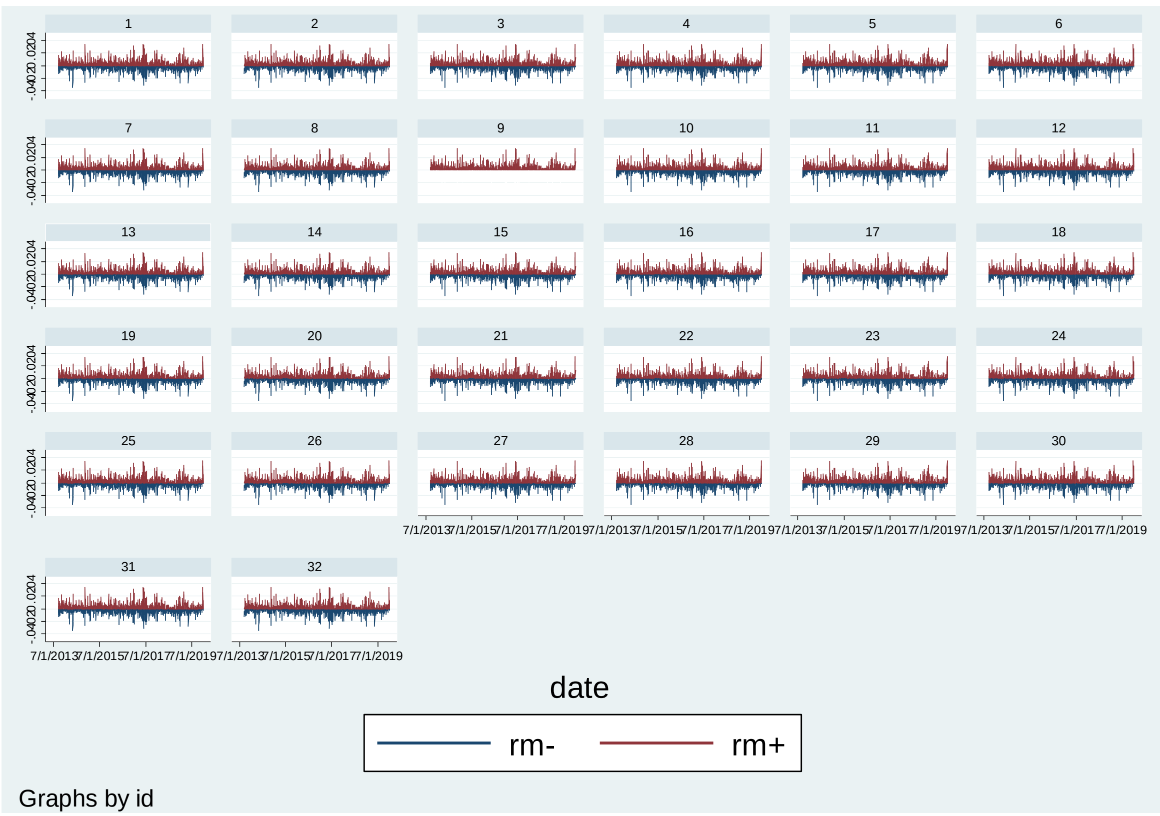

Figure 6. Evolution of market returns.

Overall, we note that the risk premium on the BRVM does not guarantee a level of remuneration to cover their investments against risk, on the contrary, we observe the persistence of negative returns higher than positive returns. This can be explained by the fact that investors play the security card in their investments. They therefore prefer to invest at risk-free rates or very little in risky assets. This results in a low level of trading, for example Hearn et al. (2008) indicate that the average annual order flow is less than 2% of the value traded on the regional exchange, which is very illiquid. Consequently, a market premium deficit can be interpreted as follows: 1) investors are risk averse and prefer to invest at the risk-free rate 2) they seek to enter the capital of a company with a large market capitalisation and hold its stock in the long and medium term. The behaviour of investors on this market does not reflect speculative behaviour leading them to seek capital gains, as they appear to be concentrated on a single stock that is active on the stock market. The strategy practised by investors in this market is that of "buy and hold", which suggests that we are in a market characterised by very low liquidity. The remuneration through dividends is higher than the remuneration through capital gains, as illustrated in **Figure 7**.

4.3. The Results

Before presenting the estimation results, it is important to specify the regression test to be applied.

- The Fisher test allows us to know if the model includes the presence of individuals (fixed effects) or if the model is without effects (ordinary least squares method). The result of our test leads us to the model without effects (p-value = 1.000).
- The Breush-Pagan test allows us to choose between the random effects model and the no effects model. According to the result of our test, the model without effects is the best (p-value = 1.000).

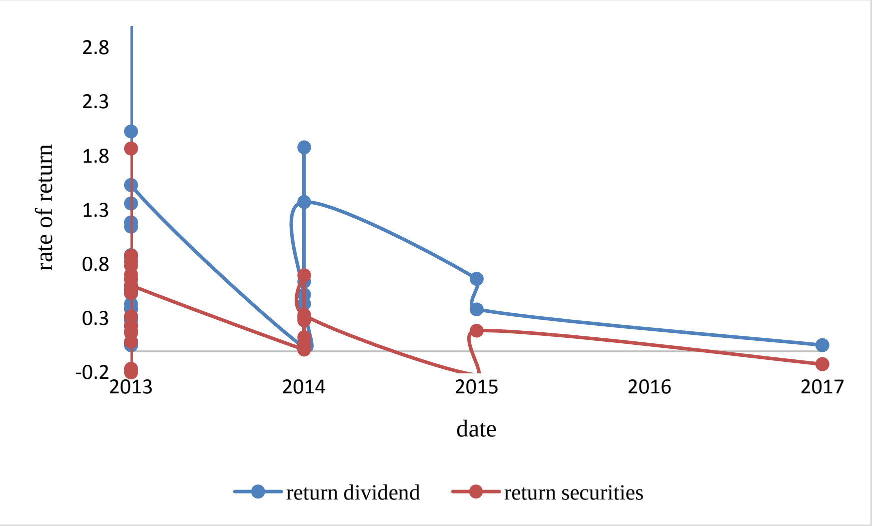

Figure 7. Evolution of dividend returns and securities.

Table 3 shows that the no-effects model is more appropriate, which leads to the choice of the ordinary least squares (OLS) regression.

Table 4 gives the following estimates

Table 4 shows the persistence of negative returns over positive returns. The coefficients of the parameters, including the constant and excluding the indicator variable, are significant. The result of the test confirms the following sub-hypotheses:

Sub-hypothesis 1: There is an excess of stock returns which leads to the asymmetric nature of the risk-return ratio on this market.

Sub hypothesis 3: the indicator variable is non-zero.

The asymmetric relationship between risk and return proves the existence of the indicator variable.

However, we note the limitations of the ARM model in predicting the fluctuation of stock returns. The constant of the model is significant at the 1% threshold, the coefficient of determination R^2 is very low and lower than 1%. The explanation comes from the fact that systematic risk factors other than those of the market are to be taken into account on the risk-return relationship at the BRVM. We can therefore confirm sub-hypothesis 2, according to which the risk suffered by investors in this market is disproportionate.

However, we may wonder about the nature of the remuneration offered by the market? Considering that the remuneration of an investor in shares is composed of the dividend and the capital gain. In the context of the BRM, it is established that the dividend is the most important component of investor remuneration. The search for capital gains is concentrated on the Sonatel share.

Table 3. Specification tests.

Tests	Results		Interpretation
	t	*p*-value	
Fisher test	0.27	1.000	- Fixed effects rejection - Model acceptance without effects
Breusch-Pagan test	0.00	1.000	- Random effects rejection - Model acceptance without effects
Conclusion	Model adoption without effects		

Source: Author' own calculation from stata software.

Table 4. Estimation of the ARM model.

Parameter	Coeff	t	Prob
β_1	0.4116063	4.45	0.000
β_2	0.2351063	2.62	0.009
β_3	0.0010195	1.05	0.294
ε	−0.0021225	−3.23	0.001
R^2	0.0014		

Source: Author' own calculation from stata software.

Table 5 will then estimate different coefficients for each firm. The post estimation tests allow to verify the validation of the ARM model. The statistical tests on the parameters as well as the good properties of the estimators are based on the hypotheses of significance of the constant, homoscedasticity and non-autocorrelation of the errors. Thus, we have the following results:

The estimation of the parameters by the ARM model does not perform well for each stock taken individually. Indeed, we note that the student coefficient for most of these securities is not significant.

Table 5. Estimation of individual ARM coefficients by OLS and validity tests.

Title	Cste	β^-	β^+	δ	Wald test	Breusch-Godfrey	White test	R^2
1	−0.0011223	0.3141258	0.0040468	−0.0000146	0.07	0.419	8.01***	0.0003
	(−0.27)	(0.53)	(0.01)	(−0.00)				
2	−0.0020159	0.0670903	0.1893215	0.0008222	0.41	20.778***	3.38**	0.0005
	(−0.64)	(0.15)	(0.44)	(0.18)				
3	−0.0052472	0.0583129	−0.1331854	0.0058904	1.78	0.891	14.27***	0.0012
	(−1.34)	(0.11)	(−0.25)	(1.01)				
4	−0.0017647	0.3726488	0.7520201	−0.0025693	0.31	2.373	7.88***	0.0032
	(−0.55)	(0.83)	(1.73)	(−0.55)				
5	−0.0011329	0.9113729	0.2069285	0.0029992	0.13	1.086	8.44***	0.0078
	(−0.36)	(2.06)	(0.48)	(0.64)				
6	−0.0101115	−0.5999497	0.0793074	0.0109423	4.36**	0.052	11.76***	0.0023
	(−2.09)	(−0.88)	(0.12)	(1.53)				
7	−0.0003783	0.4318849	1.318805	−0.0110175	0.00	0.387	8.85***	0.0019
	(−0.06)	(0.51)	(1.61)	(−1.24)				
8	−0.0003355	1.081625	1.091625	−0.0040597	0.01	2.196	7.23***	0.0074
	(−0.08)	(1.93)	(2.01)	(−0.69)				
9	−0.0044231	0.2424565	0.34238	0.0068078	3.60*	1.421	12.31***	0.0125
	(−1.90)	(0.74)	(1.08)	(1.97)				
10	−0.0021994	0.380545	−0.0805916	0.0023484	0.26	11.760***	0.48	0.0008
	(−0.51)	(0.63)	(−0.14)	(0.37)				
11	−0.0063637	−0.0801364	−0.011962	0.0064675	2.54	5.881*	11.23***	0.0014
	(−1.59)	(−0.14)	(−0.02)	(1.09)				
12	−0.0011689	0.8337282	0.4844231	0.0014513	0.46	15.207***	8.31***	0.0249
	(−0.68)	(3.43)	(2.06)	(0.57)				
13	−0.000023	0.1836173	0.8082009	−0.009241	0.00	3.177	21.13***	0.0011
	(−0.00)	(0.24)	(1.11)	(−1.17)				
14	−0.0002636	0.2036594	−1.486029	0.0034388	0.00	0.037	30.56***	0.0047
	(−0.06)	(0.34)	(−2.52)	(0.54)				

Continued

15	−0.000713	0.4427057	−0.5589263	0.0032045	0.05	3.098	8.59***	0.0020
	(−0.22)	(0.98)	(−1.28)	(0.68)				
16	0.0001215	1.115042	1.179027	−0.0065711	0.00	0.151	5.33***	0.0043
	(0.02)	(1.56)	(1.70)	(−0.88)				
17	0.0026064	1.728773	0.0977871	−0.0036051	0.29	22.971***	8.09***	0.0051
	(0.54)	(2.56)	(0.15)	(−0.51)				
18	−0.003916	0.7023375	0.853635	0.0046468	1.59	5.902*	13.02***	0.0153
	(−1.26)	(1.61)	(2.01)	(1.01)				
19	−0.0121771	−0.7556452	0.088591	0.0154406	5.60**	3.043	21.32***	0.0041
	(−2.37)	(−1.04)	(0.13)	(2.03)				
20	−0.0004648	−0.0613937	0.0943764	−0.0006039	0.20	31.853***	28.23***	0.0005
	(−0.44)	(−0.42)	(0.66)	(−0.39)				
21	−0.0016314	0.0430232	0.150262	−0.0034205	0.26	0.022	22.40***	0.0004
	(−0.51)	(0.09)	(0.34)	(−0.72)				
22	−0.0020599	0.3507974	−0.4031882	0.0057586	2.24	3.491	7.86***	0.0139
	(−1.50)	(1.81)	(−2.15)	(2.83)				
23	−0.0003529	0.3636969	0.0034803	−0.0002792	0.03	1.450	5.20***	0.0013
	(−0.16)	(1.21)	(0.01)	(−0.09)				
24	0.0024478	1.575297	1.831389	−0.0068326	30.06***	14.157***	21.77***	0.5877
	(5.48)	(25.06)	(30.05)	(−10.35)				
25	−0.0065799	−0.1910087	0.2106718	0.0076822	4.22**	0.909	12.34***	0.0040
	(−2.05)	(−0.42)	(0.48)	(1.62)				
26	0.003948	1.593517	0.1351794	−0.0041652	2.49	6.510**	12.79***	0.0153
	(1.58)	(4.52)	(0.40)	(−1.13)				
27	0.0013757	0.261211	0.2714615	−0.0088627	0.05	0.027	30.86***	0.0008
	(0.23)	(0.31)	(0.33)	(−1.01)				
28	−0.0020642	0.211933	0.430287	−0.0043248	0.27	0.237	0.94	0.0005
	(−0.52)	(0.38)	(0.80)	(−0.74)				
29	−0.0001552	0.082773	−0.1214373	−0.000648	0.04	1.965	26.26***	0.0020
	(−0.19)	(0.74)	(−1.12)	(−0.55)				
30	−0.0033853	0.8002594	−0.9509662	0.0117497	0.58	1.019	8.61***	0.0059
	(−0.76)	(1.27)	(−1.56)	(1.78)				
31	−0.001704	0.1657804	0.1508225	−0.0002065	2.18	1.111	7.17***	0.0023
	(−1.48)	(1.02)	(0.96)	(−0.12)				
32	−0.0066646	0.3413237	0.4956582	0.0093969	4.39**	14.809***	9.65***	0.0131
	(−2.09)	(0.76)	(1.14)	(2.00)				

Source: Author' own calculation from stata software.

The post estimation tests give the following results:

- The Wald test shows the significance of the constants for the headings 6, 9, 24, 25 and 32. This implies that there are risk factors, other than systematic market risk, to explain the performance of these stocks. The ARM is therefore not appropriate because this model considers that only the market should be able to explain variations in the returns of securities.
- The non-correlation of errors is tested by the Breusch-Godfrey method. This test shows 7 stocks whose errors are correlated. These are stocks 2, 10, 12, 17, 18, 20 and 26. There are several techniques for correcting the auto-correlation of residuals in the OLS framework. But each of them requires the introduction of new variables into the model, which systematically calls into question the ARM model.
- The White test shows, with the exception of headings 10 and 28, that the errors of the headings are heteroscedastic. This means that the variance of the error is linked to the use of the market return as the only explanatory factor of the risk premium of the securities.

In summary, these tests show the weakness of the ARM model in reporting on the risk-return relationship on the BRVM market. It is characterised by the level of the coefficient of determination R^2 which barely reaches the 1% threshold for each of the securities listed on the market. Nevertheless, the SONATEL share gives a higher coefficient of determination of 58.77%. This can be explained by the fact that investors speculate on this stock in order to make capital gains.

5. Discussion

We discuss our results regarding the relevance of the ARM model, on the one hand, and the attractiveness of the BRVM, on the other.

Regarding the relevance of the ARM model, our study confirms that in a BRVM-type market the distribution of returns is not symmetric as assumed in the CAPM. First, because the risk incurred by these investors is disproportionate to the market risk, contrary to what the CAPM postulates. The return expected by investors is not rewarded by that of the market. Second, because the presence of a non-zero indicator variable clearly shows the existence of this asymmetric relationship between risk and return. This calls into question the theoretical foundations of Markowitz (1952), notably on market efficiency, where this indicator variable is zero and gives a normal distribution of returns. Finally, because the behaviour of investors tends to go beyond the theory of expected utility in order to open up to alternative explanations. Indeed, if investors in the BRVM behaved in accordance with the expected utility theory, they would withdraw from their investment as soon as an opportunity arises, i.e. when the price moves away from its fundamental value. However, the opposite is true, as they tend to keep their shares even when the market is favourable. It is as if they set themselves a daily gain horizon and withdraw as soon as this is achieved. Their behaviour seems to be consistent with prospect theory (Kahneman & Tversky, 1979) if we postulate that this gain horizon serves as a reference for their decision.

It also seems interesting to invoke the theories of risk and loss aversion. Indeed, loss aversion reinforces the tendency to hold on to securities, since if one sells a loss-making security to buy another and makes a capital loss, one only pays off half the disappointment caused by the loss on the first security. This is why, despite the sometimes positive trend in returns on BRVM securities, investors prefer to hold on to them rather than sell them in order to avoid capital losses.

With regard to the attractiveness of the BRVM, our results show that this market is essentially composed of "fundamentalist[8]" investors who buy securities and hold them in order to receive dividends. This investor profile contrasts with that commonly observed in developed stock markets, which are mainly interested in returns and potential capital gains. Thus, investors in BRVM seem to take little or no risk and are only interested in stocks that have potential and/or "visibility" with a high current yield; this is the case of SONATEL stock, which concentrates most of the transactions in this market. Because of this homogeneity of behaviour, it can be said that they follow an identical model of interpretation, with the dividend or present value model as the basis of analysis and anticipation. This model focuses on the fundamentals or real determinants, such as dividends and interest rates, and all the variables that influence these factors. Despite their diverse origins, and even if each of them acts according to its own rationality, the market will always balance itself in the direction of the expectations of the dominant ones, namely those of the "fundamentalists".

All in all, driven by limit orders, composed of investors with a homogeneous profile and associated with an asymmetrical response to the distribution of returns on its securities, the BRVM is ultimately unattractive, in particular because it does not offer the possibility of obtaining significant capital gains due to returns on securities that are close to, or even confused with their fundamental values.

6. Conclusion

The objective of this article was to study the relationship between the risk and return of securities on an African market, in particular the BRVM, using the ARM model, which is better suited to studying this link than the CAPM.

The result is that the ARM model is relevant for confirming the asymmetric nature of the risk-return relationship on small markets such as the BRVM. It also has limitations in terms of its ability to predict the fluctuation of returns. The lesson that can be drawn from what it shows, moreover, that in the absence of an effective dynamic and in the face of investors whose behaviour is far removed from the theory of expected utility, the performance of these markets is rather

[8]The market is driven by capital management and intermediation companies such as investment company with variable capital (SICAV), Mutual Funds (FCP), pension funds, financial companies (credit institutions, insurance companies), etc. Small holders (individual investors) have little influence on the BRVM market.

unfavourable and restrictive of capital gains. It is this component of remuneration, sought by investors in securities, that is absent on this market, which explains its low attractiveness.

Two avenues for improving the dynamics of the BRVM seem worth exploring. Firstly, the problem of the exchange rate of the XOF is against the euro or other currencies, on the one hand, and exchange controls that do not encourage the mobility of international investors, on the other. Secondly, the quantification of the risk of loss acceptable to an investor in order to determine the level of capital required to protect against this risk.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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