Towards a Behavioral Model For Assets Pricing: Evidence From The Tunisian Stock Exchange.

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INTRODUCTION

The conception of a concise and rational model for assets pricing in an efficient market's context has been, for a long time, the axis of concern for the researchers of finance. This was warranted by the contributions of Sharpe (1964) Sharpe and Linter (1965) in their test to express the price of an asset by the systematic risk of this, last via the famous model of assets pricing known as the CAPM (*Capital Assets Pricing Model*). The identification of the systematic risk is initially on some theoretical bases, that it is about the CAPM developed by Sharpe (1964), Sharpe and Lintner (1965) and Mossin (1966) or of the theory of the arbitrage pricing theory (APT) introduced by Ross (1976) and illustrated by Chen, Roll and Ross (1986).

Indeed, while being always regarded as the most rational and the most adequate model in an efficiency market's context, the CAPM of Sharpe and Linter (1964, 1965) was criticized owing to the fact that a single factor of market is insufficient to explain the expected stock returns (Fama and French, 1992). The model takes into account the sensitivity of the considered asset known as the non diversified risk under the name of systematic risk or the market's risk generally represented by the coefficient beta (β), as well as the expected return of the market portfolio and the expected return of the risk free rate (Treasury bills).

This model, introduced by Jack Treynor, William Sharpe and Jan Mossin (1964, 1965) took its roots from the work of Harry Markowitz (1958) which is interested in diversification and the modern theory of the portfolio. Within the framework of an efficient and a rational market, assets are valued by the determination of their actual and intrinsic value starting from rational models such as the CAPM or APT. Prices, thus, vary only when this value changes, i.e. when really relevant information appears (Fama, 1965).

Unfortunately, this assumption of the markets' efficiency underwent a counter-attack emanating from the empirical studies blaming either the concept of efficiency itself (Fama and French**,** 1988; Cochrane, 2001), or the assumptions of the latter (Poterba, Cutler and Summers, 1989). We, then, obviously assist to the rejection of rational pricing models moved by the contributions of Fama and French (1992) while reclaiming the dead of beta.

Indeed, the empirical literature published during the Eighties highlighted mismatching behaviors of securities' prices with the CAPM prices' measure. Apart from anomalies in general related to calendar's effects [seasonal effects, French, 1980; Gibbons and Hess, 1981] and of the mean reverting effects over the long period, certain classes of shares expressed variations following characteristics such as stock exchange capitalization [the size effect, Banz, 1981] or certain financial ratios [the *Price Earning Ratio*, Basu, 1977; the book-to-market, Fama and French, 1992].

Thus, the work in this research was divided into two groups; those which hastened to declare the end of the CAPM (Roll, 1977) like those, far from rejecting it completely, proposed to incorporate additional factors of risk (Fama and French, 1992).

On the one hand, Roll (1977) allotted the failure of the CAPM to the fact that it is difficult, if not impossible to carry out exhaustive tests on the real market portfolio; since this latter must include all stocks presented in the market and with the adequate proportions. So, it is completely banal and normal to find results which can be, sometimes, not very conclusive.

On the other hand, Fama and French (1992) thought of introducing other sources of risk to the CAPM, and this with an aim of arriving to a better explanation of the stock prices' trend. These authors thus developed a three factor model including the market's factor, the size's factor and *the Book-to-market* ratio.

These models designed for assets pricing, that is about the CAPM or the three-factor model of Fama and French (1992) were the subject of harsh critics for either the empirical insufficiencies, or the lack of the theoretical bases

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which they presented. In fact, while the CAPM supposes that the market's factor has only one systematic risk which must be taken into account in asset pricing, the empirical literature advanced by Fama and French (1992) concludes, however, that a single factor of the market is insufficient to explain returns.

Likewise, the Fama and French three factor model (1992) was criticized because of its relatively weak empirical motivations and the lack associated to its theoretical bases. In fact, Lakonishok et al. (1994), La Porta (1996), La Porta et al. (1997) indicate that the factors incorporated in this model are firm specific factors, i.e. the risk which is associated with them must be eliminated via diversification.

Based on these critics, the first question that must be posed is, in fact: what is the alternative to these models? In other words, the questions that should have been posed are the followings: can we still analyze in terms of efficiency whereas various studies defend the markets' inefficiency? Can we still neglect the effect of individual investors' behavior on the stock price predictability? In other words, can we still turn our backs to the contributions of behavioral finance in the field of finance?

LITERATURE REVIEW

ASSET PRICING MODELS AND BEHAVIORAL FINANCE

So deep in the past, Selden (1912) wrote the Psychology of the Stock Market. He founded the book "*upon the belief that the movements of prices on the exchanges are dependent, to a very considerable degree, on the mental attitude of the investing and trading public*". So in a way, he introduced the necessity of incorporating the investor's psychology into the decision making process.

Mental attitude refers to how people think. A large empirical literature borrowed from psychology (Festinger, Riecken and Schachter, 1956; Tversky and Kahneman, 1973; Tversky and Kahneman, 1974) proves that people are prone to systematic bias in the way they think which leads to errors in their decisions. For example, they are likely to sell the gaining stocks too quickly and keep the loser stocks in their portfolio for a long time (Shefrin and Statman, 1985), and they tend to herd around the market's consensus (Banerjee, 1992), or they are overconfident when confronted with risky choices (Odean, 1988)…etc.

This inefficiency brought back the authors to overflow the subject of investor's behavior, from where the birth of behavioral finance took place. This thought current was born, according to Sewel (2001), as such, due to the publication of the paper of Debondt and Thaler (1985) under the name "Does the stock market overeact?" which directly tackled the assumption of markets' efficiency.

The originality of behavioral finance lies in the fact that it considers that the investors behave irrationally or quasi rationally. This carries out Simon (1982) to approach the notion of the limited rationality. It is thanks to him that this concept of limited rationality became an integral part of the economic sciences.

The theory of the limited rationality accentuates the revelation of the divergence between the perfect rational behavior, as postulated in the traditional financial theory, and the real behavior of the individual in the economic reality. Such a divergence does not mean that individuals act irrationally, but one can understand by this that individuals are unable to make perfect forecasts and their knowledge does not enable them to reach the optimum level as predicted in the classical theory.

Other authors (Kahnemann and Tversky, 1979; Shefrin and Statman, 1985; Odean, 1998) advance another explanation to the errors made by the individuals during the decision making process. This concerns, in particular, the fact that investors also act according to their emotions and intuitions, in other words, according to human psychology.

Moreover, a few years ago, the partisans of the efficient markets' hypothesis and the perfect rationality had considered behavioral finance as an anecdotic step. It is difficult for them, today, to turn their back to the contributions of many researchers who were versed in this field of research.

The most important paper ever known in this field of research was written in 1979 by the psychologists Kahneman and Tversky. This paper is entitled, "Prospect Theory: An Analysis of Decisions Under Risk", was published in the Review Econometrica. The paper develops an alternative model to the theory of expected utility, which is called "Prospect Theory". This theory has been very famous for several years. Indeed, this theory gives satisfactory explanations to problems discussed for a long time in the academic literature. According to this theory, gains and losses are measured relative to a reference point. It also assumes loss aversion and incorporates framing which is equivalent to say that if two related events arise; an individual has a choice of treating them as separate events or as one.

Thus, today, it becomes unacceptable to speak about finance without speaking, subsequently, about behavioral finance or at least about investors' behavior. Admittedly, this corpus (behavioral finance) does not have the formal coherence of the standard financial theory of the markets' efficiency. It remains an assembly of empirical evidence and intuition borrowed from several disciplines of social sciences, the first of which is psychology, which exposes it to attempts of assimilation (Fama 1998; Frankfurter and MC Goun, 2002), even to severe critics (Thaler, 1999) in spite of its relative youth.

For as much, this corpus allowed fertile projections to understand the behavior of individual investors and to detect its effects on stock markets. Hence, we attend to the birth of alternative models of assets pricing, based on works of the psychology. In fact, Thaler (1999) in a provocative article showed the end of behavioral finance: "*..I predict that in the not-too-distant future, the term "behavioral finance" will be correctly viewed as a redundant phrase. What other kind of finance is there? In their enlightenment, economists will routinely incorporate as much "behavior" into their models as they observe in the real world. After all, to do otherwise would be irrational.* …" In other words, Thaler (1999) indicates that there will not be any more finance but.

While basing on psychological researches, Daniel et al. (1998) conceived a behavioral model of asset pricing, taking as a starting point the fact that the individuals are overconfident about their abilities to predict the future and from this, they tend to overreact to their private signals and under react to public ones. The authors meant by the "biased self-attribution" that investors grant a great significance to signals that validate their prior beliefs and a small significance to information signals that contradict them.

However, Barberis, Shleifer and Vishny (1998) built a model based on the concepts of representativeness and conservatism. "Representativeness" means the tendency to mentally attach phenomena noted to stereotypes. So, investors will, generally, violate the rules of probabilities and they'll rather behave as if the observed events are typical of the return generating process. "Conservatism" means that when the investors created an opinion on a well determined subject, they have the authority to change it even under the effect of new circumstances. As a consequence, investors are slow to update their prior attitude in response to new information.

As noted by the researchers, many behavioral models have been drawn to identify investors' behavior and its effects on stock prices. Each of these models is motivated by empirical and theoretical evidences stimulating their attempts to include such or other behavior in explaining stock prices' variations. However, in spite of its relative importance as a behavioral bias in affecting the stock prices, the "herding" behavior hasn't been introduced until now in any behavioral model. Thus, the following section will be devoted to more explanation of this behavior and its relationship with the cross section of stock return.

HERDING BEHAVIOR AND THE CROSS SECTION OF STOCK RETURNS

The herding on stock markets was generally defined as the behavioral tendency that an investor follows actions of other people on the markets. Shiller (1984) states that the effect of the transitory modes and fervors can modify the individuals' investment decisions. This assertion was argued by Delong, Shleifer, Summers and Waldman (1990, 1991) who admit the existence of "noise traders". In other words, that means that those investors are not perfectly rational and that the arbitrage opportunities are risky and limited. This can be interpreted as the direct consequence of the "herding" behavior.

Likewise, Shleifer and Summers (1990) argue that investors imitate each other from the moment they follow the same signals or when they overreact to news which according to them is important. Friedman (1984) and Dreman (1979) advance that "herding" could not be related to information, whereas, this behavior can be the consequence of irrational psychological factors that would make temporary price bubbles.

The experts (Christie and Huang, 1995; Cheng, Chang and Khoranna, 2000; Wermers, 1995) were interested to know if this behavior exists, because the fact that investors base their decisions on collective information rather than private information can make them deviate the prices of their fundamental value and thus generate arbitrage opportunities. The herding behavior also took the attention of the academic researchers; because the behavioral effects associated to prices' movements can affect their risks and their returns' characteristics and can have subsequent effects on asset pricing models.

According to Bikhchandai and Sharma (2000), an investor is called to adopt a herding behavior if, without knowing the decisions of the others, he had invested, but he would not do so if he knew that those investors didn't decide to invest. Similarly, he is engaged in herding if he changed his decision of not investing just because the others didn't do so.

Due to the importance of this behavioral bias's effects on stock markets, many researchers (Lakonishok, Shleifer and Vishny, 1992; Wermers, 1999; Christie and Huang, 1995; Chen Chang et Khoranna, 2001; Huang and Salmon, 2004; Hachicha, Bouri et Chakroun, 2008) have focused on the question to quantify or to measure this phenomenon in order to comprehend its effect on stocks, prices, volatility…etc. These measures can be classified into two research tasks: those which are based on investors' transactions and those which are founded on the cross section of stock returns. It's worthy noting that our study of herding behavior is included in the second category.

Firstly, Lakonishok, Shleifer and Vishny (1992), propose a herding statistical measure which defines herding as the behavioral tendency of a group of analysts who buy or sell particular assets at the same time, comparing to the fact that every one interacts independently. This measure is based on some groups' transactions who are generally the portfolios' managers. Their measure which they called $H(i,t)$ is defined as the difference between; the probability that an asset might be sold (respectively bought) by the group of the managers and the probability that this asset might be the object of a purchase operation if the managers acted independently. Thus, a value equal to zero of $H(i,t)$ is an obviousness of the herding behavior.

More precisely, they investigate the behavior of the CSSD under some market conditions. They advance that if the market's investors tend to suppress their own belief and information concerning the assets during high stock market movements towards the market consensus, then the individual asset returns will follow the overall market return which leads, subsequently, to a smaller CSSD.

However, this measure has been criticized by Huang and Salmon (2001, 2004). In fact, Christie and Huang (1995) defend the assumption according to which the herding will be more prevalent during the period of market stress. This period is identified as the period within which we observe extreme index returns and has been estimated through the regression of the CSSD on two dummy variables measuring the bullish and the bearish stock market return. Nevertheless, the definition of an extreme stock market return is fuzzy.

Christie and Huang (1995) consider that this definition is arbitrary. They use the two percentage values of 1% and 5% to identify the spread of the maximum and the minimum of the return distribution. In reality, the investors differ in their belief in how to define a maximum or a minimum return. Moreover, this measure is meant to detect the herding behavior only in the period of market stress. Conversely, the herding can be obvious with a certain degree during the whole distribution and becomes more prevalent during the stress's periods.

Nevertheless, Hachicha, Bouri and Chakroun (2008) criticized the other measures since they are based on the CAPM's hypothesis, which in their turn is based on the efficiency market's hypothesis, whereas the occurrence of herding implies the market's inefficiency. Their measure uses the dispersions on the volatilities of securities' return towards the market's one.

RESEARCH'S DESIGN

The aim of our paper is, in fact, threefold. Firstly, we attempt to apply the famous CAPM in the Tunisian stock exchange. From this starting point, we jointly aim to validate the inefficiency of the Tunisian stock market, since the CAPM is recognized to be the joint test of the market's efficiency.

Secondly, we try, in this empirical work, to examine a particular behavioral bias, i.e. the herding behavior. Hence, we resort to three acknowledged measures. For every measure used, we present its results and the causes inherent to its invalidity. Finally, and after validating the presence of this behavioral bias and it's effect on the market's portfolio excess return (using the VAR), we expose our primordial objective which is presumed to be an adjustment attempt of the CAPM to this bias in the Tunisian stock market.

Our data base[1] is composed of the weekly stock returns, weekly risk free rate[2] and the weekly BVMT index return of the Tunisian Stock Exchange. Our justification advanced to the use of the weekly data rather than daily

[1] Our data base has been taken from the official site of the Tunisian stock exchange (www.bvmt.com.tn).

[2] With regard to the risk free rate, we could accommodate quotations of the rate starting from the rate of the monetary Tunisian market.

one is that the Tunisian market is neither very active compared to the other markets in the world, and often does not allow a daily stock quotation, nor has a notifying modification level in the trading volume. The use of the BVMT index rather than the TUNINDEX is justified by the fact that we want to extend our data base to a long period from 1996 to 2006, whereas the TUNINDEX was introduced only in 1998.

APPLICATION OF THE CAPM IN THE TUNISIAN STOCK MARKET

THE MODEL'S PRESENTATION

The basic ideal model for valuation of stocksis a very simple linear structure because it is a one factor model, i.e. based on a single determinant (factor), namely the degree of systematic risk, measured by the coefficient beta. It can be formulated thus: the stock expected return is equal to the financial risk free rate raised with a risk premium which is it equal to the average market risk premium multiplied by the coefficient of the stock's systematic risk. This model is called the Asset Pricing Model (CAPM).

The CAPM equation is as follows:

$$E(\tilde{R}_i) = R_f + \beta_{i,M}\left(E\left[\tilde{R}_M\right] - R_f\right)$$

Where:

R_i : The return of the individual stock *i* ;

R_f : The risk free rate (treasure bills rate);

$\beta_{i,M}$: The systematic risk of the stock i or the marginal contribution of this stock to the total risk of the of the market portfolio M;

R_M : The market portfolio returns, which is in our case, the return of the BVMT index.

The stock return is calculated as follows:

$$R_i = \left(\frac{P_{iT} - P_{iT-1} + D_{IT}}{P_{iT-1}}\right)$$

Where:

P_{iT} represents the stock *i* price of the weekend;

P_{T-1} , represents stock *i* price in the beginning of the week and

P_{it} , is the dividends rate.

It's worth noting that our reference day is the Wednesday of each week, this is in aim to avoid the Monday effect and the weekend effect. So as to estimate the CAPM, we took the weekly return data on stocks and the BVMT index, like for the bill treasure rate. It should be eminent that:

$$R_{f_{weekly}} = \left[1 + R_{f_{monthly}}\right]^{1/52} - 1$$

So as to estimate for the Betas coefficients, we use the cross section regression:

$$R_{it} - R_f = \alpha + \beta_{i,m}\left(R_{m,t} - R_f\right) + \mu_t$$

Where:

R_{mt} corresponds to the BVMT index average return,

R_f corresponds to risk free rate average return,

R_{it} corresponds to the average return of stock i at date *t*,

α is a constant and μ_t is an error term.

INTERPRETATION OF RESULTS

The results of the CAPM application are summarized in the following Table 1.

As we know, the beta of an asset is meant to be the slope in the regression of its return on the market return. Thus, we can interpret the beta as the sensitivity of the asset's return to the market's return variation.

Economically speaking, $\beta_{i,M}$ is proportional to the risk each dinar invested in asset and *i* contributes to the market portfolio. Likewise, when there is risk free borrowing and lending rate, the expected return on assets that are not correlated with the market return, $E(R_m)$ must equal the risk-free rate,R_f..

Table-1: Results of the CAPM Application

Stocks	Constant	BetaCoefficients	t-Student	(R^2)
AB	-0.002361**(0.0344)	0.204288****(0.0002)*	3.741419	0.024052
BH	-0.001774(0.2324)	0.512507****(0.0000)*	7.044153	0.080341
BIAT	-0.001327(0.3158)	0.269790****(0.0000)*	4.162928	0.029607
BS	-0.004148*(0.0889)	0.283777***(0.0177)*	2.378598	0.009880
STB	-0.004173*(0.0692)	0.467852****(0.0000)*	4.165675	0.029696
AIR LIQUIDE	-0.000754(0.5330)	0.028227*(0.6341)*	0.476252	0.000399
ASTREE	-0.002596(0.3926)	0.247931*(0.8616)*	1.758989	0.005418
ATB	-0.005607**(0.0348)	0.331722*(0.0109)*	2.554573	0.011378
BATAM	-0.017426**(0.0109)	0.189159*(0.4480)*	0.760451	0.003116
ATL	-0.001169(0.4372)	0.488580****(0.0000)*	7.382838	0.117090
BNA	-0.003399*(0.101)	0.063510*(0.5389)*	0.614876	0.000666
BT	-0.001446(0.2030)	0.162215*(0.0037)*	2.915055	0.014740
BTEI	-0.000534(0.4213)	0.099929***(0.0432)*	2.026791	0.007180
CIL	-0.000247(0.8401)	0.408592****(0.0000)*	6.997475	0.087756
ELECTROSTAR	-0.000534(0.8518)	0.683256*(0.0000)*	5.055491	0.079482
ELMAZRAA	-0.001262(0.3021)	-0.003967*(0.9472)*	-0.066206	0.000008
GIF	-0.009888(0.3484)	0.868948*(0.2074)*	1.269998	0.017606
GL	-0.002495(0.2358)	0.268017***(0.0042)*	2.877442	0.021215
ICF	-0.001329(0.3763)	0.145150****(0.0000)*	1.971482	0.006796
KARTHAGOAIRLINES	0.011887(0.3941)	0.411052*(0.6858)*	0.406252	0.002421
LACARTE	-0.001332(0.2929)	0.097809*(0.1154)*	0.406252	0.002421
LEMOTEUR	-0.000697(0.8519)	0.097809***(0.0133)*	1.576580	0.004357
TUNISAIR	-0.002441(0.3469)	0.703556****(0.0000)*	5.533389	0.051148
UBCI	-0.000208**(0.0344)	0.308843**(0.0707)*	1.811065	0.005741
UIB	-0.000986*(0.0951)	0.182980****(0.0015)*	3.190762	0.017609

***, **, * indicate, respectively, the significance level of 1%, 5% and 10%.

The results obtained confirm the weakness of the CAPM in predicting the stocks' return. In fact, in almost all cases, the beta coefficient is not statistically significant ($p > 0.1$). This means that these two variables are positively associated but that this relation is not important enough as assumed according to the Sharpe and Linter CAPM. This latter conclusion may be also deduced from the value of the R^2 which is too low and closed to zero. This confirms prior researches (see for example; Jensen (1968), Black, Jensen and Scholes (1972), Fama MacBeth (1973), and Fama and French (1992) among others) on the CAPM which found that the relationship between the beta and the expected return is so flat.

For example, for the BNA, this coefficient is about 0.6%, and can be interpreted as follows: the risk premium explains only 0.6% of the excess return variation. Consequently, it's equivalent to say that 99.4% of the excess return variation is not explained by the systematic risk. This conclusion is maintained for nearly all stocks. Subsequently, one can think that there are other variables or other sources of risk that engender this variation.

As for the intercepts, the Sharpe and Linter model assumes that the average value of an asset's excess return (the asset's return minus the riskfree interest rate, $R_{it} - R_{ft}$) is entirely explained by its average realized CAPM risk premium (its beta times the average value of $R_{mt} - R_{ft}$). This implies that "Jensen's alpha," the intercept term in the time-series regression, is equal to zero. Nevertheless, in our results, we find that this intercept is for some stocks negative and statistically different from zero, which is another violation of the CAPM assumptions.

The next assumption of the Sharpe and Linter CAPM that we have to verify in this frame work is that expected returns on all assets are linearly associated to their betas, and no other variable has marginal explanatory power. In order to test for nonlinearity between expected stock returns and betas, a regression was run between stocks' returns, calculated stocks' betas, and the square of betas. The equation regressed is as follows:

$$R_{it} - R_f = \gamma_0 + \gamma_1 \beta_{it} + \gamma_2 \beta_{it}^2 + \mu_t$$

Here are some results from the latter regression summarised in the following table:

Table-2: Test For The Linearity Between Expected Stock Returns And Betas

Stocks	Coefficients			R squared
	γ_0	γ_1	γ_2	
AMS	-0.001779	0.279996*	-2.019889	0.006170
	(0.5707)	(0.0612)	(0.5126)	
TLAIT	-0.001580	-0.018387	0.217376	0.000029
	(0.6112)	(0.9011)	(0.9433)	
STS	0.003575	0.003675	-1.500090	0.000735
	(0.2933)	(0.9797)	(0.6232)	
LA CARTE	-0.001358	0.096795	0.063835	0.004361
	(0.3257)	(0.1414)***	(0.9625)	
SOFISICAF	-0.000409	0.001149	-1.318214	0.000861
	(0.8628)	(0.9917)	(0.5615)	
PALMBEACH	-0.002214	0.261302**	-0.990506	0.010420
	(0.3303)	(0.0160)	(0.6577)	
AB	0.002062	0.049895	-0.062251	0.004370
	(0.5219)	(0.5447)	(0.1693)	
SOTUVER	3.55E-05	0.184701**	-1.883161	0.009714
	(0.9868)	(0.0473)	(0.3290)	
SOTAPRIL	0.005895*	0.969875***	-4.201824	0.145618
	(0.0559)	(0.0000)	(0.1315)	
SIPHAT	0.002199	0.485155***	-1.702782	0.056832
	(0.3910)	(0.0000)	(0.4745)	

***, **, * indicate, respectively, the significance level of 1%, 5% and 10%.

According to the results obtained, we can see clearly that the relationship between these two variables, i.e. expected return and beta, is linear. In fact, the coefficients related to the square of beta (γ_2) are, in the majority of the cases, negative and not statistically significant. This confirms the assumptions of the CAPM. However, results show that this relationship is too flat. Indeed, the R squared is too little which means, consequently, that the risk premium explains just a small part of the return variation and that there are other variables which contribute to this variation.

Basing on these gaps related to the application of the CAPM of Sharpe and Linter and concentrating especially on the fact that the predictive power is too low, our proposal is as follows: We suggest the introduction of another variable which will be able, in addition to the risk unit price, to induce together with the risk premium to the prices' movements and to increase in some kinds the explanatory power of the model.

As we have already mentioned in our objective, we will present an attempt to adjust the model to the behavioral phenomenon of herding in order to arrive to a better comprehension of the stock return's movements. Thus, the paramount interest of this study is to permit to make a combination between stocks' return, market's return and the investors' behavior.

With this intention, it is a question, initially, of trying to check the existence of this phenomenon on the BVMT through the application of some measurements of herding and to prove its impact on the excess return on the market's portfolio. Then, we introduce this phenomenon to the CAPM, while observing its impact on the improvement of the forecasting power. Therefore, the following section is devoted to verify this behavioral bias in the Tunisian stock exchange.

HERDING IN THE TUNISIAN STOCK EXCHANGE

Our target, in this section, is to verify the existence of the herding behavior in the Tunisian stock exchange. For this reason, we apply three different measures. For each one, we present its results and the potential causes related to its failure. We finally arrive to detect this behavior using the measure that sweeps the gaps of the others.

THE CHRISTIE AND HUANG MEASURE (CSSD)

MODEL'S PRESENTATION

The method followed by Christie and Huang (1995) aims to measure the dispersion of the individual stock's return compared to the market's return. If this measured dispersion is weak, then it's obvious that the herding behavior exists in the market. This method is formulated in the following manner:

$$CSSD_t = \sum_{i=1}^{N} \frac{\left(R_{i,t} - R_{m,t}\right)^2}{N - 1}$$

Where,

N represents the number of the firms included in the market's portfolio (in our case it is about the BVMT index).

$R_{i,t}$ is the observed stock return of the firm i for the period t and

$R_{m,t}$ is the average of the return of N stocks in the market portfolio at the date t

The main idea of these two authors consists in the fact that the presence of herding generates a weak dispersion in the individual stock returns. Such a result can be illustrated either by an increase in the return's dispersion in a decreasing rate, or by a reduction in this dispersion, and this if the herding is significant. Indeed, in the presence of herding, dispersions must be weak for the simple reason that investors have a tendency to remove their own belief and information to the profit of the market trend, therefore, individual stocks' prices will automatically follow the movements of the market (rise or drops).

INTERPRETATION OF RESULTS

The method of Christie and Huang (1995) supposes that a weak dispersion of the individual stock return compared to the market portfolio's return, measured by the returns' standard deviation, is an obviousness of herding. During this discussion, we do not present an exhaustive analysis of the entire results on the table; we limit ourselves only to some which seem to be notable.

From the results obtained, we can say that, during all the studied period, the stock's return standard deviation compared to that of the market portfolio's return is too weak (except in an extreme case where $CSSD_t$ is equal to 0.93), which lets us think that the herding behavior is present in the Tunisian stock exchange. However, the Christie and Huang approach (1995) defends the assumption according to which, the herding is more propagating for the period of market's stress. This period is defined in terms of extreme index return. Hence, they suggested the following equation:

$$CSSD_t = \alpha + \beta_1 D_t^l + \beta_2 D_t^u + \varepsilon_t$$

Where:

D^l_t : Equal to 1 if the market's return at the date t is around the minimum return of the distribution and equal to 0 otherwise.

D^u_t : Equal to 1 if the market's return at the date t is around the best performance of the distribution and equal to 0 otherwise.

The periods of market stress are identified, according to Christie and Huang (1995), by using the maximum extreme return of 0.99% and the minimum extreme return of 1%. In our case, and regarding the relatively weak evolution of our market, we use as minimum extreme return -0.75, which corresponds to the minimum return of the index during all the period observed, and a maximum extreme return of 10, 54%, which corresponds to the best performance obtained for the index over the complete period of observation.

We tolerated a range of 3% for the two extremes. In other words, D^l_t takes 1 if the return is lower or equal to -0.4 and 0 otherwise. D^u_t takes 1 if the market's return is higher or equal to 7%, and 0 otherwise, and $CSSD_t$ corresponds to the standard deviation measured above.

The results are presented in the Table 3.

The Christie and Huang method (1995) supposes that the presence of herding is more plausible for the periods of stress which are defined in term of extreme return of a benchmark (which is in our case the BVMT index). If there is an obviousness of herding on the market, the deviations of the individual stock return must be significantly lower for the periods of high volatility.

Table 3: Results of the Christie and Huang Measure (1995)

Variables	Coefficients	t-Statistic
Constant	0.004030** *(0.0210)*	2.314334
D^u_t	-0.001182 *(0.8629)*	-0.172709
D^l_t	0.000924 *(0.9315)*	0.085973
R-squared= 0.000068; Adjusted R-squared= -0.003459		

**, indicates the significativity level of 5%

This means, that the investors behave in a similar way during such periods.It is for this reason, that a negative and a statistically significant value of β_1 and β_2 should indicate the presence of herding on the market. Conversely, a statistically significant and positive value of β_1 and β_2 indicate, analogically, the absence of herding and confirm, consequently, the CAPM.

The results obtained show well that in the Tunisian stock market, there is no herding. Indeed, the coefficient β_1 is negative (-0.001182) but non significant *(p=0.86)* which means that there are deviations of individual stock return compared to the market portfolio during bearish periods, prices are lower (negative coefficient) but are not sufficiently significant to conclude that for the bearish periods, the investors imitate each other in their investment's strategies. As a consequent, there's no herding.

In the same way, the coefficient β_2 is positive (0.000924) but non significant *(p = 0.9315)* which means that for the bullish periods, the deviations of individual stocks return are higher (positive coefficient) from where there is absence of herding. This result confirms the Capital Asset Pricing Model (CAPM) which supposes that for the periods of stress, the dispersions increase and this owes to the fact that the individuals express different sensitivities to the market's factors.

However, basing on this measure, we cannot conclude the absence of the herding behavior. In fact, one of the principal challenges associated with the use of this approach relates to the definition of the "extreme return". Christie and Huang (1995) declare that this definition is arbitrary, and use the values of 1% and 5% like the fork to identify the best performance and the minimum of the return's distribution.

Nevertheless, in reality, investor's differ in their belief in how to consider the maximum and the minimum return. Moreover, herding can be present during the complete study period but could be enhanced during periods of stress, whereas, the Christie and Huang measure (1995) detect herding only during these periods.

Based on these limits, Cheng, Chang and Khorana (2000) developed a new herding measure which is presented in the following section.

THE CHENG, CHANG AND KHORANA MEASURE (2000): CROSS SECTIONAL ABSOLUTE DEVIATION

MODEL'S PRESENTATION

This method adopted by Chang, Cheng and Khorana (2000), is inspired from that of Christie and Huang (1995). These authors assume that under the CAPM's assumptions, the dispersion of the individual stock return, measured by the CSAD of the returns, must be a linear function of the market's return. This measurement is formulated in the following way:

$$CSAD = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right|$$

Where:

N; represents the number of the firms included in the market portfolio (in our case it is about the BVMT index).

$R_{i,t}$; represents the observed return of the firm's stock i for the period t

$R_{m,t}$; is the average of the N stocks of the market portfolio at the date t .

The principal idea of these authors rests on the fact that the CAPM supposes, not only that the dispersions are an increasing function of the market's return, but also that this relationship is linear. However, in the presence of herding, the increasing and nonlinear relationship between the dispersion and the market's return is not checked any more.

Indeed, the increasing tendency of the investors to follow the consensus of the market for the periods of strong trends of prices is sufficient to convert the nature of the relationship from the linearity to nonlinearity.
To examine the obviousness of herding behavior, Chang and al. (2000) suggest the following equation:

$$CSAD_t = \alpha + \lambda_1 \left| R_{m,t} \right| + \lambda_2 \left(R_{m,t} \right)^2 + \varepsilon_t$$

According to this equation, if the herding exists on the market, the nonlinear coefficient λ_2 should be negative and statistically significant. In other words, a positive coefficient λ_2 indicates the absence of herding.

INTERPRETATION OF RESULTS

The results of this measure are presented in the following table:

Table-4: Results of the Chang et al. (2000) Measure

Variables	Coefficients	t-Statistic
Constant	0.017693*** (0.0000)	11.17085
λ_1	-0.065979** *(0.0238)*	-2.267584
λ_2	0.115570*** (0.0003)	3.618992
R-squared= 0.024289; Adjusted R-squared= 0.020586 ***, ** indicate, respectively, the significativity level of 1% and 5%.		

We can note clearly from the results below that there's no herding evidence. In fact, the coefficient of the nonlinear term $(R_{m,t})^2$ is positive and statistically significant. Consequently, this result indicates that the herding is absent on the BVMT, while referring to the Chang, Cheng and Khorana measure (2000).
Moreover, it is observed that the coefficient of the linear term $R_{m,t}$ is negative (0.065979) and statistically significant to the level of 5%. This contradicts the assumption according to which dispersion in the individual stock return increases with the absolute value of the market return.
The major limit was brought closer with the model of Christie and Huang (1995) and that of Chang, Cheng and Khorana (2000) is that they are supposed to detect the herding for the periods of stress without taking into account the possibility of the existence of this phenomenon during other periods. Another measurement developed by Hachicha et al. (2008) pays attention to this limit.

THE MEASURE OF HACHICHA ET AL. (2008)

MODEL'S PRESENTATION

Hachicha et al. (2008), criticize the other measures owing to the fact that they were based on the CAPM which is based on the efficiency market hypothesis. However, the existence of herding implies the inefficiency of the markets.
These authors adopt a dynamic approach to measure the systematic risk of the market. More precisely, they suppose that the dynamic volatility of the market follows GARCH (1.1) as follows:

$$R_{m,t} = a + bR_{m,t-1} + \varepsilon_t \qquad \varepsilon / I_{t-1} : \quad N\left(0, h_{m,t}\right)$$

$$h_{m,t} = m + \alpha h_{m,t-1} + \beta \varepsilon^2_{m,t-1}$$

Similarly, to estimate the stock's volatility, they were referred to GARCH (1.1). As follows:

$$R_t = a + bR_{t-1} + e_t \qquad \varepsilon / I_{t-1} : \quad N\left(0, h_{m,t}\right)$$

$$h_t = m + \alpha h_{t-1} + \beta \varepsilon^2_{t-1}$$

Based on the Hwang and Salmon (2004) model, their measure is based on the standard deviation of the market's volatility, while adopting a dynamic approach of the systematic risk. Their measure is written as follows:

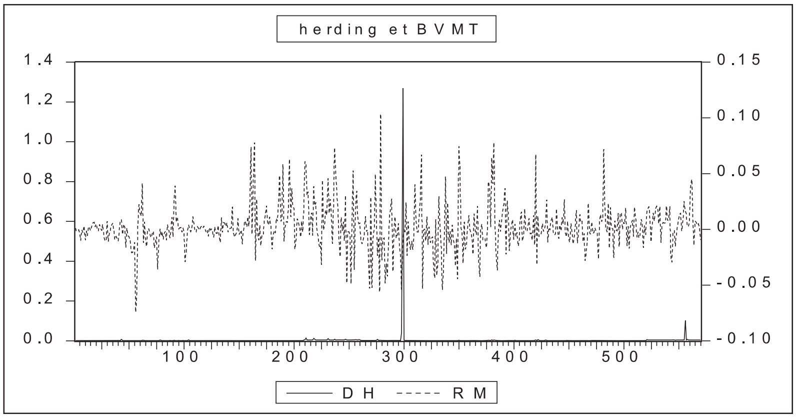
$$DH_t = \frac{1}{N} \sum_{i=1}^{N} \left| h_{i,t} - h_{m,t} \right|$$

Where:
DH_t ; measure the *herding* at the date *t*.
$h_{i,t}$; measure the volatility of stock *i* at the date .
$h_{m,t}$; is the volatility of the market at the date .

INTERPRETATION OF RESULTS

The following graph illustrates the evolution of herding and the market's return:

Figure 1: Herding And The Market's Return



According to this graph, we can note that the *herding* does not generally follow the market's return. Nevertheless, when the index's return reached a peak, the *herding* also does reach a peak. However, a simple glance on the graph does not allow us to show the nature of the relationship which exists between these two variables. For this reason, we refer to the Granger causality test between these two variables.

Table 5: Granger Causality Test Between Herding And The Index's Return

Null hypothesis :	Statistic-F	Probability
DH does not Granger Cause RM	0.10458	0.90072
RM does not Granger Cause DH	3.41601	0.03353

According to the result of this test, we note that the *herding* is not at the origin of the market's return evolution *(0.90072>0.05)*. However, *the herding* is affected by the market's return. In other words, the market's return supports the appearance of the *herding* phenomenon *(0.03<0.05)*. Thus, there is a relation of causality within the meaning of Granger between the market's return and *the herding*.

To further show the robustness of this measure, the authors also examine the relationship between herding and other market's component which is the market's volatility.

Table 6: Granger Causality Test Between Herding And Market's Volatility

Null hypothesis :	Statistic-F	Probability
DH does not Granger Cause HRM	53.4863	0.00000
HRM does not Granger Cause DH	13.9748	1.2E-06

This test indicates that there is a relationship in term of Granger between the herding and the market's volatility. It's obvious that the herding causes the market's volatility *(p = 0)*.

Based on this finding, we can affirm clearly that the herding exists, without a doubt, in the Tunisian stock market. Hence, in the following section, we try to verify that the herding generates excess return, and if yes, we propose to adjust the CAPM to this phenomenon.

CAPM ADJUSTED TO HERDING

PRELIMINARY STEPS

HERDING AND EXCESS RETURN ON THE MARKET'S PORTFOLIO (VAR)

In this section, we examine the ability of the herding measures to predict excess returns. Specifically, we study the relation between herding behavior and excess return on the market portfolio in a vector autoregressive (VAR) framework.

The results are summarized in the following two tables:

Table 7: Excess Return and Herding

Excess return $_t$		**Herding $_t$**	
Excess return $_{(t-1)}$	0.154317***(3.68047)	Herding $_{(t-1)}$	0.036018(0.85631)
Excess return $_{(t-2)}$	0.097856***(2.33376)	Herding $_{(t-2)}$	0.003810(0.09058)
Herding	-8.869839*(-1.95193)	Excess return	-0.055584(-0.50494)

Table 8: Change In Herding And Excess Return, Change In Excess Return And Herding

Excess return $_t$		**Δ Herding $_t$**	
Δ Excess return $_{(t-1)}$	-0.610728*** (-15.1682)	Δ Herding $_{(t-1)}$	-0.643751*** (-16.2471)
Excess return $_{(t-2)}$	-0.287803***(-7.15372)	Δ Herding $_{(t-2)}$	-0.327248*** (-8.26059)
Herding	-0.023087 (-1.33025)	Excess return	0.255059*** (2.02297)

Basing on the VAR estimation, we can clearly note that the herding affects negatively and significantly the market portfolio excess return (significance to the 10% level, 1.95> 1.64). This means that the presence of herding in the market significantly decreases the market portfolio return.

We can observe from the first table (Table 7) that the excess return at date and at date $t-2$ affects positively and significantly the excess return at date t. This is can be interpreted as a momentum effect. As for the second table (Table 8), it's obvious that herding doesn't affect the variation on the excess return.
However, it's worthy noting that the excess return positively and significantly affects the herding. In a nutshell, the herding creates a decrease in the excess return and the excess return variation enhances the appearance of herding. This can be interpreted as follows; firstly, when the excess return increases, this may be due to higher prices' volatility, this latter makes people to herd around the market's consensus for fear of loss. Consequently,
DH_t $t-1$ $-0.024 < 0.8$
the herding increases leading to irrational behavior. This leads from its part to a decrease of the excess return on the market's portfolio.

MULTICOLLINEARITY TEST

Before all, so that our model won't be skewed by the existence of variables which are correlated between them, we proceed on the level of this stage, to the checking of the absence of multicollinearity between the two variables of the model. Hence, we refer to the Pearson's coefficient.

Table 9: The Pearson Coefficient Test

	DH_t	$E(R_m) - E(R_f)$
DH_t	1	-.024(0.569)
$E(R_m) - E(R_f)$	-.024(0.569)	1

According to this result, the coefficient of correlation is equal to .This allows us to affirm that the problem of multicollinearity is absent.

MODEL'S SPECIFICATION

As we have already specified, our model will take into account the phenomenon of herding on the market. Hence, the CAPM will include, in addition to risk free rate and the risk premium, the *herding* measured by DH_t
Thus, the $CAPM_{AH}$ is as follows:

$$E\left(R_{i,t}\right)=E\left(R_f\right)+\beta_{i,t}\left[E\left(R_m\right)-E\left(R_f\right)\right]+a_{i,t}DH_t$$

By replacing with its equivalent expression, we obtain:

$$E\left(R_{i,t}\right)=E\left(R_f\right)+\beta_{i,t}\left[E\left(R_m\right)-E\left(R_f\right)\right]+\alpha_{i,t}\left[\frac{1}{N}\sum_{i=1}^{N}h_{i,t}-h_{m,t}\right]$$

Where,

$R_{i,t}$: represents the return on stock ι at date *t*
R_f: the risk free rate's return
$\beta_{i,t}$: represents the systematic risk of stock *i*
$\alpha_{i,t}$: is the sensitivity of the stock *i* to *herding* at date *t*
DH_t *:* represents the *herding* in the market's portfolio

The main idea of this model rests on the assumption according to which the stocks return is affected by, in addition to the risk free rate return and the risk premium, the *herding* on the market. In other words, the *herding* is an explanatory factor of the movements of individual stock return. In order to check the validity of this assertion, we carry out an econometric regression. So it is a question of checking the implications of the incorporation of this new variable on the model's explanatory power *(R^2)*.

The estimate of the model is done through the following regression:

$$R_{i,t} - R_f = \alpha_0 + \alpha_1 \left(R_m - R_f\right) + \alpha_2 DH_t + \varepsilon_t$$

INTERPRETATION OF RESULTS

The results are summarized in the following table:

Table-10: Results of the CAPM Adjusted To Herding

Stocks		**Coefficients**		**Adjusted R^2**		**Adjusted R^2 Variation**
	α_0	α_1	α_2	**CAPM**	**CAPM adjusted to herding**	
BTEI	-0.001007	0.133142***	-0.065941**	0.007180	0.144832	**0,137652**
	(0.2033)	(0.0000)	(0.0455)			
STILL	-0.000417	0.876416***	-0.011027	0.004679	0.884548	**0,879869**
	(0.6511)	(0.0000)	(0.2310)			
SIPHAT	0.001786	0.549565***	-0.053212*	0.055170	0.078735	**0,023565**
	(0.4444)	(0.0000)	(0.0913)			
STIP	-0.001091***	0.081724***	-0.017804**	0.030048	0.066187	**0,036139**
	(0.0061)	(0.0001)	(0.0127)			
BNA	0.003227	1.066050***	0.017364	0.027899	0.138861	**0,110962**
	(0.1496)	(0.0000)	(0.8069)			
AIR LIQUIDE	-0.011146	0.870801***	8.329208	-0.001361	0.681447	**0,682808**
	(0.2001)	(0.0000)	(0.2738)			
ATL	0.016927	0.947212***	-18.75456***	0.114942	0.795008	**0,680066**
	(0.3995)	(0.0000)	(0.0042)			
CIL	-0.001459*	0.885668***	-0.176498***	0.085964	0.888565	**0,802601**
	(0.0803)	(0.0000)	(0.0000)			
ELECTROSTAR	0.062520*	0.948487***	-63.13276*	0.076372	0.691313	**0,614941**
	(0.0852)	(0.0000)	(0.0804)			
GL	0.004976	1.006265***	-0.083488	0.018652	0.291866	**0,273214**
	(0.1384)	(0.0000)	(0.5760)			
ICF	-0.001037	0.867085***	-0.040809*	0.005048	0.874514	**0,869466**
	(0.1908)	(0.0000)	(0.0646)			
LACARTE	-0.000139	0.699414***	0.006155	0.002604	0.667072	**0,664468**
	(0.8503)	(0.0000)	(0.6540)			
TUNISAIR	0.005139	0.977488***	-6.959110	0.049478	0.448938	**0,39946**
	(0.7452)	(0.0000)	(0.6151)			

MONOPRIX	-0.000423	0.730373***	-0.024266	0.040118	0.238829	**0,198711**
	(0.7043)	(0.0000)	(0.2451)			
STEG	-0.000780	0.942488***	-0.161575***	0.177685	0.947289	**0,769604**
	(0.4494)	(0.0000)	(0.0000)			
SOTETEL	-0.001909***	0.461670***	-0.136500***	0.011598	0.967971	**0,956373**
	(0.0006)	(0.0000)	(0.0000)			
MAGGENERAL	-0.000992	0.867383***	-0.032343*	0.005329	0.874447	**0,869118**
	(0.2110)	(0.0000)	(0.0777)			
SITEX	0.003089	1.067049***	-0.120295**	-0.001117	0.144812	**0,145929**
	(0.1664)	(0.0000)	(0.0458)			
SPDITSICAF	-0.000832	0.877639***	-0.117466***	0.103308	0.885578	**0,78227**
	(0.2714)	(0.0000)	(0.0000)			
SFBT	-0.000927	0.891232***	-0.118012***	0.210824	0.897503	**0,686679**
	(0.1956)	(0.0000)	(0.0000)			
SOMOCER	-0.000670	0.839928**	-1.284148*	-0.004317	0.052377	**0,056694**
	(0.8963)	(0.0041)	(0.0623)			

***, **, *, respectively indicate the significativity to the level 1%, 5% and 10%.

According to this table, the introduction of herding as an explanatory variable of the securities' return movements strongly contributed to the improvement of the explanatory power of the CAPM. Indeed, the model's explanatory power increased from 1, 16% to 96, 79% for the SOTETEL stock, that is to say a variation of 95,63%. Moreover, the coefficient relating to the variable of herding is negative (-0.136500) and is statistically significant on the level of 1%. This implies that the herding is strongly present in this stock and affects negatively its return. It is the same for ICF stock where the coefficient α_2 is negative (-0.040809) and statistically significant. This means that the herding affects negatively the ICF return. As for the variation of the explanatory power, the results show that the latter is very significant for titles SFBT, SPDITSICAF, MAGGENERAL, STEG, LACARTE, ICF, ELECTROSTAR, LASH, ATL and LIQUID AIR.

Through this tentative, we also contribute to the improvement of the betas' estimation. In fact, the systematic risk coefficient is for all securities positive and statistically significant. However, this coefficient was (with the previous estimation) in some cases, not significant and sometimes negative, which contradicts the CAPM hypothesis. This may be interpreted as follows: the herding behavior gives the systematic risk its real value. In fact, the inclusion of the herding behavior corrects the errors on the beta and gives it the real shape. Hence, the misspecification of the relationship between the beta and the expected return is the consequence of the ignorance of the herding. So, when this is ignored, this bias has absorbed most of the significance of the risk premium.

Furthermore, from the regression results, we find that the intercept in the regression is for the quasi-majority of stocks, and is not significantly different from zero *(p>0.1)*. This means, consequently, that the incorporation of herding improves the regression. In fact, the regression should have a zero as intercept.

The negative relationship between the securities' return and the *herding* can be interpreted, to our opinion, in the following way:

When the investors imitate each others, they tend to remove their anticipations concerning the securities to the profit of the market information. Consequently, the securities' returns will follow the market trend instead of reacting itself, normally, according to the investors' anticipations. The surprising results relating to the increase in the explanatory power can be justified by the fact that the *herding* reflects well the Tunisian investor's behavior. This does not make anything but to imitate the others' actions and does not provide any effort neither to perceive the information nor to follow the state of his portfolio. Thus, the *herding* is a question of tutoring.

It was also noticed that for some stocks, the *herding* is quasi-absent. It's about particularly, the banking sector. Indeed, the introduction of this variable to those securities' return did not provide satisfactory results and it is found that the explanatory power was not improved and it sometimes decreased.

This allows us to conclude that the presence of herding concerns only some sectors and is not the same whether it is one sector or another. The herding must be explored separately for each sector.

CONCLUSION

In this paper, we defend the proposal according to which, the securities' return on the financial markets are affected by the irrational behavior of the individual investors. The stress will be laid, in particular, on the herding behavior and its drawbacks on securities' return. On the basis of this point of view, our objective will be to bring a satisfactory answer to the following question:

Does the inclusion of a behavioral variable in the CAPM improves the predictability of the securities' return on the Tunisian stock exchange?

In order to answer to this question, we work on a sample composed of the weekly securities' return and the BVMT index's return for the period of 1996-2006. Firstly, our empirical study confirms that CAPM's failure in explaining securities' return. Secondly, we find that the herding behavior exists in the BVMT index. The evidence of herding behavior is achieved while applying three different measures. However, only the third measure (Hachicha et al. 2008) allows us to confirm the existence of herding. As for the other two, we present the causes related to its breakdown.

After having detected the herding phenomenon on the Tunisian stock exchange, it is advisable to also apply the Granger causality test between the index's return and the *herding* like that between the market's volatility and the *herding*. Results confirm, on the one hand, that the market's return causes the herding and, on the other hand, that the herding causes the market's volatility.

To further defend our hypothesis, we apply the VAR model in order to test whether the herding generates excess return on the market portfolio. The results obtained support our idea since it's obvious that herding affects negatively and significantly the excess return on the market's portfolio. Furthermore, we find that the excess return's variation enhances the occurrence of herding.

Finally, we suggest the adjustment of the traditional CAPM to the herding bias. Via this model, we find that the behavioral variable contributes to the improvement of the model predictability. Furthermore, we find that the herding negatively and significantly affects the securities' return.

By this study, we contribute to an enrichment of the literature. Indeed, we could make, on the level of the CAPM, a combination between securities' return, the market's return and the investor's psychology.

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