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The Herding Behaviour and the Measurement Problems: Proposition of Dynamic Measure

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The topic of interest in this study is herding behaviour in the stock market. We propose a new herd measure which is based on the cross-sectional dispersion of beta to detect the prevalence of herding phenomenon towards the market. The application of our new measure to TUNINDEX and BVMT indexes- as representatives of the Tunisian market- provide better results than those obtained by the cross-sectional stock price's models developed by Christie and Huang (1995), Chang, Cheng and Khorana (2000) and Hwang and Salmon (2001, 2004). Moreover our findings show that the herd phenomenon consists of three essential components: constant term of herding which signals the existence of the phenomenon whatever the market conditions, the error term relative to the anticipations of the investors concerning the totality of assets, and the third component highlights that the current herding depends on the previous one.

Field of Research: Herd measure, cross-sectional volatility, trading volume, return

1. Introduction

In the last two decades, the theory of behavioural finance has added a new aspect to the studies on financial markets. By incorporating psychology into finance and economics, proponents in this field (see Kahneman, Slovic and Tversky, 1982; Thaler, 1992; Shefrin, 1999) attempt to explain how the market participants' perception and reaction to uncertainties could affect investment decisions, which in turn influence security price movements. This theory categorically recognises the role of human behaviour as the driving force behind price movements and therefore, it emphasizes the need to include the human element in all financial studies in order to achieve a better understanding.

Herding is widely believed to be an important element of behaviour in financial markets. it refers to a situation whereby a group of investors intentionally adopt the actions of other investors by trading in the same direction over a period of time.

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Studies that have focussed on detecting the herding behaviour among stock investors can be classified in two main categories. The first category of studies requires detailed and explicit information on the trading activities of the investors and the changes in their investment portfolios. Examples of such herd measures are the LSV measure by Lakonishok, Shleifer and Vishny (1992) and the PCM measure by Wermers (1995). The other category of studies views herding behaviour as a collective buying and selling actions of the individuals in an attempt to follow the performance of specific factors or styles. In this case, the herding behaviour is detected by exploiting the information contained in the cross-sectional stock price movements. The famous researches that are undertaken in this context are those of Christie and Huang (1995), Chang, Cheng and Khorana (2000) and Hwang and Salmon (2001, 2004).

Evidence regarding the presence of herding behaviour appears mixed. Researches on herding in U.S. equity markets indicate that herding does not exist during periods of market stress, i.e., large price movements or high price volatility (Christie and Huang, 1995). Oehler and Chao (2002) find evidence of herding in the German bond market. Chang et al. (2000) provide evidence that while American and Hong Kong investors do not herd, investors in South Korea, Taiwan, and Japan do. Kim and Wei (2002) intent to compare the behaviour of resident to non-residents investors in the Korean market and find that non-residents tend to herd more than residents.

There are two specific objectives to this study. Firstly, we intend to propose a new herd measure to detect the degree of herding in financial market. In constructing this measure, we take as our starting point the model of Hwang and Salmon (2001, 2004), but we employ a dynamic approach to analyze the market volatility. Secondly, we shall apply our herd measure to examine the potential existence of herding behaviour in Tunisian stock market. To date, most of the studies on herding and its effects are conducted in the context of the markets in developed countries. There is no known study which focuses exclusively on the Tunisian stock market with regard to this phenomenon.

The remainder of this paper is organized as follows. In the second section we provide a review of the literature on the herding concept and its measurement. The third deals with methodological details which include data description and the discussion of the empirical results. Finally, the fifth section offers concluding remarks and discusses implications of our findings.

2. Literature Review

Herding, being a non-quantifiable behaviour, cannot be measured directly. It can only be inferred by studying related measurable parameters. Generally, it refers to a situation whereby a group of investors intentionally copy the behaviour of other investors by trading in the same direction over a period of time. Depending on the types of data being used in developing the models for herd measure, we can broadly identify two main categories of studies.

The first category of studies which focuses directly on the behaviour of the investors requires detailed and explicit information on the trading activities of the investors and the changes in their investment portfolios. Examples of such herd measures are the LSV measure by Lakonishok, Shleifer and Vishny (1992) and the PCM measure by Wermers (1995).The second category of studies views herding behaviour as a collective buying and selling actions of the individuals in an attempt to follow the performance of the market or any other economic factors or styles. Here, herding is detected by exploiting the information contained in the cross-sectional stock price movements. Christie and Huang (1995), Chang, Cheng and Khorana (2000) and Hwang and Salmon (2001, 2004) are contributors of such measures. These later studies will present the object of our literature review.

2.1. Cross Sectional Standard Deviation

One of the earliest studies that attempt to detect empirically herding behaviour in the financial markets comes from Christie and Huang (1995) (henceforth referred as CH). They developed an empirical measure to test for herding behaviour in the U.S. equity market, by using the cross-sectional standard deviation of returns (CSSD) as a measure of the average proximity of individual stock returns to the market returns.

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

Where: N represents the number of firms in the aggregate market portfolio, R_{jt} is the observed stock return on firm j for day t and R_{mt} represents the cross-sectional average of the n returns in the market portfolio for day t.

The main idea in this model is based on the argument that the presence of herd behaviour would lead security returns not to deviate far from the overall market return. Such result can be illustrated either by an increase in dispersion at a decreasing rate or merely by a decrease in dispersion when the herding is important. They rationalise that during market stress − which is characterised by high volatility – herding of stocks towards the market is likely to be present. This is based on their argument that under such extreme market conditions, the investors are more likely to suppress their own beliefs in favour of the market consensus during periods of extreme market movements. Hence, CH tend to examine whether equity return dispersions are significantly lower than average during periods of extreme market movements, by estimating the following specification:

$$CSSDt = \alpha + \beta_1 D^L_t + \beta_2 D^U_t + \varepsilon_t \quad (2)$$

DLt = 1, if the market return on day t lies in the extreme lower tail of the distribution ; and equal to zero otherwise, and DUt = 1, if the market return on day t lies in the extreme upper tail of the distribution ; and equal to zero otherwise.

If the cross-sectional dispersion of the stock returns is low under the existence of large price changes, then the presence of herding is implied. This result contradicts the Capital Asset Pricing Model (CAPM) which predicts that during market stress, large dispersions should be expected since individual stocks have different sensitivities to the market returns. Herding, however, is not implied by mere detection of low cross-sectional dispersion of returns.

2.2. Cross Sectional Absolute Deviation

Based on the research of Christie and Huang (1995), Chang, Cheng, and Khorana (2000) (henceforth referred as CCK) propose an other technique to test the existence of herding behaviour by using, in place of CSSD, the cross-sectional absolute deviation of returns (CSAD) as a measure of dispersion. Under normal conditions, the conditional CAPM specifies a linear relationship between CSAD and market returns. However, if herding occurs during periods of market stress, then a nonlinear relationship will also exist. This nonlinear relationship can be modelled as follows:

$$CSAD_t = \alpha + \lambda_1 R_{m,t} + \lambda_2 \left(R_{m,t}\right)^2 + \varepsilon_t \quad (3)$$

Where $CSAD_t$ is the cross-sectional absolute deviation of stock returns at time t and R_{mt} represents the cross-sectional average of the n returns in the market portfolio at time t.

Their empirical model also considers that the rationale CAPM not only predicts that the dispersions are an increasing function of the market return, but it is also linear. Thus, in the presence of herding behaviour the linear and increasing relation between dispersion and market return would no longer be true. In fact, an increased tendency on the part of market participants to herd around the market consensus during periods of large price movements is sufficient to convert the linear relation into a non-linear one. To accommodate the possibility that the degree of herding may be asymmetric in the up and the down markets, they run two separate regression models and the presence of herding in the up and the down markets is concluded by examining non-linearity in these relationships.CCK argue that market participants suppress their own predictions about asset prices during periods of large market movement," especially "in the presence of severe (moderate) herding." They expect that return dispersions will "decrease (or increase at a decreasing rate) with an increase in the market return."

2.3. Hwang and Salmon's model

Among the latest to contribute to the development of herd measures are Hwang and Salmon (2001, 2004). Hwang and Salmon (2004) (from now on HS) define herding as the behaviour of investors who simply follow the performance of specific factors such as the market portfolio, particular sectors, styles, macroeconomic signals. Thus, these investors will buy or sell individual assets at the same time disregarding the long-run risk-return relationship. Based on this definition and on the disequilibrium CAPM, the authors have developed their own herd measure that can empirically capture the extent of this behaviour in a market. In Hwang and Salmon's (2001) paper, the herd measure can be estimated by using the cross-sectional variance of the factor sensitivities of the individual assets in the market. They formulated measures to capture market-wide herding as well as herding towards fundamental factors. The basis of their studies is founded on the discoveries from numerous empirical studies which show that the betas are in fact not constant as assumed by the conventional CAPM. According to these authors, the time-variation in betas actually reflects the changes in investor sentiment. In Hwang and Salmon's model, the herd measure is simply the cross- sectional dispersion of betas and evidence of herding is indicated by a reduction in this quantity.

In their later paper (2004), they signal the necessity to derive a correct distribution for the herd measure by adopting a different approach. They consider that the action of investors intently following the market performance inadvertently upsets the equilibrium in the risk-return relationship and as a result, the betas become biased. They model the cross-sectional dispersion of the biased betas in a state space model, and using the technique of Kalman filter, they found that market-wide herding is independent of market conditions and the stage of development of the market. Their study on the U.S and South Korean markets revealed evidence of herding towards the market under both bullish and bearish market conditions.

3. Methodology

We concentrate on detecting herding at monthly horizons by employing data of stocks included in the two principle indexes of the Tunisian stock exchange: BVMT and TUNINDEX over the period from 02/01/1999 to 31/12/2005. In deciding on a monthly interval we recognise the fact that the Tunisian stock market is not among the very active exchanges in the world, and does not generally exhibit stock price innovations occurring at high speed or on a high volume basis. We start by putting out the empirical results of the previous herd measures applied to our database. Then we discuss their relative gaps and we propose our own herd measure.

3.1. Results of previous empirical studies

We attempt to apply the previous alternative measures of dispersion to identify the difference in returns on the TUNEDX and BVMT indexes. Herding would be evidenced by a lower cross-sectional standard deviation (CSSD), and a lower or a less than proportional increase in the cross-sectional average deviation (CSAD) during periods of market stress.

3.1.1. Application of CSSD's model

The cross-sectional standard deviation (CSSD) method is used by Christie and Huang (1995) and can be expressed as:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{i,t} - R_{m,t})^2}{N-1}} \quad (4)$$

Where N is the number of firms in the aggregate market portfolio. R_{jt} is the observed stock return on firm j for day t and $R_{mt:}$ the cross-sectional average of the n returns in the market portfolio for day t.

The approach taken by Christie and Huang (1995) is to argue that herding will be more prevalent during periods of market stress, which is defined in terms of extreme returns on the TUNEDX and BVMT indexes. Consider the following equation:

$$CSSD_t = \alpha + \lambda_1 R_{m,t} + \lambda_2 \left(R_{m,t}\right)^2 + \varepsilon_t \quad (5)$$

Where D^L_t = 1, if the market return on day t lies in the extreme lower tail of the distribution and equal to zero otherwise. D^U_t = 1, if the market return on day t lies in the extreme upper tail of the distribution and equal to zero otherwise.

The test of this regression provides the following results as described by the graphic 1 and the table 1.

Graphic 1: **evolution of the cross sectional standard deviations (cssd) for TUNINDEX and BVMT indexes**

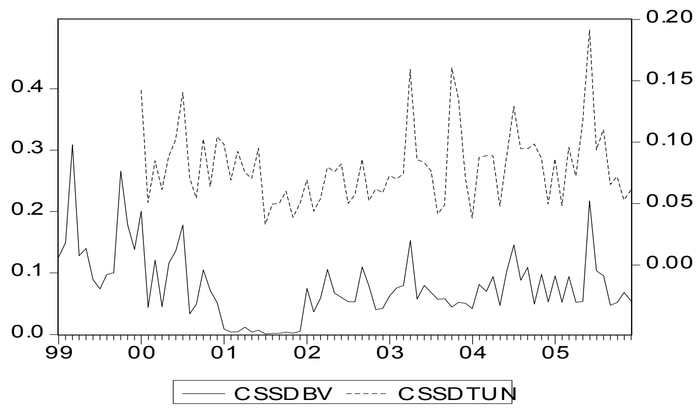


Table 1: **Summary statistics of returns (R_t) and cross-sectional standard deviations (cssd) for TUNINDEX and BVMT indexes**

Panel A : BVMT		Panel B: TUNINDEX	
α	0.073168	α	0.076358
t*	11.47112	t*	20.86226
λ_1	0.002267	λ_1	0.00243
t*	1.274626	t*	1.915826
λ_2	0.000181	λ_2	0.000272
t*	1.322816	t*	1.682187

*Denotes statistical significance at 5% level.

These results indicate that there is no evidence of herding behaviour in the Tunisian stock market.

3.1.2. CCK's model and empirical results

CCK derives their empirical model from the rationale CAPM expressed as follows:

$$E_t(R_i) = R\mathrm{f}_t + \beta_{i,t} E_t(Rm - R\mathrm{f}_t)$$

where $E_t(\ )$ denote the expectation in period t, Rf_t is the return on the zero-beta portfolio, Rm : is t he return on the market portfolio, R_i is the return on any asset i and $\beta_{i,t}$ is the time-invariant systematic risk measure of the security, i = 1, . . . ,N and t = 1, . . . ,T .

$\beta_{m,t}$ the systematic risk of an equally-weighted market portfolio can be expressed as follow :

$$\beta_{m,t} = \frac{1}{N}\sum_{i=1}^{N}\beta_{i,t}$$

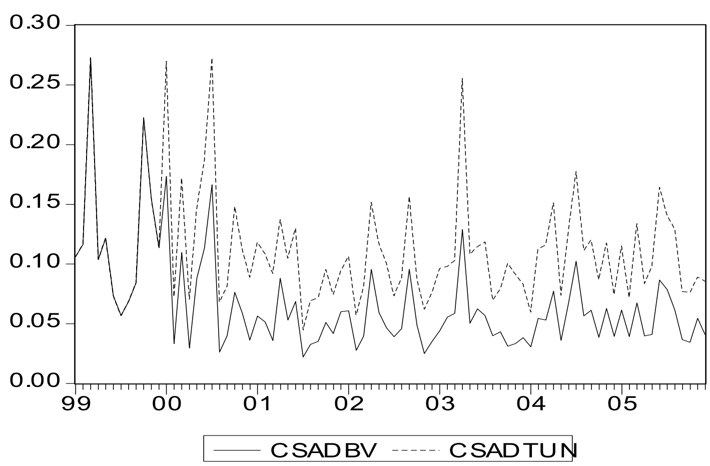
CCK define then the absolute value of the deviation (AVD) of security expected return in the period t from the portfolio expected return by the following specification:

$$AVD_{i,t} = \left|\beta_{i,t} - \beta_{m,t}\right| E_t(Rm - Rf_t) \quad (6)$$

The expected cross-sectional absolute deviation of stock returns (ECSAD) at time t is defined as follows:

$$ESCAD_t = \frac{1}{N}\sum_{i=1}^{N} AVD_{i,t} = \sum_{i=1}^{N}\frac{1}{N}\left|\beta_{i,t} - \beta_{m,t}\right| E_t(Rm - Rf_t) \quad (7)$$

Graphic 2: evolution of evolution of the cross sectional standard deviations (csad) for TUNINDEX and BVMT indexes



CCk's model considers a general quadratic relationship between $CSAD_t$ and the return of the equally-weighted market portfolio in period t is defined as follow:

$$CSAD_t = \alpha + \lambda_1 R_{m,t} + \lambda_2 \left(R_{m,t}\right)^2 + \varepsilon_t \quad (8)$$

Where the presence of a negative λ_2 parameter is an indication of herd behaviour in CCK's model. The quadratic relation suggests that $CSAD_t$ reaches its maximum value when

R_{mt} = - (λ_1/2 λ_2). That is, as R_{mt} increases, over the range where realized average daily returns are less (greater) than R_{mt}, $CSAD_t$ is trending up (down).

Table 2: Summary statistics of returns (R_t) and cross-sectional standard deviations (cssd) for TUNINDEX and BVMT indexes

Panel A : BVMT		Panel B: TUNINDEX	
α	0.062988	α	0.049773
t*	9.612136	t*	18.02483
λ_1	-0.044599	λ_1	-0.1481
t*	-0.143197	t*	-0.846848
λ_2	2.487352	λ_2	5.489616
t*	1.259212	t*	3.254416

Based on the above results, we find a positive and statistically significant parameter λ_2, thus we can affirm the absence of the herding behaviour for the two stock exchange indexes. Given the fact that the Tunisian financial market is an emerging one, we have expected a coherent result with those found by CCK in the two emerging markets in their sample: South Korea and Taiwan where the evidence in favour of herding is well pronounced.

3.1.3. HS's model and empirical results

According to the HS's approach, the cross-sectional standard deviation (cssd) of individual stock returns presents some failing points. The First gap is relative to the fact that during periods of market stress rational asset pricing would imply positive coefficients on the two dummy variables, while herd behaviour would suggest negative coefficients. However, market stress does not necessary imply that the market as a whole should show either large negative or positive returns. The introduction of dummy variables is itself crude since the choice of what is meant by ‘‘extreme’’ is entirely subjective. Moreover, since the method does not include any device to control for movements in fundamentals it is impossible to conclude whether it is herding or independent adjustment to fundamentals that is taking place and therefore whether or not the market is moving towards a relatively efficient or an inefficient outcome.

Another problem with using the cross-sectional standard deviation of individual stock returns is that it is not independent of time series volatility. Goyal and Santa-Clara (2003) and Hwang and Satchell (2002) show that cross-sectional volatility and time series volatility are theoretically and empirically significantly positively correlated and the uncertainty of return predictability (volatility measured over time horizon) moves together with cross- sectional standard deviation of individual stock returns. Hence, even if we find a negative relationship between the cross-sectional standard deviation of individual stock returns and the dummy variables, we could not be sure whether it originates from changes in volatility (measured over time) or herding.

HS' s model find its origin in the following CAPM:

$$E_t(r_{it}) = \beta_{im\,t} E_t(r_{mt}) \quad (9)$$

Where r_{it} and r_{mt} are the excess returns on asset i and the market at time t, respectively, β_{imt} is the systematic risk, and $E_t(.)$ is conditional expectation at time t. In equilibrium, given the view of the market ($E_t(r_{mt})$), we only need β_{imt} in order to price an asset i. When there is beta herding, an individual asset's expected return, $E_t(r_{it})$, is affected by the expected market movement $E_t(r_{mt})$ more than the CAPM suggests and thus β_{imt} is biased towards1. Conditional on the expected market return HS suggest the following simple model to explain herd behaviour:

$$E^b_t(r_{it}) / E_t(r_{mt}) = \beta b_{imt} = \beta_{imt} - h_{mt}(\beta_{imt} - 1) \quad (10)$$

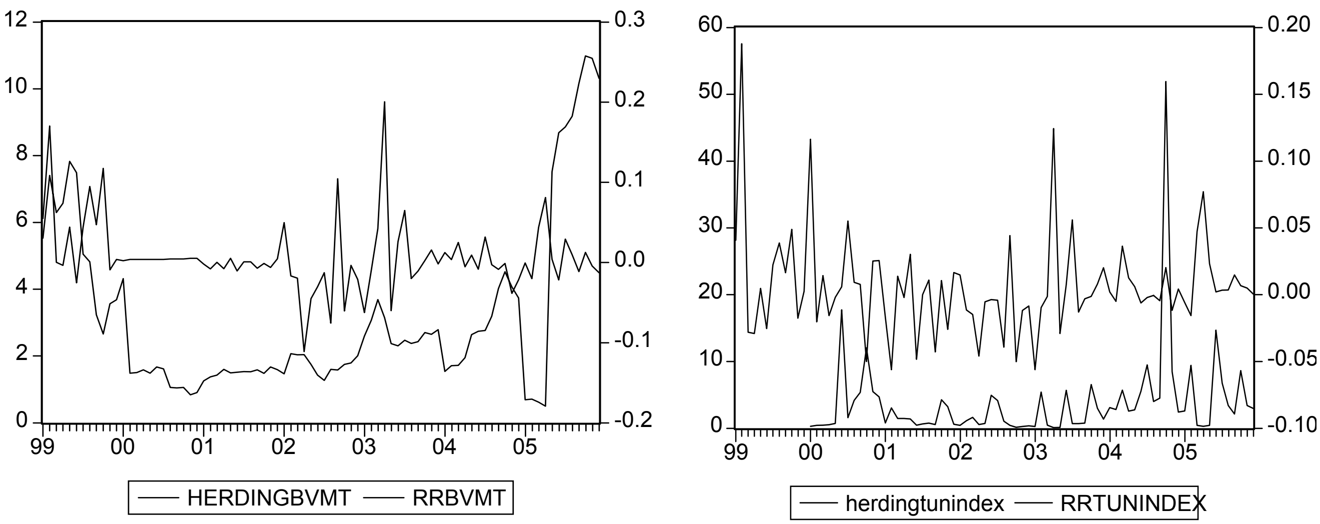
Where $E^b_t(r_{it})$ and β^b_{imt} are the market's biased conditional expectation of excess returns on asset i and its beta at time t, and h_{mt} is a parameter that captures herding and changes over time, $h_{mt} \leq 1$. This is a generalized model that encompasses the equilibrium CAPM with $h_{mt}= 0$, but allows for temporary disequilibrium.

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t} R_{m,t} \quad (11)$$

$$H_{m,t} = \frac{1}{N_t} \sum_{i=1}^{N_t} \left(\beta_{i,t} - 1 \right)^2 \quad (12)$$

The results of HS'model applied to the two indexes of the Tunisian stock exchange are illustrated by the following graphics:

Graphic 3: evolution of HS measure for TUNINDEX and BVMT indexes



In order to highlight the robustness, we tend to examine the relationship between the herding phenomenon and the three principle elements of the market: the return, volatility and feedback trading. Trading volume and volatility often reflect market sentiment and market trading activity. For this objective, we resort to the Ganger causality test for the three existent relations. The VAR model is expressed by the following specification:

$$Y_t = A + \sum_{i=1}^{d} \Phi_i Y_{t-i} + \varepsilon_t \quad (13)$$

Where Y_t et Y_{t-i} : return and sentiment vectors at time t et t-I, A : constant vector, Φ_i : matrix of autoregressive coefficients, ε_t : vector of error terms, d : optimal shifting number as determined by minimising the information criterion of Akaik = $\frac{-2l}{\eta} + \frac{2k}{\eta}$. Here k refers to the number of the estimated parameters; n is the number of observations and l represent the value of the likelihood function.

a) Herding and trading volume

Recent empirical literature examines whether herding phenomenon can be explained by trading volume. Herding arises when a group of investors trade in the same direction over a period of time, whereas positive feedback trading involves a correlation between trades and lagged returns. The investigation of the presence of herding and positive feedback trading provides mixed results. Empirical findings that succeed to highlight evidence of herding or positive feedback trading include many studies, such as those of Klemkosky (1977) which suggest that large buy imbalances are preceded by at least two months of abnormally positive stock returns, and large sell imbalances are preceded by at least one month of abnormal negative stock returns. Based on quarterly institutional holdings data, Cai, Kaul, and Zheng (2000) find that returns Granger-cause institutional trading, but institutional trading does not Granger-cause returns. Similarly, Burch and Swaminathan (2002) use quarterly institutional holdings data from 1982 to 1996 and find significant evidence of momentum trading in response to past returns, but not with respect to past earnings news. Using annual changes in institutional ownership, Nofsinger and Sias (1999) document a strong positive correlation between changes in institutional ownership and lag returns. They conclude that institutions rationally engage in positive feedback trading since the purchased stocks subsequently outperform the sold ones.

To further investigate whether the trading volume explains the herding phenomenon or the herding phenomenon determine the trading volume, we resort to the following causality test:

$$\begin{bmatrix} tur_t \\ herd_t \end{bmatrix} = \begin{bmatrix} \alpha_{tur,t} \\ \alpha_{herd,t} \end{bmatrix} + \sum_{i=1}^{r} \begin{bmatrix} \beta_{tur,t} \\ \beta_{herd,t} \end{bmatrix} \begin{bmatrix} tur_{t-i} \\ herd_{t-i} \end{bmatrix} + \varepsilon_t \quad (14)$$

Where *turt :* represent the turnover at time t and *herd t* represent the herding measure at time t. given the fact that the series turn is not stationary, we resort to Campbell et al. (1993)'s method which consist to following formula :

$$DTur_t = \log(tur_t) - \frac{1}{12}\sum_{t=-12}^{-1}\log(tur_t) \quad (15)$$

The results are reported below:

Table 3: causality test between herding and trading volume

	Lag 1		Lag 2	
	TEST 1	TEST 2	TEST 1	TEST 2
panel A: BVMT Index				
RBVMT	0.92667	0.00414	0.96441	0.01938
panel B: Tunindex				
RTUNINDEX	0.60557	0.99256	0.7203	0.75413
Test 1: transaction volume herding behaviour				
Test 2 :herding behaviour causes transaction volume				
p-value < 0.05 : causality sense is significant				

These results affirm strongly that herding behaviour explains the trading volume for BVMT index contrary to the Tunindex where there is no evidence of such relation in the two senses.

b) Herding and volatility

Similarly, to continue the investigation of the relationship between the herding behaviour and the volatility we propose the causality test below:

$$\begin{bmatrix} vol_t \\ herd_t \end{bmatrix} = \begin{bmatrix} \alpha_{vol,t} \\ \alpha_{herd,t} \end{bmatrix} + \sum_{i=1}^{r} \begin{bmatrix} \beta_{vol,t} \\ \beta_{herd,t} \end{bmatrix} \begin{bmatrix} vol_{t-i} \\ herd_{t-i} \end{bmatrix} + \varepsilon_t \quad (16)$$

Where *Herd t* is the herding measure at time t, *Vol t* represents the market volatility at time t. we are based on the concept of the dynamic volatility measured by GARCH (1, 1) model.The findings of the causality test are summarised in the following table:

Table 4: **causality test between herding and risk**

	Lag 1		Lag 2	
	TEST 1	TEST 2	TEST 1	TEST 2
panel A: BVMT Index				
RBVMT	0.55073	0.04553	0.54284	0.5911
panel B: Tunindex				
RTUNINDEX	0.30638	5.00E-05	0.18305	0.00081
Test 1: risk causes herding				
Test 2: herding causes risk				
p-value < 0.05 : causality sense is significant				

The findings of the second test provide p-value inferior to 5% for the two indexes. Such result proves the evidence that the herding phenomenon results in an increase of the market volatility.

c) Herding and return

To examine the sense of the relationship between the herding phenomenon and the market return, we resort to the following causality test:

$$\begin{bmatrix} rent_t \\ herd_t \end{bmatrix} = \begin{bmatrix} \alpha_{rent,t} \\ \alpha_{herd,t} \end{bmatrix} + \sum_{i=1}^{r} \begin{bmatrix} \beta_{rent,t} \\ \beta_{herd,t} \end{bmatrix} \begin{bmatrix} rent_{t-i} \\ herd_{t-i} \end{bmatrix} + \varepsilon_t \quad (17)$$

Where *rent t* represent the return of the market at time t and *herd t* measure the degree of herding at time t. the results of these test are given by the following table:

Table 5: **causality test between herding and return**

	Lag 1		**Lag 2**	
	TEST 1	TEST 2	TEST 1	TEST 2
panel A: BVMT				
RBVMT	0.38349	0.12535	0.38454	0.48119
panel B: Tunindex				
RTUNINDEX	0.01004	0.83525	0.04142	0.32624
Test 1: return causes herding				
Test 2: herding causes return				
p-value < 0.05 : causality sense is significant				

The p-values prove a non significant causality between the return of the Tunindex and herding phenomenon and no evident relation. Such result contradicts the theories interested in the effect of herding on the market return.

3.2. The new herding measure

In this section, we develop an empirical methodology to detect the presence of herd behavior in international equity markets. Specifically, we develop a new approach to measuring herding based on the HS's measure and a dynamic multivariate GARCH model to analyze the systematic risk of the market.

3.2.1 Derivation of the new herding measure

Two principle criticisms can be addressed to the HS herding measure. The first deals with the joint hypothesis. Thus the authors have based heir herding measure on the rationale CAPM whose principle hypothesis is the efficiency of the market, or the existence of herding phenomenon signals the inefficiency of the market. The second criticism is related to the measure of the systematic risk of the market. In that respect, HS's model considers the systematic risk of the market equal to 1. This is far from the empirical reality. In fact, there is so many factors, apart from the herding behaviour, that result in the deviation of the systematic risk from 1 such as the market microstructure and investor's psychology. That's why we adopt, in our new herding measure, a dynamic approach to estimate the systematic risk of the market, precisely, we suppose that the dynamic volatility of the market follow GARCH (1.1) process described as below:

$$Rm_t = a + bRm_{t-1} + \varepsilon_t \quad \varepsilon/\mathrm{I}_{t-1} : \mathrm{N}(0, \mathrm{h}_{m,t}) \quad (18)$$
$$h_{m,t} = \mu + \alpha h_{m,t-1} + \beta\varepsilon^2_{m,t-1}$$

Similarly, to estimate the asset volatility, we refer also to a GARCH (1, 1) specification as follow:

$$R_t = a + bR_{t-1} + \varepsilon_t \quad \varepsilon/\mathrm{I}_{t-1} : \mathrm{N}(0, \mathrm{h}_t) \quad (19)$$
$$h_t = \mu + \alpha h_{t-1} + \beta\varepsilon^2_{t-1}$$

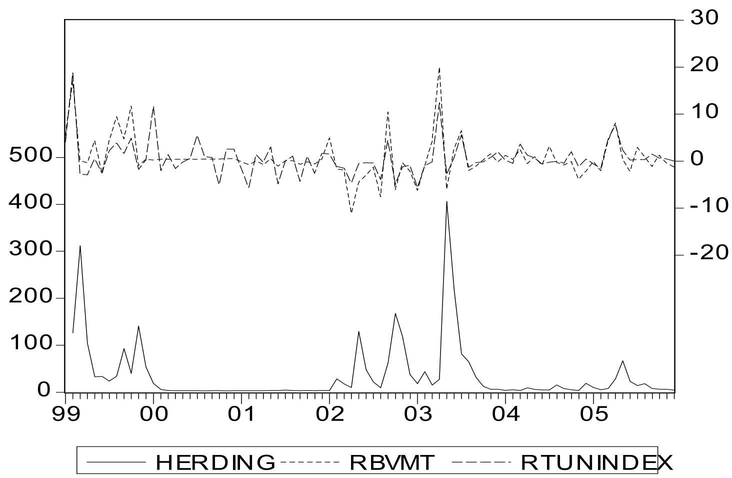
Starting from the HS's model (2004), our new herding measure is based on the cross sectional standard deviation of the market volatility while adopting a dynamic approach of systematic risk. Consequently, the dynamic herding measure becomes:

$$DH_t = \frac{1}{N_t}\sum_{i=1}^{N_t}\left|\mathrm{h}_{i,t} - \mathrm{h}_{m,t}\right| \qquad (20)$$

Where $DH_{m,t}$ measures the dynamic herding at time t , $h_{i,t}$ measures the dynamic volatility of the asset i at time t, hm,t : measures the dynamic volatility of the market at time t.

The results of the new herding measure are illustrated by the graphic below:

Graphic 4: evolution of DS measure for TUNINDEX and BVMT indexes



Like the HS's model, we demonstrate the robustness of our herding measure by investigating the relationship between the herding phenomenon and the three principle elements of the market: the return, volatility and trading volume. For this objective, we resort to the Ganger causality test that provides us with the following results:

Table 6: Granger causality test between herding and return

	Lag 1	
	TEST 1	TEST 2
panel A BVMT		
RBVMT	1.4E-09	0.56144
panel B: Tunindex		
RTUNINDEX	0.012937	0.18651
Test 1: return causes herding		
Test 2: herding causes return		
p-value < 0.05 : significant causality sense		

Table 7: Granger causality test between herding and risk

	Lag 1	
	TEST 1	TEST 2
panel A: BVMT		
RBVMT	0.00159	0.00022
panel B: Tunindex		
RTUNINDEX	0.098255	0.030561
Test 1: volatility causes herding		
Test 2: herding causes volatility		
p-value < 0.05 : significant causality sense		

Table 8: Granger causality test between herding and trading volume

	Lag 1	
	TEST 1	TEST 2
panel A: BVMT		
RBVMT	0.47959	0.013656
panel B: Tunindex		
RTUNINDEX	0.66353	0.015187
Test 1: trading volume causes herding		
Test 2: herding causes volume trading		
p-value < 0.05 : significant causality sense		

The findings of the new measure show, on one the one hand, that the return causes the herding phenomenon for the two indexes, on the other hand, the herding behaviour result in an increase of the risk and trading volume . Such empirical results are in accordance with the literature review dealing with the impact oh herding on the financial market.

3.2.2. The decomposition of the new herding measure

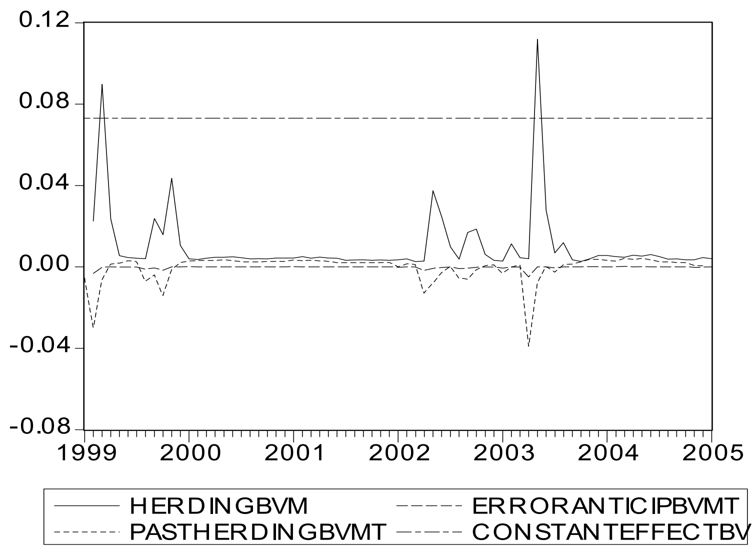
If we replace the volatility measures in the specification (19) by their expression as given by the equations (19) and (20), we obtain the following specification:

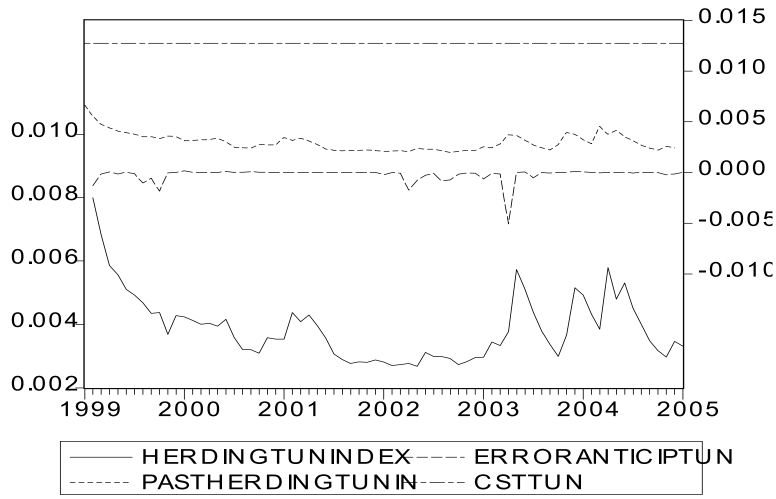
$$DH_t = \frac{1}{N_t}\sum_{i=1}^{N_t}\left|\mu_1 + \alpha h_{i,t-1} + \beta_1\varepsilon_{i,t-1}^2 - \mu_2 - \alpha h_{m,t-1} + \beta_1\varepsilon_{m,t-1}^2\right| \quad (21)$$

$$DH_t = \frac{1}{N_t}\sum_{i=1}^{N_t}\left|(\mu_i - \mu_m) + \left(\beta_i\varepsilon_{i,t-1}^2 - \beta_m\varepsilon_{m,t-1}^2\right) + \left(\alpha_i h_{i,t-1} - \alpha_m h_{m,t-1}\right)\right| \quad (22)$$

$$DH_t = \sum_{i=1}^{N_t} \left| \frac{(\mu_i - \mu_m)}{N_t} + \frac{(\beta_i \varepsilon^2_{i,t-1} - \beta_m \varepsilon^2_{m,t-1})}{N_t} + \frac{(\alpha_i h_{i,t-1} - \alpha_m h_{m,t-1})}{N_t} \right| \quad (23)$$

Graphic 5: decomposition of DS measure for TUNINDEX and BVMT indexes





This measure show that the herding behaviour consists in three components. The first one is related to the constant term which prove that the herding behaviour exist whatever the market conditions. This affirmation is consistent with the reality. In fact it is strongly probable that there is at least one investor who imitates the actions of the others. The second component deals with the anticipation error of the investors concerning the totality of assets. Finally, the third component highlights that the current herding depends on the previous one. This result finds its theoretical basis in the information cascades theory (see Givoly and Palmaon (1985) and Welch (1992; 2000).

4. Conclusion

Herding is widely believed to be an important element of behaviour in financial markets and particularly when the market is in stress. Our study contributes to the literature in several respects. First, we have proposed a new approach to measuring and testing herding in financial market. Second the majority of existing studies are undertaken for developed capital markets, in particular the US (Chang et al., 2000; Wermers, 1999; Lakonishok et al., 1992) and Japan (Kim and Nofsinger, 2000; Chang et al., 2000). The only studies of emerging markets of which we are aware are those undertaken for Korea by Choe et al. (1999, 2000), Kim and Wei (2002), and Chang et al. (2000), and for Taiwan by Chang et al. (2000).This study, to our knowledge the first undertaken for Tunisian stock exchange. We have applied our approach to the TUNEDX and BVMT indexes and found that herding towards the market consists of three components. The first one is related to the constant term which prove that the herding behaviour exist whatever the market conditions. This affirmation is consistent with the reality. In fact it is strongly probable that there is at least one investor who imitates the actions of the others. The second component deals with the anticipation error of the investors concerning the totality of assets. Finally, the third component highlights that the current herding depends on the previous one. This result finds its theoretical basis in the information cascades theory.

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