THE WEAK FORM OF INFORMATIONAL EFFICIENCY: CASE OF TUNISIAN BANKING SECTOR

Fatma SIALA GUERMEZI
Faculty of Economics and Management of Tunis, Tunisia
fatmasialag@gmail.com
Amani BOUSSAADA
Faculty of Economics and Management of Tunis, Tunisia
amani.boussaada@gmail.com

Abstract
This paper investigates the weak form of market efficiency hypothesis over eleven Tunisian banks listed on the Tunisian Stock Exchange during the period July 2012 to June 2013. GARCH (1, 1) and its extension EGARCH (1,1) are developed in order to describe the sign and size of financial volatility asymmetry. The results indicate that the Tunisian stock market, in particular the banking sector would not show characteristics of market efficiency. Some of the bank securities asymmetrically reacted to good and bad news. The presence of the leverage effect would imply that negative innovation (news) has a greater impact on volatility than a positive innovation (news). This implies that this sector is not efficient under the weak form of the hypothesis. The implication of rejecting the weak form of efficiency for investors is that they can better predict stock price movements and abnormal earnings.

Key words: *Efficiency market, GARCH (1, 1), EGARCH (1, 1), volatility, Leverage effect.*

JEL Classification: *G14*

I. INTRODUCTION

In order to stimulate their economic growth and foster international integration, many of the Arab countries reconsidered the role of stock markets. However, different steps have resulted in some growth in terms of capitalization and the number of listed companies and many reforms have been undertaken in order to improve their liquidity and efficiency.

Moreover, the issue of efficiency is fundamental in finance. Fama (1970) provides an early, definitive statement of this position suggesting that stock prices could be well approximated by a random walk model and that changes in stock returns were basically unpredictable. In general terms, market efficiency means that prices “fully reflect all the available information” (Fama, 1970, p 383). Efficiency is defined at three different levels, according to the level of information reflected in the prices. Three levels of the efficiency market hypothesis (EMH) are expressed as follows: weak-form, semi-strong and strong form. The “Weak” form asserts that all price information is fully reflected in asset prices, in the sense that current price changes cannot be predicted from past prices. The implication of the weak-form of efficiency is the random walk hypothesis, which indicates that successive price changes follow the random walk hypothesis, which indicates that successive price changes are random and serially independent. The “Semi-strong” form suggests that no profits can be made even when all public information can be used for trading. The semi-strong-form of efficiency implies that neither fundamental analysis nor technical analysis will be able to reliably produce excess returns. The “Strong” form postulates that prices fully reflect information even if some investors or group of investors have a monopolistic access to some information. Therefore, no one can have advantage on the market in predicting prices since there is no data that would provide any additional value to the investors.

Since the research contribution of Fama, there is a large empirical research that stock prices or returns exhibit random walk behavior. Over recent decades, there has been a large body of empirical research on modeling and estimating aggregate stock market volatility [e.g., Mecagni and Sourial (1999) and Kabir, et al. (2003)]. It is useful, before proceeding to describing volatility models, to give a brief explanation of the term volatility: Volatility measures variability, or dispersion of a central tendency — it is simply a measure of the degree of price movement in a stock, future contracts or any other market. It is believed that when a stock market exhibits an increased volatility, investors tend to lose confidence in the market and they tend to exit the market.

The relationship between stock price and its volatility has long interested financial researchers. Empirically, negative (positive) returns are generally associated with upward (downward) revisions of conditional volatility. This empirical phenomenon is often referred to as asymmetric volatility in the literature. One main theory that considers the relationship between volatility and equity price is the leverage effect of Black (1976) and Christie (1982). Under the leverage effect, a negative return (declining price) increases financial leverage, making the stock riskier and increasing its volatility.

II. PROFILE OF THE TUNISIAN STOCK EXCHANGE (BVMT):

The Tunisian financial market suffers from a striking mismatch between policy changes and market practices so that the stock exchange securities remained far less developed than other emerging financial markets.

Indeed, successive revisions of the regulatory reforms were made such as: devices of compartmentalization of markets (Decree-Law No. 2011-99 of 21 October 2011 which amended Law No. 1988-92 of 2 August 1988 and the new Decree No. 2012-2945 of 27 November 2012), setting up an institution on securities trading on the stock exchange and over-the-counter and updates, establishment of a platform for electronic trading and stock market capitalization indices (Tunindex, Tunindex.20 and Tunbank), all of these were without any positive effect on the development of the financial market.

In general, capital markets in Tunisia do not play a major role in the mobilization of savings and the financing of the real economy. The funds raised have averaged 2% previously. The market for government bonds remains underdeveloped and illiquid while the primary market shares and corporate bonds remain modest with listed companies which do not reflect the structure of the economy.

The Tunisian stock market is small in size and is not representative of the national economy. Similarly, the stock market has a low financing capacity of market economy (an average of only 5% of GDP, against outstanding loans to the private sector of around 68.2% of GDP on average during the period 2008-2012). In terms of market capitalization, number of listed companies, trade volumes and contribution to the financing of the economy, the BVMT remains the least efficient comparator in emerging countries.

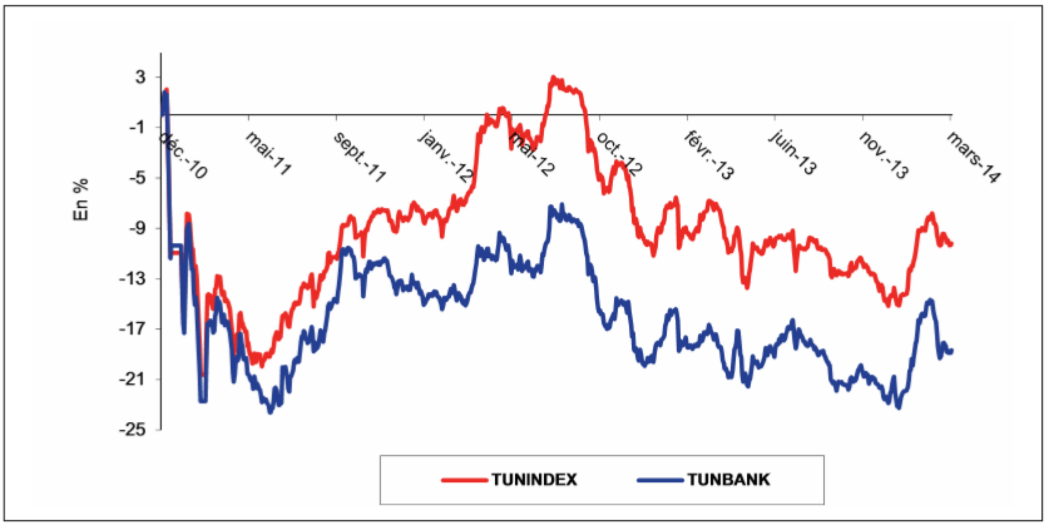
Indeed, despite new introductions of stocks on the stock exchange during the transition period, both on the main market or on the alternative market, the positioning of the main indicators of the Tunisian stock exchange when compared to those of Morocco and Egypt, the main competing emerging financial centers, is still lagging behind.

Table 1: stock market indicators

	Tunisia	**Morocco**	**Egypt**
Market capitalization (2012)	15.8	115.6	81.2
Market capitalization / GDP(2012)	23.7%	69.4%	28.7%
Average contribution to the financing of the economy	5%	19%	21%

The distribution of market capitalization in Tunisia denotes the dominance of the banking sector. The banking sector remains the largest contributor to market capitalization up to 44%. If one adds leasing companies and insurance companies, finance companies represent 70% of the global market capitalization. Unlike other emerging stock markets, the absence of sector diversity and the low representation of institutional contributions are also the source of low levels of capitalization and liquidity.

Figure: Trends in TUNINDEX and TUNBANK indices



Source: Central Bank of Tunisia.

Bank stocks have significantly affected the overall momentum of the stock market in 2013. These represent nearly 40% of market capitalization and a weight of 45% in the composition of the TUNINDEX. The bank sector index TUNBANK, for its part, registered a negative return of 3.2% for the year 2013, with a decline in price of 7 of the 11 listed banks. The largest decrease was recorded by the STB (-41.7%).The semi-annual statements that have been published with a delay of 4 months indicated a negative result of 5.1 MTD in the first half of 2013 against positive results of 5.3 MTD in the same period in 2012.

The downward trend in 2013 was backed up by a recovery in TUNINDEX during the first two months of 2014 when political and security tensions saw a halt. Nevertheless, the index declined again in March 2014, because of some profit-making operations that limited its gains from the beginning of the year to 4.8%.The first quarter of 2014 saw a consolidation of the volume of transactions on the Stock Exchange which amounted to 584 MTD, resulting in an average daily trading volume of 9.7 against 6.2 MTD in the same period in2013.

In light of “market efficiency” concept, this study attempts to empirically investigate the relationship between IT investment and bank performance in the context of an emerging country such as Tunisia. Our study will try to provide answers to following key question: What is the impact of releasing new information on the stock performance of listed banks?

Then, this paper attempts to examine the impact of releasing new information of several Tunisian banks. The technique used is autoregressive conditional heteroscedasticity (ARCH) and its generalization (GARCH). ARCH models are able of capturing and modeling many of the stylized facts of volatility behavior usually observed in financial time series including time-varying volatility or volatility clustering. Another specification of GARCH model, EGARCH (1, 1), was used in this paper to model volatility of daily stock returns for the securities of eleven banks.

The rest of the paper is organized as follows. Section III provides an overview of theoretical aspects and empirical evidence described in the literature. Section IV describes the model and analyzes the empirical findings. Finally, Section V concludes the paper.

III. Review of the Literature

The beginning of modern market efficiency literature is attributed to Samuelson (1965) when he combined the early empirical findings that support the random walk hypothesis, such as thoe of Cowles and Jones (1937), and Granger and Morgenstern (1963). According to Dimson and Mussavian (1998), Samuelson developed the theoretical framework of the random walk hypothesis, whereas Bachelier (1900) modeled the formula of random walk in asset prices. Fama (1965b) defined an “efficient” market for the first time, in his landmark empirical analysis of stock market prices that concluded that they follow a random walk. He (1965a) explained how the theory of random walks in stock market prices presents important challenges to the proponents of both technical analysis and fundamental analysis. In the meantime, Samuelson (1965) provided the first formal economic argument for "efficient markets". His contribution is neatly summarized by the title of his article: "Proof that properly anticipated prices fluctuate randomly".

Moreover, Harry Roberts (Roberts, 1967) coined the term "Efficient Market Hypothesis", and distinguished between its weak and strong form (Campbell, Lo, and MacKinlay, 1997), which became the classic taxonomy in Fama (1970). Sanford Grossman described a model which shows that "informationally efficient" price systems aggregate diverse information perfectly, but in doing this the price system eliminates the private incentive for collecting the information" (Grossman, 1976). Fama (1976) published the book Foundations of Finance. Sanford J. Grossman and Joseph E. Stiglitz (Grossman and Stiglitz, 1980) showed that it is impossible for a market to be perfectly informationally efficient. Because information is costly, prices cannot perfectly reflect available information.In 1985 Werner F. M. De Bondt and Richard Thaler (De Bondt and Thaler, 1985) discovered that stock prices overreact, evidencing a substantial weak form of market inefficiencies. This paper marked the start of behavioral finance.

Fama and French (1988) found large negative autocorrelations for stock portfolio return horizons beyond a year. Lo and MacKinlay (1988) strongly rejected the random walk hypothesis for weekly stock market returns using the variance-ratio test. Poterba and Summers (1988) showed that stock returns show positive autocorrelation over short periods and negative autocorrelation over longer horizons. Laffont and Maskin (1990) show that the efficient market hypothesis may well fail if there is imperfect competition. Lehmann (1990) found reversals in weekly security returns and rejects the efficient market hypothesis. Andrew W. Lo (Lo, 1991) developed a test for long-run memory that is robust to short-range dependence, and concludes that there is no evidence of long-range dependence in any of the studied stock returns indices. Fama (1991) wrote the second of his three review papers. Instead of weak-form tests, the first category now covers the more general area of tests for return predictability.In his third of his three reviews, Fama (1998) concluded that, "Market efficiency survives the challenge from the literature on long-term return anomalies".

Information efficiency of capital markets has been the subject of an important stream of literature. Numerous researches have examined this topic on various stock markets of different countries. Among the empirical studies on weak form efficiency in Asian stock markets, we mention that of P. Srinivasan (2010) which examined the random walk hypothesis to determine the validity of weak-form efficiency for two major stock markets in India, The results revealed that the Indian stock markets do not show characteristics of random walk and as such are not efficient in the weak form, implying that stock prices remain predictable. The empirical findings do not support the validity of weak-form efficiency for stock market returns of Indian stock exchanges.

In Malaysia, Tan and Hooy (2004) evaluated the effects of the programmed Malaysian bank merger on the volatility of the stock returns. The results showed that the proposed merger did bring about stability for the banks' stock prices. Bizhan Abedini (2009) explored some evidence whether Kuala Lumpur Stock Exchange (KLSE) is efficient in the weak form or not over the period January 2006 to June 2008 using daily General Index. The methods used for the study are Autocorrelation Function test (ACF), Runs tests, Variance ratio test and Unit root test [Augmented Dickey-Fuller Test (ADF)]. The result shows that with the ACF method, EMH is accepted (Efficient Market Hypothesis) but EMH is not accepted with the Runs test and ADF test. The variance ratio test shows that Kuala Lumpur Stock Exchange (KLSE) did not support EMH. Kashif Hamid, Muhammad T.S, Syad Z.A, Rana S (2010) investigate the weak-form market efficiency of eight Asian equity markets (Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesian and Malaysia). The tests concluded that no market is weak-form efficient among all markets. Hamid and Hamid (2005) examined the effect of a firm's capital increase announcement on the stock performance of insurance companies in Malaysia. The results indicate no significant relation between abnormal returns and date of announcement.

These empirical studies have used the conventional efficiency tests, which have been developed for testing mature markets. Emerging markets are characterized by low liquidity, thin trading, unreliable information, and less informed investors. Furthermore, the rationality assumption implies that investors are risk averse, instantaneously responding to new information, and make unbiased forecasts.

On the other hand, in developed countries, many research studies have been conducted to test the efficiency of the capital market with respect to information content of events. Cooray (2003) tested the random walk hypothesis on the stock markets of the U.S, Japan, Germany, the U.K., Hong Kong and Australia, using unit root tests and spectral analysis, which enables identifying any cyclical or seasonal patterns in stock prices. The results based upon the augmented Dickey-Fuller (1979) and Phillips-Perron (1988) tests and spectral analysis indicated that all markets exhibit a random walk. Borges (2008) studied the weak-form market efficiency applied to stock market indices of France, Germany, UK, Greece and Spain. The used data were daily closing values of stock markets. Overall, the author found evidence that monthly prices and returns follow random walks in all six countries.

Worthington and Higs (2003) have tested random walks and weak-form efficiency in European equity markets. They have studied the daily returns of sixteen developed markets (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom) and four emerging markets (Czech Republic, Hungary, Poland and Russia). Their results indicated that among the developed markets, only Germany, Ireland, Portugal, Sweden and the United Kingdom satisfy the most stringent random walk criteria with France, Finland, the Netherlands, Norway and Spain meeting at least some of the requirements of a strict random walk. Among the emerging markets, only Hungary satisfies the strictest requirements for a random walk in daily stock returns.

Several empirical studies have been conducted to test the efficiency of the stock market in the context of both emerging and industrialized economies. The vast majority of these studies focused on testing the weak-form EMH by assimilating this hypothesis to the random walk of stock returns. Some studies rejected the weak form efficiency while other accepted it.

IV. METHODOLOGY

To forecast stock market volatility, the models that were developed for this purpose are autoregressive conditional heteroskedasticity (ARCH) and its generalization (GARCH). ARCH models are able of capturing and modeling many of the stylized facts of volatility behavior usually, observed in financial time series including time-varying volatility or volatility clustering (Zivot and Wang, 2006).In addition, another specification of GARCH model, EGARCH (1, 1),was used to model volatility of daily stock returns for the securities of eleven banks. While presenting these different models, there are two distinct equations or specifications, the first for the conditional mean and the second for the conditional variance.

In order to identify ARCH characteristics in our study, conditional returns should be modeled first. The general form of returns can be expressed as a process of autoregressive AR (p), up to (p) lags, as follows:

$$R_t = \alpha_0 + \sum_{i=1}^{p} \alpha 1\ Rt - 1 + \varepsilon t$$

The ARCH model assumes that ($\varepsilon^2_{t,}$ S) have a non-constant variance or heteroscedasticity, denoted by (h^2_t). After constructing time series residuals, we modeled conditional variance in a way that incorporates the ARCH process of (ε^2)in the conditional variance with (q) lags. The general forms of conditional variance, including (q) lag of the residuals is as follows:

$$h^2_t = \beta_0 + \sum_{i=1}^{p} \beta 1\ \varepsilon 2\ t - 1$$

This model suggests that volatility in the current period relates to volatility in the past periods. We use a model selection criterion such as AIC (Akaike Information Criterion) and SIC (Schwartz Information Criterion) to determine the value of q or order of the ARCH model. The decision rule is to choose the model with the minimum value of the test information.

The GARCH model

The problem with applying the original ARCH model is the non-negativity constraint on the coefficient parameters of (βi's) to ensure the positivity of conditional variance. However, when a model requires many lags to model the process correctly, non-negativity may be violated. To avoid the long lag structure of the ARCH (q) developed by Engle (1982), Bollerslev (1986) generalized the ARCH model, the so-called (GARCH), by including the lagged values of conditional variance. Thus, GARCH (p,q) specifies conditional variance to be a linear combination of (q) lags of the squared residuals $\varepsilon^2_t$from the conditional return equation and (p) lags from conditional variance σ^2_{t-1} Then, the GARCH(p,q) specification can be written as follows:

$$h^2_t = \beta_0 + \sum_{i=1}^{q} \beta 1\ \varepsilon 2\ t - i\ + \sum_{j=1}^{p} \beta 1\ \varepsilon 2\ t - j \vee \text{j=1,…,p and i=1,…, q}$$

Where β_1, β_2> 0 and (β_1+ β_2) < 1 is to avoid the possibility of negative conditional variance.

The adequacy of the GARCH model can be examined by standardized residuals (ε/δ) where δ is the conditional standard deviation as calculated by the GARCH model, and (ε) is the residuals of the conditional return equation.

$$R_t = \alpha_0 + \sum_{i=1}^{p} \alpha 1\ Rt - 1 + \varepsilon t$$

The test for mean equation specification can be thought of as a test for autocorrelation in the standardized residuals. The test is one of a joint null hypothesis that there is no autocorrelation up to order k of the residuals. In other words, the series under investigation shows volatility clustering or volatility persistence. The same is true for the variance equation. The only difference is that in this case the test will be run on the squared standardized residuals.

Despite the fact that many ARCH-family models have been proposed (e.g. Bera and Higgins (1993), Bollerslev et. al. (1994) and Diebold and Lopez (1995) for a survey), previous studies, almost unanimously, agreed on the performance of the standard GARCH (1, 1) model rather than attempt to determine the 'appropriate' lag values. The reason can possibly be the attitude of researchers that the first lag of conditional variance is sufficient to capture all volatility clusters present in the data.

The EGARCH model

An interesting feature of an asset price is that "bad" news seems to have a more pronounced effect on volatility than does "good" news. For many stocks, there is a strong negative correlation between the current return and future volatility. The tendency for volatility to decline when returns rise and to rise when returns fall is often called the leverage effect. Symmetric GARCH models described above cannot account for the leverage effect observed in stock returns. Its main drawback is that conditional variance is unable to respond asymmetrically to rises and falls in ε_t and such effects are believed to be important in the behavior of stock returns. Consequently, a number of models have been introduced to deal with this phenomenon. These models are called asymmetric models. This models capture asymmetric responses of the time-varying variance to stocks and, at the shocks and, at the same time, ensure that variance is always positive. It was developed by Nelson (1991) with the following specification:

$$\mathrm{Ln}\,(\delta^2_t) = \omega + \beta_1 \mathrm{Ln}\,(\delta^2_{t-1}) + \left\{\alpha_1 \left|\frac{\varepsilon t-1}{\delta t-1}\right| \sqrt{\frac{2}{\pi}}\right\} - \gamma(\varepsilon_{t-1}/\ \delta_{t-1})$$

Where γ is the asymmetric response parameter or leverage parameter. The sign of γ is expected to be positive in most empirical cases so that a negative shock increases future volatility or uncertainty while a positive shock eases the effect on future uncertainty. In macroeconomics analysis, financial markets and corporate finance, a negative shock usually implies bad news, leading to a more uncertain future.

The advantage of using EGARCH is that the positivity of the parameters is guaranteed since we are working with the log of variance. Moreover, there are no restrictions on the parameters ω, α, and γ. However, to maintain stationarity, β must be positive and less than 1. The leverage effect is indicated by the value of γ. For the leverage effect to be present, γ must be negative and significant. The α parameter represents a magnitude effect or the symmetric effect of the model, the "GARCH" effect. β measures persistence in conditional volatility irrespective of anything happening in the market. When β is relatively large, then volatility takes a long time to die out following a crisis in the market.If $\gamma = 0$, then the model is symmetric. When $\gamma < 0$, then positive shocks (good news) generate less volatility than negative shocks (bad news). When $\gamma > 0$, it implies that positive innovations are more destabilizing than negative innovations.

1) Data and empirical results

The time series data used for modeling volatility in this paper is the daily closing prices of the eleven Tunisian banks over the period from the 2nd July 2012 to 28th June 2013. These closing prices have been taken from BVMT website. In this study, daily returns (R_t) were calculated as the continuously compound returns which are the first difference in the logarithm of the closing prices of the eleven Tunisian banks of successive days; namely Amen Bank (AB), Arab Tunisian Bank (ATB), Attijari Bank, Banque d'Habitat (BH), Banque Internationale Arabe de Tunisie (BIAT), Banque Nationale Agricle (BNA), Banque de Tunisie (BT), Bnaque de Tunisie et des Emirats (BTE), Société Tunisienne de Banque (STB), Union Bancaire pour le Commerce et l'Industrie (UBCI), Union Internationale de Banques (UIB):

$$\mathbf{R_t = Log\ [P_t/P_{t-1}]*100}$$

Where P_t and P_{t-1} are the daily closing prices of the eleven banks listed on BVMT at days t and t−1, respectively.

Statistical characteristics

At this stage, we focus on the study of the statistical characteristics of the different financial time series. The tests reported in Table 3 allow us to highlight the properties that characterize the returns series of daily transactions, including non-normality, stationarity.

Table 3: Descriptive statistical distributions of returns

Banks	*Daily returns*				
	Moy.	*E.T*	*Sk*	*Ku*	*J-B*
AB	0.000734	0.013122	0.863122	7.574141	245.99*** (0.0000)
ATB	0.000814	0.011428	-0.118408	5.334459	56.66*** (0.0000)
ATTIJARI	0.000128	0.010332	-0.177386	4.495480	22.24*** (0.0000)

BH	0.001569	0.013882	0.033498	3.919612	7.54*** (0.0229)
BIAT	0.000183	0.012669	-0.144260	5.502846	64.00*** (0.0000)
BNA	0.000998	0.010894	0.240078	4.539762	24.82*** (0.0000)
BT	0.000938	0.021626	8.462154	114.9105	125968.9*** (0.0000)
BTE	0.000521	0.010445	0.741187	9.537218	335.12*** (0.0000)
STB	0.001782	0.015214	-0.226553	5.604465	70.17*** (0.0000)
UBCI	0.001937	0.019220	0.447568	7.223478	135.90*** (0.0000)
UIB	0.00117	0.009834	-0.450615	5.727544	92.48*** (0.0000)

*, **, *** Significance at the 10%, 5% and 1% respectively

The statistics indicate that the average sample returns are all positive. Jarque Bera statistics are all significant at 1%. They clearly reject the normality assumption, which implies that all the variables in the model do not follow the normal distribution, which is a prerequisite for a contract to qualify for efficiency (Fama (1965) and Kamath (1998)). Asymmetry coefficients (skewness) and kurtosis (kurtosis) are significantly different from their predicted levels by the normal distribution for the two series. Indeed, Kurtosis values are much higher than 3 indicating the presence of fat tails. The distributions of the two series are leptokurtic. Similarly, skewness values (asymmetry) are strictly different from zero. This means that the distributions of the different series are asymmetrical.

Results of the Unit root test

Before applying a model to the data of our study, we perform the unit root test to ensure that each variable is stationary, and to avoid spurious regression. Unit root tests are based on the Augmented Dickey-Fuller (1979) (ADF) and Phillips-Perron (1988) (PP) tests. Table 4 presents the results of the ADF and PP tests for unit root.

Table 4: Unit root tests applied to daily returns.

Banks	**ADF**	
	Statistique	**p-value**
R_t AB	-15.41753	0.0000
R_t ATB	-13.37859	0.0000
R_tAttijari	-14.70864	0.0000
R_t BH	-14.29387	0.0000
R_t BIAT	-14.60340	0.0000
R_t BNA	-15.28446	0.0000
R_t BT	-15.70038	0.0000
R_t BTE	-19.03602	0.0000
R_t STB	-12.96306	0.0000
R_t UBCI	-15.38926	0.0000
R_t UIB	-12.83068	0.0000

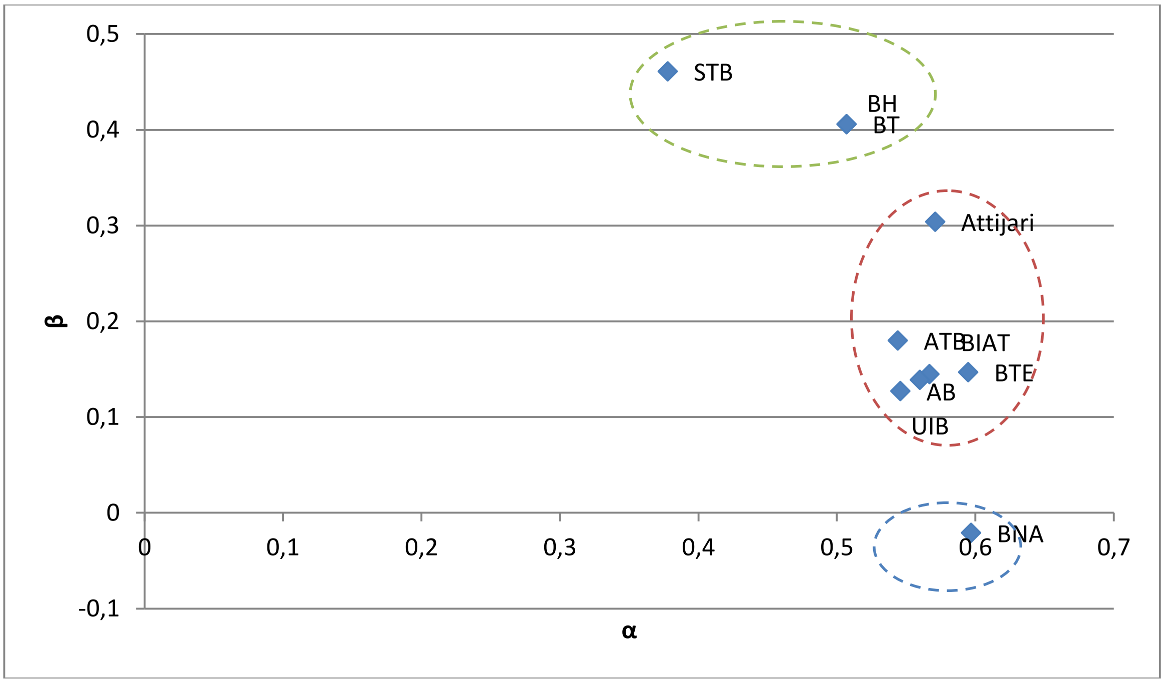
It is cleared that, the null hypothesis of unit root (non-stationarity) is rejected, as the value of the test statistic is negative than the critical value in each banks case. This result leads us to use the GARCH (1, 1) models in the trading simulation analysis, for each market and the results are reported in Table5.

Table5: GARCH (1, 1) Estimates of Daily Stock Return Data

Banks	α	β	α + β
AB	0.546690 (0.0340)	0.127347 (0.1901)	0.674037
ATB	0.544371 (0.0000)	0.180876 (0.0000)	0.725247
Attijari	0.571063 (0.0000)	0.304125 (0.0000)	0.875188
BH	0.507040 (0.0000)	0.406536 (0.0000)	0.913576
BIAT	0.567255 (0.0115)	0.145291 (0.0260)	0.712546
BNA	0.597590 (0.0052)	-0.021001 (0.0000)	0.576589
BT	0.507040 (0.0000)	0.406536 (0.0000)	0.913576
BTE	0.595794 (0.0000)	0.147689 (0.0416)	0.743483
STB	0.378916 (0.0000)	0.461499 (0.0000)	0.840415
UBCI	0.295612 (0.0000)	1.233034 (0.0000)	---
UIB	0.560509 (0.0379)	0.139623 (0.2503	0.7001713

Parameters α and β of the GARCH model are all positive and statistically significant for all listed banks. This means that the GARCH model is a good representation of the behavior of daily stocks index returns, because it managed to successfully capture the time dependence of the volatility of the index returns. It should also be noted that for BH and BT, the sum of the parameters of the GARCH model is substantially close to the unit. In such cases, the GARCH process is said to be integrated, which implies that volatility shocks are explosive and persist in future horizons.

The reported results show that the value of (α + β) is very close to 1 for most of the quoted bank shares, suggesting thereby a high persistence of volatility clusters over the sample period in the markets. This is an indication of weak form market inefficiency. This implies that the Tunisian banking system is not weak form efficient suggesting that there is a systematic way to exploit trading opportunities and acquire excess profits. The implication of rejecting the weak form efficiency for investors is that they can better predict stock price movements, by holding a well-diversified portfolio while investing in Tunisian banks.

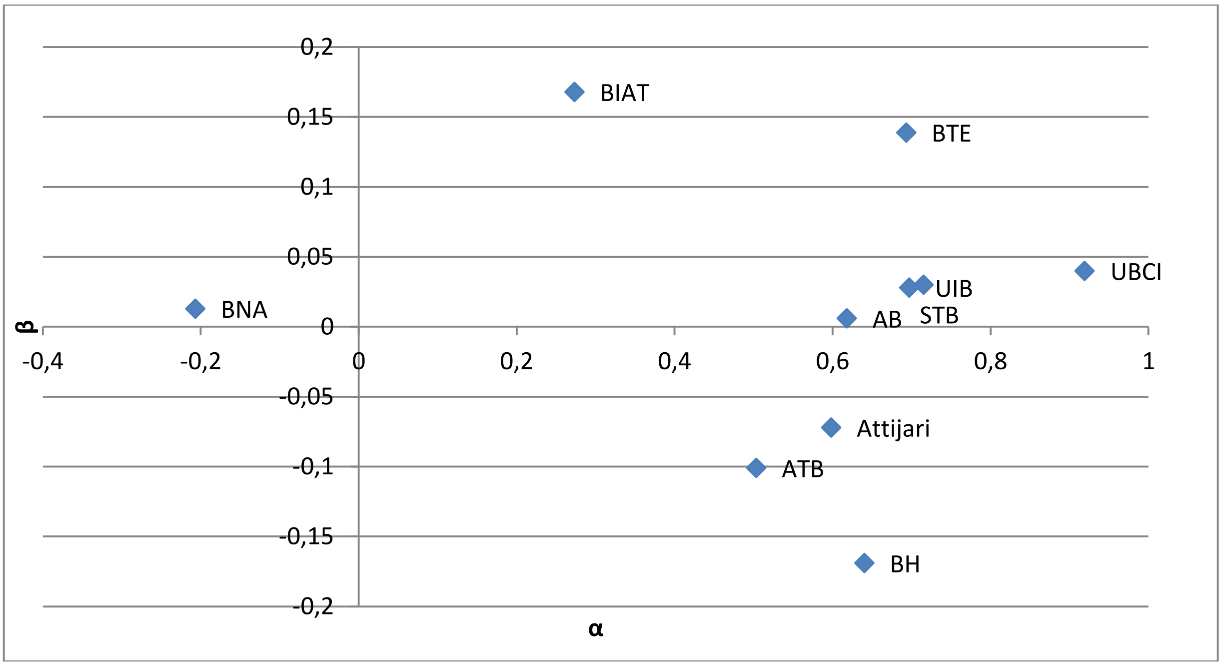


- Attijari Bank, ATB, BIAT, BTE, AB, and UIB: the results show that they are less affected by previous information shocks.
- STB, BH and BT: These banks are characterized by volatility clustering, which indicates volatility persistence (large variations in asset prices do not suddenly stop after the release of an important new information, but tend to persist).
- BNA: This bank does not check the positivity condition of the ω_2 coefficient.

In addition, to account for the observed asymmetry in the series of our study and to make our results more reliable, we estimate the EGARCH (1, 1) model.

Table6: EGARCH (1, 1) Estimates of Daily Stock Return Data

Banks	Β	α	Γ
AB	0.618766 (0.0000)	0.006279 (0.9335)	0.177037 (0.2143)
ATB	0.503654 (0.0000)	-0.101525 (0.0031)	0.907159 (0.0000)
ATTIJARI	0.598715 (0.0000)	-0.072250 (0.2081)	0.796954 (0.0000)
BH	0.640743 (0.0000)	-0.169048 (0.0043)	0.827656 (0.0000)
BIAT	0.273124 (0.0000)	0.168032 (0.0000)	0.964210 (0.0000)
BNA	-0.207229 (0.0000)	0.013329 (0.6800)	-0.975258 (0.0000)
BT	1.724127 (0.0000)	0.937115 (0.0000)	-0.042910 (0.0437)
BTE	0.693620 (0.0000)	0.136224 (0.0262)	-0.515531 (0.0000)
STB	0.715799 (0.0000)	0.030077 (0.6833)	0.495181 (0.0000)
UBCI	0.919574 (0.0000)	0.046860 (0.6502)	0.689123 (0.0000)
UIB	0.697469 (0.0000)	0.028961 (0.5493)	0.876056 (0.0000)



For the EGARCH model, we followed the same approach. However, we were unable to identify distinct groups. We were able to obtain the following results. The three banks BNA, BT and BTE the leverage coefficients γ are negative and significant, which means that there is leverage and implies that each price change responds to asymmetrical positive and negative information. This means that bad news (lower returns) have greater conditional variance on good news (higher returns) of the same order of impact magnitude. However, for the remaining banks, the leverage coefficients of banks are positive and significant. This positivity indicates that positive shocks have a higher volatility than negative shocks of the same impact magnitude. This shows that the concept of leverage (i.e. negative shocks increase volatility more than positive shocks of the same magnitude) does not apply to these banks.

V. CONCLUSION

The empirical results indicated that capital markets of the selected banks are not weak form efficient giving a way for profitable trading. In this paper, we focused also on the Exponential GARCH model to see whether there is a leverage effect on the stock market. The results showed that asymmetric effect hypothesis is accepted for only three banks BNA, BT, BTE, indicating that negative shocks have a greater impact on conditional volatility than positive shocks of equal magnitude. This means that volatility is higher after negative shocks (bad news) rather than after positive shocks (good news) of the same magnitude. Therefore, volatility seems to be affected asymmetrically by positive and negative returns. This fact is called the leverage effect.

In many studies, authors showed that low liquidity, as a result of the thin trading of assets, may imply a wrong rejection of the weak form informational efficiency because of artificial autocorrelations. Such weak form market inefficiency has a deteriorating effect on gross savings and investment status of any country, disturbing thus the resource mobilization process for the larger interest of a nation. However, such informational inefficiency of capital markets has an interesting implication. The opportunity of making excess profits in an inefficient market often provides the impetus for successful financial innovation by financial firms, making the market move towards efficiency in the long run. Therefore, policy makers and other regulators should make the necessary arrangements to improve timely corporate disclosures so that security prices appropriately and quickly reflect all available information. The efficient dissemination of information ensures that capital is optimally allocated to projects that yield the highest expected return with the necessary adjustment for risk and uncertainty. The major challenges to EMH are mainly in the following forms: empirical tests for EMH show no evidence in favor of EMH, the limitations of the statistical and mathematical models for EMH, evidence of excess volatility in mean reversion predictability, the existence of bubbles, and non- linear complex dynamics and chaos in the stock market. To test the hypothesis of informational efficiency of a market, one should take into account some peculiarities of these markets, like nonlinearity of asset prices, thin trading, and financial liberalization impact on the performance of emerging markets.

The empirical results obtained in our study would be useful to investors because they provide evidence of the nature of the volatility of the Tunisian banking sector, including the stock market. Investors aim at making the investments they make more profitable and especially less risky. Therefore, they need to study and analyze several factors, the most important of which is stock market volatility before making investment decisions. The implications for investors are also important for the stock exchange administrators and policy makers. The regulatory regime around the Budget should be stricter to keep excessive volatility under check.

VI. APPENDIX A

The literature review is summarized in the following table:

Study	Market under study	Period of study	Methodology used	Results found
Asma Mobarek and Keavin Keasey (2000)	Bangladesh	1988-1997	Auto-correlation test, Auto-regression, ARIMA model	Indicates that the daily share return of market is not Random and Market is not weak form efficient.
Claire G. Gilmore and Ginette M. McManus (2001)	Czech Republic, Hungary, and Poland	1995-2000	Autocorrelation, Variance Ratio test, Co-integration and Granger Causality test.	Evidence behavior of random walk in all markets and indicate dependency with Czech and Hungarian markets to the Polish exchange.
Natalia Abrosimova, Gishan Dissanaike and Dirk Linowski (2002)	Russia	1995-2001	ARIMA and GARCH model, Unit root, Autocorrelation and Variance ratio tests.	Found that random walk could not be rejected for the monthly data, yet it could be rejected for daily data
Coorey A. (2003)	US, Japan, Germany, UK, Hong Kong, Australia	1991- 2003	Unit Root test, spectral analysis, ADF, PP	The results show that the stocks prices of these countries follow a random walk.
Worthington A and Higgs H (2003)	Australia, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal,		Serial correlation coefficient, run tests, ADF, PP, KPSS, unit root tests, multiple variance ratio tests.	The results indicate that of the emerging markets only Hungary is characterized by a random walk and hence is weak form efficiency, while in the developed countries only Germany, Ireland, Portugal, Sweden and U.K

	Spain, Sweden, Switzerland, U.K, Czech Republic, Hungary, Poland, Russia			comply with the most stringent random walk criteria.
Helen K. Simon (2005)	USA	1995-2004	MLR Model, ANN Model.	The findings supposition that market is Weak form Efficient.
Mohammed Omran and Suzanne V. Farrar (2006)	Egypt, Jordan, Morocco, Turkey and Israel	1996-2000	Variance Ratio, Auto-correlation	The limited support for weak form efficiency in Middle Eastern emerging markets implies a degree of predictability of returns.
Hin Yu Chung (2006)	Chine	1992-2006	Serial autocorrelation test, non parametric runs test, variance ratio test, ADF unit root test	The empirical results d this study support previous studies that Chinese stock markets are weak form inefficient.
Lazar Dorina, Ureche Simina (2007)	Romania, Hungary, Czech Republic, Lithuania, Poland, Slovakai, Turkey	1995-2007	Ljung-Box test, Serial correlation LM test, ARMA models	Most of these emerging equity markets are not weak-form efficient.
Rakesh Gupta and Parikshit K. Basu (2007)	India	1991-2006	Phillips-Perron tests, augmented Dickey-Fuller (ADF) and KPSS.	The results of these tests found that this market is not weak form efficient.
Rengasamy Elango, Mohammed Ibrahim Hussein (2007)	Dubai, Saudi Arabia, Abu Dhabi, Qatar, Kuwait, Oman, Bahrain.	2001-2006	Run test, KS test. Auto-Correlation	Analysis of the daily stock index returns of markets indicates that there are larger variations in returns during the study period and the markets are not efficient in the weak-form.
Batool Asiri (2008)	India	1990-2000	ARIMA, Autocorrelation, Unit Root test.	The results suggest that current prices in the BSE reflect the true picture of the companies and which is follow random walk.
Asma Mobarek, A.Sabur Mohllaha and Rafiqual Bhuyan (2008)	Bangladesh	1988-2000	Runs test, K-S test, Auto-correlation,	Study provides evidence that security of DSE does not follow random walk and remains inefficient.
P K Mishra and B B Pradhan (2009)	India	2001-2009	Unit Root Test, Phillips-Perron tests augmented Dickey-Fuller(ADF)	The study provides the evidence of weak form inefficiency of Indian capital market.
Bizhan A. (2009)	Kuala Lumpur	2006-2008	Autocorrelation function test (ACF), Runs tests, variance ratio test and unit root test (ADF)	The analysis variance ratio test shows that Kuala Lumpur Stock Exchange (KLSE) not supported EMH.
Francesco Guidi, Rakesh Gupta and Suneel Maheshwari, (2010)	Poland, Hungary, the Czech Republic, Slovakia, Romania, Bulgaria, and Slovenia	1999-2009	Autocorrelation, Runs Test, Variance Ratio, GARCH-M.	Overall results indicate that some of these markets are not weak form efficient.
P K Mishra (2010)	India	1991-2009	Unit Root test, GARCH Model.	It represents inefficiency of Indian capital market.
Kashif Hamid, Muhammad T.S., Syad Z.A., Rana S., (2010)	Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesia, Malaysia	2004-2009	Auto-correlation, Runs Test, Unit Root Test and Variance Ratio.	Study indicates that no market is weak form efficient among all markets.
Sirinivasan P. (2010)	India	1997-2010	Unit root tests, ADF, PP	The empirical results do not support the validity of weak form efficiency for stock market returns of Indian stock exchange
Omay, Nazli C. and Karadagli, Ece C. (2010)	Bulgarian, Greek, Hungarian, Polish, Romanian, Russian, Solvenian, Turkish	2002-2010	The nonlinear unit root test, the nonlinear Panel unit root	The linear panel unit root test suggest that this group as all efficient where as nonlinear panel unit root test suggest as a group they are not efficient.

VII. REFERENCES

1. Asma Mobarek & Keavin Keasey, 2000, "Weak-form market efficiency of an emerging Market Evidence from Dhaka Stock Market of Bangladesh", ENBS Conference held on Oslo.
2. Asma Mobarek and Keavin Keasey, 2000, "Weak-form market efficiency of an emerging Market: Evidence from Dhaka Stock Market of Bangladesh", ENBS Conference held on Oslo.
3. Bachelier, L. 1900, "Théorie de la spéculation", Annales Scientifiques de l'Ecole Normale Supérieure. 3(17), pp. 21-86.
4. Batool Asiri, 2008, "Testing weak-form efficiency in the Bahrain stock market, International Journal of Emerging Markets", 3(1), pp. 38-53.
5. Bera, A.K. and Higgins, M. L. 1993, "ARCH Models: Properties, Estimation and Testing", Journal of Economic Surveys, 4, pp. 305-362.
6. Bizhan, Abedini, 2009, "An Evaluation of Efficiency of Kuala Lumpur Stock Exchange". Interdisciplinary Journal of Contemporary Research in Business. Vol. 1, No. 4.
7. Black, F. 1976, "The Dividend Puzzle". Journal of Portfolio Management, 2, pp 5-84.
8. Bollerslev, T. 1986, "Generalized Autoregressive Conditional Heteroskedasticity". Journal of Econometrics 31, pp. 307-322.
9. Borges, M.R, 2008, "Efficient market hypothesis in European stock market".
10. Brooks, C. And Burke, S.P. 2003, "Information Criteria for GARCH model selection", The European Journal of Finance, 9, 557-580.
11. Campbell, J. Y., Lo, A. W. and Mackinlay, A. C. 1996, "The Econometrics of Financial Markets", Princeton University Press, Princeton, NJ.
12. Christie A, 1982, "The stochastic behavior of common stock variances-value, leverage effects", Journal of Financial Economics, 10, pp 407-432.
13. Claire G. Gilmore and Ginette M. McManus, 2001, "Random-Walk and Efficiency Tests of Central European Equity Markets", European Financial Management Association Conference.
14. Cooray, A. 2004, "The random walk behavior of stock prices: a comparative study", Economic society, Far Eastern Meeting, 540 SAU School Economics Discussion paper 2003-05.
15. Cowles, 3rd, A. and Jones, H. E. 1937, "Some a posteriori probabilities in stock market action", Econometrica 5(3), pp. 280-294.
16. De Bondt, W. F. M. and Thaler, R. 1985, "Does the stock market overreact?", The Journal of Finance 40(3), pp. 793-805.
17. Diebold, F. X. And Lopez, J. A. 1995, Modelling Volatility dynamics, Macroeconometrics: Developments, Tensions and Prospects ed K. D. Hoover (Boston, MA: Kluwer).
18. Dickey, D. and W. Fuller 1979, "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," Journal of the American Statistical Association, 74, pp. 427-431.
19. Dimson, E. and Mussavian, M. 1998, "A brief history of market efficiency", European Financial Management 4(1), pp. 91-193.
20. Engle, R. 1982, "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of UK Inflation". Econometrica 50, pp. 987-1008.
21. Fama, E. F. 1965b, "The behavior of stock-market prices", Journal of Business 38(1), 34–105.
22. Fama, E. F. 1970, "Efficient capital markets: A review of theory and empirical work", The Journal of Finance 25(2), pp. 383-417.
23. Fama, E. F. 1991, "Efficient capital markets: II", The Journal of Finance 46(5), pp. 1575-1617.
24.
25. Fama, E. F. 1998, "Market efficiency, long-term returns, and behavioral finance", Journal of Financial Economics 49(3), pp. 283-306.
26. Fama, E. F. and French, K. R. 1988, "Permanent and temporary components of stock prices", Journal of Political Economy 96(2), pp. 246-273.
27. Fama, E., 1970, "Efficient Capital Markets: a Review of Theory and Empirical Work", Journal of Finance, 25 may.
28. Francesco Guidi, Rakesh Gupta and Suneel Maheshwari, 2010, "Weak-form market efficiency and calendar anomalies for Eastern Europe equity markets", MPRA Paper, No. 21984.
29. Granger, C. W. J. and Morgenstern, O. 1963, "Spectral analysis of New York stock market prices", Kyklos 16(1), 1–27. Reprinted in The Random Character of Stock Market Prices, edited by P. H. Cootner, The MIT Press, 1964.
30. Grossman, S. 1976, "On the efficiency of competitive stock markets where traders have diverse information", The Journal of Finance 31(2), pp. 573-585.
31. Grossman, S. J. and Stiglitz, J. E. 1980, "On the impossibility of informationally efficient markets", The American Economic Review 70(3), pp. 393-408.
32. Grossman, S., Stiglitz, J. 1980, "On the Impossibility of Informationally Efficient Markets", The American Economic Review, Vol. 70, issue3.
33. Hamid, A. & Hamid, A. 2005, "The Announcement Effect on the Increase of Paid Up Capital on Stock Performance of Insurance Companies in Malaysia", Journal of American Academy of Business, 6, pp 208-214.
34. Helen K. Simon, 2005, "An examination weak form of efficient market hypothesis within the context of NASDAQ composite index".
35. Hin, Yu Chung, 2006, "Testing Weak-Form Efficiency of the Chinese Stock Market". Lappeenranta University of Technology. Department of Business Administration.
36. Kabir M. Hassan, Waleed S. Al-Sultan, and Jamal A. Al- Saleem, 2003, "Stock Market Efficiency in the Gulf Cooperation Council Countries (GCC): The Case of Kuwait Stock Exchange". Scientific Journal of Administrative Development. Vol. 1, No. 1, I.A.D.
37. Kashif Hamid et al., 2010, "Testing the Weak form of Efficient Market Hypothesis: Empirical Evidence from Asia-Pacific Markets", International Research Journal of Finance and Economics, 58, pp. 121-133.
38. Laffont, J.-J. & Maskin, E. S. 1990, "The efficient market hypothesis and insider trading on the stock market", Journal of Political Economy 98(1), pp. 70-93.
39. Lazar Dorina, Ureche Simina, 2007, "Testing Efficiency of the Stock Market in Emerging Economies", Annals of the University of Oradea - Economic Sciences, XVI.
40. Lehmann, B. N. 1990, "Fads, martingales, and market efficiency", The Quarterly Journal of Economics 105(1), pp. 1-28.
41. Lo, A. W. 1991, "Long-term memory in stock market prices", Econometrica 59(5), pp. 1279-1313.
42. Lo, A. W. and MacKinlay, A. C. 1988, "Stock market prices do not follow random walks: Evidence from a simple specification test", The Review of Financial Studies 1(1), pp. 41-66.
43. Mecagri M & Sourial M, 1999, "The Egyptian stock market: Efficiency tests and volatility effects", IMF working paper N°99/48.

44. Mohammed Omran and Suzanne V. Farrar, 2006, "Tests of weak form efficiency in the Middle East emerging markets, Studies in Economics and Finance", 23(1), pp. 13-26.
45. Natalia Abrosimova, Gishan Dissanaike and Dirk Linowski, 2002, "Testing the Weak-Form Efficiency of the Russian Stock Market", Centre for Economic and Financial Research.
46. Nelson, D. B. 1991, "Conditional heteroskedasticity in asset returns: A new approach", Econometrica 59, pp. 347-370.
47. Omay, Nazli C. and Karadagli, Ece C, 2010, "Testing Weak Form Market Efficiency for Emerging Economies: A Nonlinear Approach", http://mpra.ub.uni-muenchen.de/27312.
48. P. Srinivasan, 2010, "Testing Weak-Form Efficiency of Indian Stock Markets". APJRBM. Volume 1, Issue 2, November ISSN 2229-4104.
49. P.K. Mishra 2010, "Indian Capital Market – Revisiting Market Efficiency", http://ssrn.com/abstract=1339901.
50. Phillips, P.C.B. and P. Perron 1988, "Testing for Unit Roots in Time Series Regression," Biometrika, 75, pp. 335-346.
51. Rakesh Gupta and Parikshit K. Basu, 2007, "Weak Form Efficiency in Indian Stock Markets", International Business & Economics Research Journal, 6(3), pp. 57-64.
52. Rengasamy Elango, Mohammed Ibrahim Hussein, 2008, "An Empirical Analysis on The Weak-Form Efficiency of The GCC Markets Applying Selected Statistical Tests", International Review of Business Research Papers, 4(1), available at SSRN: http://ssrn.com/abstract=1026569.
53. Roberts, H. 1967, "Statistical versus clinical prediction of the stock market", Unpublished manuscript.
54. Ryoo H. J & Smith G, 2002, "Korean stock prices limits: variance ratio tests of random walks", Applied Financial Economics, Vol. 12, issue 8, pp. 545-553.
55. Samuelson, P. A. 1965, "Proof that properly anticipated prices fluctuate randomly", Industrial Management Review 6(2), pp. 41–49.
56. Summers, L. H. 1986, "Does the stock market rationally reflect fundamental values?", The Journal of Finance 41(3), pp. 591–601.
57. Tan, H. and Hooy, C. 2004, "Bank Merger and Bank Stock Volatility: A Post-Announcement Analysis", Managerial Finance, 30, pp. 29-48.
58. Worthington, A.C & Higgs H, 2003, "Weak-form market efficiency in European emerging and developed stock markets", School of Emerging and Finance Discussion paper, 159.
59. Worthington, A.C & Higgs H, 2006, "Weak-form market efficiency in Asian emerging and equity markets: comparative tests of random walk behavior", Accounting Research Journal, Vol. 19, issue 1, pp. 54-63.