Julijana Angelovska. 2018. Testing Weak Form of Stock Market Efficiency at the Macedonian Stock Exchange. *UTMS Journal of Economics* 9 (2): 133–144.

Review
(accepted September 3, 2018)

TESTING WEAK FORM OF STOCK MARKET EFFICIENCY AT THE MACEDONIAN STOCK EXCHANGE

Julijana Angelovska[1]

Abstract
The efficient market research to date has focused mostly on the developed stock markets. To be efficient the market needs to be large and liquid, transaction costs should be cheaper than the expected investment strategy profits and Macedonian capital market as a developing market is characterized by low liquidity, shallow trading, large price fluctuations, uninformed investors with access to unreliable information and significant instability. According to these characteristics the aim of this study is to investigate emerging, Macedonian Stock Exchange (MBI10) and test the weak form of efficiency. Tests are performed for daily returns on sample spanning from January 4th 2005 to April 2nd 2018. The application of Random Walk Model and GARCH (1,1) model provides evidence that Macedonian Stock Market is not weak form efficient. The evidence of stock market inefficiency has implications. Negative implication of such inefficiency can be found in disturbing the allocation of national resources for development projects. Of course, there is positive implication as well that provides incentives for new financial products. Creation of new innovative financial products can produce material that will move the stock market towards efficiency in the long run.

Keywords: random walk model, GARCH (1,1), stock returns, investor rationality, capital market.

Jel Classification: G15; C32; G14

INTRODUCTION

Many researchers has been investigated the issue of stock market efficiency by globally. The very first interest in the stock market efficiency that produced ideas and findings date back to the 19th century. Development of these ideas gained popularity gradually until they reached a peak in the eighties. There were multiple reasons have been drivers to wide research of stock market efficiency. The driver to research of stock market efficiency first of all can be found in an expectation that, a risk-weighted return is higher in inefficient markets. When it comes to return expectation then, research in the field of stock market efficiency is of great importance to private and institutional investors as

[1] **Juliana Angelovska**, PhD, Associate Professor, University of Tourism and Management in Skopje, Macedonia.

well. Also, corporate executives need comprehensive understanding of market efficiency that is crucial for the decisions and actions that will determine perceived value of companies. Market efficiency is important for stock market operators and supervisors also, because they may use it to model the further development of the stock market. The last, but not least in importance is that market efficiency is used as a base assumption in financial modeling. The behavioral finance theory after 80's has been shifted academic and professional focus, but it does not eliminate the usefulness of the stock market efficiency. Financial models and assumptions are in close relation with the efficient market hypothesis. To be the stock market efficient it essentially assumes that market participants or investors are absolute or partial rational. Market participants are not rational, they are human being and leaded by different motives they act against rationality. It means that trades and made transactions are being done not based on a rational analysis, meaning that the trades of irrational investors are random and should not impact the stock prices. Shleifer (2000) gives an example that if a share price is positively affected by a random purchase, then it will consequently be negatively affected by a random trading. That is because the probability of random sale and random purchase is equal (Shleifer 2000). At the beginning of the 20th century, a number of significant works attempted to demonstrate the randomness of stock prices.

Academics and investors are interested in stock market efficiency because it has important implications for investor 'returns. But efficient market can impact regulatory authorities as well as in efficient capital markets, the role of regulatory authorities is limited because securities are priced accurately. In efficient capital market there will be no undervalued or overvalued stocks offering higher than expected return or lower than the expected return. In efficient capital market reward to risk will be optimal because all the assets are correctly valued. Gupta and Basu (2007) concluded that in an efficient stock market an optimal investment strategy focus will be to on risk and return characteristics strategy of the asset and/or portfolio.

Many studies have been concerned with market efficiency, yet most of the markets under examination have been developed markets. Developing markets are not with the same characteristics as developed markets. They are characterized by low liquidity, shallow trading, large price fluctuations, uninformed investors with access to unreliable information and significant instability. The question of market efficiency in emerging markets has been less under investigation compared with the developed markets. This research addressed market efficiency in its weak form for the Macedonian Stock market. Macedonian Stock market is with short history and the issue of efficiency lacks a comprehensive research. The efficient market hypothesis in its weak form in the context of the Macedonian stock market is tested.

The remainder of the paper is organized as follow. After reviewing some of the literature on market efficiency in section 1, section 2 presents the methodology used. Section 3 gives description of data and analyses with the results regarding efficiency in its weak form at the Macedonian Stock market. The last section offers conclusion.

1. LITERATURE REVIEW

The issue of market efficiency is considered one of the most controversial topics, but central to finance and financial economics. The concept of capital market efficiency has

been in focus of researchers and in the last three decades has been widely investigated. Unfortunately, the focus was to answer the question whether developed markets are efficient or not. The researches on market efficiency in less developed countries are scarce.

The theory and empirical studies of stock market efficiency mostly are based on the assumption that asset prices follow a random walk behavior. If they follow random walk behavior it means that the asset prices cannot be predicted. This is known as the Random Walk Hypothesis (RWH) or alternatively the Efficient Market Hypothesis (EMH). The hypothesis means that if the asset's price moves randomly and if it cannot be rejected, then it the market supports efficiency theory.

Empirically, random walk hypothesis was applied as early as 1933 when Cowles (1933) published his paper where he analysed 45 agencies dealing with professional forecasting of stock prices. He was following the prediction failures of 1929 crash of US stock market of these agencies that attempted to predict stock prices. He found that the performance on average was not any better than the performance of pure chance, concluding that capital market predictors were unable to predict the future movements. In 1965, Fama also speak that stock prices are unpredictable and follow a random walk in his doctoral dissertation, "The Behavior of Stock Market Prices". In his dissertation Fama established the basic principles of the efficient market hypothesis and delivered the definition for efficient market: "An 'efficient' market is defined as a market where there are large numbers of rational, profit-maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value." The interests of empirical researchers since then have been shifted greatly to this literature and an ample empirical research has been dedicated to examining the behavior of asset prices. The term "Efficient Market Hypothesis" was coined by Roberts (1967) and he introduced the classical taxonomy of information sets. There are three forms of the market efficiency: "weak-form where the information set includes only historical data, semi-strong form in which the information set includes publicly available information, and strong-form where information set includes all information that can be known to any market participant including private information" (Campbell, Lo, and MacKinlay 1997).

The researchers that were among first to test weak form of market efficiency started on the developed market and commonly found couldn't reject the null hypothesis. They supported weak-form of market efficiency considering a low degree of serial correlation and transaction cost (Working 1934; Osborne1962; Fama 1965). The researches mostly supported the proposition that price variations are random and past changes were not useful in predicting future price changes principally after transaction costs were taken into account. But there were some researches that found the forecastibility of stock price changes (for example, Fama and French 1988; Poterba and Summers 1988) in developed markets. What is important they did not got to a conclusion that there were profitable trading rules. In their study Poterba and Summers (1988) propose that noise trading,

delivers a plausible explanation for the transitory component in stock prices. They defined noise trading as trading by investors whose demand for shares is determined by factors other than their expected returns. So they proposed constructing and testing theories of noise trading as well as theories of changing risk factors could account for the characteristics of stock returns auto-correlogram they detected. In their article Fama and French (1988) found that auto-correlation's may reflect market inefficiency. In other words time-varying equilibrium expected returns generated by rational investors and another view suggests that the patterns of auto-correlation should be stable for a long sample period. Another researchers found that the technical trading rules have forecasting power but not sufficient to enable excess return in U.K market (Hudson, Dempsey and Keasey, 1994). Likewise, Groenewold (1997) also conclude that past returns have forecasting power in Australian market but the level of predictableness of return is not so high. Generally, the practical studies on developed market shows no profitability from using histories or past price series supports the weak-form efficiency of the efficient market hypothesis overall.

In the last decades of the 20th century, many studies on the EMH concluded inefficiency. Namely the markets could not be efficient since the cost of information existed. (Grossman and Stiglitz 1980). Therefore return on investment should be higher than the cost of information, because the inclination to invest would vanish. Efficient market hypothesis was opposed later with the concept of excess volatility (Shiller 2003). He found that the actual volatility of stock prices had been higher than that designed on the basis of fundamental information. Shiller's hypothesis of excess volatility was reconfirmed by De Bondt and Thaler (1985). According to them, people tendency to overreact to company announcements, result of which is reflected in stock prices. Also they were first who noticed that in January stock returns were generally higher than in other months. These findings could not be explained only by fundamental information (De Bondt and Thaler 1985). The term "noise traders" was firstly introduced by Black (1986). Different from some authors referenced above, he claimed that "noise traders" could make a substantial effect on market prices. Efficient market hypothesis was rejected by Lehmann (1990) and Jegadeesh (1990). It was not obvious whether returns seemed predictable due to market inefficiency or whether this was driven by misleading assumptions in asset pricing models (Fama 1991). Although the disagreement to the efficient market hypothesis became robust, a number of researches proved the validity of the efficient market hypothesis. An overreaction in stock prices was as common as underestimation which therefore did not lead to inefficiency (Fama 1998). Criticism reduced the popularity of the efficient market hypothesis, but the idea of market efficiency remained relevant in modern finance.

The investigation outcomes of weak-form market efficiency of developing and less developed markets on the other hand, are controversial. Less developed market are characterized with the problem of thin trading. These are also small markets and in smaller markets, it is at ease for large traders to influence the market. Though it is commonly believed that the less developed markets are less efficient, the empirical evidence does not always support the supposed. There are two sets of findings; the first one are authors who found weak-form efficiency in developing and less developed markets: Branes, (1986) in the Kuala Lumpur Stock Exchange; Chan, Gup, and Pan, (1992), in major Asian markets; Dickinson and Muragu, (1994), Parkinson (1987), in the Nairobi Stock Exchange and Ojah and Karemera, (1999), on the four Latin American countries market, despite the problems of thin trading. The second set consists of authors who found that the market of developing

and less developed markets are not efficient in weak-sense: Cheung, Wong, and Ho, (1993), on the stock market of Korea and Taiwan; in a world bank study by Claessens, Dasgupta, and Glen (1995), report significant serial correlation in equity returns from 19 emerging markets and suggest that stock prices in emerging markets violates weak form efficient market hypothesis. The behavior of stock prices in the Saudi stock market was examined seeking for evidence of weak-form efficiency and it was found that the market is not weak-form efficient (Khababa 1998). He clarified that the inefficiency can be due to delay in operations and high transaction cost, thinness of trading and illiquidity in the market. Evidence of non-randomness stock price behavior and the market inefficiency (not weak-form efficient) on the Johannesburg Stock Exchange and on the Indian market was detected (Poshakwale 1996). Urrutia (1995) found mixed results of weak form of market efficiency for Argentina, Brazil, Chile, and Mexico using different methods.

Beside the controversial findings and criticism the efficient market hypothesis remains a significant subject of discussion in the modern financial theory. Efficient market hypothesis is called the "half-true" by Shiller (2013). The efficient market hypothesis effortlessly defines trading conditions in the modern stock market, because the information flow and trade execution are faster than ever. On the other hand, there are certain patterns in stock prices, which the efficient market hypothesis fails to explain.

Historical argument for the weak-form efficiency is return independence which is often measured by correlation. Brealey, Myers, and Allen (2011) investigated a set of blue-chip stock companies where the correlation coefficient of return on two consecutive days ranged from -0.03 to 0.03. Consequently, the conclusion is made that stock return today will not influence the stock return tomorrow. On the other hand, Brealey, Myers and Allen, (2006) found that the results remained nonetheless unchanged when analysing weekly returns. Serial correlation tests had repeatedly validated the efficient market hypothesis when analysing returns of individual companies as well as equity indices (Parks and Zivot 2006). Stock market predictability could be tested by applying the trading rules of technical analysis, but these rules often fail to yield a constant excess return (Schleifer 2000). Parks and Zivot (2006) discussed that technical analysis would only be profitable if transaction costs did not exist. Among academics technical analysis is not popular but is still widely applied by professionals (Mishkin and Eakins 2012).

When it comes to comparison of the active and passive portfolio management there is another point in favour of the efficient market hypothesis. If actively managed portfolios fail to outperform pasive portfolios, then it is not profitable to collect market information, and the market is efficient. Brealey, Myers, and Allen (2011) outlined the following returns of the U.S. mutual funds: mutual funds earned higher returns than their benchmarks in 16 of the 47 years studied. Malkeil (2003) estimated that around 70% of the mutual funds from 1991 to 2001 earned lower returns than their benchmarks. After having increased the data sample, Malkiel (2011) found that 66% of the U.S. mutual funds from 1970 to 2010 had lower returns than their benchmarks.

Multiple modern finance phenomena appear to be incompatible with the efficient market hypothesis like investing in small-cap companies' that yields generally higher returns than investing in large-cap companies. Fama and French (1988) studied this phenomenon as well. They concluded that small firm effect did not discredit the efficient market hypothesis but was a result of a misleading assumption in the CAPM. Fama and French (1988) also discussed that the risk taken investing in small cup company is less dependent on the correlation of company and market return. Contrariwise, many researches

presented this phenomenon as a shortcoming of the efficient market hypothesis. The so-called value effect, i. e. value stocks tend to outperform growth stocks and a higher return was not necessarily due to higher risk taken (Brealey, Myers, and Allen 2011). 75% of the U.S. corporate profits could be explained by changes in the P/BV ratio (Vuolteenaho 2002). Shleifer (2000) showed that the P/E and P/BV ratios could be used to forecast the future share price, which is a contradiction to the market efficiency. Campbell and Shiller (1998) estimated that the P/E ratio could explain around 40% of the future stock market volatility. The value effect was also found by Fama and French (1996), but they interpreted it as a result of additional risk.

The review of literature about stock market efficiency that the developed markets are generally weak-form efficient. Of course, the scarce literature that investigate the emerging markets requires clarification. Comparison and a needed additional information about the world's emerging capital markets is needed. An interesting empirical question whether and to what extent, the results will prove that it is also the case with less developed stock markets. The review of previous empirical evidences addressed the research question in this study: Is the Macedonian Stock market as a less developed emerging market, weak form efficient or not?

2. DATA AND METHODOLOGY

The aim of this study is to investigate the efficient market hypothesis in its weak form in the context of the emerging Macedonian stock market. The considered sample period spans from 4th January 2005 (since MBI10 was introduced) to 2nd April 2018. MBI10 is a price index weighted with the market capitalization. The data were obtained from Macedonian Stock Exchange database. It gives a total of 3235 observations and include both bull and bear phases, high and low volatility and different market conditions. Thin or infrequent trading can introduce serious bias in empirical work. In order to avoid the possible bias a longer time-period is used, which reduces the problem of non-trading bias (Lo and MacKinlay 1988) and increase the power of random walk test. MBI10 daily closing stock price indices over the sample period are plotted and shown in Fig. 1.

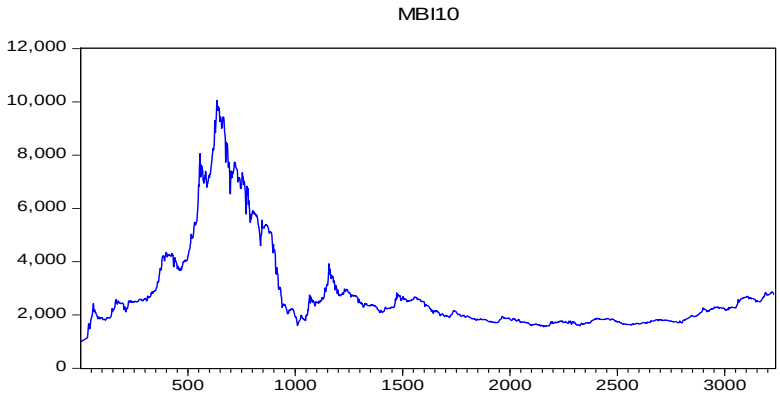

Figure 1. Stock market index movement in the period January 4th 2005 to April 2nd 2018
Source: Macedonian Stock Exchange.

The study uses the daily closing stock price indices to calculate daily stock returns as the change in the logarithm of the closing price on successive days by the formula:

$$Rt = \ln (Pt / Pt\text{-}1)*100 \quad (1)$$

Rt is the daily stock return at time „t"
Pt and Pt-1 are the closing value of the MBI10 at time „t" and „t-1" respectively.

The daily stock return data return data have been plotted to observe volatility of the Macedonian Stock Market official index (see Fig.2).

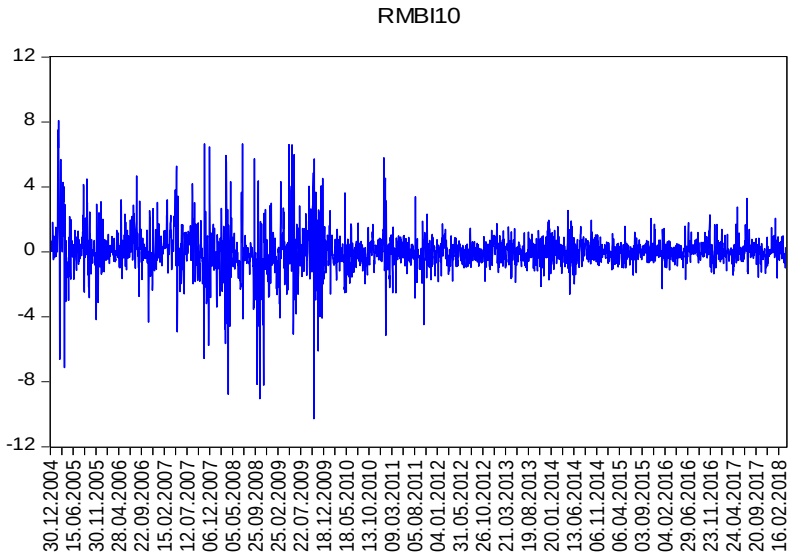

Figure 2. Time Series Plot of Daily Stock Return Data
Source: Macedonian Stock Exchange

Table 1 reports basic descriptive statistics for the time series of stock market returns in the period January 4th 2005 to April 2nd 2018 and can give the characteristics of the stock market behavior. All stock return series show leptokurtosis and there is evidence of negative (long left tail) skewness. Skewness is a particular feature of returns in emerging markets. Significant kurtosis (much higher than 3) and skewness indicate rejection of normality in stock return distribution.

Table 1. Descriptive statistics of the MBI10 in the period January 4th 2005 to April

	#Obs.	Mean	St.dev.	Skewness	Kurtosis
MBI10	3235	0.032	1.267	-0.130	13.30

Source: Macedonian Stock Exchange

To test weak form of market efficiency in this study, basic random Walk (RW) model and a GARCH (1,1) are used and null hypothesis to be tested are:

H01: MBI10 follows random –walk model;
H02: MBI10 is efficient in weak form.

Stock market prices according to The Random Walk Hypothesis evolve to a random walk and thus, prediction of the prices of stock market cannot be done. The theory of Random Walk in stock prices actually consists of two separate hypotheses: First successive price changes are independent; Second, the price changes confirm to some probability distribution. The Augmented Dickey and Fuller (1979) (ADF) unit root test runs a regression of the first difference of the series against the series lagged once, lagged difference terms and optionally, a constant and a time trend. The test consists of estimating the following regression:

$$\Delta y_t = \propto + \beta_t + (\rho - 1) y_{t-1} + \sum_{i=1}^{k-1} \theta_i \, \Delta y_{t-i} + \alpha_t \quad (2)$$

Δ is first difference;
y_t is financial variables such as stock price;
t is trend variable; and α_t is a white noise term.

The null hypothesis is ρ=1 and y_t is said to be unit root if the null failed to reject the null null.

Beside ADF test nonparametric Philip-Peron (PP) test is used.

If the null hypothesis is accepted it means the existence of unit root, which further on implies that the time series under consideration, is non-stationary, indicating that the market shows characteristics of random walk and as such is efficient in its weak form. The rejection of null hypothesis means the non-existence of a unit root which implies the time series Pt is stationary and do not show characteristics of random walk.

The econometric estimate further on, of the GARCH (1,1) model is employed to observe the volatility clustering and thus, the weak form of market inefficiency. According to the GARCH (1,1) model, the presence of persistence in volatility means inefficiency of a stock market. The GARCH (1,1) model as put forward by Bollerslev (1986) can be specified:

Mean Equation:

$$R_t = \mu + \phi R_{t-1} + \varepsilon_t \quad (3)$$

Variance Equation:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (4)$$

$$r_t / \sigma_t \sim \mathrm{N}(0,1)$$

Since σ_t^2 is the one-period ahead forecast variance based on past information, it is called the conditional variance. The above specified conditional variance equation is a function of three terms: a constant term (ω), news aboutvolatility from the previous ε_{t-1} period, measured as the lag of the squared residual from the mean equation, and the last period's forecast variance σ_{t-1}^2. If the sum, α+ β in variance is being very close to 1 then it shows high persistence in volatility clustering and thus, means inefficiency of the capital market.

4. EMPIRICAL RESULTS

In the weak form of stock market efficiency, prices of the assets at very instant fully reflect all available information of past prices. This implies that by using past prices, future price movement can't be predicted. The research on weak form of stock market efficiency is important for individual and institutional investors and has implications in their investment decision. ADF unit root test for Macedonian Stock Market has been performed with the hypothesis:

H0: if a0 = 0 and a1 = 0, then the MBI10 index is a random walk;

H1: if a0 ≠ 0 and/or a1 ≠ 0, then the MBI10 index is not a random walk.

The results are reported in Table 2.

Table 2. Linear unit root test results

Null Hypothesis: RMBI10 has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic - based on SIC, maxlag=28)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-33.92924	0.0000
Phillips-Perron test statistic		-34.70943	0.0000
Test critical values:	1% level	-3.432187	
	5% level	-2.862237	
	10% level	-2.567185	

*MacKinnon (1996) one-sided p-values.

The results showed that, the null hypothesis of unit root (non-stationarity) is rejected. It is clear because the value of test statistic is more negative than the critical value. The results indicate that the stock prices in Macedonian Stock Market do not perform random walk and as a result can be concluded that is not weak-form efficient.

Further on in the research to confirm the results of ADF and PP unit root test and find the reasons for such results, GARCH (1,1) model is employed and the results are reported in Table 3.

Table 3. GARCH (1,1) estimates for MBI10

	μ	Φ	ω	α	β
MBI10	60.01	0.34	0.03	0.21	0.77
Z stat.	(0.46)	(24.16)***	(13.89)***	(20.46)***	(91.9)***

The reported results show that the value of (α+β) is very close to 1, suggesting a high persistence of volatility clusters in the examined sample period at the Macedonian Stock Market. This means that Macedonian capital market is not weak form efficient. The confirmation of weak form inefficiency means that a sizable amount of stock prices exist in the Macedonian capital market to be either undervalued or overvalued. Hardworking investment analysts have a chance to consistently outperform the market averages. Of the stock market is less efficient, then stock prices may not necessarily expose the true

value of stocks. In such a market companies with low true values may be able to mobilize a lot of capital, while companies with high true values may find it difficult to raise capital.

CONCLUSION

The concept of stock market efficiency is important for investors, portfolio managers and regulatory authorities, because in an informationally efficient stock market. In efficient market information is disseminated in such way that ensures that stock market is optimally allocated to projects that will give the highest expected return with necessary adjustment for risk and uncertainty. An economy's savings and investment within the efficient pricing mechanism are efficiently allocated. In that way an efficient stock market affords no opportunities to include in profitable trading activities on a constant basis. If the stock market is not efficient, then on the contrary, regulatory bodies need to undertake required steps to guarantee that stocks are correctly priced achieving stock market efficiency. The goal of this research in view of such important implications of the efficient market hypothesis is to examine the Efficient Market Hypothesis in its weak form in the context of Macedonian Stock Market. The sample of the time series data on MBI10 spans in the period January 4th 2005 to April 2nd 2018. The application of most popular econometric techniques of ADF unit root test and GARCH model estimation provides the evidence that the Macedonian Stock Market is not weak form efficient providing conditions for profitable trading. Detected weak form of market inefficiency can have worsening effect on the investor's' savings and investment status in the country. Such informational inefficiency of stock markets provides an opportunity of making excess profit to speculators. But it often can provide the impetus for successful financial innovation by financial firms giving possibility to the market to move towards efficiency in the long run. In that way policy makers and other regulators should engage to make necessary arrangements in improvement of timely corporate disclosures of sensitive market information, so that security prices appropriately and quickly will reflect all available information.

Acknowledgment: this work is part of the project financed by UTMS: "Integration of the Macedonian capital market with the financial markets in the Balkans: perspectives and opportunities for securities' return maximization", No.18-19/1, 2016.

REFERENCES

Black, Fischer.1986. Noise. *Journal of Finance* 41 (3): 528–543.

Bollerslev, Tim. 1986. Generalized Autoregressive Conditional Heteroscedasticity. *Journal of Econometrics* 31: 307–327.

Branes, Paul. 1986. Thin trading and stock market efficiency: A case of the Kuala Lumpur Stock Exchange. *Journal of Business Finance & Accounting* 13 (4): 609–617.

Brealey, Richard A., Stewart C. Myers, and Franklin Allen. 2006. *Principles of Corporate Finance.* New York: McGraw-Hill/Irwin.

———. 2011. *Principles of Corporate Finance*. New York: McGraw-Hill/Irwin.

Campbell, John Y., and Robert J. Shiller. 1998. Valuation Ratios and the Long-Run Stock Market Outlook. *The Journal of Portfolio Management* 24 (2): 11–26.

Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay. 1997. *The Econometrics of Financial Markets.* New Jersey: Princeton University Press.

Chan, Kam C., Benton E. Gup, and Ming-Shiun Pan. 1992. An Empirical Analysis of Stock Prices in Major Asian Markets and United States. *The Financial Review* 27 (2): 289–307.

Cheung, Yan-Leung, Kie-Ann Wong, and Yan-Ki Ho. 1993. The pricing of risky assets in two emerging Asian markets—Korea and Taiwan. *Applied Financial Economics* 3 (4): 315–324.

Claessens, Stijin, Susmita Dasgupta, and Jack Glen. 1995. Return behaviour in emerging Stock Market. The World Bank Economic Review 9 (1): 131–151.

Cowles 3rd, Alfred. 1933. Can Stock Market Forecasters Forecast? Econometrica 1 (3): 309–324.

De Bondt, Werner F. M., and Richard Thaler. 1985. Does the market overreact? *The Journal of Finance* 40 (3): 793–805.

Dickey, David A., and Wayne A. Fuller. 1979. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association* 74 (36): 427–431.

Dickinson, John P., and Kinandu Muragu. 1994. Market Efficiency in Developing Countries: A case study of the Nairobi Stock Exchange. *Journal of Business Finance & Accounting* 21 (1): 133–150.

Fama, Eugene F., and Kenneth R. French.1988. Dividend yields and expected stock returns. *Journal of Financial Economics* 22 (1): 3–25.

———.1996. Multifactor explanations of asset pricing anomalies. *Journal of Finance* 51 (1): 55–84.

Fama, Eugene F. 1965. The Behaviour of Stock-Market Prices. *Journal of Business* 64: 34–105.

———. 1991. Efficient Capital Markets: II. Journal of Finance 46 (5): 1575–1617.

———. 1998. Market Efficiency, Long-Term Returns and Behavioural Finance. *Journal of Financial Economics* 49: 283–306.

Groenewold, Nicolaas. 1997. Share market efficiency: Tests using daily data for Australia and New Zealand. *Applied Financial Economics* 7 (6): 645–657.

Grossman, Sanford J., and Joseph E. Stiglitz. 1980. On the Impossibility of Informationally Efficient Markets. *American Economic Review* 70 (3): 393–408.

Gupta, Rakesh, and Parikshit K. Basu. 2007. Weak form efficiency in Indian stock markets. *International Business & Economics Research Journal* 6 (3): 57–64.

Hudson, Robert, Michael Dempsey, and Kevin Keasey. 1994. A note on the weak-form efficiency of capital markets: The application of simple technical trading rules to UK Stock prices-1935 to1994. *Journal of Banking & Finance* 20 (6): 1121–1132.

Jegadeesh, Narasimhan. 1990. Evidence of predictable behavior of security returns. *Journal of Finance* 45 (3): 881–898.

Khababa, Nourredine. 1998. Behavior of stock prices in the Saudi Arabian Financial Market: Empirical research findings. *Journal of Financial Management & Analysis* 11 (1): 48–55.

Lehmann, Bruce N. 1990. Fads, martingales and market efficiency. *The Quarterly Journal of Economics* 105 (1): 1–28.

Lo, Andrew W., and A. Craig MacKinlay. 1988. Stock Market Prices do not Follow Random Walks: Evidence from a Simple Specification Test. *Review of Financial Studies* 1 (1): 41–66.

Malkiel, Burton G. 2003. The efficient-market hypothesis and its critics. Journal of Economic Perspectives 17 (1): 59–82.

———. 2012. The efficient-market hypothesis and the financial crisis. In *Rethinking Finance: Perspectives on the Crisis*, ed. Alan S. Blinder, Andrew W. Lo, and Robert M. Salow, 75–98. New York: Russel Sage Foundation.

Mishkin, Frederic S., and Stanley G. Eakins. 2012. *Financial Markets and Institutions*. 7th ed. New Jersey: Pearson-Prentice Hall.

Ojah, Kalu, and David Karemera. 1999. Random walks and Market efficiency Tests of Latin American Emerging Equity Markets: A Revisit. *The Financial Review* 34 (2): 57–72.

Osborne, M. F. M. 1962. Periodic Structure in the Brownian Motion in the Stock Prices. *Operation Research* 10 (3): 345–379.

Parkinson, John M. 1987. The EMH and the CAPM on the Nairobi Stock Exchange. *Eastern African Economic Review* 3 (2): 105–110.

Parks, Rowan W., and Eric Zivot. 2006. *Financial market efficiency and its implications.* PowerPoint slides. http://faculty.washington.edu/ezivot/econ422/Market%20Efficiency%20EZ.pdf (accessed August 10, 2018).

Poshakwale, Sunil. 1996. Evidence on the Weak-form efficiency and the day of the week effect in the Indian Stock Market. *Finance India* 10 (3): 605–616.

Poterba, James M., and Lawerence H. Summers. 1988. Mean reversion of stock prices. *Journal of Financial Economics* 22 (1): 27–59.

Roberts, Harry. 1967. Statistical Versus Clinical Prediction of the Stock Market. Unpublished manuscript, CRSP, University of Chicago.

Shiller, Robert J. 2003. From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives* 17 (1): 83–104.

———. 2013. Sharing Nobel honors, and agreeing to disagree, The New York Times, October 26. http://www.nytimes.com/2013/10/27/business/sharing-nobel-honors-and-agreeing-to-disagree.html? (accessed August 10, 2018).

Shleifer, Andrei. 2000. *Inefficient Markets: An Introduction to Behavioral Finance*. New York: Oxford University Press.

Urrutia, Jorge L. 1995. Tests of random walk and market efficiency. *Journal of Financial Research* 18 (3): 299–309.

Vuolteenaho, Tuomo. 2002. What drives firm-level stock returns? *The Journal of Finance* 57 (1): 233–264.

Working, Holbrook. 1934. A Random-Difference Series for Use in the Analysis of Time Series. *Journal of the American Statistics Association* 29 (185): 11–24.