

Examining the random walk hypothesis in the Amman stock exchange: An analytical study

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ABSTRACT

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The current study aimed to examine the weak-form efficiency of the Amman Stock Exchange using the weekly stock closing prices of shares for the period 2017-2019. In order to achieve the research objective, the study used the time lags that occurred between one and three weeks through the following tests: simple regression, Pearson correlation coefficient, and Spearman correlation coefficient. The study sample consisted of 179 companies. The current study concluded that the weekly stock closing prices of the shares of public joint-stock companies in the Amman Stock Exchange do not follow the Random Walk Hypothesis of prices, and therefore, do not follow the characteristics of a normal distribution. Therefore, the Amman Stock Exchange is inefficient at the weak-form level. Consequently, the lack of randomness in weekly stock closing price movements does not comply with the hypothesis of the first study. Likewise, the lack of independence of the changes in the current weekly stock closing prices from the previous ones also does not correspond to the hypothesis of the second study.

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1. Introduction

Investing in securities and their trading depends primarily on the disclosure of all the activities of the companies listed in the stock exchange. The accuracy of the information disclosed, even if it has a historical dimension, influences the decisions of dealers in the Stock exchange. Accordingly, the nature of the information reflects the levels of efficiency in the stock exchange, which is divided into three levels (weak, semi-strong, and strong). The concept of stock exchange efficiency refers to the extent to which all information is reflected to a high degree in the market stock price, whether that information is in the form of financial statements, information transmitted by the media, the historical record of the stock price, or analyses and reports about the general economic situation on the company's performance. The stock price in an efficient market also reflects investor expectations about future earnings and the risks these earnings are exposed to. The random walk theory asserts that stock price movements are predictable and follow a randomly irregular pattern. Therefore, past stock price movements do not help in predicting future price movements. Kendall (1953) is considered one of the first scholars to suggest that stock prices move randomly. However, in the 1960s, the random walk hypothesis was one of the most controversial topics in the stock market literature. Fama (1970) sees in his study that the random walk process does not mean that the trends and movement of stock prices are abnormal or distorted movements, but the meaning in itself shows that the fluctuation of stock prices from time to time must be statistically independent and unpredictable, and since prices respond fully to the information, so the price

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fluctuation based on this information must be random and not related to any trends. Accordingly, it can be said that the efficient stock exchange is mainly concerned with the prices of stocks that reflect the new information that comes to it; the extent of the response to it, and the speed of its analysis, and that the disagreement about which of the levels of stock exchange efficiency (the strong level, the semi-strong level, and the weak level), enjoys stronger support by financial analysts, is limited to the nature of that information, the speed of price response to it, and that there is a strong relationship between the two concepts of stock exchange efficiency and Random Walk. As a result, the greater the efficiency is, the greater the randomness of prices.

1.1 Objectives of the study

The study seeks to explain the progress of the weekly closing prices of stocks, and to identify the factors that limit the efficiency of the Amman Stock Exchange (ASE). Therefore, the study attempts to answer the following questions:

- 1- Does ASE maintain efficient form at weak level?
- 2- How do we measure this efficiency, if exists?

The answer for these questions are important for the following reasons?

First: If the closing prices of shares on the ASE are determined randomly, the current closing price variable for the stock cannot be implemented to forecast future closing prices.

Second: When we describe the behavior of stock prices, it facilitates exploring the stock exchange, and therefore, appropriate investment policies ought to be set and the stock exchange may be prepared for unwanted possibilities.

1.2 Hypotheses of the Study

The first hypothesis

Changes in the weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange move randomly and thus follow the characteristics of a normal distribution.

The second hypothesis

Changes in the current weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange are independent of the previous weekly closing prices.

1.3 Study Population and Sample

The study population consists of all public joint-stock companies listed on the ASE; consisting of (224) public joint-stock companies during the study period extending from 2017-2019. Some of these companies were excluded due to the lack of daily data on the closing prices of their stocks in the ASE. Therefore, companies that trade their stocks daily at the ASE were approved during the study period. The study sample consisted of (179) companies.

1.4 Random Walk Model Test (Simple Linear Regression Analysis)

Random Walk Model of random error in any time period (t) in the equation (e_{it}) is considered as independent and is not related to random errors in previous periods. It also assumed that changes or fluctuations in prices are uniformly distributed and follow the characteristics of the normal distribution, through the following relationship:

$$P_{it} = \alpha + \beta P_{it-1} + e_{it} \quad (1)$$

$$P_{it} = \alpha + \beta P_{it-2} + e_{it} \quad (2)$$

$$P_{it} = \alpha + \beta P_{it-3} + e_{it} \quad (3)$$

where P_{it} is the stock price of firm i in period t . Moreover, P_{it-1} , P_{it-2} and P_{it-3} are weekly stock price of period $t-1$, $t-2$ and $t-3$, respectively. Finally, e_{it} represents random error and β indicates the price factor.

2. Literature review

A study carried out by Fama (1965) aimed at explaining the stock price behavior of US firms listed on the New York Stock Exchange (NYSE) by using the Random Walk Model. The study found that changes in stock prices on the New York Stock Exchange were subject to the Random Walk Model, and thus, have the characteristics of a normal distribution. A study carried out by Ball and Brown (1968) aimed to identify the degree of correlation between earnings and a number of specific indicators

of efficiency. The study revealed that there is a strong relationship between them and that they have a direct impact on each other, such as cash flows, not to mention many other studies that examined the selection and determination of financial ratios that are distinct factors for the performance of companies and contribute to raising the efficiency of the stock exchange and predicting its future performance (Curtis, 1998; Laurent, 1999). Adams (2003) based on a survey of executives in about 2000 American organizations regarding the importance of those measures that affect the assessment of stock exchange efficiency in the USA, indicated that efficiency is determined by the information available to dealers on walk factors in prices, such as profitability, cash flows, and announcements of dividends, and accordingly, predicting market trends. As for the Gulf markets, the study carried out by Al-Kahili (2011) which dealt with the Saudi stock exchange revealed that prices and returns are related to previous returns and prices so they do not achieve the weak form level of efficiency. The study carried out by Muhammad and Gharaya (2012) tried to discuss the efficiency in the markets of Kuwait and Morocco from 2008 to 2010 and concluded that the markets of Morocco and Kuwait were inefficient at the weak form level. The study of Muhammad et al. (2013) intended to clarify the random walk behavior in the Karachi Stock Exchange and included daily, weekly and monthly closing prices for shares. The study found that the Karachi Stock Exchange Index did not follow the random walk behavior, and thus, is inefficient at the weak form level. A study conducted by Saad (2014) revealed that the financial market is inefficient at the weak form level and thus there are opportunities to achieve extraordinary profits. The study by Al-Hasnawi and Al-Abadi (2019) aimed to test random walk through the ISX60 market index to be able to judge the efficiency of the stock exchange at the weak form level. The study concluded that the returns of the ISX60 stock exchange index in the Iraq Stock Exchange do not follow Random Walk *in general*, and as a result, the Iraqi *stock exchange* is inefficient within the weak form level of efficiency. In the study by Habibah et al. (2017), the objective was to test the RWH in the Pakistani equity market which is an important emerging market and characterized by high turnover and high price volatility. The study suggested that the KSE-100 stock returns were predictable based on past information and the investors can earn abnormal profits by following the systematic pattern. In other words, the Pakistani stock market does not reflect the weak form efficiency. Further, Said and Harper (2015) examined the weak form efficiency of the Russian stock market testing the Random walk hypothesis model. They follow the Box-Ljung test statistics, the autocorrelation, and the variance ratio test on the daily data from July 2003 to December 2012. Results suggest that the Russian stock market is not weak-form efficient. Mishra (2011) tested the weak form efficiency of emerging and developed markets (India, China, Brazil, South Korea, Russia, Germany, US, and the UK) during the period from January 2007 to December 2010. The study by Rahman et al. (2016) provided empirical evidence on weak form efficiency which has been carried out to diagnose the random walk behavior of the Chittagong Stock Exchange (CSE) by composing daily returns of three indices for the period 2006 – 2015. While Obayagbona and Igbinsosa (2015) aimed at the weak-form market hypothesis in the emerging capital market of Nigeria from January 2006 to December 2011. The study founded significant indications of dependence in return series and hence, of non-randomness. The overall results suggest that the emerging Nigerian Stock Market is not efficient in the weak form. In the study by Fadda (2019), an interesting finding is that all the tested US Indexes fail to accept the random walk hypothesis, given that it is the market with the highest volume of trade. A recent study conducted by Al-Shakurji Jaqmakji (2019) found the absence of a normal distribution of the weekly closing price data for the Iraq Stock Exchange Index 2016-2019, and the inefficiency of the *stock exchange* at the weak level.

3. Statistical analysis and discussion of results

3.1 *The first hypothesis*

Changes in the weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange move randomly and thus follow the characteristics of a normal distribution. To examine this hypothesis, the weekly closing prices of public joint-stock companies listed on the stock exchange were subjected to test the random walk model, since it is assumed that the changes or fluctuations in prices are distributed in a similar form and follow the normal distribution. The extent to which the weekly closing price data is subject to random walk was studied to identify the extent to which this data is subject to a normal distribution, which leads to the inability of any investor to achieve unusual profits when analyzing the historical data of stock prices in the Amman Stock Exchange at the expense of other investors, thus proving the validity of efficiency at the weak level. Through the use of Simple Linear Regression Analysis between the current weekly closing prices (dependent variable), and the previous weekly closing prices (independent variable), Table 1 shows some basic the statistics. It is evident from the results of Table 1 that the current weekly closing prices in the Amman Stock Exchange are directly affected by the previous prices (Lag 1) at a level of statistical significance of 0.01. Likewise, the current weekly closing prices are affected by the previous prices (Lag 2) directly at the level of statistical significance 0.01. It was also found that the current weekly closing prices are affected by the previous prices (Lag 3) directly, at the level of statistical significance of 0.01. This means using previous closing price data to predict stock exchange random walk and future trends, which means that the studied stock exchange does not have the weak form level of efficiency, and therefore, the studied market is inefficient. It is evident from the previous analysis that the changes in the weekly closing prices of the stocks of public joint-stock companies on the Amman Stock Exchange do not proceed randomly, nor do they have the characteristics of a normal distribution. Therefore, the Amman Stock Exchange is not an efficient market at the weak form level. This confirms the rejection of the hypothesis of the first study that states Changes in

the weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange move randomly, and thus follow the characteristics of a normal distribution.

Table 1
Simple Linear Regression Analysis

spt	Lag1	Lag2	Lag3
Sig * (level of significance)	0.000	0.000	0.000
t-value	29.515	26.061	23.188
R-Square	0.04	0.032	0.031
β	0.209	0.146	0.124
Standard Error (SE)	0.008	0.008	0.008
Durbin-Watson statistic (D-W)	1.330	1.463	1.453
F-value	1247.1	898.05	824.05

* Statistically Significant at the level of 0.01

3.2 The second hypothesis

Changes in the current weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange are independent of the previous weekly closing prices. To examine this hypothesis, the weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange were subjected to a Pearson and Spearman correlation coefficient test, to identify whether the closing prices were independent of their historical data. This is a statistical analysis most commonly used by researchers and professionals to test for independence. The existence of a positive correlation between changes in stock closing prices means that changes in prices will continue to change in the same direction as the previous period or periods. This means that investors may be able to achieve extraordinary returns, by buying the stock in the current period (the current week) and selling it in the future period (the next week), through their belief that the stock price in the stock exchange will continue to rise in the future period and vice versa.

Table 2
Pearson Correlation Coefficient Test Results

		lag3	lag2	lag1	Spt
lag3	Pearson Correlation	1	.990**	.189**	.124**
	Sig. (2-tailed)		.000	.000	.000
	N	28834	28834	28834	28834
lag2	Pearson Correlation	.990**	1	.191**	.146**
	Sig. (2-tailed)	.000		.000	.000
	N	28834	28834	28834	28834
lag1	Pearson Correlation	.189**	.191**	1	.209**
	Sig. (2-tailed)	.000	.000		.000
	N	28834	28834	28834	28834
Spt	Pearson Correlation	.124**	.146**	.209**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	28834	28834	28834	28834

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3
Spearman correlation coefficient test results

		lag3	lag2	Lag1	Spt
lag3	Correlation Coefficient	1.000	.989**	.321**	.405**
	Sig. (2-tailed)	.	.000	.000	.000
	N	28834	28834	28834	28834
lag2	Correlation Coefficient	.989**	1.000	.323**	.447**
	Sig. (2-tailed)	.000	.	.000	.000
	N	28834	28834	28834	28834
lag1	Correlation Coefficient	.321**	.323**	1.000	.489**
	Sig. (2-tailed)	.000	.000	.	.000
	N	28834	28834	28834	28834
Spt	Correlation Coefficient	.405**	.447**	.489**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	28834	28834	28834	28834

** . Correlation is significant at the 0.01 level (2-tailed).

Table 2 and Table 3 show that there is a positive correlation (in the Pearson test and the Spearman test) between the current closing prices of the stocks in the Amman Stock Exchange and the closing prices of the stocks for the previous week (Lag1), where the degree of correlation in this period was stronger than in other previous periods in both tests. There is also a positive correlation between the current closing prices of stocks and the closing prices of the shares in the previous second period (Lag2).

This correlation score was stronger than the association score at week 3 (lag3). There is also a positive correlation between the current closing prices and the closing prices in the previous third period (Lag3), but the degree of correlation in this period was less than anything in both tests. The correlation is positive at the level of significance (0.01) between the current closing prices and the closing prices for previous periods (Lag). This means the possibility of using previous (historical) prices to predict future prices of stocks, in addition to the possibility of achieving extraordinary returns, which indicates that the stock prices of public joint-stock companies do not proceed randomly. This means that the weekly closing prices of the public joint-stock companies in the Amman Stock Exchange do not enjoy the weak level of efficiency, and this is in contrast to the hypothesis of random walk of prices, which indicates the independence of current prices. This confirms the rejection of the study hypothesis: Changes in the current weekly closing prices of the stocks of public joint-stock companies listed on the Amman Stock Exchange are independent of the previous weekly closing prices.

This is what the following charts show: There is a certain clear pattern seen in Fig. 1 in the context of stock prices:

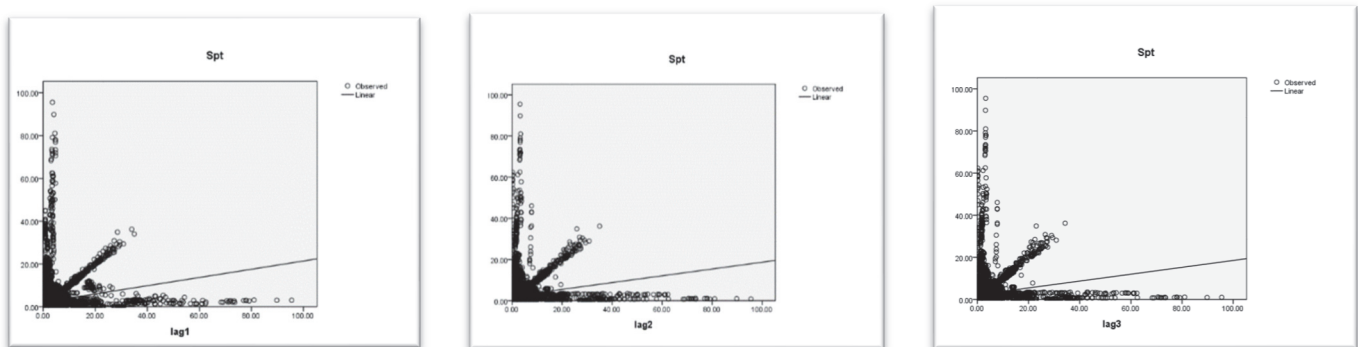


Fig. 1. The patterns of stock price in lag1, lag2 and lag3

The results of the chart test show the lack of independence of weekly closing prices (Sig. =0.000< 0.05), and from this, it is clear that the random walk hypothesis confirms that the stock price movements will not follow any of the expected patterns and trends and that the fluctuation in past stock prices cannot be used to predict future price fluctuations. Through the results of the frequency test, it supports the results of the sequential correlation test, as the correlation is strongly shown between the variables and clearly in the study charts, and therefore market returns do not move randomly, prices can be predicted, and the possibility of achieving extraordinary returns by some investors. Accordingly, the Amman Financial Market does not follow the random course and is therefore inefficient at the weak form level of efficiency. This confirms that the companies that were approved in the analysis were from all sectors operating in the financial market during the study period, and after analyzing the statistical results, which showed a strong correlation between the financial market sectors. In sum, the random walk hypothesis follows a unique random formula that cannot be fully or clearly explained and analyzed. Consequently, the higher the level of financial market efficiency, the chances of obtaining exceptional (extraordinary) profits and also in favor of the ordinary non-professional investor will decrease because the prevailing market price of the security will match or at least will be very close to its economic value.

4. Conclusion

The results of the current study have shown that the weekly closing prices of the stocks of public joint-stock companies in the Amman Stock Exchange do not follow the hypothesis of random walk of prices. Two basic models were relied on to test the hypothesis of the random walk: The first model was the use of the random walk model (simple regression analysis), meaning that the current price is a result of the previous price for three periods (lags). The second model was the Pearson and Spearman correlation coefficient test. The two models provide evidence that prices are not subject to the theory of random walk of prices, and therefore, do not follow the characteristics of the normal distribution in the Amman Stock Exchange. The results of the current study conform with the findings of this study (Maqableh & Barhoma, 2002) and partly conform with the study of Al-Qudah (1997) and Al-Hassan (2014) in the sense that the Amman Stock Exchange is not considered as an efficient Stock Exchange at the weak form level, and prices do not proceed randomly. Perhaps one of the most important factors that limit the efficiency of the Amman Stock Exchange is speculation and manipulation in the stock exchange due to the lack of information on the performance of companies, incomplete disclosure of data and information on companies, and wrong analysis of information by investors. The results of the analysis showed that the weekly closing prices were not random, and this does not comply with the first hypothesis of the study. The results of the analysis also revealed that the changes in the current weekly closing prices were not independent of the previous weekly closing prices, and this does not comply with the second hypothesis of the study. The findings of the current study are a reflection of the practical (analytical) reality of the public joint-stock companies in question. The study also recommends the necessity of conducting more studies to ensure that the Amman Stock Exchange is inefficient at the weak form level, by increasing the time period for studying, and studying the daily closing prices,

and also working to facilitate the access of information to all investors in the Amman Stock Exchange to rely on in making sound investment decisions. The study also recommends the necessity of working to raise the level of efficiency of the Amman Financial Market at its various levels by supporting the process of disclosure and transparency in providing information, in order to ensure fair evaluation of securities.

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