

# An Application of the Weak Form of the Efficiency Hypothesis on the Saudi Arabia Stock Market after Tadawul

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## Abstract

The aim of this study is to test the efficiency of the Saudi Stock Market (SSM) after “Tadawul” (the entity responsible for operating the SSM). The weak form of the efficiency theory was applied to test the SSM efficiency. The SSM daily stock price returns index was examined using autocorrelation and the run test of randomness from January 1<sup>st</sup> 2007 to March 18<sup>th</sup> 2007 (before Tadawul) and from March 19<sup>th</sup> 2007 to May 29<sup>th</sup> 2007 (after Tadawul). The results suggest more investigation to be done on the SSM behavioral finance and under reaction and overreaction split to confirm the SSM “efficiency”.

**Keywords:** Saudi Stock Market, Hokroh, Tadawul, Efficient Market Hypothesis, Fama

## 1. Introduction

### 1.1 *The Efficient Market Hypothesis (EMH)*

The Efficient Market Hypothesis (EMH) is a key discussion in the finance literature. Dr. Eugene Fama pointed out that there are three forms of this theory, the strong, semi-strong and weak form. He further defined the weak-form as a market where, under analysis, firms' historical information will be fully and quickly reflected in its present stock price. (Poshakwale 1996) This is to differentiate it from the strong form which is defined as a market where, under analysis, firm's publicly available or privately held information will be fully and quickly reflected in its present stock price. On the other hand, the semi-strong form is defined as a market where, under analysis, firm's publicly available information will be fully and quickly reflected in its present stock price. (Gili et.al. 2008) Few applications of the theory were attempted in the Saudi Stock Market (SSM).

### 1.2 *The History of the Saudi Stock Market (SSM) and the “Tadawul” system*

The history of the SSM goes back to early 1934, when stocks were unofficially traded. In 1983, the official SSM was formed and gradually emerged until this date. (Al-Bogami 1996) “Tadawul” is the name of the company responsible for operating the market effectively and efficiently, ensuring market integrity, fairness and education of customers (Tadawul 2013a). The Tadawul Company was formed on March 19<sup>th</sup> 2007 and is assumed to bring transparency to the market, thus ensuring availability and reliability of information to all market participants (Tadawul 2013b). Few researchers tested the weak-form of the EMH in the SSM.

## 2. Literature Review

### 2.1 *Previous work*

Few researchers discussed the efficiency theory in the SSM (Butler et.al. 1992, Al-Razeen 1997, Khababa 1998, Onour 2004, Al- Abdulqader et.al. 2007). Butler et.al. (1992) examined 35 Saudi stock market returns from 1985 to 1989 and could not confirm if the SSM exhibited a weak form of efficiency. Al-Razeen (1997) reviewed 28 companies' weekly share price data from 1992 to 1995 and found that the SSM has low level of efficiency. Khababa (1998) examined 61 companies' weekly share price returns from 1985 to 1997. Khababa (1998) found that 72% of the autocorrelations were significant at the 5% level and 51 out of the 61 firms studied revealed evidence of predictability in their share returns and concluded inefficiency. This view was definite for Onour (2004) who also signified inefficiency. Onour (2004) observed the SSM's daily returns from March 2003 until August 2004 and advised greater focus on increasing the market transparency. The most comprehensive of all studies was for Al-Abdulqader et.al. (2007) as it contained a good mix of firms varying in size and age. They studied 45 firms from July 1990 to August 2000 and covered six market sectors (banking, industrial, cement, services, electricity and agriculture). Al-Abdulqader et.al. (2007) reported improvement in efficiency and instructed that it may be due to the introduction of Information Technology (IT).

## 2.2 Discussion

Although Al-Abdulqader et.al. (2007) proposed that IT may have contributed to the improvements of the SSM efficiency, their study was not aimed at examining Tadawul impact on efficiency. Abdulqader et.al. (2007) study was conducted before the “Tadawul” period when there was another system in place called the “Electronic Security Information System” (ESIS) offered by the Saudi Arabian Monetary Agency (Al-Bogami 1996). According to Al-Bogami (1996), the ESIS was the first technology to be introduced in the SSM in 1990. The ESIS helped make the SSM more transparent and provided investors with instant bid feature but had limitations (e.g. 400 domestic and oversea bank terminals) (Al-Bogami 1996). As a result, it was replaced by the “Tadawul” system (Tadawul 2013c).

Opposing to previous work, this study is aimed at examining the “Tadawul” effect on efficiency, an examination that has never been attempted in previous literature. Accordingly, the autocorrelation and the run test of randomness are used to test for the weak-form of the EMH before and after “Tadawul”.

## 3. Methodology

### 3.1 Data Collection

The empirical work of this research is based on a comparison between the SSM daily stock price returns (close price) before and after Tadawul. Using the Tadawul Company’s official website data engine, I was able to obtain the SSM stock price returns from January 1<sup>st</sup> 2007 onward. Accordingly, the SSM daily stock price returns index before Tadawul (January 1<sup>st</sup> 2007 to March 18<sup>th</sup> 2007) and after Tadawul (March 19<sup>th</sup> 2007 to May 29<sup>th</sup> 2007) were collected. The SSM daily stock price returns index includes all the daily closing price for all shares traded from 11:00 a.m. to 3:30 p.m. (Tadawul 2013d). All data was collected from the Tadawul Company’s website (<http://www.tadawul.com.sa>) using the websites’ historical database search engine (Tadawul 2013d). The total number of observations was 104 observations (52 before Tadawul and 52 After Tadawul).

### 3.2 Autocorrelation test

Autocorrelation is a statistical analysis technique used to describe the degree to which one variable is related to another (Levin et.al. 1998). In other words, to test the association between variable won values at different intervals of time (Kashif et.al. 2010). Accordingly, if there is a strong association between variables at a time series, a pattern can be predicated and as a result, the efficiency hypothesis is rejected. However, if the opposite occur, the efficiency hypothesis cannot be rejected and randomness is assumed.

Given measurements, Y<sub>1</sub>, Y<sub>2</sub>, ..., Y<sub>N</sub> at time X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>N</sub>, the lag k autocorrelation function is defined as:

$$r_k = \frac{\sum_{i=1}^{N-k} (Y_i - \bar{Y})(Y_{i+k} - \bar{Y})}{\sum_{i=1}^N (Y_i - \bar{Y})^2}$$

Accordingly, two hypotheses are obtained;

*H<sub>0</sub>: data is random, there is no sequence.*

*H<sub>1</sub>: data is not random, follow a predictable sequence.*

The autocorrelation was applied on the SSM daily stock price returns index from 1/1/2007 until 3/18/2007 and from 3/19/2007 until 5/29/2007.

### 3.3 The Run Test of Randomness

The Run Test of Randomness is statistical test that is used to evaluate the randomness of a series of observations by analyzing the number of runs it contains. A run is defined as the consecutive appearance of one or more observations that are similar. (Weiers 2008) Accordingly, the run is the order of identical occurrence preceded and followed by different occurrence or by none at all (Levin et.al. 1998). To illustrate this, suppose for example that a random observation table contained the following data: 2, 7, 6, 8, 9, 6, 7, 6, 6 and 4. The median of these observations is 4.5. Thus, the digit (2) which is below the median (4.5) constitutes one run. The digit (4) which is also below the median will constitute another run and the middle eight digits that are all above the median make up another run. As a result, the observation table contained three runs. (Weiers 2008).

The run test can be calculated as follows:

$$Z = \frac{T - ((2n_1 n_2 / n) + 1)}{\sqrt{2n_1 n_2 (2n_2 n_1 - n) / n^2 (n-1)}}$$

T is the number of runs, n<sub>1</sub> is the number of observation of the first type, n<sub>2</sub> is the number of observation of the second type and n is the total number of observations (n<sub>1</sub> + n<sub>2</sub>).

Similier to autocorrelation, two hypothesizes are obtained:

*H<sub>0</sub>: data is random, there is no sequence.*

*H<sub>1</sub>: data is not random, follow a predictable sequence.*

The run-test was applied on the SSM daily stock price returns index from 1/1/2007 until 3/18/2007 and from 3/19/2007 until 5/28/2007 to examine the efficiency hypothesis before and after “Tadawul”.

## 4. Results and Findings

### 4.1 Results

Before performing the test statistics, an overview of price returns correlation over time was captured using a simple scatter diagram. Diagram 1 shows the price returns before “Tadawul” while diagram 2 shows price returns after “Tadawul”. The scatter plot in diagram 1 shows a

moving trend of prices inclining over time which suggest a predictable pattern. Diagram 2 shows a variation of price movements but fewer patterns are observed.

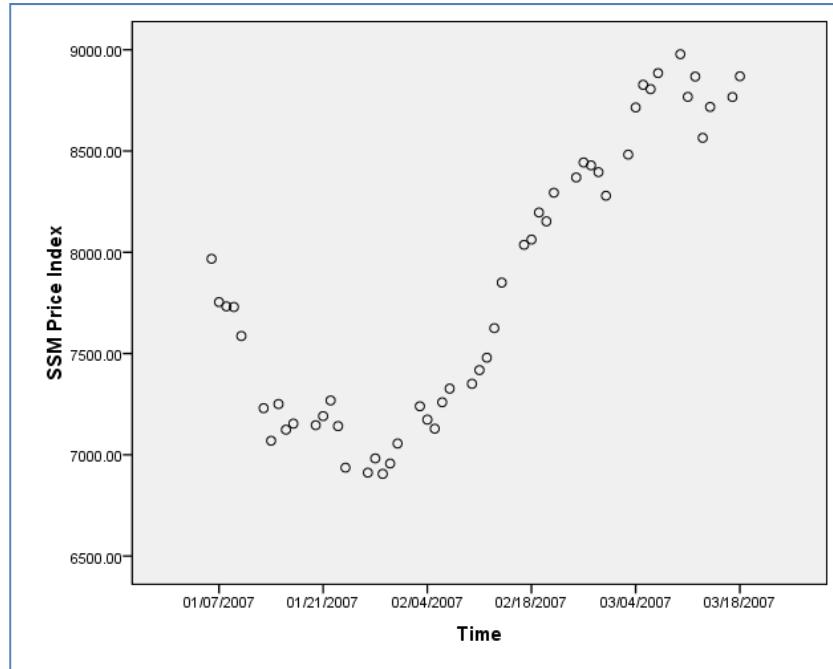


Diagram 1. The SSM price index before Tadawul

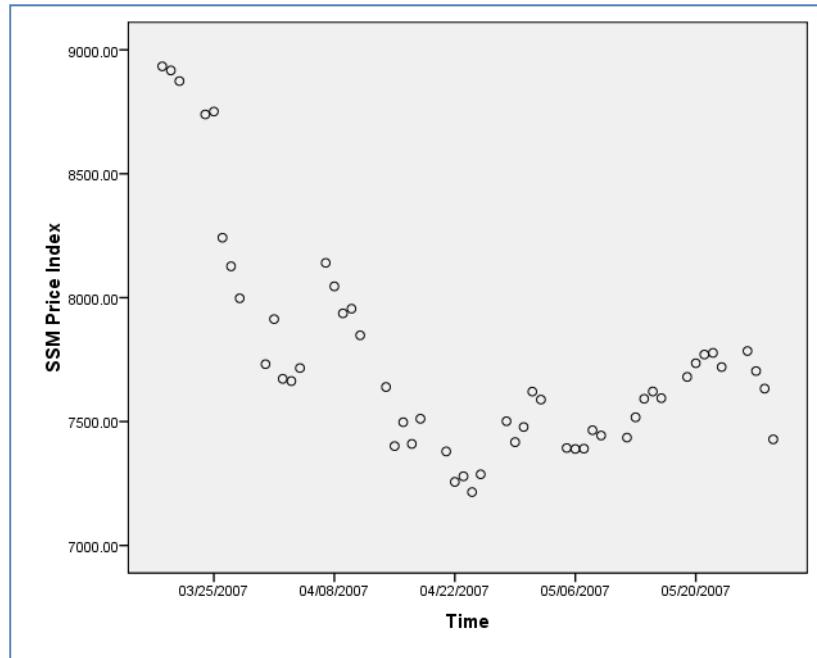


Diagram 2. The SSM price index after Tadawul

To test  $H_0$  and  $H_1$ , autocorrelation and the run test of randomness were applied on the price returns. The results of the autocorrelation test are shown in table 1 and 2 while the result of the run test of randomness is shown in table 3:

Table 1. (Autocorrelations)

Series: Before Tadawul (1/1/2007 to 3/18/2007)					
Lag	Autocorrelation (P)	Std. Error <sup>a</sup>	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	.958	.135	<b>50.502</b>	1	.000

a. The underlying process assumed is independence.

b. Based on the asymptotic chi-square approximation.

Table 2. (Autocorrelations)

Series: After Tadawul (3/19/2007 to 5/29/2007)					
Lag	Autocorrelation (P)	Std. Error <sup>a</sup>	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	.864	.135	<b>41.120</b>	1	.000

a. The underlying process assumed is independence.

b. Based on the asymptotic chi-square approximation.

Table 3. (Runs Test)

	Before Tadawul	After Tadawul
Test Value <sup>a</sup>	7731.44	7636.15
Cases < Test Value	26	26
Cases $\geq$ Test Value	26	26
Total Cases	52	52
Number of Runs	3	4
Z	<b>-6.723</b>	<b>-6.443</b>
Asymp. Sig. (2-tailed)	.000	.000

a. Mean

#### 4.2 Findings

Although both the autocorrelation and run tests validate the correlation assumption between the SSM price returns, the strength of correlation obviously decreased after “Tadawul” by 9.8%

(autocorrelation), 18.5% (box-ljung statistic) and 4.16% (run test). This decrease gives a clear indication that an alteration in the SSM efficiency has obviously occurred after the formation of “Tadawul”. However it is not clear if this “efficiency improvement” is predominantly due to the “Tadawul” or just a “shock” resulting from regulatory changes? To further investigate, the SSM stock price index returns from 5/30/2007 until 12/31/2007 were tested via same tests to see if the alteration of efficiency preserved or decreased over time. In addition, the SSM stock price index returns from 1/1/2008 to 12/31/2008 were also tested. The results are shown in tables 4, 5, 6 and 7.

**Table 4. (Autocorrelations)**

Series: (5/30/2007 to 12/31/2007)					
Lag	Autocorrelation (P)	Std. Error <sup>a</sup>	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	<b>.972</b>	.082	<b>138.885</b>	1	.000

a. The underlying process assumed is independence.

b. Based on the asymptotic chi-square approximation.

**Table 5. (Runs Test)**

	Series: (5/30/2007 to 12/31/2007)
Test Value <sup>a</sup>	7837.67
Cases < Test Value	72
Cases >= Test Value	72
Total Cases	144
Number of Runs	12
Z	<b>-10.202</b>
Asymp. Sig. (2-tailed)	.000
a. Mean	

**Table 6. (Autocorrelations)**

Series: (1/1/2008 to 12/31/2008)					
Lag	Autocorrelation (P)	Std. Error <sup>a</sup>	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	.979	.065	228.943	1	.000

a. The underlying process assumed is independence.

b. Based on the asymptotic chi-square approximation.

**Table 7. (Runs Test)**

Series: (1/1/2008 to 12/31/2008)	
Test Value <sup>a</sup>	9285.31
Cases < Test Value	118
Cases >= Test Value	118
Total Cases	236
Number of Runs	12
Z	-13.960
Asymp. Sig. (2-tailed)	.000

a. Mean

The results in tables 4, 5, 6 and 7 clearly show more correction as time passes. The correlation coefficient observed has clearly increased even more than what have been noticed before “Tadawul”. The reason behind that is the period of the correlation test. When the tests are applied on the selected data over a short period of time (e.g. three months), less correlation is observed, however, if the tests are applied on data selected over a longer period of time (more than three months), more correlation is observed. Fama (1998) explains that there is a growing literature that relates this phenomenon to market slow adjustment to information, but he challenges this assumption by arguing that most of the studies done on long term returns will conclude inefficiency and questions if “efficiency” should be discarded? Fama (1998) argue that for long term returns, if an even anomalies split between underreaction and overreaction can be observed, then they cannot be attributed to chance and are consistent with market the EMH. Hence, future research may consider investigating underreaction and overreaction split before and after “Tadawul” to test for “efficiency”. Another aspect is the rationality of the SSM participants. It is true that, the “Tadawul” technology improved the dissemination of information to market participants, but it is not necessary that the SSM participants rationally perceive information dissemination. Doran

et.al. (2010) found that investments objectives of finance professors are largely driven by the same behavioral factors for those amateur investors. Doran et.al. (2010) found that personal confidence in the ability to beat the market is independent of opinion on market efficiency. Thus, future research may look more on the behavioral finance of the SSM. Without looking collectively to all of these factors (behavioral finance, underreaction and overreaction split and returns correlation), it is difficult to confirm the SSM “efficiency”.

## 5. Conclusion

The aim of this study is to test the weak form of efficiency in the SSM before and after “Tadawul”. The SSM daily stock price returns index was examined from January 1<sup>st</sup> 2007 to March 18<sup>th</sup> 2007 (before Tadawul) and from March 19<sup>th</sup> 2007 to May 29<sup>th</sup> 2007 (after Tadawul) to investigate alterations in efficiency through autocorrelation and the run test of randomness. More investigation should be made on behavioral finance, underreaction and overreaction split. Without looking collectively to all of these factors (behavioral finance, underreaction and overreaction split and returns correlation), it is difficult to confirm the SSM “efficiency”

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