MARKET EFFICIENCY OF THE AMMAN STOCK MARKET: EVIDENCE FROM THE EXAMINATION OF TRADING RULES

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ABSTRACT

This paper tests the validity of the weak-form of the Efficient Market Hypothesis for the Amman Stock Exchange (ASE) for a full sample and three sub-periods of that spanning period 2000-2012. The research uses statistical analyses and moving average rules and offers further evidence of the inefficiency of the Amman stock market when applying trading rules. The empirical results indicate that moving average strategies are successful in predicting the returns for the ASE Index and outperforming the naive buy-and-hold strategy. However, the findings for the sub-periods suggest a certain degree of improvement toward the efficiency achieved by the Amman stock market that has occurred from recent developments such as the introduction of new regulations and the development of market microstructures.

Keywords: *Accounting Information, Market efficiency, Autocorrelation tests, Runs test, Trading rules, Moving average strategy, sub-periods, Amman Stock Exchange.*

I. INTRODUCTION

The current study investigates whether future price changes for a market index can be predicted effectively based on historical data. In particular, the weak-form of the Efficient Market Hypothesis (EMH) is investigated in this research. According to Fama (1970), the weak-form of the EMH suggests that current share or index prices will impound all available past information, such that investors cannot outperform the market consistently by trading exclusively on only historical information.

Most studies examining the weak-form of the EMH focus on statistical analysis and only examine the correlation between current and past returns and conduct runs tests for patterns clearly evident in the signs of stock price changes (Fama, 1970; Butler and Malaikah, 1992). Other groups of the literature have focused on the performance of trading rules (Sweeney, 1988; Brock *et al*., 1992; Hudson *et al*., 1996); research in this area normally has examined whether an investor who trades on the basis of trends in historical security prices can outperform a passive investment approach (Fifield *et al.*, 2005, 2008). One of the most common strategies already investigated in the literature is moving average rules (Brock *et al.*, 1992). According to this rule, buy and sell signals are generated after a comparison of the short-run moving average of the share price to its long-run moving average counterpart.

Most of the research in this area has focused on the developed market, such as that in the US and the UK (Fama, 1965; Fama and Blume, 1966; Sweeney, 1988; Hudson *et al*., 1996). Most of those findings suggest that these markets are efficient with respect to past information. For instance, the research has noted that any autocorrelations that compares the current and historical returns are usually close to zero (Fama, 1965), and the run test that looks at the sign of share price changes suggests no pattern (Fama, 1965) and indeed that trading rules cannot outperform an investor who buys a portfolio of diversified shares and holds that portfolio over a specific time horizon (Fama and Blume, 1966; Sweeney, 1988). However, increasingly, the analysis literature suggests that stock markets in the developing countries may not be weak-form efficient since less disclosure and transparency is usually realised in such emerging stock markets. The current investigation adds valuable research to this area of study.

II. BACKGROUND OF THE AMMAN STOCK EXCHANGE

The Amman Stock Exchange (ASE) is an immature developing market that was established in 1978. However, over the last two decades this market has shown incredible changes in its trading system, regulations and opening as an exchange the world (Jaradat and Al-Zeaud, 2011). A new electronic trading system

was acquired in 2000 as well as new regulations were adopted for listing firms and those foreign companies who want to be listed on the ASE (Jordanian Security Commissions, 1997). In particular, the restrictions were relaxed for ownership of shares in Jordanian firms by non-nationals. Since 1997, foreign investors have been permitted to own large stakes of equities in Jordanian companies listed on the ASE with certain exceptions in specific sectors, such as construction, mining, and commercial service Al-Zeaud, 2011). A new electronic trading system was acquired in 2000 as well as new regulations were adopted for listing firms and those foreign companies who want to be listed on the ASE (Jordanian Security Commissions, 1997). In particular, the restrictions were relaxed for ownership of shares in Jordanian firms by non-nationals. Since 1997, foreign investors have been permitted to own large stakes of equities in Jordanian companies listed on the ASE with certain exceptions in specific sectors, such as construction, mining, and commercial service firms (Jaradat and Al-Zeaud, 2011). Theses administrative changes could improve the efficiency of the ASE. For instance, foreign listed firms on the ASE and international investors could push forward toward more disclosure and transparency in the market.

Table 1 illustrates some of the growth that the ASE has witnessed over this eight-year time span from 2004 to 2011. For example, the number of listed firms has increased from 192 in 2004 to a high of 277 in 2010. The trading value of these firms has risen by more than 500 per cent as of 2008; market capitalization also grew by a factor of 2.2 between 2004 and 2007 before declining slightly in 2008, presumably as a result of the global financial crisis affecting Jordanian equities. The ASE, however, still displays all of the characteristics of an emerging market (Lesmond, 2005; Aguiar and Gopinath, 2007; Al-Zubi *et al.,* 2010) in terms of fast growth, volatile price / earnings ratios and low dividend yields. In addition, the annual returns available from investment in the ASE have varied dramatically, ranging

Table 1. Key Statistics for the Amman Stock Exchange 2004 – 2011.

Market Profile	2004	2005	2006	2007	2008	2009	2010	2011
Item								
Number of Listed Companies	192	201	227	245	262	272	277	247
Market Capitalization (JD Million)	13,034	26,667.1	21,078.2	29,214.2	25,406.3	22,526.9	21,858.2	19,272.7
Trading Value (JD Million)	3,777	1,6871.0	14,209.9	12,348.1	20,318.0	9,665.3	6,690.0	2,850.2
Turnover Ratio (%)	36.3	94.1	101.1	91.2	91.5	91.3	102.2	58.2
P/E Ratio (times)	30.4	44.2	16.7	28.0	18.8	14.4	26.3	22.6
Price / Book Value Ratio	3.0	3.2	2.9	3.0	2.2	1.8	1.7	1.5
Dividend Yield (%)	1.5	0.6	2.3	1.8	2.5	2.8	2.7	3.3
Change in Index (%)	50.9	50.1	-29.2	21.0	-24.9	-8.1	-6.3	-15.9

Note: This table shows the key statistics for the ASE from 2004 to 2011 based on the Amman Stock Exchange, 2012.

from a low of -29.2% in 2006 to a high of 50.9% in 2004. Further, unlike the analysts for developed stock markets, most ASE analysts of the ASE do not have the knowledge and experience to be qualified to give precise advice to their clients. The ASE trading system is not sophisticated and does not require a mathematical model to analyse large amounts of data. Finally, the vast majority of its stock trading is executed by walking to stockbrokers on the floor of the exchange, as online trading only started in 2010 (Fares and Khamis, 2011)

The findings of the current study on a market that presumes that it has the precise and similar characteristics as those of an emerging market, should have valuable policy suggestions for those market regulatory authorities who now pay more attention to the overall efficiency of the ASE. These positive developments could indeed attract more international investors to the market. Further, the current research should be helpful in providing more precise strategy implications for local and foreign investors and also those analysts who wish to understand exactly how the market has behaved in different sub-periods and how the performance of moving average rules in an emerging stock market like the ASE works.

Academics can also build from the current finding for useful future research, such as examining the performance of trading rules such as filter rules and trading range break-out strategy or even investigating accounting disclosures on the ASE.

III. REVIEW OF PRIOR EMPIRICAL STUDIES

Early investigations of the EMH were conducted on the Developed Stock Markets (DSMs) and suggest that such markets tend to be efficient whereas the returns are not predictable when using historical data. For instance, Kendall (1953) examined weekly changes in the British industrial share price index and an index of commodity prices for the ten-year period ending in 1938, using the serial correlation test. He found no significant association between previous price changes and current returns; indeed, the serial correlation coefficients calculated for these price changes were instead very small. For example, the means for the serial correlation coefficient for a one-week and a two-week period were 0.131 and 0.134, respectively.

In a subsequent study, Fama (1965) examined the daily prices for each of 30 listed shares for the five years' ending September 1962, again using the serial correlation test. He discovered that the correlation coefficient was small for most of the shares that were studied; indeed, the average coefficient was 0.03. Further, 73.3% of these correlations had positive values, while 26.7% had negative values. In addition, Fama analysed daily, 4-day, 9-day, and 16-day price changes using a runs test and found that traders

could not earn excess returns by trading on the signs of past price changes. Several academics then built on Fama's pioneering analysis from the 1960s and arrived at similar conclusions, namely, that the serial correlation coefficients for weekly changes in share prices were not statistically or significantly different from zero (Van Horne and Parker, 1967; Cootner, 1969; Cooper, 1982).

In brief, the empirical investigation of the early DSMs showed that share prices tended to move in an unpredictable fashion. However, a recent study that investigated the Dow Jones Industrial Average index in the U.S. for the period 1897 to 1986 suggested that a trading strategy might generate profits (Brock *et al.,* 1992). They stated that an investor who had followed a moving average strategy would have outperformed a passive buy-and-hold approach by more than 0.05% per day. Other investigations of trading rules in the developed markets by Hudson *et al*. (1996) and Fifield *et al.* (2005) share the same view. However, they both highlighted that transaction costs may indeed eliminate any out-performance that may be present.

A vast amount of this literature has reported on statistical tests and investigated the profitability of trading rules for DSMs, while only a relatively small number of papers have studied the validity of the weak-form of the EMH in Emerging Stock Markets (ESMs). This small number is growing, however, as data on ESMs become more available and there is a growth of journals dedicated to studying these issues in emerging market finance. The number of academics in emerging market countries who are studying national data are also increasing, and the findings of this increasing emerging market research continues, as these developing governments seek to understand how the stock markets in their countries can further assist economic development at home and abroad .

Little is yet known about the efficiency of the Amman stock market, particularly, when both statistical analyses and trading rules are used for long time of periods and include the sub-periods that cover economic growth and the global financial crisis. Further, the research findings on the ASE still remain quite mixed. Karemera *et al.* (1999) claim that the ASE is weak-form efficient, while the majority of empirical papers suggest that the ASE is simply inefficient (Omet, 1990; Civelek, 1991; El-Erian and Kumar, 1995; Lagorde-Segotand and Lucey, 2005; Atmeh and Dobbs, 2006; Jaradat and Al-Zeaud, 2011; Elbarghouthi *et al*., 2012). This outcome is due to the fact that most studies have focussed on statistical analysis and rarely investigate the predictability of trading rules based on the historical prices. For example, El-Erian and Kumar's study (1995) was one of the early research efforts that investigated the efficiency of ASE, using statistical analyses for both daily and weekly indices from December 1988 to April 1993. The results of their

serial correlation tests suggest that significant trends were present in the data, while the findings from the runs tests indicated that the market rejected the null hypothesis of no pattern present in the signs of price changes.

In addition, a limited number of studies have investigated the efficiency of ASE using trading strategies (Omet, 1990; Atmeh and Dobbs, 2006), although both of the cited studies here were relatively older, examined a shorter period of price data, and did not look at sub-periods. Omet (1990) found that weak-form efficient was violated when using filter rules for the data for the eight years ending in December 1986. Atmeh and Dobbs (2006) suggested that moving average rules does have the ability to predict based on the historical prices studied after investigating the data for ASE from January 1, 1992 to July 30, 2001.

The current research endeavours to resolve these conflicting views by testing a recent and indeed longer historical pricing that covers an era of growth and also an economic recession cycle (full sample and sub-periods). Further, it uses several tests, including serial correlation, runs test, and moving average strategies. Therefore, unlike the previous studies, the current study is broader. It investigates certain including serial correlation, runs test, and moving average strategies. Therefore, unlike the previous studies, the current study is broader. It investigates certain statistical analyses with a relatively larger number of trading rules and further links the large consolidated data to the data from different sub-periods.

IV. METHODOLOGY, DATA AND DESCRIPTIVE STATISTICS

This study uses the daily closing prices obtained from the Amman Official Market Index for the period December 29, 1999 to August 29, 2012. The data totalled 3112 observations. Further, sub-periods was also investigated. We divided the full sample into three sub-periods to test the efficiency of the market in different economic cycles. We also believe that recessions or a full global financial crisis can cause the ASE market to be volatile or drop. Therefore, inefficiency could be observed in the gathered data. Further, testing different sub-periods provides a good basis for comparison between sub-periods, because this process allows for an examination of whether the efficiency of the ASE has improved. According Gore (2010), the global financial crisis started on 1 December 2007 and ended as of 30 June 2009. During this time period, the vast majority of global stock markets witnessed a sharp decline in most of their stock prices (Blundell-Wignall *et al.,* 2008). The data also includes sub-period S1 (the pre- global financial crisis) from December 29, 1999 to November 30, 2007; the sub-period S2 (global financial crisis) from December 1, 2007 to June 30, 2009; and the sub-period S3 (the

post- global financial crisis) from July 1, 2009 to August 29, 2012.

The daily returns for the current research were calculated using the following formula (1):

$$R_t = Ln\left(P_t / P_{t-1}\right) \qquad (1)$$

Where P_t is the closing price of the index at time (day) *t,* and P_{t-1} is the closing price for the previous day, and *Ln* represents the natural logarithms for the ASE index.

Descriptive Statistics

The summary statistics for the ASE index are shown in Table 2.

A visual inspection of this table shows that the daily mean return for the full sample was very small, with the highest of being 0.0002 and variations from -0.0452 to 0.0468 with a standard deviation of 0.0096. All sub-periods were not different except for one, (S2), which showed a relatively high standard deviation of 0.0145, presumably as the global financial crisis affected the ASE. All returns for both the full sample and the sub-periods except for one, (S3), showed signs of skewness. The kurtosis statistic (3.51) for normality confirmed the skewness statistic, indicating that the return series for the ASE index was not well approached by normal distribution. The values of kurtosis for the full sample and the sub--periods were more than twice their standard errors. The descriptive statistics thus suggest that further caution needs to be considered when parametric tests are implemented,

Table 2. Summary Statistics for Daily Returns

Statistics	Full Sample	Non Overlapping Sub-periods		
		S1	S2	S3
N	3112	1936	386	788
Mean	0.0002	0.0006	0.0006	0.0004
StDev	0.0096	0.0096	0.0145	0.0062
Min	-0.0452	-0.0452	-0.0437	-0.0234
Max	0.0468	0.0468	0.0468	0.0232
Skewness	-0.31*	-0.29*	-0.26*	-0.14
(Standard errors)	(0.044)	(0.056)	(0.124)	(0.087)
Kurtosis	3.51*	3.65*	0.66*	1.51*
(Standard errors)	(0.088)	(0.111)	(0.248)	(0.174)
Lag1	.228*	.196*	.326*	.128*
Lag2	-.029	-.099*	.093	.013
Lag3	.010	-.019	.052	.037
Lag4	.032	.047*	.022	-.051
Lag5	.016	.069*	-.107*	.008
B-L	169.122*	107.966*	50.577*	16.220

Note: Returns are presented for the full sample and three non-overlapping sub-periods (S1, S2 and S3). Returns are measured as log differences for the level of the ASE index. Lag (i) is the estimated autocorrelation at lag I for each series. An * indicates significance at the 5 per cent level. The full sample is for a period that ranges from December 29, 1999 to August 29, 2012, subiperiodS1 (pre-financial crisis)covers December 29, 1999 to November 30, 2007, the sub-period S2 (financial crisis)runs from December 1, 2007 to June 30, 2009, andsub-periodS2 (post-financial crisis) spans the time from July 1, 2009 to August. 29, 2012.

and possibly more weight should be placed on non-parametric tests, such as a runs test and trading rules.

Autocorrelations Testing

The autocorrelation coefficient calculates the correlation between the value of a variable at time (*t*) and its value *k* periods previously (*t-k*). This test can provide evidence on whether a significant relationship does exist between the current and the lagged values of a series by comparing the coefficients with their standard errors. The null hypothesis stating that no significant association exists can be rejected if the coefficient is significantly different from zero at the 5.0 per cent level. Such rejection of the null would suggest that the current index price changes depend on their past values and thus contradict the weak-form of the EMH. Several studies in the U.S. and the UK have investigated the size of the autocorrelation coefficient for share price changes and found that these coefficients were not significantly different from zero (Kendall, 1953; Cootner, 1964; Moore, 1962; Fama, 1965).

For example, Fama (1965) investigated the daily price changes for each of 30 shares on the DJIA index over the five-year period ending September 1962 and found that the average correlation co-efficient was only 0.03. In addition, 73.3% of the correlations had positive values, while 26.7% had negative values. Evidence from those Middle Eastern countries using the autocorrelation test also found that the estimated coefficients were not statistically significant (Butler and Malaikah, 1992; El-Erian and Kumar, 1995). For instance, Butler and Malaikah (1992) used daily and weekly data for the 36 and 35 most liquid shares listed on the Kuwaiti and Saudi stock markets, respectively. For the Kuwaiti shares, the authors found that the correlation coefficient for 23 of the 36 (64.0 per cent) sample shares listed on the Kuwaiti stock market was not statistically significant at the 5.0 per cent level for the first lag. Autocorrelation was thus calculated as follows:

$$\rho_k = \frac{\sum_{t=1}^{n-k}(R_t - \overline{R})(R_{t+k} - \overline{R})}{\sum_{t=1}^{n}(R_t - \overline{R})^2} \qquad (2)$$

where ρ_k is the correlation coefficient of the time series $R(t)$ with its lagged values, R_t represents the return on an index at time *t,* and *K* is the lag length where *k* =1, 2, 3, 4 and 5 days. Obviously, other lag lengths could have been selected, but the ones tested appear to be commonly used in the literature and thus allow the current results to be compared with the past findings (Fama, 1965; Butler and Malaikah, 1992; Brock *et al.,* 1992).

The Non-parametric Runs Test

A runs test is a non-parametric test that does not require a data series to be normally distributed; it looks at the sign of the index price changes and investigates whether any pattern is present (Butler and Malaikah, 1992). A run is a sequence of consecutive index price changes of the same sign. Obviously, three possible signs for index price changes can occur:

Positive (+), negative (-) or no change (0). Randomness of a series is analysed by comparing the actual number of runs with the expected number of runs in a random manner. If the actual number of runs is higher than the expected number of runs, then this finding would suggest that price changes more frequently than one would expect in a random series. However, if the number of runs is less than expected, then that particular finding indicates that trends may exist in the index price series. The actual runs (*A*) are then counted and matched to the expected number of runs (*E*) under the assumption of independence as in the formula (3):

$$E = \frac{\left[N(N+1) - \sum_{i=1}^{3} n_i^2\right]}{N} \qquad (3)$$

Where N the total number of its return observations and n_i is a sum of the price change for each sign. For a large number of observation (N> 30), E corresponds approximately to a normal distribution with a standard error (σ_E) of runs as identified in the formula (4):

$$\sigma_E = \left[\frac{\sum_{i=1}^{3} n_i^2\left[\sum_{i=1}^{3} n_i^2 + N(N+1)\right] - 2N\left(\sum_{i=1}^{3} n_i^3 - N^3\right)}{N^2(N-1)}\right]^{\frac{1}{2}} \qquad (4)$$

The Z-Statistic $\left(Z = \frac{(A-E)}{\sigma_E}\right)$ tests the null hypothesis, which states that the number of actual runs is equal to that which would be expected in a random series. A positive (negative) Z value is obtained when the actual number of runs exceed (fall below) the expected number of runs. A Positive (negative) Z value indicates a negative (positive) serial correlation in the return series.

Trading Rules (Moving Average Rules)

The current study examines the profitability of moving average strategies and compares trading rule profits relative to a buy-and-hold strategy. These tests seek to discover whether various moving average rules can outperform a buy-and-hold strategy. If any moving average strategy based on past information can generate excess returns relative to the naive buy-and-hold strategy, then the weak-form of the EMH is rejected, and the market is inefficient. However, the weak-form of the EMH is accepted if the returns from the moving average strategies are equal, or less than those of the buy-and-hold strategy (Fifield *et al.,* 2005).

The weak-form of the EMH for the ASE for this study was investigated using 10 moving average rules. According to this rule, buy and sell signals are generated after a comparison of the short-run, moving average of the index price to its long-run, moving average counterpart. Specifically, this study adopts the version of the Variable Moving Average (VMA) rule employed by Brock et al., (1992):

"[it] initiates buy (sell) signals when the short moving average is above (below) the long moving average by an amount larger than a band[width]. If the short moving average is inside and band[width] no signal is generated." (Brock et al., 1992, pp. 1735–6).

The bandwidth is introduced to avoid frequent trading when the short-run moving average is just above its long-run moving average counterpart. Fifield et al. (2008) argue that the purpose of the bandwidth is:

"To avoid 'whiplash' signals which may occur if the short-run and long-run moving averages are close to each other (Brock et al., 1992)? The bandwidth also lowers the incidence of trading and reduces transaction costs to some extent" (p. 1521).

Once a buy signal is detected, the share is purchased and held until a sell signal emerges. Several VMA rules are used to investigate the performance of moving average rules. In particular, three short-run periods (1, 2, and 5 days), four long-run periods (50, 150, and 200 days) and two band-widths (0.0 and 0.01) were used in this study. These rules were selected because they have been used by other academics who have investigated this same topic in different countries (Brock *et al.,* 1992; Hudson *et al.,* 1996; Bessembinder and Chan, 1998). For example, a moving average rule (1, 150, 0.01) means that the rule is applied with a short-run period of 1 day, a long-run period of 150 days, and a 1.0% band-width. The profitability of these moving average rules is then compared to the returns from a buy-and-hold strategy to examine whether excess returns were achieved.

In implementing the moving average rules, the assumptions proposed by Fifield *et al.* (2005, 2008) were followed. First, it was assumed that an investor always starts with a buy position; after a buy signal, that same investor holds the index until a sell signal is generated. Following the sell signal, the investor sells the index and remains out of the market until a subsequent buy signal emerges. This process is repeated over the period to be analysed. Thus, the returns generated are calculated for all buy-sell transactions and then compared with the profits from a corresponding buy-and-hold strategy that assumes that the investor buys the index on the first day and holds it until the last day when that same investor then sells the index. The returns from both the moving average rules and the buy-and-hold strategies are then calculated, taking into consideration the transaction costs of 0.54% in the ASE. These assumptions make the trade more realistic and overcome the criticisms of other studies in the substantive literature that have ignored the impact of transaction costs (Sweeney, 1988; Huang, 1995).

Second, each investor has a limited amount of cash, so all money is invested at each buy transaction. Thus, no borrowing is allowed to either purchase or sell securities. Third, the profits generated from the rules are not assumed to be reinvested. Fourth, no short selling is allowed since short selling is not permitted in the ASE. In

addition, multiple buys (sells) are not permitted; the purchase of the index has to be followed by a sale before another purchase can be made. (see Note 1)[1] Finally, any interest earned when an investor is out of the market is not considered in the analysis.(see Note 2)[2] These assumptions we believe make the study more realistic and bias the results against finding any evidence of moving average rule profitability.

sub-periods for the ASE returns are generally small with the exception of a few relatively large values at the first lag, particularly, the earliest sub-periods (0.196 and 0.326). For the earlier sub-period (S1), the autocorrelation coefficients are significant for lags of 1, 2, 4 and 5, thus indicating the presence of serial dependence among the daily ASE returns. However, overall, the findings do suggest that there is some evidence

Table 3. Results of the Runs Test

	Observations *N*	Cases <0	Cases ≥ 0	Expected No. of Runs	Actual No. of Runs	Z-Statistic	P-Value
Fall Sample	3112	1522	1590	1556.26	1273	-10.162*	0.000*
S1	1936	952	984	968.736	741	-10.357*	0.000*
S2	386	179	207	192.984	161	-3.277*	0.001*
S3	788	367	421	393.150	362	-2.231*	0.026*

Note: This table shows the results from the runs test using daily returns of the Amman Stock Exchange Official Index for the \Fall Sample and sub-periods. The column entitled Cases <0 is the number of negative values for the return series over the period while the column entitled ≥ 0 details the number of positive or zero values for the return series. The table also illustrates the expected number of runs and the actual number of runs present in the data. The Z-Statistic tests the null hypothesis, which states that the number of actual runs is equal to that which would be expected in a random series.

V. EMPIRICAL RESULTS

The results of the autocorrelations are reported in Table 2. A visual inspection of this table shows that the autocorrelation coefficients for entire series and the

to reject the null hypothesis that states that past returns can help predict current index price changes.

Table 3 presents the results of the runs test. Unlike autocorrelations, this test does not require that the data follow a normal distribution. The table shows that the Z-values for the ASE Index returns for the entire series was -10.162 and were not different in the sub-periods, which is also significant at the 5% level (±1.96). The Z-values were much lower in the more recent sub-periods (S2 and S3), but still negative, indicating that fewer runs occurred than were expected and also suggesting that trends may be

[1] Some studies of trading rules (e.g. Gunasekarage and Power, 2001) do permit a one -buy transaction to follow another with the assumption that the investor can borrow unlimited funds to leverage up any long position that already exists. This approach was not adopted in the current study.

[2] It is assumed that no investment is made, such as investing at a risk- free rate of interest when the investor is out of the market. However, the inclusion of investment at the risk-free rate would still not fundamentally affect the results presented in Table 4.

present in the index price changes for the ASE Index.

Table 4 Panel A presents the performances of the 10 moving average rules and compares them to the profitability of the buy-and-hold strategy for the full sample. An analysis of this table shows that the buy-and-hold strategy achieved an average return of 90.94%, suggesting that the market witnessed an upward rise over the 13-year period investigated here. A visual inspection of Table 4 Panel A shows that the average number of trades ranged from a high of 126 for the (1, 50, 0.0) rule to a low of 26 for the (1, 150, 1.0) and the (1, 200, 1.0) rules. Moreover, the introduction of a bandwidth decreased the number of trades significantly. For instance, a bandwidth of 1.0% was associated with 56 trades compared to 126 for a 0.0% bandwidth when using the (1, 50, 0.0) strategy.

The results thus are accrued by applying the moving average rules appear profitable and outperformed a buy-and-hold strategy for 6 out of the 10 rules examined. On average, the buy-and-hold strategy achieved a profit of 90.94%; however, this return did not exceed the mean gains recorded for the moving average rules at 141.10%. In fact, the moving average strategies outperformed the buy-and-hold approach by 50.16%. Therefore, sizeable profits were indeed available to those investors who followed this technical strategy over the course of the period investigated here. Overall, the best moving average rule (1, 150, 0.0) achieved a profit of 312.73%, while the worst moving average strategy (5, 150, 0.0) generated returns of -65.16%.

An analysis of these findings reveals that a short- run period of one day yields the most profitable rules; when the short -run period is increased to two or five days, however, the performance of the rules deteriorates. Indeed, a short -run period rule of one day generated a mean return of 256.36%, while short -run periods of two and five days produced a mean return of -31.79%. This finding suggests that the profits from moving average rules decreased on the ASE as the short-run period increased.

The introduction of a band into the trading strategies seems to have had a different impact on the moving average strategies. For example, the introduction of 1.0% to the (1, 50, 1.0) strategy had a positive impact on the profitability of the rule. In contrast, the introduction of the 1.0% to the (1, 200, 1.0) rule had a negative impact on the profitability of this specific strategy.

Panel B of Table 4 reports the findings for non-overlapping sub-periods for all the rules. An analysis of this panel shows that the buy-and-hold strategy across the rules for the earlier sub-period (S1) achieved an average return of 243.30%, while generating losses for the most recent sub-periods (S2 and S3); This

Table 4. Moving Average Rule Results for ASE and the Sub- periods

Rule	Panel A: Fall Sample										
	(1 50 0.0)	(1 50 1.0)	(1 150 0.0)	(1 150 1.0)	(1 200 0.0)	(1 200 1.0)	(2 200 0.0)	(2 200 1.0)	(5 150 0.0)	(5 150 1.0)	AVG
No. Trades	126	56	54	26	44	26	40	30	44	28	47.4
B&H Profits	90.94										90.94
Rule Profits	164.44*	190.8*	312.73*	304.05*	287.3*	278.82*	-16.32	-10.3	-65.16	-35.38	141.10*
Diff	73.5*	99.86*	221.79*	213.11*	196.36*	187.88*	-107.26	-101.24	-156.1	-126.32	50.16*

Panel B: Non Overlapping Sub-periods				
	S1	S2	S3	AVG
AVG. No. Trades	27.4	3.4	12.2	14.33
B&H Profits	243.30	-22.35	-31.10	63.28
AVG. Rule Profits	144.79*	-0.255	-19.41	41.71*
Diff	-98.50	22.09	11.68	-21.57

Note: The table presents the findings for 10 moving average rules when taking transaction costs into account. Specifically, it highlights the number of trades (No T) produced by following each moving average rule. In addition, it shows, in percentage terms, the sum of the rule profits for each moving average rule as well as the profits from the buy-and-hold strategy; the difference between the rule and the buy-and-hold profits, also presented in the table. AVG is the average of the number of trades, of rule profits and of the difference between the rule and corresponding buy-and-hold profits. All profits from the moving average rules and the buy-and-hold strategy are reported as the net of transaction costs of the ASE. Asterisks indicate returns from the rules that are profitable (and) outperformed the buy-and-hold strategy. Results for the sub-periods are given in Panel B.

result presumably was due to the global financial crisis affecting the recent data for the ASE index.

Further the results show that, on average for the sub-periods, the moving average rules appear profitable at 41.71%, but could not outperform a buy-and-hold strategy of 63.28%. For the individual sub-periods, only the earlier sub-period of (S1) was profitable, while the rest were unprofitable. The underperformance is higher for the most recent sub-period (S3). However, when the buy-and-hold strategy was compared to moving average rules for most recent sub-periods (S2 and S3), then the moving average strategies outperformed the buy-and-hold approach by 22.09% and 11.68%, respectively.

VI. CONCLUSION

This study investigated whether the Jordanian Stock Market is weak-form efficient by examining daily data for a full sample and sub-periods of the ASE official index over a 13-year period from 2000 to 2012. Autocorrelations, runs tests, and moving average strategies were used to achieve the goal of the study. Overall, the evidence from these results suggests that the ASE is not weak-form efficient; all tests indicated that the returns for the ASE index could be predicted using historical data, particularly for a short lag.

Further, it appears that moving average strategies are successful in forecasting the ASE Index. Indeed, on average, moving average rules in the current paper outperformed the buy-and-hold strategy, results that further suggest that the ASE is not weak-form efficient. The current findings also suggest that the development that has occurred over the past years for the Amman stock market has not made that market an efficient market. This finding is consistent with the substantive literature, which suggests that emerging stock markets are generally inefficient (Fifield *et al.*, 2005, 2008; Xu, 2010). In particular, the recent studies of Jaradat and Al-Zeaud (2011) and Elbarghouthi et al. (2012) suggest that the weak-form of the EMH is violated by the ASE. However, the findings from the current study for the sub-periods suggest instead that some degree of improvement toward efficiency has been achieved by the Amman stock market due to certain specific recent developments such as the restrictions of foreign firms and investors that are relaxed and an upgrade of trading system of ASE.

The findings of the current study suggest that the characteristics of the market participants in the Amman stock market, including unsophisticated investors and unqualified analysts and stockbrokers, can explain the degree of inefficiency of the ASE. Other causes could be lack of information, transparency and disclosure, psychological biases and noise trade effect, characteristics of that market's microstructure, and the opportunity to arbitrage, which causes longer horizon

returns to deviate from market efficiency (Lim and Brooks, 2011).

Market regulatory authorities should pay closer attention to increasing the level of disclosure and transparency for listed companies on the ASE and could develop a policy that educates market participants, such as investors, analysts and stockbrokers, on investment decision-making. Overall, this research may also benefit fund managers and all decision-makers who are involved in many aspects of stock markets, including those studying the efficiency and profitability of moving average strategies in the ASE. This current effort thus fills more of the gap that exists between actual practice and academic research on how trading strategies, such as moving average rules, perform in a developing stock market, like ASE.

The limitations of this work lie in the commonly noted limitations of empirical investigations for how trading rules, such as moving average, do perform in the Amman stock market. Hence, future research on the ASE could examine a different trading rule and use a wider range of statistical tests and study individual shares to address these limitations.

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