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An Investigation of the Weak form of the Efficient Markets Hypothesis for the Kuwaiti Stock Exchange

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Abstract

This paper investigates the weakform of the Efficient Market Hypothesis (EMH) for the Kuwaiti Stock Exchange (KSE). In particular, it tests whether share returns on the KSE exhibit patterns which may be used to predict future share price changes. Ten filter rules are tested on weekly data for 42 firms over the period 1998 to 2011. The results suggest that the KSE was not weak form efficient because patterns and trends were present in security prices. In addition, the results are consistent with the substantive literature which has argued that emerging stock markets are informationally inefficient, such as Fifield et al. (2005, 2008) and Xu (2010) and particularly those early studies of Al-Shamali (1989) and Al-Loughani and Moosa (1999) that looked at trading rules for the KSE.

Keywords: market efficiency, trading rules; filter rules; emerging market; Kuwaiti stock market

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1. Introduction

This paper examines the weak form of the EMH for the Kuwaiti Stock Exchange (KSE). According to this hypothesis a market is efficient "if it fully and correctly reflects all relevant information in determining security prices" (Malkiel, 1992). The weak form of this hypothesis focuses on historic information and suggests that no trends or patterns are present in share return data. An investor, therefore, cannot achieve abnormal returns by trading on past information since the historical news is already impounded into share returns and price changes follow a random walk process.

When investigating the weak form of the EMH, studies have typically concentrated on statistical tests by looking at the correlation between current and historic returns and conducting runs tests which examine for patterns in the sign of share price changes. In addition, another strand of the literature has focused on the performance of trading strategies; studies in this area normally investigate whether an investor who trades on the basis of trends in past security prices can outperform a passive investment approach. One of the most common strategies which has been studied in the literature is filter rates. The filter rule recommends the purchase (sale) of a share if its price has risen (falls) by a certain percentage from a previous low (high) value.

To date, a lot of studies which have tested the weak form of the EMH have concentrated on developed markets such as the US and the UK (Fama, 1965; Fama and Blume, 1966; Sweeney, 1988; Hudson et al., 1996). In general, the findings from such studies suggest that markets are efficient with respect to historic information[1]. Correlation co-efficients between current and past returns are typically close to zero (Fama, 1965),

[1] Some more recent evidence suggests that trading rules may identify profitable investment opportunities for investors in developed countries. For example, Brock et al. (1992) reported that an investor who had followed a moving average rule for the Dow Jones Industrial Average index in the USA over the period 1897 to 1986 could have outperformed a passive buy-and-hold approach by over 0.05% per day. Other investigations of trading rules in developed markets such as Hudson et al. (1996) and Fifield et al. (2005) suggest that transaction costs may eliminate any outperformance which is present.

the sign of price changes exhibit no specific patterns (Fama, 1965) and trading strategies cannot outperform a passive investment approach where an investor buys a portfolio of diversified securities and holds them over a specific time horizon (Fama and Blume, 1966; Sweeney, 1988). However, a growing number of investigations indicate that stock exchanges in emerging market countries may not be weak form efficient. The current study adds to research in this area.

Specifically, the current paper tests a comprehensive set of filter rule strategies on weekly data for a sample of 42 Kuwaiti shares to examine whether the KSE is weak form efficient. A number of previous studies have examined this issue (Gandhi et al., 1980; Al-Mudhaf, 1983; Al- Shamali, 1989; Bulter and Malaikah, 1992; Al-Loughani, 1995; Al-Loughani and Moosa, 1999; Abraham et al., 2002; Hassan et al., 2003; Al-Khazali et al., 2007; Smith, 2007; Elango and Hussein, 2008). However, a majority of these concentrate on statistical tests, analyse relatively old data and focus on indices rather than on individual security returns. The current paper therefore contributes to the literature in this area by examining the weak form of the EMH for the KSE using individual company share price information over a recent period to test the profitability of a large number of filter-rule trading strategies.

There are a number of reasons why the weak form of the EMH should be reconsidered for the KSE. First, a lot of the existing literature has arrived at mixed conclusions about whether or not the KSE is weak form efficient; a comprehensive study using data for a relatively large sample of securities might help to clarify any confusion in the literature. Second, the KSE has changed since the early 1990s when data for a number of previous studies were used. For instance, several regulations were introduced[2]

[2] For example, in 1998, the KSE mandated that all listed companies to follow International Accounting Standards and disclose all relevant information about their companies' operations on a quarterly basis(Al-Yaqout, 2006).

in order to improve the transparency and disclosure levels of companies listed on the KSE (Al-Yaqout, 2006). In addition, restrictions were lifted on the ownership of shares in Kuwaiti companies by non-nationals; since 2000, foreign investors are allowed to own up to 100 per cent of the equity of Kuwaiti firms listed on the KSE. The influx of foreign investors may have altered the analysis of Kuwaiti equities undertaken and improved the efficiency of the KSE. Further, the trading system of the KSE has been updated in recent years while a privatisation programme by the Kuwaiti government has more than doubled the number of companies listed over the period 1998-2011. As the supply of shares has increased, the appetite of investors for purchasing equities has grown (Almujamed, 2011) and the liquidity of the market may have improved.

Currently, the KSE has 230 listed companies from eight sectors with a market capitalisation of around $169billion (*Central Bank of Kuwait, 2011*). It provides an interesting research site for examining the weak form of the EMH since it is a liquid market with a T+1 settlement system where the value of shares transacted and trading volume have grown by 971.0% since 2000 (*Central Bank of Kuwait, 2011*). Further, it is a well regulated market where transaction costs are minimal. Thus, unlike a lot of other emerging markets, any excess returns from following a filter rule investment strategy that are documented for the KSE may be achievable by practitioners.

2. Literature Review

Empirical studies from stock markets of the Gulf Cooperation Council (GCC) countries are relatively sparse when compared with investigations from other regions in the world[3]. Investigations about the stock market of Kuwait are even less common; to

[3] The age, size and domestic focus of many of these markets possibly explain why so few investigation of their efficiency have taken place. For example, some of the stock markets in the region are relatively new (Qatar) while others are incredible small (Bahrain) (*AFM, 2012*). In addition, until the oil price rise of the 1970s, the domestic investor base was tiny as most nationals did not have funds to invest (Al-Yaqout, 2006). Further, the range of companies to invest in was typically limited and foreign investors did not include GCC countries within their portfolios (Abraham et al., 2002). However, this situation has started to change

date, only 11 investigations about the efficiency of the KSE have been published. Within these published articles, there is a lack of consensus about the efficiency of the KSE. For example, three of the studies have suggested that the KSE is weak form efficient (Al-Mudhaf, 1983; Bulter and Malaikah, 1992; and Al-Khazali et al., 2007) while another eight papers have argued that returns in the market are predictable (Gandhi et al., 1980; Al- Shamali, 1989; Al-Loughani, 1995; Al-Loughani and Moosa, 1999; Abraham et al., 2002; Hassan et al., 2003; Smith, 2007; Elango and Hussein, 2008). A majority of the empirical studies that have been conducted over the last three decades, therefore, have suggested that the KSE is inefficient.

A number of reasons may explain why some studies of the KSE reject the weak form of the EMH while others do not. A detailed investigation of the literature reveals that there have been variations in the time periods studied and the data sets used to examine the efficiency of the KSE. For example, eight out of the 11 papers' data sets were relatively old (Gandhi et al., 1980; Al-Mudhaf, 1983; Al-Shamali, 1989; Bulter and Malaikah, 1992; Al-Loughani, 1995; Al-Loughani and Moosa, 1999; Abraham et al., 2002; Hassan et al., 2003) with share price information being studied from 1975 to 1999. In addition, only a minority (three out of 11) used data for individual shares to test the weak form of the EMH for the KSE (Al-Mudhaf, 1983; Al-Shamali, 1989; Bulter and Malaikah, 1992); eight focussed on index values when conducting their tests. Further, a majority of studies about the KSE have concentrated on statistical tests to investigate the weak form of the EMH; most have employed the serial correlation test, runs test and/or variance ratio test (10 out of 11 papers). By contrast, only two studies have investigated the performance of trading rules such as filter and moving averages rules (Al-Shamali, 1989; and Al-Loughani and Moosa, 1999).

and a number of studies have begun to investigate the weak form of the EMH for such markets in the GCC countries (Moustafa, 2004; Benjelloun and Squalli, 2008; and Al Abdulqader et al., 2007).

Studies by Al-Mudhaf (1983) and Bulter and Malaikah (1992) have documented that the KSE is weak form efficient. Both used data for individual shares and employed statistical tests such as serial correlation analysis and runs tests. For example, Bulter and Malaikah (1992) used daily data for the most-liquid shares listed on the KSE and the SSM (36 shares for the KSE and 25 for the SSM)[4]. The results indicated that the returns for 60.0 per cent of the sample of the most-liquid Kuwaiti shares followed a random walk process. Other paper has documented similar results but employed different methods (Al-Khazali et al., 2007); they used a non-parametric version of the variance ratio test and the runs test after correcting for infrequent trading[5].

By contrast, several investigations have used statistical analysis and found that KSE is not weak form efficient. One of the early studies was conducted by Gandhi *et al.* (1980). They used serial correlation and run tests with monthly data for the All Share and Industrial indices from December 1975 to May 1978. They found that simple linear regressions of current returns on lagged returns suggested that significant patterns were present in the data. Al- Loughani (1995) also investigated the weak form of the EMH using a variance ration test but a different time period and an alternative market index called the Al-Shals Composite Index; he rejected the null hypothesis that share price changes followed a random walk.

[4] Bulter and Malaikah (1992) excluded shares that are traded less than 10.0 per cent of trading days.

[5] However, these findings for Kuwait were inconsistent with the general results of Abraham et al. (2002) who documented that the returns earned by the KSE rejected the weak form of EMH. Abraham et al. (2002) also used a variance ratio test as well as the runs test with weekly index data but found different results. They investigated three Gulf markets for the period from October 1992 to December 1998. Their results rejected the random walk model for share price changes in all three Gulf markets. However, after removing the effects of infrequently traded shares from their index data, the random walk model could not be rejected for the markets of Saudi Arabia and Bahrain. The null hypothesis that share price changes are random was rejected for the KSE even after the data were corrected for the impact of infrequent trading. The researchers argued that the Kuwaiti results might be explained by the fact that the data was influenced by the First Gulf War. The authors further suggested that infrequent trading might influence the results for tests of the weak form of the EMH. They suggested that correcting for this infrequent trading problem could lead to more robust findings.

The most relevant investigations for the current paper are those that studied the performance of trading rules; a detailed review of the literature shows that only Al-Shamali (1989) and Al- Loughani and Moosa (1999) investigated the weak form of the EMH using such trading rules; Al-Shamali (1989) investigated the predictability of filter rules using daily and weekly share prices for 42 securities listed on the KSE over a 5 year period from January 1983 to December 1987. By contrast, Al-Loughani and Moosa (1999) examined the performance of moving average rules using weekly data for the KSE index over two sample periods from 27th of August 1986 to 12th of March 1997. Both studies suggested that the KSE was not weak form efficient. For example, Al-Shamali (1989) used 4 filter rules (4%, 6%, 8% and 10%) and discovered patterns were present in the returns of most shares analysed[6]; the returns from the most of filter rules outperformed a buy-and-hold strategy. For instance, an analysis of daily prices revealed that the 10.0 per cent filter rule outperformed the buy-and-hold strategy by 0.066 per cent (0.140 vs. 0.074) while for the weekly data the naïve strategy underperformed by 0.037 per cent (0.098 vs. 0.061). Further, he noted that the returns generated from filter rules appeared to decrease as the filter size increased suggesting that only small filter sizes should be employed.

A decade after the Al-Shamili (1989) study, Al-Loughani and Moosa (1999) analysed the performance of 8 long-run moving average periods (5, 10, 15, 20, 25, 30, 35 and 40 weeks) compared to a buy-and-hold strategy. According to their investigation, a buy (sell) signal occurred when the current price was higher (lower) than a moving average of path prices; thus, their short-run moving average period was only 1 week. They assumed that KD1000 was invested to make the trade realistic. In addition, transaction

[6]Al-Shamali (1989) attributed the inefficiency in the KSE to many factors including: (i) the relatively recent recovery of the market from the 'Almanakh Crisis'; (ii) the dearth of information in the market; (iii) the speculative strategies of investors; (iv) the absent of institutional investors at that time who might have valued shares based on fundamentals; and (v) insider trading.

costs of 0.1 per cent were taken into account. Further, the findings from their first sub-period indicated that trading rules outperformed the buy-and-hold strategy significantly when 5 and 10 week moving average periods were used; the buy-and-hold strategy only outperformed the trading rules when moving average periods of 35 and 40 weeks were employed. Moreover, the findings from the second sub-period were consistent with the results of the first sub-period; for instance, the 5- week moving average rule outperformed the naïve strategy by 0.0519 per cent (93.09 % vs. 87.9%). The researchers concluded that any developments which had occurred in Kuwait during its recent post-liberation period had not improved the efficiency of the KSE.

3. Data and Method

The empirical work in this paper is based on weekly closing share prices of 42 companies over the period 5th January 1998 to 10th January 2011. The start date was selected because a sizeable number of firms were listed in 1997[7]; an earlier start date would have reduced the sample size by a significant amount[8]. The data were obtained from both the KSE and Datastream; one source was used to check on the information supplied by the other[9]. Both datasets were not adjusted for distributions such as cash dividends, share issues and capital reductions. Further, the KSE did not have information about any share distributions prior to 2001; information for the years 1997 to 2000 was obtained from two organisations: the Orient Consulting Centre and the Gulf Investment

[7] There were 15 firms listed on the KSE in 1997 (Aljoman Centre for Economic Consultancy, 2009).

[8] According to the firm selection procedure, "dead" shares and recently listed firms were excluded from the sample; only "live" companies were used with share prices available during the whole sample period. Thus, there may have be some bias in the data since companies were assumed to remain "alive" throughout the time period being studied (Park and Irwin, 2005). To permit newly listed firms to join the sample as their shares became quoted would have made the testing of the trading rules difficult because of the assumption made about the buying and selling strategy employed

[9] In fact, Datastream was the main source of information employed as the KSE data were only recorded on an infrequent basis. For example, in 1999, the average Kuwaiti share in the KSE database had only 168 entries, which represented only 65.0 per cent of the entries that should have been available.

House. Datastream only stored share price information from April 2001; thus, the data prior to 2001 were collected from the KSE on an Excel work sheet.

Table 1 reports details about the final sample of 42 firms that was used for this research. A visual inspection of the table reveals that the sample firms were drawn from seven different industries and ranged in size from a high of KD 429.7m (TEL) to a low of KD 8.5m (RRI)[10]. Thus, a good mix of firms were included in the analysis although a majority were drawn from the Banking, Investment and Industrial sectors; only two companies from the food industry were included in the final sample and none from the insurance sector were included[11]. Further analysis shows that banks are all classified among those large capitalisations. An analysis of the final column of Table 1 indicates that most of the firms were profitable in 2011. Only five firms made losses in that year.

Insert Table 1

The tests in the current research are based on both the share prices as well as the natural logarithms of the security returns which were calculated according to the following equation:

{ EMBED Equation.3 }

Where $R_{i,t}$ is the return for share i in week t, $P_{i,t}$ is the price of share i in week t, $D_{i,t}$ is the dividend for share $_i$ and $P_{i,t-1}$ is the price of the share in the previous week.

Table 2 highlights the descriptive statistics for the weekly returns of the sample companies. An analysis of the table highlights a number of points. First, the means of the average weekly returns among the sample firms were very small; they varied from a low of -0.36 per cent for PEA to a high of 0.31 per cent for NBK. Second, a majority (76.2 per cent) of the average returns for the sample firms were positive which implies an upward

[10] These firms were classified into small, medium and large. Firms with a paid-up capital of not more than KD30.0m are small, while firms with a paid-up capital of between KD30.0m and KD80.0m or over KD80.0m are medium and large, respectively.
[11] Insurance companies were not included in the sample because their shares were inactively traded.

trend in the share prices of most firms during the 13-year period studied. The standard deviation figures associated with these returns were relatively large; they varied from a high of 7.54 per cent for AGH to a low of 3.34 per cent for CBK. Also, it appears that there is no strong link between the mean and the standard deviation of returns for the firms. For example, the second best performing share (WAR) and the worst performing security (PEA) had standard deviations of 6.21 and 6.95 per cent, respectively. This image of volatile returns among the different shares is corroborated by an analysis of minimum and maximum values. The gap between the figures is sizeable for most firms; for instance, PEA recorded a drop of -51.38 per cent in one week and an increase of 37.20 per cent in another week during the 13-year period studied. Such a finding is not surprising since returns for emerging market securities typically exhibit a high level of volatility (Harvey, 1995). In addition, Table 2 highlights that sector influences affect the return series for the firms in the sample. For example, the Banking shares, on average, were among the best performing firms with relatively low standard deviation values being recorded. By contrast, Real Estate shares were more volatile and had a higher risk on average.

Insert Table 2

Third, a visual inspection of the skewness and kurtosis for the firms being investigated reveals that, in most cases, the distributions of share returns were not normal; 33 of the 42 firms had skewness statistics that were statistically different from zero. Of these significant skewness statistics, 14 were negative and 19 were positive suggesting that the most of the firms' returns series had a large tail of positive values. The kurtosis values are even more emphatic in confirming that the distribution of the returns series are non-normal; the values of this statistic for all the shares in the sample were more than twice their standard errors. This finding suggests that statistical tests, which are based upon the assumption of normally distributed data, may not be appropriate. Thus, care must be

exercised when examining the outcomes of parametric tests and greater emphasis given to the trading rules results.

This research investigates the profitability of filter rules and compares the trading rule profits relative to a buy-and-hold strategy. The tests attempt to discover whether various filter rules can outperform a buy-and-hold strategy. If any filter 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 filter strategies are equal, or less than, those of the buy-and-hold strategy.

Ten different filter rules were investigated to test the weak form of the EMH for the KSE. These include filter sizes of 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0, 14.0, 16.0 and 18.0 per cent. The filter sizes were chosen because (i) they have been used by other researchers who have investigated this topic in different countries (Fama and Blume, 1966; Fifield et al., 2005; Xu, 2010); (ii) the small increments of either 1.0 or 2.0 per cent will be able to detect whether any patterns exist based on the magnitude of previous price changes in the data; and (iii) relatively few trades might be generated for filter sizes that are larger than 18.0 per cent[12]. The filter-rule strategy suggests that a buy signal emerges when a share's price increases by X% from the previous low. It recommends that the share is held until its price declines by X% from a subsequent high. Any price changes of less than X % are ignored (Fifield, et al., 2005).

In implementing the filter rules, the assumptions proposed in Fifield et al. (2005, 2008) are followed. First, it is assumed that an investor always begins with a buy position; after a buy signal, the investor holds the security until a sell signal is generated. Following the sell signal, the investor sells the share and remains out of the market until a subsequent

[12] Table 3 shows that the 18.0 per cent filter rule generated an average of 23.9 trades as compared to a mean of 223.7 for the 1.0 per cent filter.

buy signal emerges. This process is repeated over the 13-year period analysed. Thus, the returns generated are calculated for all buy-sell transactions and compared with the profits from a corresponding buy-and-hold strategy which assumes that the investor buys the security on the first day and holds it in their portfolio until the last day when the investor sells the share. The returns from both filter rules and buy-and-hold strategies are calculated taking into consideration transaction costs of 0.1 per cent in the KSE. Second, each investor has a limited amount of funds so that all cash is invested at each buy transaction. Thus, no borrowing is allowed to purchase or sell securities. Third, profits generated from the rules are not assumed to be reinvested. Fourth, no short selling is allowed since this is not permitted in the KSE. In addition, multiple buys (sells) are not permitted; the purchase of security has to be followed by a sale before another purchase can be made[13]. Finally, any interest earned when an investor is out of the market is not considered in the analysis. Such assumptions make the study more realistic and bias the results against finding evidence of trading rule profitability.

4. Results of Filter Rules

Table 3 and Figure 1 present the performances of the ten filter rules and compare these with the profitability of the buy-and-hold strategy[14]. The profit figures for each filter rule and buy-and-hold strategy are reported after transaction costs of 0.1 per cent have been deducted. This commission fee was added to inject a measure of realism into the analysis and to overcome any criticisms of other studies in the substantive literature which have ignored the impact of transaction costs (Sweeney, 1988; Huang, 1995).

[13] Some investigation of trading rules (e.g. Gunasekarage and Power, 2001) do permit 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.

[14] Table 3 presents the results of the filter rules assuming that no short sales are permitted. In addition, it assumes that no investment is made like investing at the risk free rate of interest when the investor is out the market. However, the inclusion of investment at the risk-free rate would not fundamentally affect the results in the table.

From Table 3, it appears that the buy-and-hold strategy achieved an average return of 0.20 per cent for all 42 firms in the sample; only 13 of the 42 shares achieved positive returns although the market witnessed an upward rise over the 13-year period studied. The findings from the buy-and-hold strategy reveal that large-size firms outperformed small- and mid-sized companies. For example, a passive investment in large firms such as NBK, CBK, ABK, KFI, and TEL generated returns of over 180.0 per cent while small- and mid-sized companies reported gains which ranged from 3.5 per cent for SGC to 46.2 per cent for FAC; the majority (80.0 per cent) of the large profitable firms were in the Banking sector (NBK, CBK, ABK and KFI), which confirms the finding from the descriptive statistics that the Banking industry was the most profitable among the various sectors in the KSE over the period investigated. Indeed, the vast majority of Kuwaiti banks (6 out of the 7) achieved returns which ranged from a high of 398.3 per cent for the Commercial Bank of Kuwait (CBK) to a low of 19.3 per cent for Gulf Bank of Kuwait (GBK). Moreover, an analysis of the results for other sectors shows that all firms in the Real Estate, the Food and Non-Kuwaiti sectors as well as most of the Industrial and Service sector companies recorded losses for the buy-and-hold strategy.

Insert Table 3

An analysis of the number of trades in Table 3 shows that, on average, the number of trades declines significantly as the filter size increases. For example, as the filter size rises from 1.0 to 18.0 per cent, the average number of trades generated by the filter rules decreases from 223.7 to 23.9. Therefore, an investor who followed the 18.0 per cent filter rule over the 11-year period studied would only have transacted about 24 times for each share. A more detailed investigation of the number of trades for the individual firms in the sample reveals that the 1.0 per cent filter for three firms (TEL, IPG and AGH) generated the largest number of transactions (262), while Gulf Bank of Kuwait (GBK) was associated with the smallest number of transactions (4) when the 18.0 per cent filter rule was tested.

A visual inspection of Table 3 shows that, when the difference between the rule profits and the buy-and-hold gains are compared, the differences are positive for nine of the ten filter rules. Indeed, all filter strategies except the small filter sizes (1.0 per cent) outperformed their buy-and-hold counterparts in the KSE[15]. Such findings were different from the results reported by Al-Shamali (1989) and Fama and Blume (1966). Al-Shamali documented that profits from filter rules for Kuwaiti firms declined as the filter size increased. In the US, Fama and Blume suggested that only small filters of 0.5 per cent outperformed their corresponding buy-and-hold strategies; possible reasons for this difference between the results of previous papers and the findings of the current study could be: (i) the market witnessed an upward trend over the 13-year period investigated; and (ii) large-sized filters generated higher returns relative to small-sized filters over the bullish market for the time period analysed.

Figure 1 provides a complete picture of the profitability of filter rules and the buy-and-hold strategy; the box plots of this figure show the distribution of profits (losses) of all filter rule sizes and the buy-and-hold strategy; it summaries the results of the filter rules. Overall, the results are similar to those in Table 3. However, a visual inspection Figure 1 shows that none of the medians across the filter rules underperformed the buy-and-hold strategy which suggests that filter rules are more profitable than their buy-and-hold alternatives. Moreover, it appears that some outliers are present in the results which suggests that some shares generate enormous profits for most of the filter rules. For example, when the 18.0 per cent was employed, a firm such as IFI achieves profit of 801.7 per cent. Therefore, investors could have achieved incredible profits over the period 1998-2011 if they had implemented this filter rule.

[15] Xu (2010) investigated the performance of ten filter rules in China over the period 31st January 1997 to 28th February 2008 and found that small filter rules underperformed the buy-and-hold strategy. Indeed, she found that the difference between small filter rules of 0.5 and 1.0 per cent and the buy-and-hold strategy was (22.01) and (4.02) per cent, respectively.

Insert Figure 1

A more detailed analysis of Table 3 shows that, on average, larger-sized filters (12.0, 14.0, 16.0 and 18.0 per cent) outperformed both medium-sized filters (6.0, 8.0 and 10.0per cent) and small-sized filters (1.0, 2.0 and 4.0 per cent). Indeed, on average, the 18.0 per cent filter rule achieved the largest mean profit of 136.3 per cent while the 1.0 per cent filter recorded the largest loss of -7.0 per cent. In addition, the analysis illustrates that the number of firms that outperformed the buy-and-hold strategy increased significantly as the filter size rose except in the case of the 2.0, 8.0, 16.0 and 18.0 per cent filters. For instance, in the case of 22 firms, the 1.0 per cent filter outperformed the buy-and-hold strategy, in 29 instances the 6.0 per cent filter was more profitable and for 36 of the 42 firms studied the 14.0 per cent filter outperformed the buy-and-hold alternative. Overall, in 68.3 per cent (287 out of 420 instances)[16] of the cases investigated, the filter rules outperformed the buy-and-hold approach, which suggests that patterns exist in the KSE. As a result, the filter tests indicate that the KSE may not be weak form efficient since a trading strategy based on historic data outperformed the corresponding naïve trading tactic.

It is apparent from Table 3 that when the 1.0, 2.0, 4.0, 6.0, 8.0, 10.0 and 12.0 per cent filters are tested on bank shares, the buy-and-hold strategy dominates; this suggests that the Banking sector is more efficient than other industries in the sample. For example, when the 1.0 per cent filter rule was tested for the Commercial Bank of Kuwait (CBK), it underperformed the buy-and-hold strategy by -435.1 per cent. The results of filter rules from other sectors appear to be successful in most cases. Finally, Table 3 highlights that some shares such as IFI, GCE and WAR achieved incredible returns for most of the filters investigated. For instance, when the 18.0 per cent filter rule was implemented for IFI, GCE and WAR, the buy-and-hold strategy underperformed by 880.3, 605.5 and 557.5 per cent,

[16] The number of 420 results from the ten filter rules multiplied by 42 companies.

respectively. Thus, sizeable profits were available to investors who followed this technical approach over the period 1998-2011.

5. Analysis of Variance

A General Linear Model (GLM) was fitted to the data in order to explain any variance between those profits earned by filter rules and the returns achieved by the corresponding buy-and-hold strategy (Diffs). The purpose of this testing is to investigate whether any difference in profits (Rule-B&H) varied systematically from one sector to another of across different filter sizes or levels. The GLM also seeks to uncover whether any difference in profits is related to the size of the firms (the market capitalisation) analysed in the sample. In explaining the variance of any difference between those profits earned by filter rules and the returns achieved by the corresponding buy-and-hold strategy, the model took the form:

$$\text{Diffs}_{j\,(s,\,r,\,m)} = \mu + \alpha_s + \beta_r + (\alpha\beta)_{sr} + \alpha_m$$

where $\text{Diff}_{j\,(s,\,r,\,m)}$ is the difference between the returns generated by filter rules and the profits earned by the corresponding buy-and-hold strategy for company *j* in sector *s* for market capitalisation *m*; μ is the overall mean for the difference between the filter rule profits and the buy-and-hold strategy for all firms across the rules, α_s is the main effect for sector, β_r is the main effect for the filter's size. $(\alpha\beta)_{sr}$ is the interaction effect for sector *s*and the rule's size; this allows for the possibility that the profitability of rules may vary across sectors for different rule characteristics. Finally, α_m is the regression coefficient for the market capitalisation.

Table 4 shows that the model was capable of explaining approximately 22.08 per cent (R^2) of the variation in profit differences. A visual inspection of Table 4 shows that there is very strong evidence of differences in profitability between rules (F = 3.35, *p= 0.001*) and between sectors (F = 6.02, $p < 0.0005$); these main factors are statistically significant since the F-ratios are large and the *p*- values are less than 0.05. However, there

is no evidence that the rules behave differently in different sectors; the interaction term had an F-ratio of only 0.26 with a *p*-value of 1.000. Thus, no single filter consistently outperformed the buy-and-hold strategy in different sectors[17].

Insert Table 4

The analysis suggests that selecting the filter size is extremely important for determining the overall profitability of the trading strategy. Not surprisingly, this result is consistent with the substantive literature which argues that the selection of an appropriate filter size influences the success of the filter strategy (Huang, 1995). For example, Huang found that, of the 24 filters tested, filters sizes, ranging from 4.5 to 18.0 per cent, outperformed the buy-and-hold strategy once transaction costs were considered whereas filters below 4.5 per cent did not. Such a finding is consistent with the results in Section 4 which indicated that larger-sized filters (12.0, 14.0, 16.0 and 18.0 per cent) outperformed both medium- (6.0, 8.0 and 10.0 per cent) and small-sized filters (1.0, 2.0 and 4.0 per cent). Figure 2 shows that the difference in profits achieved by the filter rules increased as the filter-sized rose. Further, all filters, except the 1.0 filter size, outperformed their buy-and-hold counterparts[18]. Indeed, on average, the small-sized filters (1.0, 2.0 and 4.0 per cent) recorded the lowest returns of 11.7 per cent; medium-sized filters (6.0, 8.0 and 10.0 per cent) achieved returns of 79.6 per cent while the larger-sized filters (12.0, 14.0, 16.0 and 18.0 per cent) recorded the largest returns of 121.88 per cent. In addition, an inspection of the results shows that the Banking industry is the only sector which consistently achieves losses when filter trading strategies are implemented. For example, this sector achieved large losses, on average, of approximately -15.6 per cent from the various filters tested.

[17]In addition, we tested whether the rules behave differently in different sectors when rules are categorised into small- (1.0, 2.0 and 4.0 per cent), medium- (6.0, 8.0 and 10.0 per cent) and large-sized filters (12.0, 14.0, 16.0 and 18.0 per cent); the results were similar to those which suggest that no evidence that the rules' profitability varied significantly from different size categories across the different sectors (interaction term: $F = 0.72$, $p=0.73$).

[18]Indeed, on average, the 1.0 per cent filter recorded the largest losses of -7.0 per cent while the 18.0 per cent filter rule achieved the largest mean profit of 136.5 per cent (see Table 3).

Such a conclusion corroborates the findings in Section 4 which suggested that shares in the Banking sector were the most efficiently priced amongst the securities traded on the KSE. Finally, the investigation shows that there was no significant association between differences in filter rule profitability and firm size as measured by market capitalisation ($F = 2.06$, $p = 0.152$).

6. Conclusion

This study employs 10 filter rules to test the weak form of the EMH for the KSE over the 13-year period 1998 to 2011 for 42 firms listed in the KSE. The analysis showed that the KSE was not weak form efficient because patterns and trends were present in the share prices; individuals who had followed filter strategies based on past price information could have made profits.

Further, the profitability of the technical trading rules shows that transaction costs of 0.1 per cent in Kuwait have no impact on the performance of filter rules. This finding is very different from the conclusion reached by studies such as Fama and Blume (1966) and Tijjani (2008) who believed that transaction costs eliminated a lot of the gains achieved by trading rules. One explanation for this difference is that the level of transaction costs imposed by the KSE is very small. The findings from the sectoral analysis suggests that securities in the Banking industry are the most efficiently priced amongst the shares traded on the KSE. One possible justification for this finding is that the level of transparency and disclosure is much higher for banks relative to other industries analysed in the sample.

Therefore, the results are consistent with the substantive literature which has argued that emerging stock markets are informationally inefficient, such as Fifield et al. (2005, 2008) and Xu (2010). In particular, the current findings also confirm the results from the early studies of Al-Shamali (1989) and Al-Loughani and Moosa (1999) that looked at trading rules for the KSE and found that trading strategies could exhibit patterns in share price changes. This study might assist policy-makers in the State of Kuwait with

understanding the context of the KSE; it might, therefore, lead them to introduce regulatory changes which could improve the level of the efficiency of the KSE.

Future research of the KSE could use new listed companies, focus on daily data and investigate the performance of a wider range of statistical and non-statistical tests. In order to facilitate future research in this area, a comprehensive database of high-frequency share price information is needed so that future researchers do not have to spend time gathering information about stock splits and share dividends before manually adjusting the returns earned by firms. Further, a methodical data capture system is need which records the closing price of every share each day so that the academics might have confidence in the dataset being analysed.

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Table (1)
Sample Details

Note: This table provides details about the companies' market values on 10 January 2011 (the end

Sector	No	Name	Code	Paid-up Capital Size (KD in Million)	EPS
Banking (1)	1	National Bank of Kuwait	NBK	359.8	0.077
	2	Gulf Bank of Kuwait	GBK	250.8	0.011
	3	Commercial Bank of Kuwait	CBK	127.2	0.034
	4	Al-Ahli Bank of Kuwait	ABK	144.1	0.038
	5	Kuwait International Bank	KIB	103.7	0.019
	6	Burgan Bank	BUR	140.1	0.010
	7	Kuwait Finance House	KFI	248.9	0.031
Investment (2)	8	Kuwait Investment Company	KIV	55.1	-0.010
	9	Commercial Facilities Company	FAC	53.7	0.028
	10	International Finance Advisors	IFI	72.0	-0.020
	11	National Investment Company	NIV	87.6	-0.001
	12	KIIPCO Asset Management	KPR	121.2	0.038
	13	Al-Ahlia Holding Company	AIN	82.8	-0.026
	14	The Security House Company	SEC	68.0	-0.080
	15	Industrial Investment Company	IIC	44.9	-0.019
	16	Securities Group Company	SGC	25.5	-0.001
	17	Kuwait Financial Centre	KFC	50.6	0.007
Real Estate (3)	18	Kuwait Real Estate	KRE	90.6	-0.022
	19	United Real Estate	URE	118.7	0.004
	20	National Real Estate	NRE	81.4	-0.049
	21	Pearl of Kuwait Real Estate	PEA	25.1	-0.006
	22	Tamdeen Real Estate	TAM	37.3	0.012
Industrial (4)	23	National Industrial Group	NIN	129.5	-0.017
	24	Pipes Industrial & Oil Service	PIP	22.5	-0.029
	25	Kuwait Cement Company	KCE	60.7	0.021
	26	Refrigeration Industries	RRI	8.5	0.011
	27	Heavy Engineering and Ship building	SHP	16.3	0.035
	28	United Industrial Company	UIC	49.5	0.005
	29	Boubyan Petrochemical Company	BPC	48.5	0.047
Service (5)	30	Agility Public Warehouse	WAR	104.6	0.015
	31	Zain Telecommunication	TEL	429.7	0.252
	32	Independent Petroleum Group	IPG	15.2	0.021
	33	National Cleaning Company	CLE	10.2	0.013
	34	Sultan Centre Food	SUL	57.8	-0.069
	35	Arabia Holding Group	AGH	13.5	0.006
Food (6)	36	Cattle Livestock Transport & Trading Co.	CAT	21.6	-0.022
	37	Danah Alsafat Foodstuff	DAN	28.8	-0.004
Non-Kuwaitis (7)	38	Sharjah Cement & Industrial Development	SCE	42.2	0.002
	39	Gulf Cement Company	GCE	62.7	-0.001
	40	Fujairah Cement Industries Company	FCE	27.2	0.002
	41	Ras Al Khaimah Company	RKW	35.7	0.013
	42	Arab Insurance Group	ARG	61.7	0.022

of the sample period), their Earnings Per Share (EPS) and their Price/ Earnings ratio (P/E). N/A = not available.

Source: *www. Aljomant.net, 2011.*

Table (2) Descriptive Statistics

Note: This table shows descriptive statistics for the shares for the sample firms. The Mean is the average

Code	Sector	Mean	StDev	Minimum	Maximum	Skewness	Kurtosis
NBK	Banking (1)	0.0031	0.0402	-0.315	0.305	0.08*	17.11*
GBK		0.0016	0.0432	-0.725	0.254	-6.75*	119.53*
CBK		0.0029	0.0334	-0.165	0.218	0.58*	5.57*
ABK		0.0027	0.0386	-0.178	0.228	0.80*	4.70*
KIB		0.0009	0.0514	-0.246	0.228	-0.23*	3.84*
BUR		0.0021	0.0483	-0.262	0.249	-0.39*	6.09*
KFI		0.0026	0.0442	-0.357	0.322	-0.43*	14.96*
KIV	Investment (2)	0.0003	0.0543	-0.307	0.216	-0.23*	4.08*
FAC		0.0013	0.0378	-0.223	0.211	-0.29*	7.59*
IFI		0.0004	0.0743	-0.293	0.405	0.95*	5.18*
NIV		0.0023	0.0608	-0.316	0.296	-0.20*	5.13*
KPR		0.0021	0.0562	-0.3254	0.254	-0.05	3.90*
AIN		-0.0028	0.0735	-0.468	0.405	-0.67*	8.39*
SEC		-0.0005	0.0432	-0.237	0.2	-0.57*	5.99*
IIC		-0.0020	0.0560	-0.223	0.223	0.05	3.04*
SGC		0.0011	0.0459	-0.245	0.305	0.76*	7.58*
KFC		0.0005	0.0624	-0.223	0.336	0.57*	4.54*
KRE	Real Estate (3)	-0.0016	0.0646	-0.336	0.336	0.52*	5.58*
URE		-0.0005	0.0558	-0.357	0.357	0.46*	12.93*
NRE		0.0005	0.0684	-0.283	0.336	0.28*	3.82*
PEA		-0.0036	0.0695	-0.5138	0.372	-1.14*	12.76*
TAM		0.0008	0.0548	-0.521	0.325	-0.80*	15.66*
NIN	Industrial (4)	0.0006	0.0591	-0.31	0.278	-0.25*	4.69*
PIP		0.0000	0.0648	-0.357	0.268	0.12	3.98*
KCE		0.0018	0.0552	-0.357	0.288	-0.07	7.16*
RRI		0.0000	0.0487	-0.268	0.288	0.29*	7.09*
SHP		0.0011	0.0574	-0.189	0.336	1.00*	5.35*
UIC		-0.0007	0.0717	-0.405	0.388	0.07	5.20*
BPC		0.0012	0.0510	-0.268	0.238	-0.32*	5.23*
WAR	Service (5)	0.0029	0.0621	-0.293	0.262	0.05	3.48*
TEL		0.0028	0.0489	-0.511	0.223	-2.05*	21.49*
IPG		0.0008	0.0463	-0.179	0.231	0.24*	2.45*
CLE		-0.0013	0.0725	-0.365	0.388	0.60*	5.48*
SUL		0.0008	0.0671	-0.254	0.336	0.53*	4.28*
AGH		-0.0005	0.0754	-0.288	0.336	0.54*	3.39*
CAT	Food (6)	0.0004	0.0439	-0.305	0.305	0.71*	9.32*
DAN		0.0007	0.0714	-0.405	0.405	0.28*	5.53*
SCE	Non-Kuwaitis (7)	0.0015	0.0582	-0.223	0.326	0.67*	5.57*
GCE		0.0014	0.0557	-0.254	0.258	0.14	3.05*
FCE		0.0003	0.0581	-0.282	0.223	0.18	3.67*
RKW		0.0011	0.0658	-0.329	0.299	0.46*	5.31*
ARG		-0.0033	0.0508	-0.23	0.31	0.11	6.72*

return over the period while StDev is the standard deviation of the values around the mean. Minimum the Maximum refer to the minimum and maximum weekly return over the sample period respectively. Skewness is a measure of the symmetry of the distribution while Kurtosis examines whether the data are peaked or flat relative to a normal distribution. An * indicates significantly greater than zero at the 5% level; the standard error for skewness was 0.94 and 0.187 for Kurtosis.

Source: *Various publications from KSE and Datastream.*

Table (3) Filter Rule Results

		1.0%		2.0%		4.0%		6.0%		8.0%		10.0%		12.0%		14.0%		16.0%		18.0%	
Share	**B&H Profits**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**	**No. T.**	**Diff %**
Sector 1																					
NBK	365.3	236	-247.4	144	-254.0	70	-191.7	44	-158.7	34	-155.8	22	-47.5	20	-71.9	16	-124.3	14	-143.0	8	85.2
GBK	19.3	226	95.9	142	121.8	74	153.7	50	145.7	32	179.7	26	167.1	20	157.2	14	150.4	6	297.1	4	460.7
CBK	398.3	258	-435.1	168	-355.8	86	-278.3	40	-183.7	24	-140.9	20	-168.7	12	-81.3	10	123.5	8	133.1	6	194.0
ABK	272.4	242	-291.9	178	-240.1	106	-216.2	56	-147.1	38	-117.7	24	-91.1	24	-147.0	20	-153.4	10	-78.9	8	-66.5
KIB	-25.3	236	151.4	188	191.5	112	175.9	82	113.6	60	119.6	52	83.4	42	80.9	36	71.1	28	94.9	26	60.4
BUR	89.1	232	21.4	188	22.5	118	-19.3	80	5.6	54	-4.5	42	-4.3	38	-15.5	22	152.2	18	122.0	14	152.1
KFI	201.2	230	-34.2	150	-60.5	90	-35.8	68	-100.2	46	-73	42	-110.5	28	-10.2	28	-64.8	20	-52.2	16	-0.6
Sector 2																					
KIV	-55.0	224	24.4	200	10.3	136	42.4	88	130.2	58	138.5	46	122.7	38	99.9	38	46.5	30	48.9	28	45.2
FAC	46.2	250	-104.3	168	-111.1	86	-89.2	62	-51.6	42	-32.4	30	-16.8	22	0.5	16	23.6	16	-23.4	14	-21.2
IFI	-78.6	228	310.6	180	327.6	128	422.3	94	402.0	86	453.3	62	519.2	54	486.7	48	443.2	34	478.1	28	880.3
NIV	37.0	244	132.3	180	165.1	140	123.2	98	173.9	74	188.8	52	201.8	38	235.6	36	223.3	34	166.5	30	138.3
KPR	43.4	244	71.4	208	89.0	146	102.6	98	152.7	70	210.2	48	274.0	32	328.7	30	232.5	28	177.1	26	156.8
AIN	-98.2	200	-47.0	186	-63.7	144	-92.1	108	-70.5	84	-27.5	70	-3.2	60	-0.2	56	-75.8	46	-63.7	42	-78.8
SEC	-63.3	220	-11.0	136	42.7	80	137.9	54	176.1	42	206.1	28	234.7	24	212.7	18	209.8	18	117.7	16	107.9
IIC	-91.7	180	-149.5	164	-142.9	140	-123.5	104	-177.3	92	-160.2	64	-84.1	50	-54.0	34	16.8	24	59.5	24	16.4
SGC	3.5	196	-17.0	172	-24.6	104	27.9	74	-11.5	46	46.5	36	69.2	26	105.8	22	54.8	20	15.5	16	19.3
KFC	-61.3	222	-7.6	198	-11.8	150	18.4	106	101.2	72	145.6	46	141.7	42	117.0	36	83.5	32	118.0	30	105.8
Sector 3																					
KRE	-91.8	172	-47.7	158	-23.7	126	-0.5	88	90.8	68	96	60	88.4	56	-4.9	48	22	28	158.6	26	141.3
URE	-74.9	180	-213.7	160	-195.7	124	-174.4	78	-88.9	64	-99.8	38	16.6	32	-10.5	24	-6	24	-40.0	24	-59.0
NRE	-72.2	260	45.8	226	3.4	160	114.5	106	211.8	76	255.3	66	251.5	50	292.4	46	173.3	34	222.3	32	207.7
PEA	-98.8	196	-119.4	180	-91.6	148	-103.7	114	-112.8	82	-70.4	58	-31.4	42	43.9	36	24.8	34	-8.8	30	1.7
TAM	-43.6	216	17.5	188	-10.4	144	-62.2	96	73.1	58	212.3	42	230.8	30	271.7	28	189.4	24	201.0	24	143.9
Sector 4																					
NIN	-55.3	258	258	208	282.4	126	328.2	80	348.4	64	346.1	44	474.5	38	413.8	36	268	36	196.6	30	139.9
PIP	-76.3	250	154.8	226	164.2	148	225	96	294.4	74	260.2	60	229.4	52	234.1	38	253.4	32	247.1	30	197.1
KCE	17.1	246	34.1	196	-15.1	136	-28.3	92	33.4	54	131.3	44	111.2	34	95.4	26	155.1	24	95.6	16	154.8
RRI	-55.5	220	1.0	166	-8.3	106	60	78	36.5	54	73.2	38	137.9	30	95.6	24	114.6	22	61.3	16	120.2
SHP	-28.4	254	-98.7	232	-101.4	156	19.9	98	89.3	74	32.6	62	79.7	40	184.5	34	143.9	28	115.8	22	131.0
UIC	-89.5	234	-47.1	208	-44.7	160	-74.8	114	-34.6	96	-85.2	80	-24.1	54	52.7	50	21.8	40	17.9	40	-35.2
BPC	-5.4	260	42.6	186	91.6	118	131.7	82	123.8	56	120.7	36	186.8	32	124.0	32	57.4	28	85.5	24	70.8
Sector 5																					
WAR	93.2	236	219.1	196	236.8	132	322.7	102	251.2	82	209.6	66	269.1	52	330.4	48	461.5	34	575.3	26	557.5

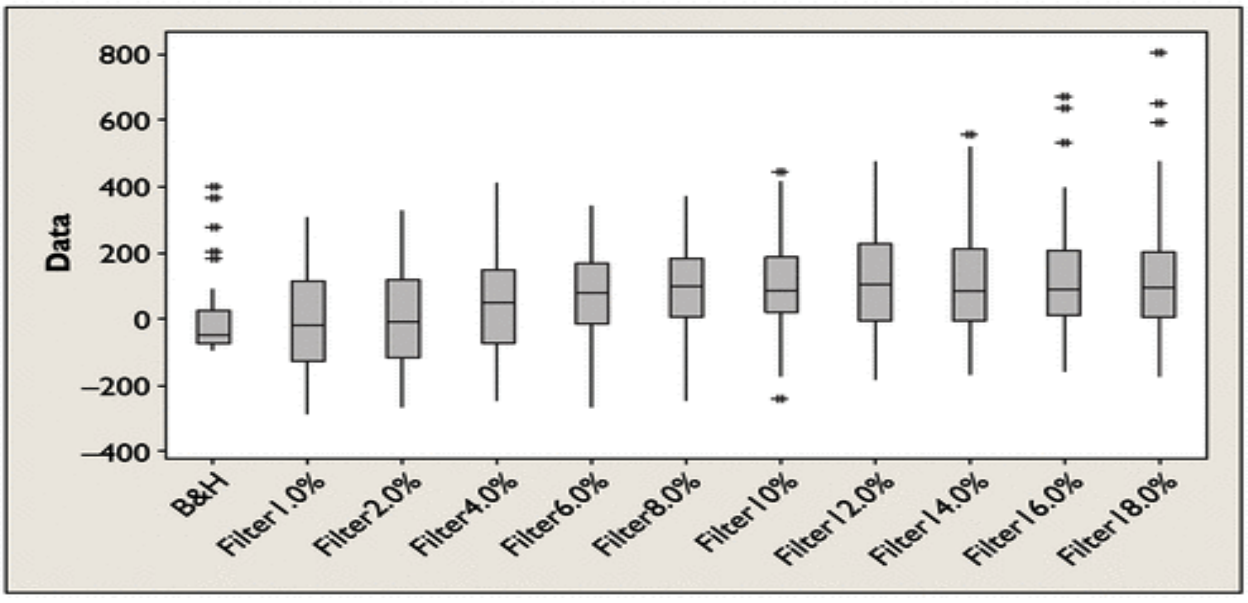
TEL	181	262	-92.4	154	10.1	106	-28.6	62	53.0	48	6.6	38	41.3	26	112.6	24	39.8	20	82.1	18	51.5
IPG	-18.6	262	-114.3	220	-112.4	132	-7.6	90	11.3	66	38	42	99.9	30	90.8	26	74.3	22	60.7	22	-0.5
CLE	-93.1	230	178.4	184	210.1	134	229.1	98	166.4	80	250.8	66	164.7	58	148.4	48	163.9	40	175.7	34	207.3
SUL	-61.2	244	145.8	196	211.7	140	298.9	102	209.3	84	206.9	68	203.1	54	288.9	48	278.6	36	290.1	32	311.8
AGH	-89.3	262	-55.4	230	-63.8	170	-1.6	136	12.7	108	-14.8	88	7.8	72	-1.3	54	45.3	42	99.8	38	80.1
Sector 6																					
CAT	-30.6	200	15.2	176	12.7	98	121.5	56	163.7	48	95.9	40	73.7	40	10.4	30	26.3	28	12.0	20	42.9
DAN	-71.5	216	55.6	194	71.9	158	59.3	130	30.7	92	125.1	66	120.5	62	73.2	46	131	38	182.5	32	185.4
Sector 7																					
SCE	-11.9	190	64.3	156	88.5	94	132	70	181.0	62	161.7	46	126.8	42	110.2	38	105.4	36	106.9	36	65.2
GCE	-9.7	182	142.9	158	115.5	120	132.7	94	170.9	76	118.1	60	417.3	42	488.2	32	446.2	26	646.1	26	605.5
FCE	-61.1	206	-161.9	184	-143.3	130	-131.2	94	-114.1	84	-100.4	70	-110.2	44	78.1	38	111.8	24	166.6	20	185.1
RKW	-52.6	162	-215.7	142	-194.6	126	-200.5	98	-175.5	76	-175.9	70	-190.8	58	-136.9	44	-79.5	34	-57.4	28	-44.3
ARG	-95.7	130	35.8	114	23.3	96	26	62	85.3	54	2.1	46	-12.6	38	10.1	28	49	24	57.0	22	16.3
AVG	**0.2**	223.7	**-7.0**	180.7	**5.3**	123.8	**36.8**	86.2	**62.2**	65.1	**75.5**	50.1	**101.2**	40.0	**115.3**	33.5	**111.5**	27.2	**124.2**	23.9	**136.5**

The table presents the findings of ten filter rules ranging from 1.0 to 18.0 per cent. Specifically, it reports the number of trades (No T) produced by each filter rule strategy. In addition, it highlights, in percentage terms, the profits from the buy-and-hold strategy; the difference between the rule and the buy-and-hold profits (Diffs). AVG is the average of the number of trades, of the buy-and-hold strategy and of the difference between the rule and corresponding buy-and-hold profits across all 42 firms in the sample. All profits for the filter rules and the buy-and-hold strategy are reported net of transaction costs of the KSE. Sector 1 denotes to Banking while 2 to 7 represent Investment, Real estate, Industrial, Service, Food and Non-Kuwaiti sectors, respectively.

Table (4) Analysis of Variance (ANOVA) of the Difference between Filter Rule Returns and the Profits of the Buy-and-Hold Strategy

The table shows the results of an ANOVA on the difference between the filter rule profits relative to the buy-and-hold strategy. The table tests whether any differences between sectors, rule percentages, firm sizes as measure by market capitalisation and for interactions between rules and sectors are significant. R-square represents the percentage of the variability in profit differences explained by the fitted model. Finally, Sig of F presents the significance of the F-test, or P-value. An * significance at the 5.0 per cent level. Data is based on information in Table 3.

Source of variation	Degrees of freedom	Sum of Squares	Mean Square	F-ratio	Sig. of F
Sector	6	877103	146184	6.02	0.000*
Rule	9	967340	81292	3.35	0.001*
Rule*Sector	54	342782	6348	0.26	1.000
Market Cap	1	215969	49954	2.06	0.152
Error	349	8478826	24295	---	---
Total	419	10882020	---	---	---
R-Sq	22.08%				



These box plots show the distribution of profits (losses) for the buy-and-hold strategy and all filter rule sizes. These box plots summarise data of Table 3 on an interval scale. Each box plot presents data into five values including: (i) the smallest observation (minimum); (ii) lower quartile (Q1); (iii) median (Q2); (iv) upper quartile (Q3); (v) and largest observation (maximum). Any values beyond whiskers might be considered outliners and marked by *