Testing the Efficiency of an Emerging Stock Market Using Trading Rules: The Case of Kuwait#

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Abstract:

In this paper we test efficiency of the Kuwaiti Stock market using a moving average trading rules as applied to a weekly time series of stock prices. We obtain results indicating that performance of the trading rule depends crucially on the length of the moving average and that short moving average rules outperform a buy and hold strategy. This finding is interpreted to imply that the market is inefficient.

Introduction:

Empirical studies of the efficiency of emerging stock markets have predominantly dealt with weak-form efficiency(1). In these studies, the efficiency hypothesis is tested invariably by examining, using various techniques, the behaviour of the rate of return (the first log difference of the prices of individual stocks or the price index). None of these studies has attempted to test the efficiency of these markets by using trading rules. The idea, as developed by Alexander (1961), is that if the market is efficient then adopting a strategy based on a mechanical trading rule will not produce profit in excess of what would result from a passive buy and hold strategy. These rules take the form of either a

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1- See, for example, Gandhi et al. (1980), Bulter and Malaikah (1992), Dickinson and Muroga (1994) and Al-Loughani (1995).

filter rule, a moving average rule or a combination of both. This procedure i advocated on the grounds that simple random walk tests do not normally rejec the null of random walk (implying weak efficiency) because they are incapabl of detecting nonlinear dependence in a time series of stock returns[2]. More over, the procedure is described as being a "direct" test of market efficienc since efficiency is a condition that precludes the possibility of obtaining ab normal profit.

The objective of this paper is to test the efficiency of the Kuwaiti stock mar ket, using a moving average rule as applied to two samples of historical data o Al-Shal composite index. The first sample consists of 205 weekly observation covering the period 27 August 1986 to 1 August 1990, while the second sampl contains 232 observations over the period 30 September 1992 to 12 March 1997 The reason for using two samples is to find out if the results are affected by th institutional changes that occurred in the post-liberation period. These includ such things as the introduction of limits on the daily movements in stock price and the dominance of institutional investors. Another development is the appar ent reluctance to bail out investors when the losses are incurred. Yet, another de velopment is the sale of the government shareholding in a number of publicly listed companies. We start with a brief description of the Kuwaiti Stock Market We follow that by a presentation of the methodology, then we apply the meth odology to our data. This is followed by a presentation of the result, discussio and conclusions.

The Kuwaiti Stock Market:

Two hypotheses about the behaviour of KSE have recently been empirically investigated. Al-Loughani (1995) examined the validity of the weak-form ef ficient market hypothesis (EMH). He finds that stock returns do not follow a ran dom walk but rather resemble a GARCH (1,1) process. Al-Loughani and Chap pell (1998) examined the evidence for the existence of a day-of-the-week effect

2- Al-Loughani (1995) could not reject the null of random walk when he applied conventional test to the same sample of data used in this study. However, when he used more sophisticated tests, th null of random walk was rejected, implying market ineffeicincy.

They find that, unlike the pattern observed in more mature Western Stock markets, the returns for the first day in the trading week are higher. They also note that the current volatility of stock returns can be explained by past volatility, and that the past volatility tends to persist over time.

The growth and development experience of KSE seem to suggest that stock price movements have not been influenced by companies' profits and operating results. Rather, these movements have been induced by socio-economic factors, competition among rival business groups, rumours, the political situation in the Gulf region and the size and distribution of government spending. Socio-economic factors refer to the "Business Group" phenomenon which implies that the same parties that dominate the real sectors of economic activity also have control over the loanable funds of the banking system and are strongly linked with government. Leading business groups' members favour investment activity in real estate, import commerce and the stock market. Another distinguishing feature of KSE is the tendency of the government to bail out stock market speculators, thereby indirectly encourarging market participants to indulge in unjustifiably risky transactions.

The most actively traded shares in KSE are those of commercial banks and investment companies. A substantial proportion of bank credit ends up in the hands of market manipulators. The principal operating activity of investment companies is trading in other locally listed companies. With the exception of commercial bank, the bulk of all listed companies' profits is non-operational, originating from trading in other companies' shares. Almost all companies' accounting reports are insufficiently informative and always published several months after the end of the operating year.

The growth and developement of KSE is constrained by a number of factors: there is a lack of market makers; foreign access to the market is restricted to GCC nationals; a significant part of economic activity remains under government control; short selling is illegal and there is no facility for securities lending and borrowing; information disclosure requirements are lax; and derivatives are not available.

Methodology:

The moving average rules is a mechanical trading which is based on buy-sell signals derived from the behavior of stock prices relative to a moving average of a certain order. Suppose that we observe stock prices, P_t, over discrete time intervals, $t = 0, 1, 2, 3 \ldots\ldots, T$. A moving average of order (length) q at time t can be measured as

$$M_t^q = \frac{1}{q} \sum_{i=0}^{q-1} P_{t-1} \qquad (1)$$

Buy and sell signals are indicated by the intersection of the time paths of the price and the moving average. This proposition can be illustrated with help of Figure 1 which shows the theoretical behaviour of the price and the moving average ($P = M$ respectively). Let us observe the relationship between P and M at three points in time:

t_1, t_2 and t_3. At t_1 the moving average is above the price, i.e. $P_1 < M_1$ or $P_1 - M_1 < 0$.

This realtionship is reversed at t_2 at which $P_2 > M_2$ or $P_2 - M_2 > 0$ resulting from the intersection of the moving average and the price such that the former cuts the latter from above. This is a buy signal. At t_3 the relationship is reversed once more, i.e. $P_3 < M_3$ or $P_3 - M_3 < 0$, after the moving average cuts the price from below. This is a sell signal, therefore, the moving average rule implies that the trader should buy at t_2 and sell at t_3 which obviously produces profit in the case illustrated by the diagram, since the sell price is higher that the buy price ($P_3 > P_2$)[3]. The rule can be generalised as follows:

1 - Buy when the moving average cuts the price from above, i.e. when

$$P_t > M_t \text{ or } P_t - M_t > 0 \qquad (2)$$

3 - Although the buy and sell signals are indicated by the points of intersection, the execution of transactions is carried out later at times t_2 and t_3 because prices may not be observable exactly at the time when the points of intersection occur. This is particularly valid if low frequency data are used.
The implicit assumption here is that P_2 and P_3 are the first observable prices after the two points of intersection, while P_1 is the last observable price before the fist point of intersection.

and

$$P_{t-1} < M_{t-1} \text{ or } P_{t-1} - M_{t-1} < 0 \qquad (3)$$

2 - Sell when the moving average cuts the price from below, i.e. when

$$P_t < M_t \text{ or } P_t - M_t < 0 \qquad (4)$$

and

$$P_{t-1} > M_{t-1} \text{ or } P_{t-1} - M_{t-1} > 0 \qquad (5)$$

The objective of this exercise is to find out whether or not a trader can outperform the market by following this trading rule, i.e. whether or not the trader can achieve a higher rate of return by following the trading rule than by adopting the passive strategy of buy and hold. Thus, we need a method whereby comparable rates of return can be calculated. This method is illustrated below.

If, by adopting the trading rule, the buying takes palce at time 1 and the selling takes place at time 2, the rate of return over the period extending between 1 and 2 is given by

$$R_1^2 = \frac{P_2}{P_1} - 1 \qquad (6)$$

which can be generalised to buying and selling at any two points in time, t and $t+k$, as

$$R_t^{t+k} = \frac{P_{t+k}}{P_t} - 1 \qquad (7)$$

Now, let us imagine that an initial amount of capital, X_0, is invested in the stock market. Assume that over some period of time the rule gives a buy signal at 1 and a sell signal at 2, followed by a buy signal at 4 and a sell signal at 7. If this is the case then the value of the accumulated capital at time 7 is given by

$$X_7 = X_0 (1 + R_1^2) (1 + R_4^7) \qquad (8)$$

equation (8) can be generalised for m buy and sell signals occurring over a time period extending between $t = 0$ and $t = T$ as follows:

$$X_T = X_0 \prod_{i=1}^{m} R_i \qquad (9)$$

where $R_i = R^{T-k}_{T-s}$ and $R_m = R^{T}_{T-l}$ such that $k > s$ and $l > k$. The underlying assumption is that the first buy and sell transactions take place at times T- s and T - k respectively, while the last of these transactions take place at T - l and T respectively.

If brokerage fees are charged to the seller at the rate of τ percent of the value of the shares sold, then

$$X_T = X_0 \prod_{i=1}^{m} R_i \ (1 - \tau) \qquad (10)$$

In both cases (with or without brokerage fees), the rate of return on the entire period can be calculated from the values of the capital at the beginning and the end of the period as:

$$R^{T}_{T-s} = \frac{X_T}{X_0} - 1 \qquad (11)$$

On the other hand, a buy and hold strategy implies that shares are bought and sold only once. If the buy and sell prices correspond to the first buy price and the last sell price applicable to the trading rule then

$$X_T = X_0 R^{T}_{T-s} \qquad (12)$$

If brokerage fees are charged then

$$R^{T}_{T-s} = \frac{P_T (1 - \tau)}{P_{T-s}} - 1 \qquad (13)$$

Results, Discussion and Conclusion:

The methodology presented in the previous section is applied to our data of 205 weekly observations using eight moving averages of lengths ranging between five and forty weeks with an incremental step of five weeks. Figure 2 graphs the stock price index, P, and the eight moving averages, M, Showing that the buy and sell signals are indicated by the intersection of the time paths of P

and M. Figure 3, on the other hand, shows the behaviour of the difference between P and M such that the buy and sell signals are indicated by the intersection of the time path of this difference with the time (horizontal) axis (i.e. whenever the difference changes sign). Obviously, the five-week moving average gives a considerably larger number of transactions than longer moving averages.

For the purpose of this exercise, an amount of KD 1000 is invested using the moving average rule and the buy and hold strategy. Once the buy and sell signals are indentified, the prices associated with them are used to calculate the rates of return on each pair of consecutive buy and sell transactions. These rates of return are then used to calculate the accumulated value resulting from investing the initial KD 1000 until we obtain the final value. Subsequently, the overall rate of return is calculated from the initial and final values. The first buy signal is indicated by the first negative difference between the price and moving average following a positive difference. The last sell signal is associated with the first of a series of negative differences that are not followed by a positive difference.

Tables 1 and 2 report the results based on the first data which covers the period 27 August 1986 to 1 August 1990. Table 1 lists the transactions implied by the five week moving average rule together with their timing, the resulting rates of return as well as the value of accumulated capital before and after brokerage fees which amount to 0.1% of the value of shares sold. Table 2 reports the final value (X_T) and the overall (the entire period) rate of return ($R^{T}_{T\text{-}s}$) for each moving average rule and the corresponding figures for the buy and hold strategy. The results are obvious: the moving average rule outperforms the buy and hold strategy by a substantial margin when the moving average length is five or ten weeks. Only when the moving average is 35 or 40 weeks will a buy and hold stategy be better than the trading rule, although both strategies produce losses in this case. The results are (qualitatively) unaffected by allowing for brokerage fees. When a five-week moving average rule is used, the resulting rate of return is 38.64% as opposed to 10.94% resulting from a buy and hold strategy.

Tables 3 and 4 report the results based on the second data sample which covers the post-liberation period. In order to save space the results are reported for

the five week and the forty week moving average without taking into consideration brokerage fees.

Table 3 shows that following a five week moving average trading rule produces a rate of return of 93.09 percent while a buy and hold strategy produces a rate of return of 87.9 percent. Table 4, on the other hand, shows that a forty week moving average rule produces a loss while a buy and hold strategy produces a rate of return of 3.81 percent. The results are therefore consistent.

The results obtained in this study provide some evidence indicating that the market is inefficient, a finding that cannot be normally detected by (linear) measures of serial correlation. These results corroborate the findings of Al-Loughani (1995) which indicate a rejection of the null of random walk (i.e. weak efficiency) but only if more sophisticated tests are used. It also seems that the developments that took place in the post-liberation period have not contributed to the efficiency of the stock market.

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Table (1)

Transactions Implied by a Five Week Moving Average Rule (1986-90)

Week	Transaction	Price	Rate of Return (%)	Value Before Fees (KD)	Value After Fees (KD)
9	Buy	35.82		1000.0	1000.0
11	Sell	35.38	- 1.23	987.70	986.71
15	Buy	36.87			
20	Sell	38.04	3.17	1019.01	1016.97
24	Buy	37.95			
35	Sell	46.11	21.50	1238.10	1234.39
47	Buy	41.74			
50	Sell	41.50	- 0.57	1231.04	1226.12
52	Buy	44.03			
56	Sell	43.19	-1.91	1207.53	1201.50
69	Buy	39.72			
73	Sell	40.84	2.82	1241.58	1234.15
89	Buy	37.11			
98	Sell	39.14	5.47	1309.49	1300.35
100	Buy	43.81			
105	Sell	44.44	1.44	1328.35	1317.76
110	Buy	42.76			
113	Sell	42.70	0.14	1330.21	1318.29
123	Buy	41.21			
125	Sell	40.50	- 1.72	1353.09	1339.62
135	Buy	37.82			
143	Sell	37.93	0.29	1357.01	1342.16
149	Buy	39.34			
150	Sell	38.03	- 3.33	1311.83	1296.17
153	Buy	38.41			
170	Sell	41.04	6.85	1401.69	1383.57
172	Buy	41.43			
173	Sell	41.00	- 1.04	1387.11	1367.81
185	Buy	39.19			
189	Sell	39.95	1.94	1414.02	1392.96
198	Buy	40.53			
203	Sell	39.74	- 1.95	1386.44	1364.43

Table (2)

Final Value and Overall Rate of Return for Various Moving Averages (1986-1990)

Moving Average	5	10	15	20	25	30	35	40
Before Fees								
X_T (Rule)	1386	1328	1094	1104	1004	996	892	901
X_T (Buy and Hold)	1109	1078	1061	1061	884	953	953	953
$R^T_{T\text{-}s}$ (Rule)	38.64	32.83	9.36	10.43	0.35	- 4.49	-10.86	- 9.87
$R^T_{T\text{-}s}$ (Buy and Hold)	10.94	7.78	6.14	6.14	- 11.62	- 4.75	- 4.75	- 4.75
After Fees								
X_T (Rule)	1364	1315	1081	1094	996	947	884	895
X_T (Buy and Hold)	1109	1077	1060	1060	883	952	952	952
$R^T_{T\text{-}s}$ (Rule)	36.44	31.51	8.16	9.44	- 0.45	- 5.53	- 11.65	-10.50
$R^T_{T\text{-}s}$ (Buy and Hold)	10.93	7.68	6.04	6.04	- 11.72	- 4.84	- 4.84	- 4.84
Number of Transactions	32	20	22	18	16	18	14	14

Table (3)

Transactions Implied by a Five Week Moving Average (1992-1997)

Week	Transaction	Price	Rate of Return (%)	Value (KD)
23	Buy	87.20		1000.00
31	Sell	90.60	3.89	1038.99
32	Buy	91.60		
33	Sell	90.90	- 0.76	1031.05
35	Buy	91.20		
51	Sell	109.90	20.50	1242.60
53	Buy	111.20		
54	Sell	110.70	- 0.45	1237.05
58	Buy	109.80		
60	Sell	107.90	- 1.73	1215.64
66	Buy	105.40		
69	Sell	104.50	- 0.85	1205.26
80	Buy	99.20		
85	Sell	101.40	2.22	1231.99
92	Buy	98.80		
101	Sell	103.50	4.76	1290.60
107	Buy	101.70		
109	Sell	100.70	- 0.98	1277.91
110	Buy	101.50		
111	Sell	100.10	- 1.38	1260.28
116	Buy	100.20		
118	Sell	99.60	- 0.60	1252.73

(تابع) Table (3)

Transactions Implied by a Five Week Moving Average (1992-1997)

Week	Transaction	Price	Rate of Return (%)	Value (KD)
119	Buy	100.80		
126	Sell	100.70	- 0.10	1251.49
133	Buy	98.40		
137	Sell	98.60	0.20	1254.03
138	Buy	100.00		
156	Sell	120.70	20.70	1513.61
158	Buy	122.80		
161	Sell	121.10	- 1.38	1492.66
162	Buy	124.00		
167	Sell	125.50	1.21	1510.72
171	Buy	125.60		
174	Sell	125.40	- 0.16	1508.31
175	Buy	126.40		
181	Sell	128.10	1.34	1528.60
186	Buy	127.90		
191	Sell	128.30	0.31	1533.38
193	Buy	130.00		
198	Sell	132.90	2.23	1567.59
203	Buy	134.90		
217	Sell	168.60	24.98	1959.20
221	Buy	165.60		
223	Sell	163.90	- 1.03	1939.09

Table (4)

Transactions Implied by a Forty Week Moving Average

(1992-1997)

Week	Transaction	Price	Rate of Return (%)	Value (KD)
41	Buy	97.00		1000.00
64	Sell	98.00	1.03	1010.31
65	Buy	101.90		
74	Sell	103.30	1.37	1024.19
95	Buy	103.60		
102	Sell	101.40	- 2.12	1002.44
107	Buy	101.70		
109	Sell	100.70	- 0.98	992.58
110	Buy	101.50		
111	Sell	100.10	- 1.38	978.89
123	Buy	102.70		
126	Sell	100.70	- 1.95	959.83

Figure 1: Diagrammatic Representation of the Moving Average Rule

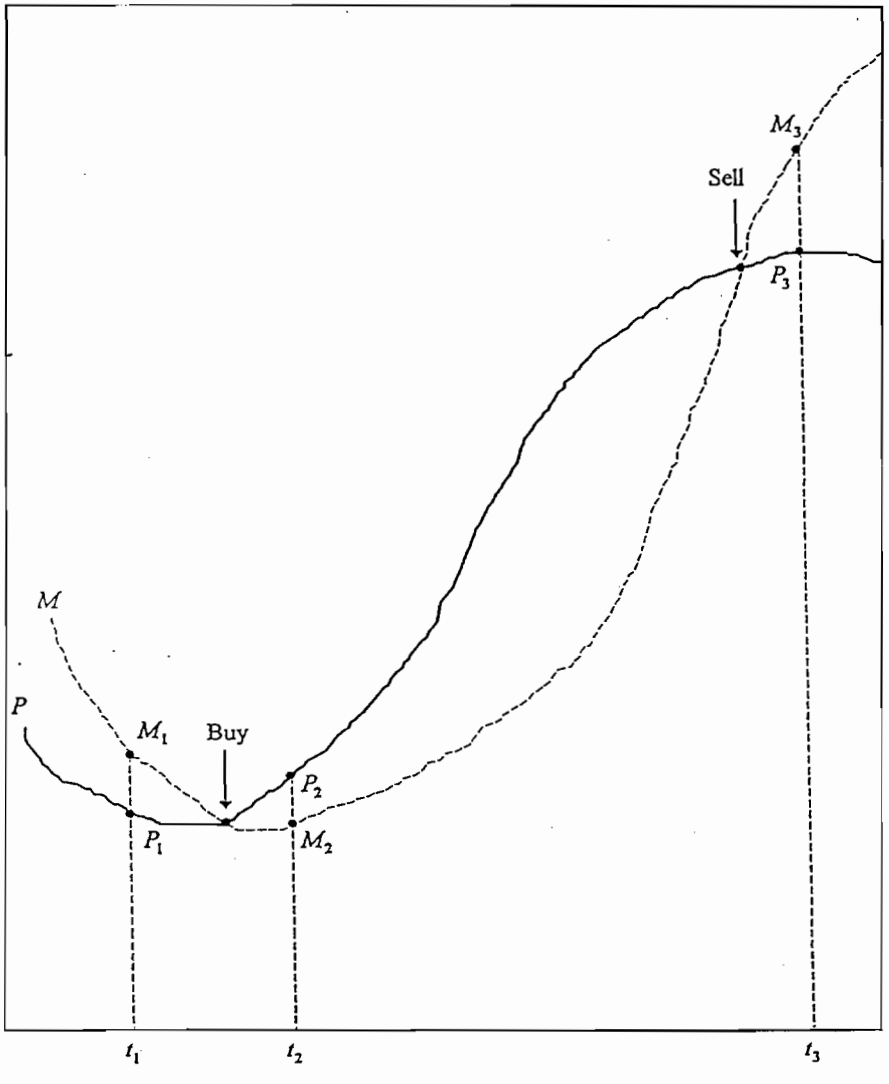

Figure 2: Price and Moving Average

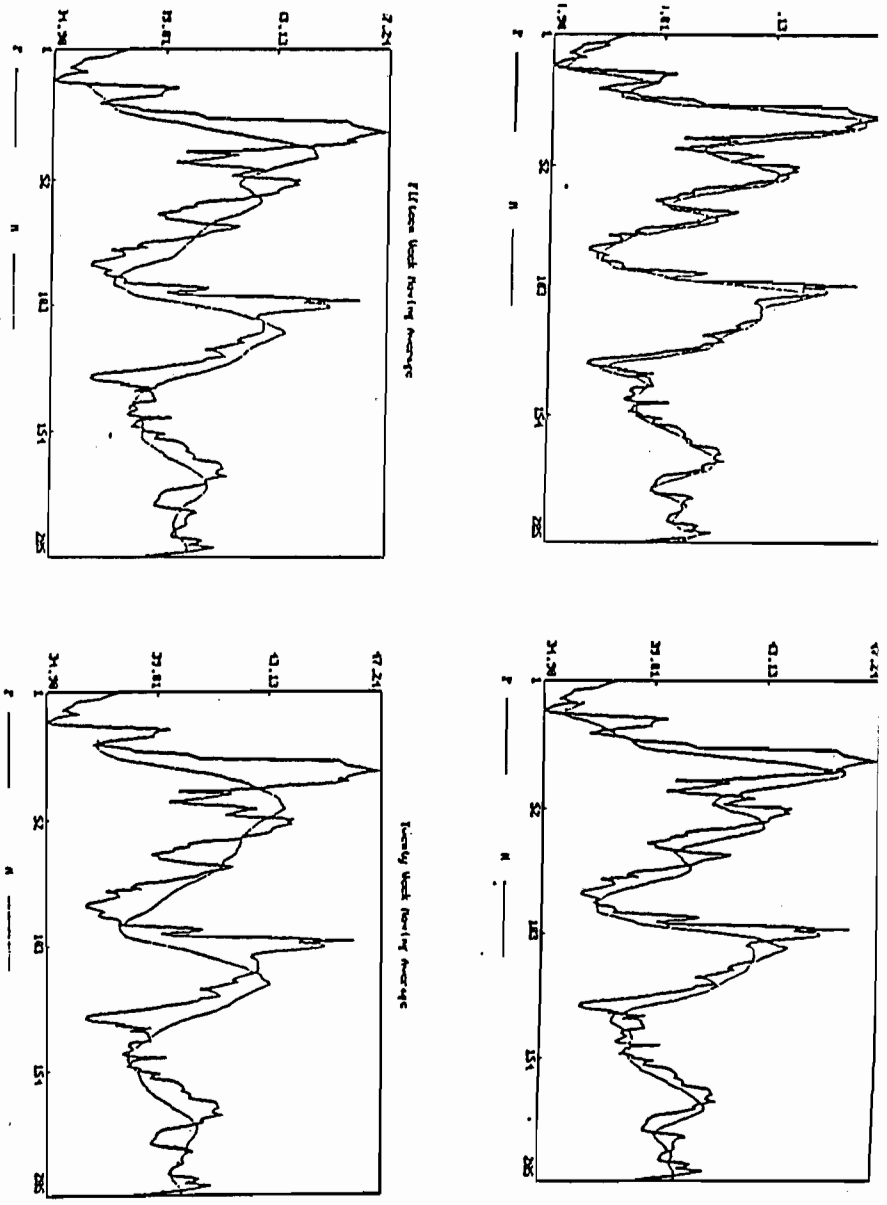

Figure 2: Concluded

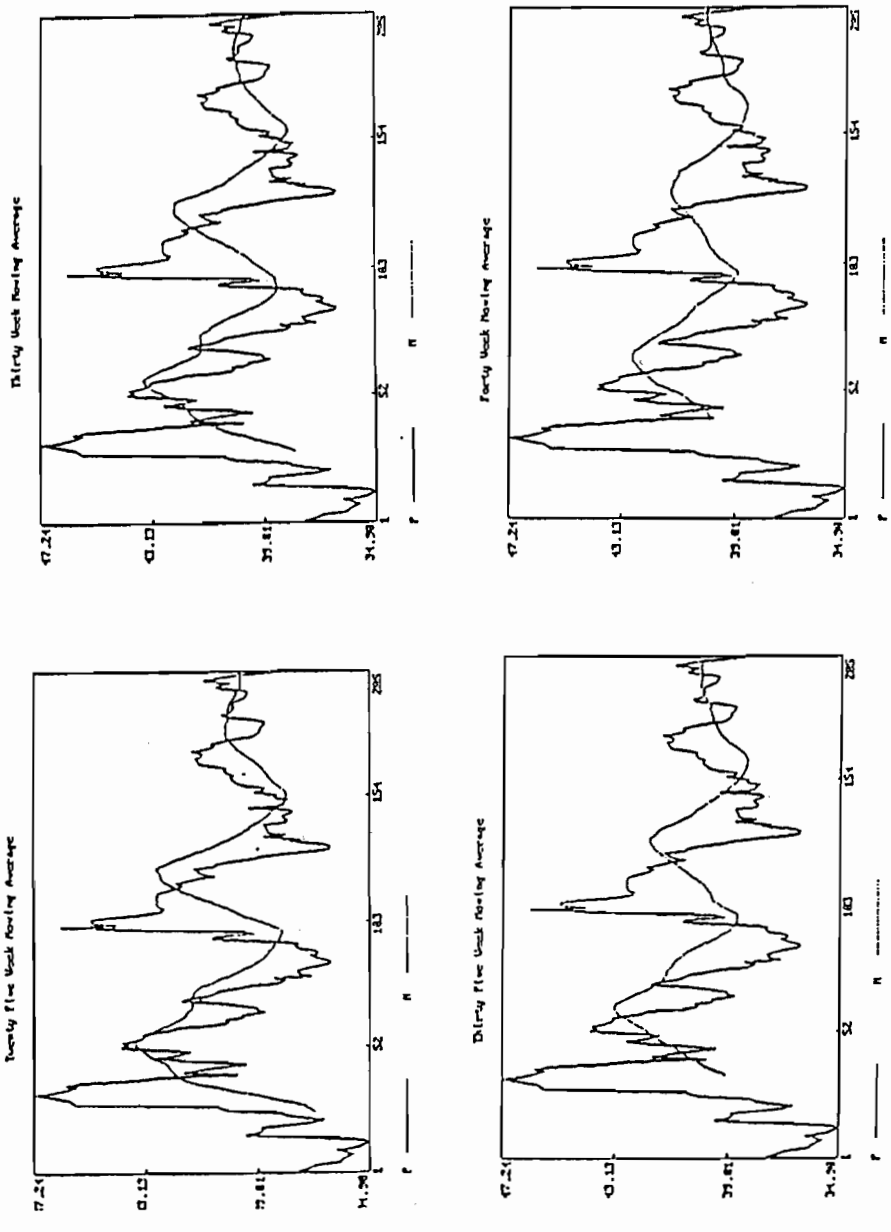

Figure 3: The Difference Between Price and Moving Average

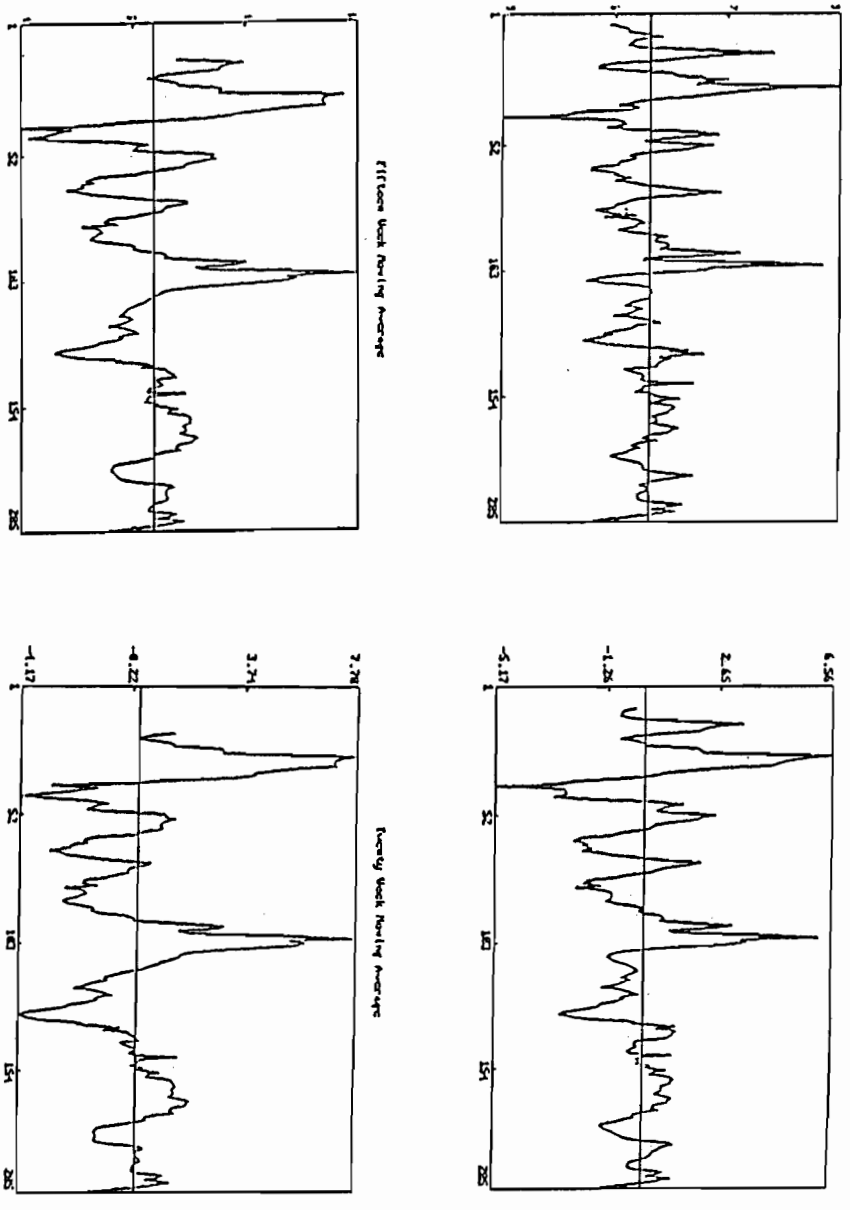

Figure 3: Concluded