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DISSERTATION

THE SAUDI ARABIAN STOCK MARKET: EFFICIENT MARKET HYPOTHESIS AND INVESTORS BEHAVIOR

Submitted by

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In partial fulfillment of the requirements
for the degree of Doctor of Philosophy
Colorado State University
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Summer 2000

COLORADO STATE UNIVERSITY

MAY 19, 2000

WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY AHMED ABDULKREEM ALKHOLIFEY ENTITLED "THE SAUDI ARABIAN STOCK MARKET: EFFICIENT MARKET HYPOTHESIS AND INVESTORS BEHAVIOR" BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Adviser

Department Head

ABSTRACT OF DISSERTATION

The objective of the study is to determine the informational efficiency of the Saudi Arabian stock market. I argue that the Saudi market is weakly informationally inefficient as is the situation in a number of other developing countries stock exchanges. A strong motivation to study the market is lack of rigorous research about the stock market specifically and the financial system in general.

I use a number of empirical tests, namely the autocorrelation test, the runs test, the filter technique and the more modern approach, the cointegration test, to examine the efficiency of the SA stock market. In addition, the study includes a survey of the market in order to have a better idea about market agents' behavior as well as the information flow mechanism in SA. Results of these tests, along with the survey results, revealed that the SA stock market is not informationally efficient. Finally, based on the conclusions, a number of recommendations are suggested to minimize the informational inefficiency snags. Among these recommendations are: the need of the market for stock market law, a more reliable financial reporting, a presence of dynamic community of analysts and an independent financial press as well as establishing a unified watchdog body to monitor the market mechanisms.

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TABLE OF CONTENTS

Chapter I. Introduction

1.1: Purpose of the study

The purpose of this research is to examine the informational efficiency of the Saudi Arabian (SA) stock market. The main hypothesis is that the market is weakly inefficient which means stock market returns are not independent. The reasons for such an argument are several. Among the reasons are: market thinness, weak regulation, heavy speculation, asymmetrical information, monopolistic practices and limited number of market analysts.

A number of statistical methods are employed to test the efficiency of the market. In addition, since a thorough investigation of the market has never been implemented, which means lack of supporting literature regarding the Saudi market, a survey of Saudi investors was conducted. The survey is meant to provide real evidence regarding the market participants' behavior and the flow of information, both of which are important ingredients of an efficient market.

1.2: Why the stock market?

An understanding of the roles that financial markets play in the world economy is an essential goal not only of economists or financial analysts, but also of the general public. Of particular importance are stock markets, since they play a vital role in channeling savings to the most productive investments. Capital markets in general are perceived by some as the engine of growth. They allocate capital efficiently by pooling funds from dispersed savers and directing them to dispersed entrepreneurs.

The agglomeration of savings in the market enlarges the set of investment projects, allowing large projects to enjoy economies of scale, which leads to long run growth. Although the effect of stock markets in economic growth is not unanimously agreed upon, there is growing evidence of the positive correlation between stock markets and economic growth (Bekaert and Harvey, 1998).

Levine and Zervos (1996) argue for the importance of the services provided by stock markets that are said to boost economic growth. A strong and healthy stock market can benefit a country's economic development in several ways. First, it promotes the stability of the financial system and hence the economy by providing equity financing for firms. This in turn reduces the vulnerability of firms to high interest rates charged by financial intermediaries. In addition, while firms, under external debt financing, are required to pay even when they are losing, they can adjust payment levels to suit their needs under equity financing. Second, stock markets allow for a wider distribution of equity ownership among people by enabling large segment of the society to participate in the market. Third, a well-regulated stock market can enhance economic efficiency through fair prices of securities and minimum transaction costs. Fourth, and the most important aspect, is the ability of the market to stimulate growth and employment (Gill and Tropper, 1988).

By allowing agents to diversify their portfolio, stock markets reduce the rate of return risk. In addition, they have a peculiarity of buffering individuals from liquidity shocks by giving them the ability to liquidate their shares. Because stock market liquidity enables agents to liquidate their equities almost instantaneously, it encourages them to invest in high return projects that require long-term commitment

of capital. It also allows firms to raise capital easily. Without liquid stock markets, people will hesitate to relinquish control of their savings for lengthy period of time. It is through stock markets that risks and costs of long-term investment are reduced. Hence, stock markets, besides improving the allocation of capital, do enhance prospects of long- term growth. Such features of the stock market enhance the willingness of agents to invest in less liquid and more productive projects. The recent tendency of internationally integrated stock markets allows for more risk sharing and diversification, which increase investments in higher return projects that tend to have a positive effect on economic growth (Levine and Zervos, 1996).

Moreover, since stock markets allow risk sharing, they tend to induce more specialization, hence increasing productivity. Markets also promote the acquisition of information about firms. An investor who has information will be able to make profits in the market before such information is widely known. Motivated by profits, investors will be encouraged to search for information and to monitor firms. Thus, by acting as a mechanism of monitoring firms, the market will be able to improve capital allocation, which stimulates growth. Another way of promoting growth is via corporate control. Efficient stock markets, by easing corporate takeovers, do mitigate the principal-agent problem and promote efficient allocation of resources (Levine and Zervos, 1996).

In addition, capital markets channel funds from households who save to those who dis-save by providing consumer credits and mortgages. This solves part of the problem of household liquidity constraint, which can be witnessed during times of loan supply shortage (Pagano, 1993).

1.3: The growth of emerging markets

In 1981 the International Finance Corporation (IFC) used the term "emerging markets", which implies that a process of change in a stock market is underway so that these stock markets grow in terms of both size and sophistication. It also refers to any market in a developing economy. Hence, an emerging stock market is considered so if it meets at least one of two criteria: an emerging economy criterion as well as a developing stock market criterion. As a result, a threshold of GNP per capita, put forth by the World Bank, is used to measure the eligibility of any stock market to be designated "emerging".

A middle income country is any country with per capita GNP range of US$ 766 - US$ 9,385, according to 1995 World Bank threshold (IFC, 1997). Such a country's stock market would be considered to be emerging, provided that it has a regulated and functioning securities exchange, or is in the process of developing one (Keppler and Lechner, 1997). An increasing number of the developing countries have already realized the advantages of more expanded and liberalized stock markets for their development. As a result, developing-country stock markets have undergone major changes in recent years. It was not until the beginning of the 1990s, that foreign investments in the form of equity portfolios in these emerging markets began to surpass expectations, which was an ultimate result of more liberalized policies. According to Mullin (1993), international investors tripled their emerging market equity portfolios between 1989 and 1992 (p.54).

Figure 1.1 reproduces the portfolio equity flow to the emerging stock markets, throughout the world, from 1985 to 1997. As shown, in 1985, funds flowing to emerging markets through equity portfolios were meager, amounting to US $100 million. Portfolio equity gradually increased, to reach US$ 11 billion in 1992. But it did not begin its significant increase until 1993, when it reached US$ 45 billion. Then it witnessed a decline in the following two years, 1994 and 1995. In 1996, funds flowing to emerging markets reached a peak of US$ 45.8 billion. After the Asian contagion of 1997, the equity portfolio declined by 30 percent to US$ 32.5 billion. Despite this big reduction of the flows of funds to emerging markets, these markets are still promising candidates to receive more flows of funds in the near future (IFC, 1998).

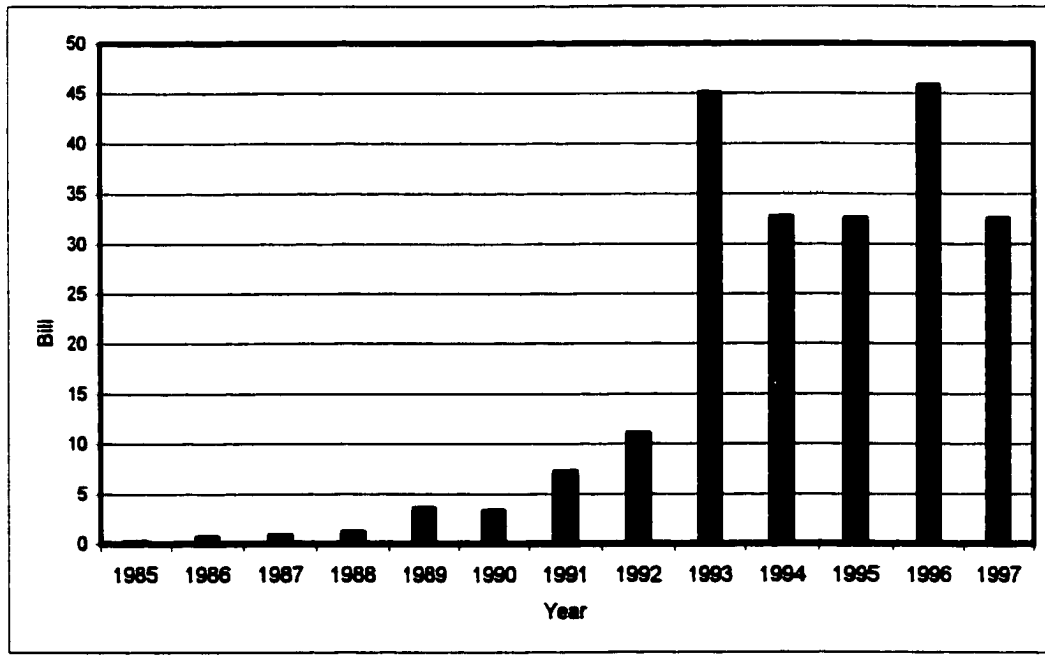


Figure 1.1 Portfolio Equity Flow to Emerging Markets

Of great importance in emerging market development are the quantitative and qualitative indicators of these markets. Since it is hard to measure qualitative indicators, especially in developing markets, it suffices to compare quantitative indicators. Such indicators as market capitalization, values of traded shares, as well as number of listed firms, have increased substantially in all the emerging markets. Within eight years (from 1990 to 1997), the total emerging market capitalization increased from only US$ 613 billion in 1990 to more than US$ 2,200 billion at the end of 1997. This is a substantial increase of almost 259 percent. In contrast, the developed market's capitalization has increased from US$ 8,784 billion in 1990 to approximately US$ 21,311 billion, an increase of almost 143 percent.

In addition, the dollar value of shares changing hands in all emerging markets has increased within the same period from US$ 899 billion in 1990 to approximately US$ 2,701 billion in 1997. This shows an increase of more than 200 percent. In comparison, the figures for all developed countries have increased from US$ 4,614 billion in 1990 to US$ 16,782 billion in 1997, an increase of 263 percent.

By the same token, the number of listed companies in all emerging markets has increased from 12,866 firms in 1990 to 19,937 firms in 1997, whereas the number of listed firms in developed markets has increased from 16,323 in 1990 to 20,656 in 1997 (IFC, 1997). All these indicators show the substantial and comparable changes these emerging markets have undergone and lead us to believe there will be more changes to come.

Table 1.1 in the appendix shows the three quantitative indicators mentioned above. The table compares these indicators among 14 selected emerging markets in different regions and the changes they have undergone between 1990 and 1997. It also compares the same variables among the 14 markets on one hand and the markets of the largest three economies in the world: Germany, Japan and the USA. During that period, the 14 emerging markets had an average market capitalization increase of 318 percent in comparison to 127 percent for the three developed markets. The increase in average value of shares traded in the 14 markets was 126 percent compared to 224 percent for the three developed markets. Despite lagging behind, the increase is considered substantial, bearing in mind that we included only 14 markets of the 80 emerging markets throughout the world. The average change in the number of listed companies in the 14 markets was 47 percent compared to 31 percent in the three developed markets.

Chapter II: The Saudi Arabian Economy and Its Capital Market

2.1: The Saudi economy and the role of oil

Not until the discovery of huge oil reserves in 1932 was Saudi Arabia introduced to the outside world. Despite a severe shortage in water, the Saudi's land is blessed with large reservoirs of crude oil and natural gas. Nowadays, more than 26 percent of the world's proven crude oil is in SA. In the mid 1970s the country became one of the world's major producers and exporters of oil. This fact contributed greatly to changing the structure of an economy that used to be dependent on agriculture and some artisan products. The nation's oil revenues began to increase by the end of 1973 when OPEC (Organization of Petroleum Exporting Countries) embargoed the western world. The result was an increase of SA's oil prices from an average of US $1.90 per barrel to US $9.76 per a barrel within two years (1972-1974). During 1978-1980, when oil prices took another sharp increase from an average of US $12.70 to US $28.67 per a barrel, the country's revenues continued their rise until they reached their peak of US $102 billion in 1981 (Baily and Friedman, 1995).

Since these revenues belonged to the SA government, they found their way into massive development programs that gave the country a more developed infrastructure. As a result, there was an improvement of all sectors of the economy, including the financial sector. Figure 2.1 shows SA's GDP and oil exports from 1970 to 1997. As that figure displays, the strong positive correlation between the country's GDP and oil exports reflects the fact that economic activities in SA are positively

correlated with oil prices. In 1972, SA's GDP was only 40.5 billion Saudi riyals[1] (S.R.) (US $10 billion), a figure that had increased by more than 240 percent within two years to reach more than 139.6 billion SR (US $39.3 billion) by the middle of 1974 (SAMA, 1997). This correlation persisted also in the 1980s with the 1986-1987 GDP being the lowest, a reflection of the lowest world oil prices during those years.

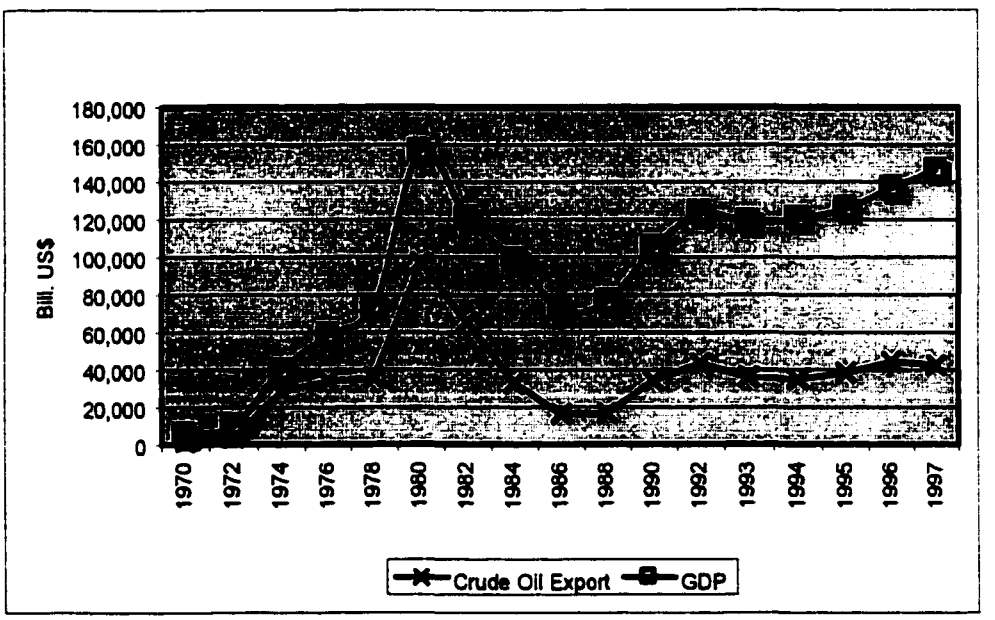


Figure 2.1 Saudi Arabian GDP and Oil Exports

Saudi Arabia had adopted a five-year plan system that began with the first plan in 1970. The country currently is in the sixth plan, which began in 1995. Because one of the major goals of SA is to end its complete dependency on oil, the average non-oil GDP growth reached approximately 6 percent during the first five plans (1970-1994).

The current development plan continues its goal of diversifying the country's income sources by encouraging the private sector to take its role in economic and social development. This is clear from the tendency of the government towards more economic liberalization and privatization. The goal of privatization is meant to achieve more economic efficiency and ease the burden on the government (MOPP, 1995).

Under the current situation of continuing government budget deficits, private capital is seen as the only source to finance new projects. Projects such as power stations, desalination plants, and telecommunication equipment need huge amounts of funds that the government is no longer able to provide. Besides the wholly government-owned enterprises, such as the Saudi Airlines and Saudi Ports Authority, the government holds substantial shares in 38 companies whose shares are traded on the SA stock market. The government's intention is to gradually reduce its holding in these companies. In addition, it will sell to private entities up to 49 percent of commercially viable public establishments.

Yet, under the recent poor performance of the SA stock market, the environment is not ready for privatization because of insufficient demand in the market. Due to thin trading and lack of breadth of the market as a result of lax regulatory measures, the privatization program, at the current time, is questionable (Azzam, 1997). It is estimated that the contribution of the private sector into the GDP has increased from 21 percent during the second plan (1975-1979) to 45 percent during the fifth plan (1990-1994).

The growth of the non-oil sector in 1997 was 1.7 percent against 1.1 percent in 1996. Yet, in 1997, 87 percent of SA's exports' receipts were mainly oil based. These receipts were derived from crude oil, natural gas, and refined petroleum products. The growth of the oil sector in 1997 was 2.3 percent compared with 2 percent in 1996 (SAMA, 1998).

The stock market began to improve as the SA government realized that the country needed to have more saving channels, which are restricted because of the institutional factors which contrast with Western-style banking, namely, the prohibition of all types of usury.

2.2: The Saudi Arabian capital market

As is true for any country in the world, SA organized its stock market, as a seed for future capital market, in order to accomplish its development plan objectives. Among the objectives of the development plans were diversifying the country's resources, achieving balanced development through all regions of the country, and increasing the role of the private sector.

To ensure more diversity in the progressing private sector, the SA stock market was given special attention from regulators. It is believed that establishing the SA stock market will not only guarantee more balanced distribution of income among the social strata, but also it will protect the country's already established family-owned entities from disappearance as the original founders of entrepreneurs die. Also, an organized market is able to siphon savings and provide means of investment to those who have neither managerial ability nor the financial worth to establish their own businesses.

In 1985, the Saudi government began regulating the market in order to protect investors from the adverse effects of speculation. Since that time, the structural and operational system of the SA stock market continues to develop.

Presently, the Saudi stock market is one of the emerging markets around the world that offer good opportunities for investment. In 1997, market capitalization reached US$ 59.3 billion, and the number of publicly traded firms was 71. Despite being semi-closed, the market is promising for international investors, for it is characterized by high growth rates of both market capitalization and value of shares traded. In addition, the market is relatively secure in terms of currency risk (i.e. unstable exchange rate) and operational risk.

Despite the fast growth of the stock market during the fifth plan (1990-1994), the capital market in general is beset by several major pitfalls that have inhibited the efficiency of the stock market. First, the capital market is narrow because it includes the companies' shares only, neither corporate bonds nor government bonds which are interest-bearing bonds issued by the Saudi Arabian Monetary Agency (SAMA). Even though SAMA's charter prohibits the agency from paying or receiving interest[2], SAMA, by the order of the Ministry of Finance (MOF), does issue some bonds (i.e. development bonds and floating rate notes)(SAMA, 1998). Yet, these bonds are illiquid, for they cannot be traded. Banks can either keep bonds to maturity or sell them back to the state (Seznec, 1995). According to Azzam (1997), the country's outstanding debts through bond issuance reached US $100 billion in 1996. Moreover, corporate bonds, though legal, are still not widely accepted by the public in SA. In addition, corporations do not need to issue bonds at this stage, for the market has huge liquidity in search of investment havens, not to mention the negative view the public has towards bond-issuing firms for religious reasons. Yet, the inability of corporations to issue debts prevents them from the benefits of financial leverage, which results in less optimal financing options.

The second major pitfall that inhibits efficiency is that the market's ability to serve investors is not suitable to the current fast growth of the private sector. Investors in any market would not be willing to forego their savings when the market is thin, which is the case of the SA stock market. Third, the stock market is still small and limited. In 1997 there were only 71 registered firms that are publicly traded. In addition, dealing is limited to Saudi citizens and in Saudi shares only. There are,

however, some exceptions with regard to Gulf Cooperation Council (GCC)[3] citizens and other countries' citizens through the US$ 250 million closed-end fund that was inaugurated in August 1997. Recent developments have allowed foreigners to invest in the stock market through mutual funds managed by Saudi banks.

A: Structure of the Saudi stock market

The seeds of Saudi stock trading started in 1935 with the establishment of the first joint-stock company to go public at that time, the Saudi Arabian Car Company. In 1954, the Arabian Cement Company was offered to the public, followed in the 1960s by electricity companies. In the 1970s, the Saudi government Saudized the joint stock foreign banks operating in SA. However, a great stake (40 percent) in these banks still remains in foreign partie's control. The end of 1986 saw more joint stock companies offered publicly.

In 1997, the number of new companies registered by the Ministry of Commerce (MOC) was 428, of which four were joint stock companies that intended to be listed in the near future. Table 2.1 shows the total number of companies operating in SA through the end of 1997. By the end of that year, there were 109 joint stock companies with a total capital of SR 82,724.1 million (US $22,059.8 million). Of these companies, 71 are listed in the stock market with a total capital of SR. 76,150 million (US $20,306 million). With about 54,128 private legal entities in SA, the number of joint stock companies, let alone those publicly traded, is considered small by all measures. The rest of the joint stock companies will be offered publicly after meeting the MOC's criteria. The numbers of other legal forms of Saudi companies are shown in the table. Those types of partnership and proprietorship, though they are not permitted to be traded publicly, do reflect the increasing size of

the private sector in SA. They are also entitled legally to change their type of partnership to joint stock companies for future listing on the SA stock market.

Table 2.1 Legal Forms of Companies in SA

Legal form of a firm	Number	Capital (US$ Mill.)
Joint-stock companies	109	22,059.8
Limited liability partnerships	5,505	18,833.3
Joint liability partnerships	2,379	1,044.1
Mixed liability partnerships	969	472.5
Individual proprietorships	45,166	NA
Total	**54,128**	**42,409.6**

Source: SAMA's annual report (1998).

In the absence of regulation, by 1986, informal trading was the common trait of the market. Until the end of 1985, there were only about 80 brokers operating in the market. After the "Souk Almanakh"[4] crisis in neighboring Kuwait, the Saudi government took the issue of regulation seriously (Azzam, 1997).

As a result, the MOF, the MOC, and SAMA formally established a ministerial commission in 1983. The main task of the commission was to regulate, monitor, and improve the stock market's performance. The MOC is the main body that oversees the primary market, specifically, initial public offerings (IPO) and the process of underwriting new shares into the primary market as well as regulating the company's affairs.

SAMA's task, however, is to oversee daily circulation of shares into the secondary market. In addition, it is SAMA that establishes the rules that regulate the market's conditions.

In 1984, SAMA ended the informal brokerage system. Instead, banks were given the authority to execute trading in the market, though banks were not allowed to act as market makers (Azzam, 1997). Table 2.2 shows some of the stock market's activities for the period 1986 to 1997.

Table 2.2 SA Stock Market Activities (1986-1997)

Year	Number of Transactions	Shares Traded (US$ mill.)	Turnover Ratio	Number of Listed Companies	Market Cap. (US$ mill.)
1986	10,833	221.3	1%	46	16,560
1987	23,267	449	2%	51	19,840
1988	41,960	543	2%	52	23,200
1989	110,030	897	3%	54	28,613
1990	85,298	1,174	5%	56	26,053
1991	90,559	2,274	5%	58	47,973
1992	272,075	3,653	7%	58	54,960
1993	319,582	4,629	9%	64	52,560
1994	357,180	6,632	17%	66	38,693
1995	291,742	6,194	15%	69	40,907
1996	283,759	6,773	15%	70	45,893
1997	460,056	16,549	31%	70	59,457
Average % Change	**56%**	**54%**	**36%**	**4%**	**15%**

Source: SAMA's annual report (1997)

As shown in the table, the number of transactions as well as the value of shares traded in the Saudi market has continued to increase considerably. Both variables have had average annual increases of more than 50 percent during the period 1986 to 1997. However, the turnover ratio, which measures the percentage of the value of shares traded relative to market capitalization, is still low, with an average annual percentage change of only 36 percent, in comparison to other world markets. In 1997, the SA market turnover ratio of 31 percent was far below the average world markets ratio of 51 percent (IFC, 1998).

The weak turnover ratio comes as a result of a wide bid-ask spread due in large part to poor transparent information regarding corporate performance and the actions of noise traders. In addition, it is estimated that more than 52 percent of total shares issued by Saudi companies are held by bodies that do not trade, such as government entities and foreigners. Within the same period, the table shows that both the numbers of listed companies and market capitalization have had average annual increases of 4 percent and 15 percent, respectively.

Since there are no brokerage houses in SA, commercial banks act as brokers or agents in the stock market. In 1984, a coalition of all Saudi banks established a company for registering Saudi shares, the Saudi Shares Registration Company (SSRC). The role of this company is to facilitate share registration after each transaction and make settlement and clearance of stock market operations through its advanced electronic clearance and settlement system that was set up in 1989 (SAMA, 1997). The SSRC receives orders from banks and then processes them through its electronic system. It also reports daily trades to SAMA (Butler and Malaikah, 1992). At the current time, trading is executed through the advanced Electronic Securities

Information System (ESIS). The system connects SAMA to 500 bank branches dispersed throughout the country (Azzam, 1997). The ESIS has contributed significantly to the development of the Saudi stock market. The system is capable of completing share sales and purchases in real time (T+0)[5]. Such a factor will definitely enhance the operational efficiency of the market.

The stock market in SA is composed of six sectors: the banking sector, the industrial sector, the cement sector, the services sector, the electric sector, and the agricultural sector. The total value of shares traded in all the six sectors has increased considerably within six years, from approximately 13 billion riyal (US $3.6 billion) in 1992 to about 62 billion riyal (US $16.5 billion) in 1997. By the same token, the number of annual transactions has increased by almost 70 percent for the same period, from only 272,000 in 1992 to 460,000 in 1997.

Figure 2.1 compares movement of shares among the six sectors in years 1992 and 1997. In terms of the number of shares traded, the market in 1992 was not so active. However, all sectors' movement of shares traded increased considerably in 1997. The average percentage increase in the same period was more than 750 percent. As shown in the figure, the average number of traded shares reached 52.3 million in 1997 from a meager number of 5.9 million shares in 1992.

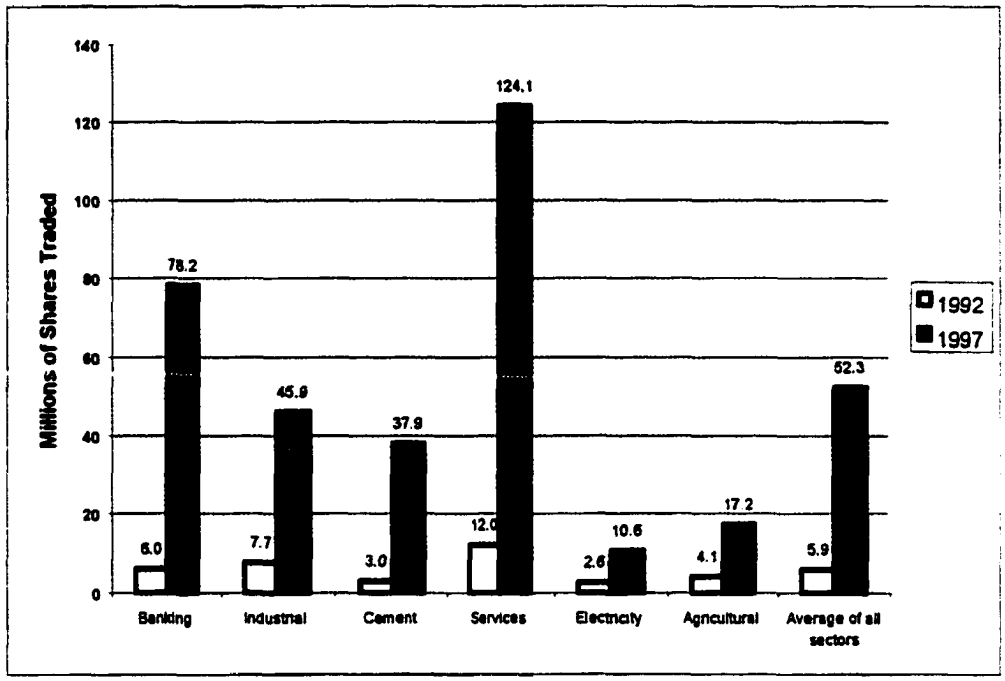


Figure 2.1 Number of Shares Traded in Each Sector

Yet, the composition of the activity has changed, as shown in Figure 2.2, which compares each sector's percentage weight of shares traded in 1992 versus 1997.

Among the six sectors, only three of them, banking, cement and service witnessed an increase in the percentages of annual number of transactions relative to the total number during the six-year period. The others have declined. The service sector got the lion's share of the annual number of traded shares relative to total market in years of comparison, followed in 1997 by the banking sector which ranked third in 1992. The industrial sector occupied the third position in 1997, dropping from the second place in 1992 (SAMA, 1997).

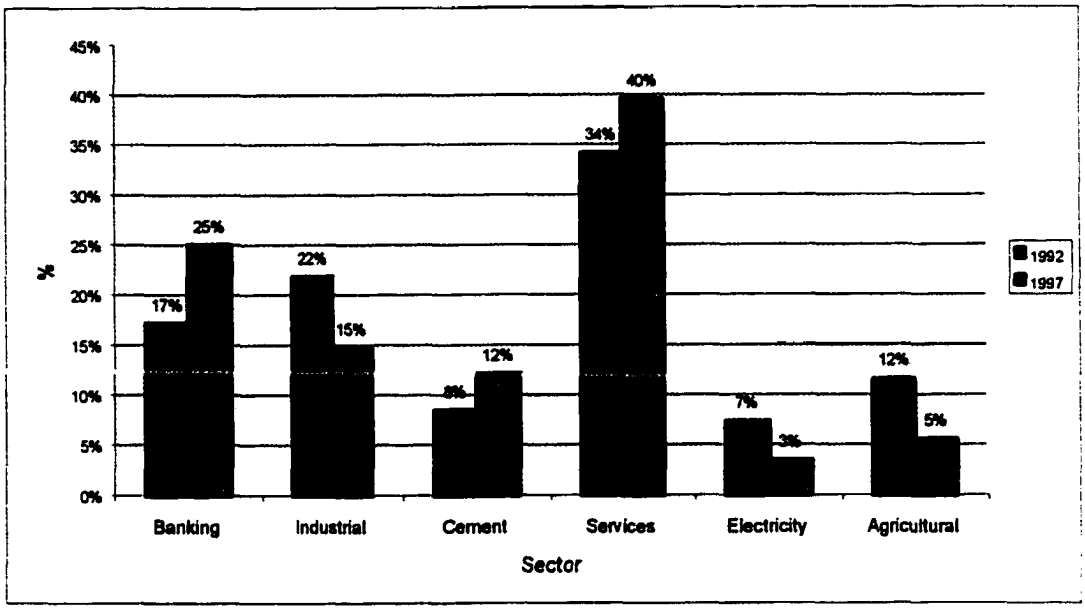


Figure 2.2 Composition of Shares Traded by Sector (1992 Vs. 1997)

B: Saudi Arabia as an emerging market

In April 1997, the IFC, a member of the World Bank, announced that it would incorporate the Saudi stock market index as part of the IFC's Global Composite Index. The move of the IFC implies several important features the Saudi market has shown in recent years. Along with other emerging markets around the world, the Saudi market has certain structural, operational, and financial parameters. Among these parameters are settlement procedures, accounting conventions, growth in market capitalization, new listings, and volume of trade.

Although most emerging markets have completely removed the ban on foreigners investing in their stock markets, the Saudis have not yet reached such a stage. Nevertheless, foreign investors have been given indirect access to the Saudi market through a closed-end fund and recently through mutual funds. In addition, citizens of the GCC have access to invest up to 5 percent in all Saudi stock except the banking sector. The inclusion of the Saudi index in the IFC global index, allowing the

GCC citizens to invest in the Saudi market, as well as opening the closed-end fund and mutual funds to foreign investment, are all signs of new era of financial market liberalization.

Relative to 103 markets around the world, both developed and emerging, the Saudi market ranked number 30 in terms of market capitalization in 1997. With market capitalization of US$ 59.3 billion in 1997, it has shown an increase of almost 30 percent relative to 1996 market capitalization of US $45.8 billion. This considerable growth in the Saudi market capitalization brings it up to 11^{th} place among 80 emerging markets. Figure 2.3 shows a comparison of the highest 15 emerging markets as of 1997 in terms of market cap denominated in billions of US $.

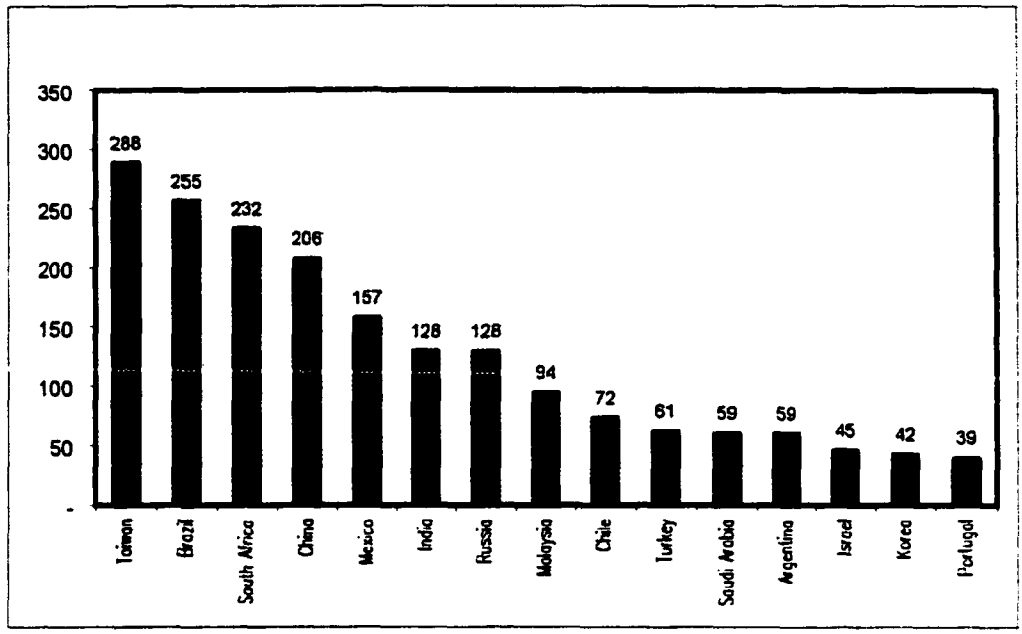


Figure 2.3 Largest 15 Emerging Markets Cap. (1997)

Table 2.3 in the appendix shows the ranking of the Saudi market relative to 16 emerging markets in terms of value of shares traded. It also depicts the size of the Saudi market relative to GDP in comparison to the other emerging markets. While the Saudi market ranks 11th in terms of market capitalization (as shown before in figure 2.3), it occupies the 16th position among the emerging markets in terms of value of shares traded. This value was less than the average of the 16 emerging markets in the table. Having values of shares traded and a turnover ratio far less than the averages of the 16 markets in the table is a clear reflection of market thinness at least relative to these markets.

In terms of the weight of market capitalization relative to GDP, the SA's 16 percent in 1997 remains far less than the average percentage ratio of 48 percent of the 16 emerging markets in the table. This indicates that economic activities in SA are still dominated by the public sector and hence not financed in large part through equity issuance.

In addition, the ratio of value of shares traded relative to GDP was 12 percent in 1997, less than the 70 percent average of the 16 markets.

The average Saudi company size in 1997 was US $ 848.4 million, well above the average company size in all the 80 emerging markets. In terms of the average company size criterion, figure 2.4 in the appendix shows the first fifteen markets around the world, both developed and developing. The Saudi market occupies the 11^{th} position, ahead of several large markets such as Mexico, Taiwan, and Hong Kong.

The large average size of the Saudi company manifests the strict screening the MOC imposes on firms before they can launch an IPO. For example, for a company to go public in SA, the law stipulates that it have minimum net assets of S.R. 75 million (US$ 20 million) and a return on equity no less than 10 percent for any of the five years prior to the IPO[6]. Moreover, a large part of the explanation stems from the exaggerated market capitalization due to heavy speculation in the market by a few investors.

Relative to other Arab emerging markets in 1997, the Saudi market occupies the first position in terms of market capitalization with 44 percent, followed by Kuwait and Egypt, 19 percent and 15 percent, respectively. The other six Arab markets collectively account for half of the Saudi market capitalization. However, the SA market occupies the second position among the Arab emerging markets in terms of value of shares traded, as shown in table 2.4 in the appendix.

C: Openness of the Saudi market

Recent changes in the Saudi regulations have allowed foreigners to invest in the Saudi stock market through mutual funds managed by Saudi banks. However, there is a limited percentage of the total traded stocks these mutual funds can invest. Yet, the initiative by the Saudi regulators is a step forward to a more liberalized market. With regard to other Arab markets, only five of them, to varying degrees, allow foreigners to invest in their stocks. Table 2.5 compares the degree of openness in the ten Arab markets:

Table 2.5 Degree of Openness in 10 Arab markets

Country		GCC nationals	Foreigners	Repatriation of capital & dividends
GCC	Bahrain	Open	Residents for at least 3 years allowed up to 1% of any firm's capital	NA
	Kuwait	Open	Allowed through mutual funds	Allowed
	Oman	Open	Through mutual funds, up to 49% of listed stocks	NA
	SA	Up to 25% of listed stocks other than banks	Through mutual funds, up to 49% of listed stocks	Allowed
	UAE	Open	Not allowed	Allowed
Other Arab Countries	Egypt	Open	Open	Allowed
	Jordan	Up to 50% of a firm's capital	Up to 50% of a company's capital	Allowed
	Lebanon	Open with some restrictions on Real Estate firms		Allowed
	Morocco	Open	Open	Allowed
	Tunisia	Open with 49% constraint		NA

Source: Azzam (1997). NA: no available information

Chapter III: Literature Review

3.1: Origins and definitions of EMH

When talking about the efficient market hypothesis (EMH), we should emphasize that it is an informationally efficient market with which we deal, but not the allocational or pareto efficient market. Efficiency means that all relevant information regarding a stock is reflected in its market price. Because market participants take advantage of even the smallest piece of information and include it into market prices, they eliminate the profit opportunities. Their action leads, under costless trading, to market efficiency, for prices do reflect all available information. Therefore, no profits can be made from information-based trading (Lo, 1997).

The EMH, therefore, differs from the traditional approach, which contends that forecasts of at least some security analysts contain information that is not completely incorporated into market price. This approach claims that there are differences in analysts' estimates because some analysts, through their superior knowledge of technology, economics, and industries, can make better than average forecasts, which lead to superior returns (Elton and Gruber, 1987).

There are three forms or levels of market efficiency in the literature: the weak form (WFEMH), the semi-strong form (SSFEMH) and the strong form (SFEMH). The weak form efficiency is said to exist if all the information regarding past price movements is reflected in the current stock price. Under this form, the information set is just historical prices that should offer no prediction of future changes in prices. In

this case, no charts or analyses based solely on past prices can help to obtain abnormal profits. Put differently, no profit opportunities are left unexploited, hence the end result is a fair game. The fair game results from the fact that no prior expectations will be biased. Hence, under a fair game, on average, expected return on an asset equals its actual return (Fama, 1970). It implies that expected profits to speculators should be zero.

The semi-strong form is reached when all publicly available information is reflected in the stock price. Thus, one cannot make abnormal profits by looking at publicly available information such as stock price movements, volumes of trade, announcements of annual earnings, stock splits, and so on. The strong form, on the other hand, exists if all information including nonpublic information is reflected in the stock price. This form is concerned with accessibility to any relevant information and whether a group of people enjoys monopolistic access to such information (Fama, 1970). In such a case, even insiders would find their use of private information futile since, if the market is strongly efficient, such information would be reflected in the stock price (Levy and Sarnat, 1984). The strong form of efficiency encompasses both the weak level and the semi-strong one.

Historically, empirical work was concerned only with the weak form tests; specifically, the random walk literature. After realizing the extensive support for that level especially in advanced markets, researchers turned their attention to the semi-strong form test, which is concerned with the speed of price adjustment to publicly available information. And finally, empirical testing of the strong form appeared. The classification of the EMH into three levels allows a person to identify the level of information at which the hypothesis breaks down (Fama, 1970).

From the above definitions, one realizes that the EMH concentrates on the conditions under which an investor can earn excess return in the stock market (Elton and Gurber, 1987). What makes the study of the EMH important is the lack of consensus among economists and financial analysts regarding whether markets are efficient. In addition, lack of efficiency of the market reflects wrong signals to both suppliers and users of capital. Such signals might lead both groups to employ wasteful techniques of exploiting inefficiency. Thus, the importance of the EMH stems from the fact that economic agents are in search of more reliable market mechanisms (Keane, 1983).

What makes a stock market distinct from other markets is the fact that it is a highly organized and elaborate information type of market. To be more specific, it is characterized by the rapidity with which information disseminates within the market. These types of markets around the world do employ the most recent informational technology, signaling the importance of speed in spreading information (Keane, 1983).

Yet, perfectly informationally efficient markets do not exist because, if they did, the return on collecting information would be zero and there would be no reason to trade, which would result in market collapse (Lo, 1997). In reality, many market participants do profit from the market, which proves the existence of inefficiencies. Fama (1970) points to market conditions under which it is obvious that efficient adjustment of prices to information takes place. His hypothesis is that if there are no transaction costs in trading securities, information is costlessly available to all market participants and all participants agree on the implications of current information, then it is needless to say that prices fully reflect all available information. However, Fama

adds, existence of such a market is doubtful (p.387). Therefore, the market might be efficient if sufficient numbers of investors have ready access to available information.

We could say, then, that the absence of market conditions mentioned above are not necessarily causes of market inefficiency, but they are potential ones (Fama, 1970). Therefore, the challenging issue of determining the EMH is an empirical one.

The WFEMH rules out technical analysis, which assumes stock price movements follow some sort of repetitive pattern as a profiting technique because all relevant information is contained in the past history of stock prices. Therefore, such analysis by "chart trading" is considered a waste of time. The task then is to show that, empirically, stock prices follow apparent cycles, but only randomly.

One way of testing the presence of cycles that could be used in forecasting future price movements is the so-called "filter rule"[7]. A number of researchers[8] have used this technique and concluded that share prices do not follow consistent cycles over time; hence, future prices cannot be predicted from past history (Houthakker and Williamson, 1996). Other proponents of the WFEMH assert that prices exhibit a random walk[9](RW), hence their expected values in the next period is the same as its most recent value. Researchers have employed autocorrelation and runs tests as tools for examining the RW.

3.2: Empirical Testing of Weak-Form Efficient Market Hypothesis

A: Autocorrelation and runs tests of developed markets

Despite the widespread departures from a RW in the 1970's, the markets now, especially in developed countries, conform to a RW. Thus, there is growing evidence supporting the weak form of EMH. This fact does not necessarily mean that prices are constant on average, but they exhibit a long-run upward trend while fluctuating randomly. Thus, stock prices are said to follow a RW with drift (Houthakker and Williamson, 1996).

The French mathematician Bachelier in 1900 did the first test of a RW on the behavior of security prices in the Paris Bourse (Campbell et al., 1997). His principle was that the behavior of prices should be a fair game. Kendall (1953) did extensive analysis of autocorrelation in some share prices in Britain and the USA. He states that "The series looks like a "wandering" one, almost as if once a week the Demon of Chance drew a random number from a symmetrical population of fixed dispersion and added it to the current price to determine the next week's price."

According to Fama (1970), Kendall, Workings and Roberts concluded that a series of speculative prices follow a RW. Fama also states that Osborne in 1959 provided an economic rationale behind the independence of successive price changes. His rationale claims that the decisions of investors in an individual security are independent from transaction to transaction, which is one reason why we see such independent price changes (Fama, 1970).

Cootner (1964) asserts that price changes result from the emergence of new information. And since such information is random in appearance, stock price movements should follow an RW, which means they are statistically independent

(p.232). Fama (1965) examined the log of the daily stock prices of the Dow-Jones Industrial Average using both correlation coefficients and runs tests. He found a very small positive correlation, which was not statistically different from zero, while the number of runs was smaller than expected which indicates the positive correlation found by the autocorrelation test. Yet, this finding suggests that any dependence on these series is not strong enough to be used to generate profits. Under the finding of weak or no-dependence, one cannot conclude in favor of market inefficiency. Fama (1965) warns that the simple linear relationship is unsophisticated, and thus might not pick up the complicated patterns that a chartist sees in stock prices.

Dryden (1970) conducted a similar method of testing applied to the log of daily prices of 15 shares in the UK. In order to determine whether these prices follow a RW, he applied both autocorrelation and runs tests. With regard to the first method, he found no evidence to refute the RW hypothesis. However results from the latter method seemed to give evidence of dependence, for the number of actual runs was less than what would be expected under the assumption of independent price changes indicating the existence of positive correlation. The fact is, however, that the difference between the actual and expected number of runs did not exceed 10 percent. This led him to regard his findings as evidence of the RWH in accord with the research carried out by Fama (1965) on the Dow Jones. Yet, Dryden asserts that his findings cannot be definitive because the time series used in the study were short and for a small number of shares.

Conard and Juttner (1973) tested the efficiency of the German stock market using both autocorrelation and runs tests. Their data covered daily prices of 54 stocks for the period 2 January 1968 to 22 April 1971. The results of the autocorrelation test

revealed dependence in most of the stocks, whereas the runs test demonstrated significant non-random behavior in the series. According to the authors, the degree of dependence discovered by both tests was remarkable.

Al- Loughani and Chappell (1997) tested the validity of the weak form of EMH for the Financial Times Stock Exchange (FTSE) 30-share index using daily price changes covering the period 30 June 1983 to 16 November 1989, a period which they describe as free of changing government economic policy toward financial markets. Despite most earlier studies' supportive conclusions of the WFEMH, they concluded that the FTSE 30 does not follow a RW. Hence, the WFEMH is not valid for the FTSE 30.

B: Autocorrelation and runs tests of developing markets

Other empirical studies also have been conducted in some developing countries. Laurence (1986) applied both the autocorrelation and runs tests on the Kuala Lumpur Stock Exchange (KLSE) and the Stock Exchange of Singapore (SES). Data of the study were composed of individual stock price observations from 1 June 1973 through 31 December 1978 for the KLSE and from 1 January 1973 through 12 February 1978 for the SES. Results of both tests suggest some deviation from perfect weak-form efficiency on the two markets.

Parkinson (1987) examined the WFEMH of the Nairobi Stock Exchange (NSE). Using monthly prices of individual companies quoted from 1974 to1978, he calculated the first-order autocorrelation. He found a strong negative correlation between share prices at end of succeeding months. According to Parkinson, data deficiencies, principally lack of price quotation at month ends, were the main culprit behind half of these extreme results. He also used the nonparametric test of runs up

and down to test the randomness of the data. Of the 50 companies in the NSE, 49 exhibited fewer numbers of runs than expected. Accordingly, the hypothesis of randomness was rejected for these data. Hence, in the NSE, the astute investor would be able to predict the movements of share prices and earn abnormal profits. This finding contradicts the EMH.

Civelek (1991) tested the efficiency of the Amman Stock Exchange (ASE) in Jordan. He examined daily price changes of 15 industrial firms for the period from 1 January 1988 to 3 March 1989. Using both autocorrelation and runs tests, he discovered that daily price changes of the ASE exhibited large positive dependence and revealed lack of randomness. Accordingly, the ASE is not weakly efficient.

Borgia (1991) employed both autocorrelation and runs tests to examine the efficiency of the Securities Exchange of Barbados (SEB). The study employed data for all the 14 stocks listed in the exchange covering the period from August 1987 to August 1990. With regard to the autocorrelation test, only one stock return was significantly autocorrelated based on both monthly and daily returns, while results of the runs test showed significant dependence in successive returns in two stocks of the monthly returns and in only one stock of the daily returns.

Butler and Malaikah (1992) tested out the EMH of the Kuwaiti and Saudi stock markets. They used daily stock returns of the two markets for the period 1985 to 1989 of 54 and 59 stocks in SA and Kuwait, respectively. In order to avoid the effect of thinness in both markets on the results, 19 Saudi stocks and 23 Kuwaiti stocks were dropped from the sample. The reason for dropping them was that they were traded on less than 10 percent of trading days. Hence, the sample consisted of 35 and 36 stocks for SA and Kuwait, respectively. The results they reached were different.

All the 35 Saudi stock showed significant departure from the RW. There was strong negative autocorrelation in the successive returns of SA stocks. The runs test revealed consistent results. The results in the Saudi market are similar to those of thinly traded markets.

The autocorrelation test of the Kuwaiti market showed results similar to those of thin markets, too. Stock returns in that market exhibited statistically significant autocorrelation. However, price change runs in the Kuwaiti market resemble those of active markets.

Following the same method, Muradoglu and Unal (1994) examined the EMH in the Istanbul Securities Exchange (ISE). Their hypothesis was that the ISE is weakly inefficient. They employed daily data for 20 listed stocks for the period from 1 January 1988 through 31 December 1991. Their findings were not in support of the EMH. They therefore concluded that above-normal profits are present in the ISE due to the informational inefficiency in the market.

Urrutia (1995) conducted a test of efficiency in four Latin American emerging markets. He used monthly data of index prices in local currency for the period December 1975 to March 1991. Employing the runs test, he obtained results that revealed weak-form efficiency for the four Latin American markets.

Dockery and Kavussanos (1996) investigated the empirical efficiency of the Athens Stock Market (ASM). They used stock price monthly data for the period from February 1988 to October1994, and performed a joint test of efficiency over all stocks. By rejecting the RW hypothesis for stock prices, a necessary condition for stock market efficiency, they ended up with results contradicting the EMH of the ASM.

Ahmad and Erdem (1996) tested the weak-form efficiency of the Karachi Stock Exchange (KSE). Their data included the daily prices of the 24 most actively traded stocks. The data covers the period between 1 January 1991 and 31 July 1994. Following Fama's methodology, they employed autocorrelation and runs tests. The results they reached were that the individual stock prices of KSE do not conform to the RW hypothesis. They concluded that the evidence had failed to support the WFEMH.

Hsiao (1996) tested out the weak efficiency of the Shanghai Securities Exchange (SSE). He used stock returns of 190 securities for the period from January 1993 to May 1995. Employing the autocorrelation test for both daily and weekly returns, he found 18 securities, of the daily sample, significantly autocorrelated, whereas the weekly returns showed only 10 significantly autocorrelated returns. These findings are similar to Fama's study of 1965. Hsiao also used the runs test for randomness and found out that for daily returns, 48 turned out to be non-random, whereas the results of the weekly returns were less significant because there were only 3 non-random securities returns.

Antoniou et al. (1997) tested the weak-form EMH for the Istanbul Stock Exchange (ISE) using daily closing prices for 63 stocks for the period January 1988 to December 1993. Since thin (or infrequent) trading may induce autocorrelation between consecutive returns, they carried out the analysis for both unadjusted and adjusted-for-thinness returns. For the unadjusted returns series, out of the 63 companies, 60 (95 percent) exhibited dependence, which suggested inefficiencies of the ISE. But after adjusting for thin trading, they found 41 firms of the 63 exhibited serial dependence. Despite the improvement with adjusted returns the companies' consecutive returns still show dependence in 65 percent of the total. Hence, according to their results the ISE is weakly inefficient.

C: Filter test

Since the weak-form EMH suggests that all relevant information contained in the past history of stock prices will be reflected in the current price, technical analysis known as "chart trading" would therefore be a waste of time. Chartists believe that stock prices follow some repetitive pattern, hence they could be predicted. A great deal of research has put that assumption under investigation. One test for the presence of cycles is to compute the performance of the filter rules and compare it to the simple buy-and-hold policy. The technique used is that a person buys a stock after it has risen x percent from a low because it signals that an upward cycle has begun. Hold that stock until its price falls by x percent from its most recent peak, then go short. When the stock again rises by x percent from its most recent bottom, establish a long position again (Houthakker and Williamson, 1996).

A number of researchers have tracked the performance of the filter technique relative to that of the buy-and-hold policy. Alexander (1961) reported tests of filter technique for filters of different sizes. His tests covered different time periods for two indexes: the Dow-Jones Industrial Average and the Standard and Poor index. The results of his tests revealed that filters of different sizes yielded substantial profits, greater than that of buy-and-hold policy profits. Accordingly, the independence assumption of the RWH was not supported by his data. Therefore, chartists would be able to take advantage of the two indexes and beat the market.

Fama and Blume (1966) applied the test on daily closing prices of the individual securities of the Dow-Jones Average for the period from 1956 to 1962. They used twenty-four different filters ranging from 0.5 percent to 50 percent. Their final findings depend on whether the data are adjusted for dividends and commission or not. They argued that adjustment for dividends increases the advantage of buy-and-hold over the filter technique by at least 2 percentage points. Therefore, their analysis of the filter method by security has not produced evidence of significant dependence, which supports the EMH.

Dryden (1970a) has also applied the filter technique and tested the independence assumption of U.K. share price changes using three index daily numbers, which cover a four-year period from 1963 to 1966. He concluded that the U.K. stock market indexes tend to follow some pattern and indicate sufficient divergence from the independence assumption under the RWH.

D: Cointegration test

Economic theory predicts that certain pairs of economic variables should not depart, in the long run, from each other. Granger (1986) asserts that the correctness of such a relationship is an empirical question (p.213). Since cointegration implies the existence of Granger-Causal orderings among series, asset prices in a weakly efficient market cannot be cointegrated. Thus, cointegration can be used as a basis for testing asset market efficiency. Notwithstanding, one has to bear in mind that the exact form of EMH differs depending on the market under investigation. If one, for instance, considers silver and gold markets, it should not be possible to forecast one price from the other. Hence, gold and silver prices should not be cointegrated. If one considers spot exchange rates in the foreign exchange market, it should not be possible to forecast one spot exchange rate from the other if the market is efficient. Because under EMH, spot exchange rates incorporate all relevant information, they should not be cointegarted across currencies (Maddala, 1992). By the same token, stock markets are said to be efficient if speculators cannot use one market index to forecast movement of the other. As a result, cointegrated stock markets are not efficient.

Coleman (1990) tested the efficiency of foreign exchange markets of 18 countries using log levels of daily spot bid and ask rates. The argument is that two spot exchange rates can't be cointegrated if they are determined in an efficient market. Because such cointegration allows for the ability to forecast one exchange rate using the other, Coleman's finding was that the behavior of daily exchange rates is described by a simple random walk model. Using both pairwise and higher order, he found little evidence of a cointegrating relationship. Thus, spot exchange rates are determined in a weakly efficient market.

Mananyi and Struthers (1997) examined monthly spot and futures cocoa prices on the London Futures and Options Exchange using cointegration. Their results suggest that cocoa spot and futures prices are not cointegrated. This finding contradicts the EMH, which necessitates the existence of cointegration between these two variables. The EMH suggests that futures prices (F_{t-1}) should be an unbiased predictor of spot prices (S_t).

Groenewold (1997) tested for semi-strong efficiency using the co-integration method between Australian and New Zealand share prices. The finding was that both countries' indexes cannot be cointegrated, a result which is consistent with the EMH. El-Sakka and McNabb (1994) tested the efficiency of the black market of foreign exchange in Egypt. Their hypothesis was that if the black market for foreign exchange was efficient, the purchasing power parity (ppp) theory would hold in the long run. Based on seven tests, their findings suggest the possibility of cointegrating the black market exchange rates depreciation and relative ppp. The result supports the ppp hypothesis and the supplementary hypothesis of market efficiency in the black market of foreign exchange rates in Egypt.

Hsiao (1996) tested for cointegration among four stock markets in Hong-Kong, Shanghai, Shenzen and Taiwan. The result obtained supported the idea of cointegration among these markets. There is at least one common force binding these markets during the sample period. Cointegration implies that at least one of the markets could not be weak form efficient. With cointegration existent, speculators would be able to take advantage of the inefficiency of the markets.

Yuhn (1997) used the cointegration method to test the assumption that market integration of different stock exchanges promotes efficiency of these exchanges. He therefore applied this method on a number of stock exchanges in the US, Canada, Japan, the UK and Germany. The data used were monthly stock prices and dividend indices for the period from January 1970 to March 1991. The main concern of the study was whether equity prices in national stock markets were cointegrated by a common stochastic trend.

The economic implication in international stock price movements is that national stock prices may be nonstationary, but combinations of them may be stationary. Then if price series in different markets are cointegrated, this might indicate the existence of inefficiency in these markets. The study findings were that the US and Canadian stock markets obey the long run equilibrium path implied by the cointegration model. But the Japanese, British and German exchanges showed no evidence of such characteristics. Consequently, the researcher claimed that the stock markets of the US and Canada are informationally efficient while those of Japan, the UK and Germany are not.

A similar approach was used by Palac-McMiken (1997) who examined the ASEAN stock markets. Using monthly data ranging from 1987 to 1995, he tested the assumption that these markets were collectively efficient. His argument was that if these stock markets were collectively efficient in the long run, stock prices should not be cointegrated. Results have shown that with the exception of Indonesia all markets under examination are linked with each other. Therefore, during the period of the study, these markets were not collectively efficient.

Niarchos and Alexakis (1998) have investigated the EMH using stock prices of common and preferred stocks from the Athens Stock Exchange (ASE). They used daily data for a period ranging from 1 July 1991 to 4 April 1994. Using cointegration and error correction models, they concluded that price movements of preferred shares follow the price movements of common shares in ASE. Hence, contrary to the prediction of EMH, the speed of adjustments to news of the two types of shares is different.

Ferret and Page (1998) tested the efficiency of four South African stock indexes by examining future contracts and their underlying spot market values. In their study, they utilized daily closing prices of the Johannesburg Stock Exchange (JSE) for the period ranging from 1990 to 1996. The research was centered around the lead-lag relationship between the spot and futures markets. The outcome of their study was that all the four series pairs were cointegrated and there was a long-term equilibrium relationship between each cash market instrument and its future contracts. As a result, the JSE indexes were not jointly efficient.

Yang and Leatham (1998) applied the cointegration approach in examining the efficiency of the major US grain markets. The data they used were daily closing prices for wheat, corn, oat, and soybeans covering the period from January 1, 1992, to December 29, 1995. They argued that cointegration among grain spot prices violates the weak form of the EMH. In conducting their test they employed both the bivariate and the multivariate, Johansen cointegration methods. Their test results proved no presence of cointegrated grain prices, which lend support to the EMH in the US grain markets.

3.3: Semi-strong and strong forms of Efficient Market Hypothesis

With regard to the other two forms of the EMH, the semi-strong form and the strong form, a number of tests have been conducted. Balaban and Kunter (1997) have tested the semi-strong form of the EMH in the Turkish financial market, which consists of, the stock market, the foreign exchange market and the inter-bank money market. They employed daily data of the three markets for the period January 1989 to July 1995. Their finding was that the informational efficiency of the three markets is rejected. Hence, the three markets in Turkey do not fully reflect publicly available information on liquidity. Their results are consistent with earlier research, which concluded that there is inefficiency in the three markets separately.

Ball and Brown (1968) tested the semi-strong form of the US stock market using income numbers for 1946 to 1966 from S&P Compustat tapes. To some extent, they found a support for the semi-strong form since they concluded that prices showed between 85percent to 90percent of adjustment before corporate income reports were released. According to Houthakker and Williamson (1996), their findings implied either of two conclusions: First, most of the publicly-released information contained in earning reports had already been perceived by market participants on the basis of other data such as macroeconomic conditions. Second, the market tends to adjust very quickly in response to the release of new information so that prices of equities reflect this information. Therefore, the market seems to be semi-strongly efficient so that no one can make abnormal profits by simply collecting publicly- available information (p.138).

Others tested the third form of the EMH. Jaffe (1974), for example, found out that the strong form of the EMH does not hold. Accordingly, by being an insider, one can outperform the market by trading on inside information.

Kara and Denning (1998) tested the efficiency of the US capital markets. Their hypothesis was that the US securities markets are strong-form efficient. Using the Securities and Exchange Commissions reported trades of insiders from 2 March 1979 to 14 July 1980, they constructed a log-linear regression. They looked at the profitability of insider trading as a function of risk aversion and transaction costs. Their empirical finding was that the US securities markets are not strongly efficient since insider trading generates positive abnormal profits.

Though the aforementioned literature review is far from exhaustive, it is sufficient to show the increasing interest of the literature in the RWH and the EMH.

3.4: Implications of EMH

A number of implications can be detected with regard to the EMH. First, there is wide support of the fact that public information is rapidly incorporated in stock prices. As a result, any attempt to earn excess return on the basis of such information in standard ways is futile. As a result, one should be careful when choosing stock simply on the basis of new publicly available information. Second, from his/her observation of the share price, an investor should be able to draw a conclusion about the information relevant to the prospect of a share, because under the EMH, share prices do reflect their intrinsic values. Third, good or bad news that is incorporated into stock prices should be defined relative to expectations. The analyst's job therefore is to find stocks that have more favorable characteristics than expected. The efficient market tests have found that price movements occur with securities that

show an unexpected change. Fourth, efficiency tests imply that returns can be generated by highly skilled market participants who use nonstandard ways of combining and analyzing information in obtaining information that is not available to others or in obtaining new information prior to any other market participants (Elton and Gruber, 1987). Fifth, operational efficiency is a prerequisite for informational efficiency. This efficiency is said to exist when trades are executed at the lowest possible transaction costs. Hence, the degree of informational efficiency would decrease if transaction costs were relatively large. With low transaction costs, however, traders would respond quickly and easily to any flow of new information relevant to stock prices (Houthakker and Williamson, 1996).

Chapter IV: Testing of Saudi Stock Market Efficiency

To test the efficiency of the Saudi stock market, an empirical work study was done. Most researchers who tested for efficiency in developing countries have concluded in either of the first two levels: weak level or semi-strong level. Since the Saudi stock market is no different from other thinly-traded markets, I tested for the WFEMH in SA. Butler and Malaikah (1992) have tested the SA stock market, as a part of their research of both the Kuwaiti and Saudi stock markets, and concluded that all firms' returns exhibited serial dependence when testing for autocorrelation (p.209).

Their study, however, covers relatively old data for the period from June 1986 to September 1989. In addition, the original version of their research was conducted in 1990 before the inauguration of ESIS, which moved transaction settlement from T+3 to real time (T+0). One would expect the new electronic system to enhance the operational efficiency that is a prerequisite to informational efficiency. Also, the SA market used to include 54 registered firms only. Nowadays, the number of publicly traded firms has reached 71. In addition, since the date of their study, several political, economic, and social factors have changed, thus changing the market environment. Moreover, Butler and Malaikah could not draw a clear conclusion with regard to the informational efficiency in the SA market. They asserted that it was difficult to arrive at with a final decision as to whether the SA market is informationally or operationally inefficient. The reason for such confusion, as they

put it, was that the SA market had been inhibited by institutional factors contributing to operational inefficiency. Among these factors were trading delays, illiquidity, market fragmentation, and the absence of official market makers.

After obtaining sufficient data for daily and weekly SA stock prices, I tested for the efficiency of the Saudi market. For this study, the autocorrelation test, the runs test, the filter technique test and the cointegration test were applied. If the RW hypothesis is empirically confirmed, one could say that the stock market is weak form efficient which means chartists do not have profitable opportunity.

4.1: Methodology of the study

Prices or returns that fully reflect available information are assumed to imply, first, independence between two successive price changes (returns). Second, they are also assumed to be identically distributed (Fama, 1970). One version of the RW hypothesis is the independently and identically distributed increments (IID) which are given by the following:

$$P_t = \mu + P_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim \text{IID}\ (0, \sigma^2)$$

μ is the drift or expected price change and ε_t is identically and independently distributed with mean of zero and variance σ^2. Campbell et al. (1997) state that "Independence implies not only that increments are uncorrelated, but that any non-linear functions of the increments are also uncorrelated" (p.32). One could, though, use the runs test, which is a common nonparametric test for RW hypothesis. Under such a test, we examine the randomness of runs by how runs behave in a random sequence of observations (Gujarati, 1995).

The assumption of identically distributed price changes is not convincing for financial data over long time spans. The determination of stock prices will be affected over a long period by economic, institutional, and regulatory changes. Therefore, it is easier to relax the assumption of identical distribution among increments (Campbell et al., 1997). It is hard, however, in time series data to test for independence without assuming identical distribution. Therefore, some nonparametric methods could be applied to test for independence because such tests do not require identical distributions. The filter rule is also a way of testing without the requirement of identical distribution.

A more general version of a RW hypothesis, which is often tested in empirical studies, does relax the independence of distribution assumption. This version includes dependent but uncorrelated increments. Under such a method, for instance,

$$\text{Cov.}[\varepsilon_t , \varepsilon_{t-k}] = 0 \quad \text{for all } k \neq 0 \text{ , but } \quad \text{Cov.}[\varepsilon^2_t, \varepsilon^2_{t-k}] \neq 0 \quad \text{for some } k \neq 0.$$

It has uncorrelated but not independent increments (Campbell et al., 1997).

4.2: Data description and distribution of returns

We used daily and weekly average prices of the listed shares in the Saudi market. Before we analyze the results, one should mention that daily and weekly prices have been adjusted for stock splits. The reason for adjustment is to avoid any effect the process of splitting might cause in real stock values.

Although there were 71 listed stocks in the market as of July 1998, for the purpose of our study, we selected only those traded in the market for more than 55 percent of the trading days. Hence, for daily prices there are 41 companies whose shares were traded 55 percent or more. Table 4.1 shows the frequency of trading in all the 41 companies selected and the sectors of concentration.

Table 4.1 Frequency of Trading in Each sector

Sector	Days traded %							Total stocks
	<55	55-70	71-85	86-90	91-96	97-98	99	
Bank	2	0	0	0	1	5	2	10
Industry	8	2	1	1	1	5	0	18
Cement	4	0	0	1	0	2	1	8
Service	8	0	1	2	1	3	1	16
Electricity	5	1	0	1	3	0	0	10
Agriculture	3	3	2	1	0	0	0	9
%	42.3%	8.5%	5.6%	8.5%	8.5%	21.1%	5.6%	71

Only 4 firms had their shares traded for 99 percent of the trading days. They represent 5.6 percent of the listed firms. The number of firms traded 86-98 percent of the time are 27. They constitute 38 percent of the publicly-traded firms. On the other hand, ten stocks or 14 percent of the listed firms included in our sample, were traded about 55-85 percent of the time. The rest of the listed stocks in the market, whose trading days were less than 55 percent, were eliminated from the study due to thin trading. They, however, constitute 42.3 percent of the listed firms.

As shown in the table, relative to the six sectors, the banking sector includes the most actively traded shares. With the exception of two stocks, banks' shares frequency of trading exceeds 90 percent of the trading days. In contrast, the agriculture sector includes the least active shares by trading for less than 90 percent of the time. Stocks in that sector are traded between 55-89 percent of the time. The other four sectors are in between.

A: Kurtosis

In spite of the fact that price change series should have normal distribution, the presence of leptokurtosis in empirical distributions is indisputable, according to Fama (1965). One therefore would expect to see returns on speculative markets to be more concentrated in tails than normal.

Table 4.2 in the appendix illustrates the distribution of daily returns. Most daily returns of the 41 stocks used in the study are leptokurtic. Of the 41 price change series, only ten have kurtosis less than 3, which is the kurtosis of a normal distribution. Thus, more than 75 percent of the series displays leptokurtosis. The average value of kurtosis with 31.3 is very high. There are 13 observations of kurtosis above 10 and 17 between 3 and 10. According to Cootner (1962), if successive price changes were independent, price changes over longer intervals would tend to approach the average kurtosis of a normal distribution (p.35).

Table 4.3 in the appendix displays the same results as above, but for weekly price changes. In weekly returns, only eight kurtosis coefficients are less than 3. There are 18 parameters between 3 and 10, whereas the rest are above 10. Hence, our weekly returns, too, are leptokurtic with more than 80 percent of them having kurtosis above 3. Yet, the average weekly leptokurtosis is less than the daily one. This is consistent with Cootner's (1962) findings. Fama (1970) states that non-stationarity is one reason for long-tailed empirical distributions. While the distribution of price changes might be normal at any point in time, they change across time (p.56).

As a result, daily returns of the Saudi market exhibit non-normality of distribution. The high average kurtosis value indicates the existence of volatile price changes in the market, which creates forecasting difficulty. Herding behavior is one

consequence of such difficulty. According to Olsen (1996), if herding exists, actual earnings fall into the tails of the predicted earning distributions with greater than normal frequency (p.38).

B: Skewness of returns

If the distributions of returns are symmetric about the mean, as in normal distribution, the value of skewness will be zero. However, returns in the Saudi market are not symmetric about the mean. They rather exhibit left and right skewness. Negative numbers are left skewed while positive ones are right skewed. There are 30 observations of the daily returns or 73 percent which revealed left skewness whereas the rest have right skewness. Because they display relatively small values, the mean of the distribution lies below the mode. By the same token, weekly returns are skewed. However, unlike daily ones, they show more of a positive skewness than negative. As table 4.3 in the appendix shows, 53 percent of the returns are skewed to the right rather than left. Positively- skewed distributions tend to have a lower limit but no theoretical upper boundary. The average skewness of weekly returns of –0.24 is less than that revealed by daily returns of –1.16.

Negatively-skewed returns in our sample are more likely to result from the fact that market returns have an upper limit and no significant lower boundary. Hence day traders in Saudi Arabia, who constitute no less than 50 percent of our surveyed investors, are more likely to watch carefully and abide by the resistance level than the support level of stock prices. As a matter of fact, since stock prices tend to rise over time, the skewness will normally have positive values. Yet, the preponderance of evidence suggests that returns are more likely to be negative for most of the securities.

4.3: Empirical work and findings

A: Autocorrelation test

Our task here is to check for autocorrelation between different returns for each firm at different dates. The null hypothesis is that autocorrelation of first differences at various lags is zero (Campbell et. al., 1997). A test of correlation coefficient (ρ) gives us a measure of the relationship between the value of a random variable at time t and its value τ_t periods later.

We first difference the price series P_t ($t = 1,2,3...n$) and get:

$V_t = P_{t+1} - P_t$ where: V_t ($t=1,2,3...n-1$).

For the weak form of EMH to hold, the correlation coefficients between consecutive terms of V_t will not be statistically different from zero. Now, we take the natural log (Ln) of stock prices since the variability of simple price changes ($P_{t+1} - P_t$) is an increasing function of P_t (Fama, 1965).

Thus, our variable is $h_t = \text{Ln } P_{t+1} - \text{Ln } P_t$

And $\rho_\tau = [\text{cov.}(h_t, h_{t+\tau}) / \text{Var.}(h_t)]$ ($t = 1,2,3...n-1$)

If the distribution of h_t has a finite variance, the standard error of ρ_τ in large samples will be as follows:

$\sigma(\rho_\tau) = [1/(N-\tau)]^{1/2}$ where: N is the sample size.

Fama (1965) concludes that for large samples, the autocorrelation coefficient is very effective. We will use such an approach on the daily and weekly data of Saudi stock prices.

- **Findings of the test**

As we mentioned previously, the autocorrelation coefficient (ρ) measures the relationship between the value of a random variable in time t and its value in the previous period ($t-1$). The decision rule of the test is that the null hypothesis of

independence among price changes would be rejected if the autocorrelation coefficient were more or less than two standard errors. The null and the alternative hypotheses therefore are:

H_o: $\rho = 0$ (Price changes are independent)

H_a: $\rho \neq 0$ (price changes are not independent)

The sample autocorrelation for both daily and weekly price changes has been computed. Table 4.4 in the appendix shows the results of daily price changes. We report the autocorrelation coefficients for one, four, nine and sixteen-day lags.

The table manifests coefficients of autocorrelation between successive price changes after taking their natural log. The number of observations of each stock varies from company to company. All data however begin in January 1998 and end in April 1999. As shown, the results give evidence of autocorrelation among stock returns in the Saudi market. About 61 percent of the stocks included in our sample reveal significant autocorrelation. The pattern of the signs, though, differs according to lag length. For a one-day lag, 27 coefficients are negative and 14 are positive. As we lag the data further, four days, 21 coefficients turn out to be negative while 20 are positive. This pattern continues with 9-day and 16-day lags that turn to have 20 and 17 negative coefficients, respectively. The preponderance of negative signs in our study contradicts that found by Fama (1965), Dryden (1970), Ahmad and Erdem (1996). Yet it is very consistent with the study of the earlier Saudi market by Butler and Malaikah (1992).

The tendency toward negative autocorrelation coefficients in the Saudi market reflects the heavy speculative behavior of investors. According to Fama (1965), common signs of the autocorrelation coefficients tend to be affected by two

components, one of which is a market component, while the other is a firm-or-industry-specific component (p.74). It is the first component that might produce agreement among signs of the sample autocorrelation for different securities. Our sample of coefficients shows some evidence of the industry-specific component effect, for negative coefficients are heavily concentrated in 3 sectors only, while the positive ones are in the other 3 sectors.

For daily returns, 25 of the coefficients show significant results, of which 80 percent have negative correlation. The average value of correlation coefficients is – 0.025. It is consistent with that reported by Fama (1965) and Civelek (1991). Yet, the average correlation coefficient in the Saudi market is negative. The following table summarizes the result of daily autocorrelation of returns in the Saudi market.

Table 4.5 Daily correlation coefficients

Coefficients	Lags			
	1	4	9	16
Number:	41	41	41	41
Positive	14	20	21	24
Negative	27	21	20	17
Average	-0.02	0.001	0.001	0.01
Significant:	25	5	1	1
Positive	5	2	1	1
Negative	20	3	0	0
Percentage	61%	12%	2%	2%

Table 4.6 in the appendix shows the autocorrelation results of weekly price changes for 1, 2, 3 and 4 lags. The table uncovers the autocorrelation coefficients of price changes for 41 firms. Table 4.7 summarizes the results of weekly correlation coefficients.

Table 4.7 Weekly correlation coefficients

Coefficients	Lags			
	1	2	3	4
Number:	41	41	41	41
Positive	31	28	27	22
Negative	10	13	14	19
Average	0.183	0.075	0.047	0.017
Significant:				
Total	25	4	5	2
Positive	21	3	5	2
Negative	4	1	0	0
Percentage	61%	10%	12%	5%

In absolute value, the coefficients are considered high with an average of 0.183, which is larger than the highest correlation coefficient of 0.12 reported by Fama (1965). Among the 41 coefficients in the table, 25 are statistically significant with a value greater than two standard errors. With two lags, both the absolute value of the coefficients and these values relative to their standard errors decrease. The average of the autocorrelation coefficients of 41 firms is 0.075 only. In addition, of these only four are statistically significant. With three-week lag, five coefficients turn out to be significant while the average value of the coefficients is 0.047. When we lag further the number of significant coefficients decreases. Only two significant coefficients are found in four-week lag coefficients. The average value is 0.017.

Percentage-wise about 61 percent of the one-week coefficients are significant, more than those reported by Fama (1965 and 1970) with 36 percent significant coefficients and more than those reported by Dryden (1970) of 40 percent. They are however fewer than those found by Erdem and Ahmad (1996) of 83 percent.

Our findings, though, are similar to those found by Laurence (1986) of 60 percent when testing the Kuala Lumpur and Singapore stock exchanges and close to those reported by Civelek (1991) of 53 percent when testing Amman stock exchange.

With regard to the signs, there are 10 negative coefficients with one lag of which only five turns out to be significant. For the two lags, there are 13 negative coefficients of which only one is statistically significant. For the three and four lags, 14 and 19 are negative coefficients, respectively.

Some negative autocorrelation among price changes is obvious. When prices get close to the barrier, they tend to be followed by movement to the other direction, hence producing negative autocorrelation (Cootner, 1962). Movement of prices between barriers is more likely to occur within a longer interval of time. However, this pattern could not be confirmed in our results as seen in the table.

In the Saudi market, there are some psychological factors, which cause overestimation of both good and bad news. Market participants are unable to perceive market fundamentals well, which causes the extreme moves of prices between barriers. In addition, thin trading introduces bias into the results and hence affects the efficiency.

Regardless of the direction of the dependency, which varies from study to study (Fama, 1965), with 61 percent of both and weekly returns being significant, an evidence of dependence of price changes is detected. Thus, there is a deviation from weak-form efficiency in the Saudi market according to autocorrelation results. The striking feature of the reported coefficients of both daily and weekly returns is the range of their absolute values, especially those of daily returns.

The range of coefficients for one lag daily returns is 1.16 and that of weekly coefficients is 0.41. Both are considered high, hence indicating the presence of dependency among returns in the Saudi market.

The remarkable degree of dependence revealed by the autocorrelation test is due to a number of factors. Such a high number of significance is probably due to thin trading since we did include all weekly returns in our model as long as their corresponding stocks were traded in the market for more than 55 percent of the trading days. Market participants in Saudi Arabia tend to overestimate both good and bad news. As a result, the market cannot efficiently reflect the full effect of such news.

In addition, the existence of poorly informed traders in the market who trade based on noise might be one factor. It seems that random animal spirit causes prices to deviate from fundamental values. The result of such deviation would be serial dependence in stock returns (Merton, 1987). Moreover, there is an official intervention in the market, which restricts price change movements within barriers hence forbidding new information from taking their full effect on prices.

In addition to testing the individual stock returns, we also applied the autocorrelation test on both daily and weekly general index returns. Table 4.8 summarizes the results.

Table 4.8 Daily and weekly autocorrelation coefficients

Day	Lags			
	1	4	9	16
Coefficients	0.21*	0.11*	-0.007	0.042
Week	**Lags**			
	1	2	3	4
Coefficients	0.19*	0.064	0.039	-0.064

*Significant at 0.05

According to the results obtained, the index returns for one-day and four-day lags are significant with coefficients of 0.21 and 0.11, respectively. However, the coefficients for the 9 and 16 day lags are all turn out to be statistically not different from zero. The weekly returns are significant with a one-week lag, but not for the other lags, as shown on the table.

Before we conclude this section, we compare daily and weekly results obtained above with those reported by Cooper (1982) from a number of world stock markets. Table 4.9 illustrates that comparison.

Table 4.9 Comparison of world stock markets

Country	Daily*		Weekly**	
	Observation	Coefficients	Observation	Coefficients
Developed				
Australia	372	-0.076	300	0.00
Belgium	372	-0.042	300	0.27
Canada	372	-0.04	300	-0.05
France	372	-0.046	300	-0.06
Germany	372	-0.086	250	-0.05
Japan	372	-0.05	300	-0.23
UK	536	0.058	300	0.06
USA	372	-0.045	300	-0.05
Developing:				
India	205	0.212	205	0.56
Saudi Arabia	386	-0.02	216	0.19
South Africa	372	-0.078	300	0.26
Turkey	100	0.055	100	0.26

*For individual stocks **For indexes

To conclude, one should mention that correlation coefficients are sometimes obscured by sequences of price changes in one direction, which is a reaction of investors that makes the pattern unclear. Since we reject the RWH due to the strong dependency found above, the question arises whether or not non-randomness is of sufficient magnitude for an investor to make profits in excess of a randomly-selected portfolio. In the next section, we buttress our previous findings with the runs test.

B: Runs test

The Bernoulli-trial model assumes that each outcome is independent of the others. But sometimes we suspect that the outcomes are not really independent. A runs test is one way of testing the independence assumption.

Runs tests are nonparametric, intended to test for randomness of runs. A run is an uninterrupted sequence of like signs: plus, negative or no change[10]. The number of elements in each run represents the length of the run. If there are too many runs relative to the number of runs expected, the series changes sign frequently, which suggests negative autocorrelation. If, however, there are too few runs, it suggests positive correlation (Gujarati, 1995).

Thus, we examine the difference between total actual number (R_a) of runs and total expected number of runs. The total expected number of runs (R_e) could be computed as follows:

$$R_e = [N (N+1) - \sum_{i=1}^{3} n_i^2] /N$$

Where: N is total number of stock price changes.

n_i is the number of price changes of each sign.

The amount of dependence implied by the runs test can be generated by the size of the difference (k) between actual number of runs and the total expected number of runs. $K=(R_a \pm 0.5)-R_e/\sigma_{Re}$

Where: R_a is actual number of runs.

0.5 is a discontinuity adjustment which is plus if Ra> Re and minus otherwise.

σ_{Re} is the standard error of R_e.

σR_e is calculated as follows:

$$\sigma_{Re}=[(\sum_{i=1}^{3} n^2i \ (\sum_{i=1}^{3} n^2i + N(N+1) - 2N \sum_{i=1}^{3} n^3i-N^3) / N^2(N-1)]^{1/2}$$

For large N, k follows normal distribution with mean of zero and variance 1. k would be significantly different from zero if its value is more than two standard errors (Fama, 1965). After obtaining daily and weekly changes in SA stock prices, I computed the above equations and analyzed the results accordingly.

- **Findings of the test**

We apply the nonparametric test, the runs test, in order to test the hypothesis that stock returns are random and to determine whether they behave in a momentum or reaction pattern. The focus here is on the actual number of runs given by the data and the expected number of runs, which assumes a RW with equal probability of rise or fall. Either a very large or a very small actual number of runs can be an indicator of nonrandom sequence of returns as long as the difference between actual and expected runs is statistically different from zero. If there are very few actual runs, then the data exhibit a surprising amount of momentum; if there are a large number of actual runs, then a large amount of reaction is shown. With momentum, the outcomes are characterized by small number of long runs. With reaction, there are a large number of short runs (Smith, 1994). While too small a number of runs indicates positive dependence among returns, too big a number indicates negative serial dependence.

The consecutive price changes are said to be random when the difference between the actual number of runs and the expected number of runs is not significantly different from zero. Otherwise, those returns are said to be systematic, which violates the independence assumption of the EMH. Under the independence assumption, the total expected number of runs, whether negative, positive or zero is established as follows:

$$R_e = N(N+1)-\sum_{i=1}^{3} n_i^2/N$$

Where: N is the total number of price changes (runs).

n_i is the number of price changes of any sign with i=1,2,3.

As mentioned above, the test of significance is conducted by calculating the difference between the actual number of runs and the expected number of runs.

The null and the alternative hypotheses for the test are:

H_o: The sequence of stock returns is random.
H_a: The sequence of stock returns is nonrandom (systematic).

The decision rule is to reject Ho when |k| >1.96, at 0.05 significance level. Therefore, we applied the runs test on the 41 stock returns. Table 4.6 in the appendix shows the results of runs tests for daily and weekly returns. For convenience, table 4.10 reproduces a summary of the results.

Table 4.10 Summary of runs test results

Observation Interval	N	Significant "K" at 0.05	0.10	Signs of K Positive	Negative	Average "K"	Overall pattern
Daily	41	12	15	25	16	0.022	Reaction (61%)
Weekly	41	15	18	4	37	-0.10	Momentum (90%)

For daily returns in the table above, 12 of the 41 (29 percent) turn out to be statistically significant at the 0.05 significance level, while 15 of these returns (37 percent) are significant at the 0.10 level of significance. Whether we use 0.05 or 0.10 level of significance does not change the overall results that much. It seems that we fail to reject H_o in a range of 26 to 29 of the stock returns, depending on the significance level chosen. The parameter K of table 4.11 in the appendix shows the difference between the actual number of runs and the expected number expressed in percentage terms.

A negative sign means that actual runs are fewer than expected runs, if data are random, which indicates positive autocorrelation among daily returns, while a positive sign reveals negative autocorrelation. As shown in the above table, of the 15 significant coefficients, at 0.10 significance level, 10 (66 percent) demonstrate a negative autocorrelation or a large number of short runs where the actual number of runs is greater than expected. Thus, daily returns seem to have a reaction pattern rather than momentum. This is expected in a highly speculative market characterized by noise trading and herding behavior. Accordingly, signs of returns are rapidly alternating in the SA stock market.

The coefficients in the overall market returns, whether significant or not, show the same pattern. Of the 41 stock returns examined, 25 (61 percent) turned out to have a positive difference (K) between the actual number of runs and their corresponding expected runs.

The table also illustrates the runs test results of the weekly returns. According to results, we fail to reject (we accept) H_o in 23 (41-18) to 26 (41-15) return coefficients, depending on the significance level. There are 15 (37 percent) and 18 (44 percent) significant K value coefficients at 0.05 and 0.10 levels of significance, respectively. Of the significant K values, 37 (90 percent), at 0.10 percent significance level, show negative difference (K) between actual and expected runs.

However, unlike daily results, all weekly coefficients but one reveal a positive autocorrelation ($R_a < R_e$) among returns. Therefore, weekly stock returns change less rapidly for the difference between the actual runs and expected runs. The same results obtained in 37 (90 percent) of the 41 stocks, significant or not, under examination. Therefore, overall weekly returns follow a momentum pattern. While sign results of

weekly returns (momentum) seem in contradiction with daily (reaction) results, this contradiction is apparent rather than real. Both daily and weekly sign return patterns seem to conform to the noise trader's behavior. It seems that day traders in the Saudi market tend to react to noise (not news) on a daily basis. For that reason, one can capture their behavior via daily stock returns rather than weekly ones, because weekly returns are the average of daily, which smooth data fluctuation and massage the data, hence distorting the overall picture of weekly returns. Alexander (1961) argues, "...the probability of one month's movement depending on the previous month is entirely the result of using an average of weekly prices for each month's observation."

In general, based on the test of significance at 10 percent level of significance, for daily returns, 36 percent of the coefficients are significant while 44 percent of weekly returns are significant. Hence, both daily and weekly return results do not violate the EMH. This may seem a moderate evidence in support of the independence hypothesis among price changes, but in fact, for daily returns, it means no more than 2.3 percent difference (K) between actual and expected number of runs, on average. Yet, for weekly returns the average K value for all stocks examined is greater than 10 percent in absolute value. According to Fama (1965), the percentage difference between the actual and expected number of runs is a more relevant measure of dependence than the absolute difference.

To reach an unambiguous conclusion, we also apply the runs test on the daily and weekly general index following the same method applied on individual stocks. Table 4.12 summarizes the results:

Table 4.12 Runs test on daily and weekly indexes

Interval	R_a	R_e	P-value**	Ra-Re/Re
Day	498	638.9	0.00*	-0.22054
Week	92	108.9	0.02*	-0.15519

*Significant at 5%
**Probability value

Unlike results of individual stocks, both daily and weekly index returns show highly significant results at 0.05 level with large percentage differences. As a result, we reject the null hypothesis of randomness in returns. Consequently, returns of the SA stock market follow a systematic pattern in violation of the EMH. Therefore, the SA stock market seems to show signs of inefficiency. Though, results obtained from individual stock returns are not in strong support of such a conclusion, results from daily and weekly general index returns confirm it.

C: Filter Test

We pursue testing the independence assumption among stock returns using Alexander's filter test. We expect the Filter test to bolster our earlier findings of other statistical tools such as the autocorrelation test. Fama and Blume (1966) state " ...the simple linear relationships that underlie the autocorrelation model are much too unsophisticated to identify the complicated "patterns" that the "chartist" sees in stock prices." Similarly, they argue that runs tests are too rigid to determine the duration of movements in prices. As a result, they suggest applying Alexander's filter technique as a more sophisticated method to identify movements in stock prices.

Through different sizes of filter, this test scrutinizes the magnitude of dependence among returns. The filter technique is a mechanical way of trading stocks. It attempts to use more sophisticated criteria to track movements in equity price changes and hence furnishes evidence that these changes could not have been generated by a random walk. The technique allows the investor to filter out all movements smaller than a specified size and examine the remaining movements. It is defined as follows: "If the daily closing price of a particular security moves up at least x percent, buy and hold the security until its price moves down at least x percent from a subsequent high, at which time simultaneously sell and go short...Moves less than x percent in either direction are ignored." (Fama, 1966). According to Alexander (1961), stock price movements that are generated by a RW are expected to yield zero profits when filters are used. In a long-term trend, however, they might be expected to produce some profits, which will not surpass the profits expected from buy-and-hold policy.

- **Findings of the test**

Following the approach of Alexander (1961), Fama and Blume (1966) and Dryden (1970a), we tested the SA stock market dependence assumption using the general index numbers. Just like the other earlier tests, this model implies that the probability of a change in price of any given magnitude is independent of the past history of such changes. Again we take the log of the price changes (returns) as follows:

$$\Delta \text{ Log } P_t = \log P_t - \log P_{t-1}$$

The assumption is that if the index price changes follow a RW with zero mean then it is impossible to formulate a trading rule, which, on average, would generate

abnormal profits. Hence, a price change history gives no insight into future prices; therefore, an investor would not be able to earn positive profits. Filter rules, as a result, would not outperform the simple buy-and-hold policy. Table 4.13 summarizes results of both daily and weekly price index returns for the period from 1 January 1998 to 29 April 1999:

Table 4.13 Filter test results

Filter size	Average daily returns		Average weekly returns	
	B&H	Filter*	B&H	Filter*
0.1%	-0.00988	-0.00076	-0.00091	-0.00293
0.3%	-0.00609	-0.00020	-0.00091	0.00319
0.5%	-0.00609	-0.00096	0.00508	0.00346
1.0%	0.00369	-0.00177	-0.04333	0.00123
1.5%	0.00049	0.00188	-0.04013	-0.00459
2.0%	0.00814	0.01548	0.02768	-0.00325
2.5%	-0.00580	0.00039	0.00910	-0.00362
3.0%	0.00000	0.00000	-0.01273	-0.00278
Average	-0.00194	0.00176	-0.00702	-0.00116

*Unadjusted for transaction costs

We used eight filter sizes ranging from 0.001 to 0.03 expressed in percentage forms. The table shows daily and weekly returns generated by applying the filter technique in comparison to the return of simply buy-and-hold policy. Our main objective is not finding profitable trading rules, but rather testing the independence assumption through a comparison between these two types of returns. As shown in the table, for daily return, the filter-trading rule, on average, is more profitable than the buy-and-hold policy. In fact, the average profits of the buy-and-hold policy, from daily returns, are negative. This result should not be surprising because the Saudi market during the period of the study took a downward trend as figure 4.1 demonstrates.

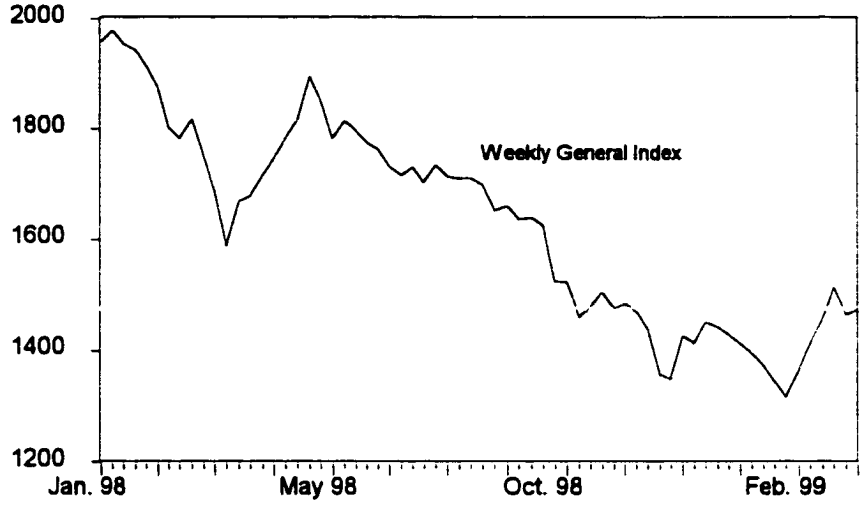


Figure 4.1 S A Stock Market Index

Of all filter sizes we employed, with the exception of 1.0 percent filter size, the filter technique generates better returns in either direction, positive or negative.

For weekly index numbers[11], the situation is different. Both types of return generated losses rather than profits. Yet, the losses from applying the filter rules are much fewer than those encountered by the buy-and-hold policy returns.

Thus, both daily and weekly return results disclose violation to the independence assumption of the EMH. We reach this conclusion despite the fact that weekly returns produce negative profits in the two policies of investment. As a matter of fact, by reducing the amount of loss, filter rules outperform the buy-and-hold policy even in the weekly index returns. An explanation for the different results obtained is that weekly data have many fewer observations, hence they are unable to capture the full changing pattern of the series. In addition, as argued in the runs test section, obtaining weekly data by averaging out daily indexes tends to screen some of the filters out by failing to capture all market fluctuations.

Thus, though filters enable investors to capture daily changes, they fail to provide such opportunities on weekly returns. Therefore, using a longer time interval for weekly data might mitigate the data-massaging problem.

Before concluding this section, there are a number of factors one should point out. First, in our test we restricted the trading rules to long positions only and hence ignored short selling, for such a practice does not exist in the SA market. Second, our calculation of filter returns ignores commissions paid to brokers. Third, the numbers are not adjusted for dividends. However, one can conclude from the foregoing analysis that these results uncovered some dependence among stock market returns in SA, which an investor might exploit profitably.

4.4: Cointegration test

A: Theoretical background

Because most of the economic time series are non-stationary, regressing one non-stationary variable against another can lead to spurious results. Such results might indicate the existence of a relationship between the variables that most of the time is an apparent, rather than real relationship.

B: Stationary versus non-stationary series

A stationary variable is the one, which has a constant mean and constant variance. On the other hand, non-stationary series do not exhibit mean-reversion (Eichhorn, 1999). The following two equations are representations of both stationary non-stationary series, respectivly:

$$Y_t = \delta + \lambda y_{t-1} + \epsilon_t \qquad 0 < \lambda < 1$$

$$Z_t = \delta/1 - \lambda + \epsilon_t + \lambda\epsilon_{t-1} + \lambda^2\epsilon_{t-2} \qquad \lambda = 1$$

The series Y_t is stationary whereas series Z_t is non-stationary. Figures 4.2 and 4.3 display a representation of both types of series.

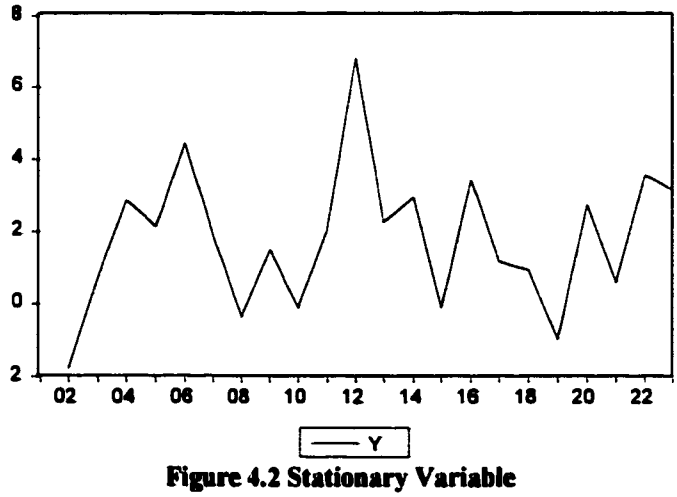


Figure 4.2 Stationary Variable

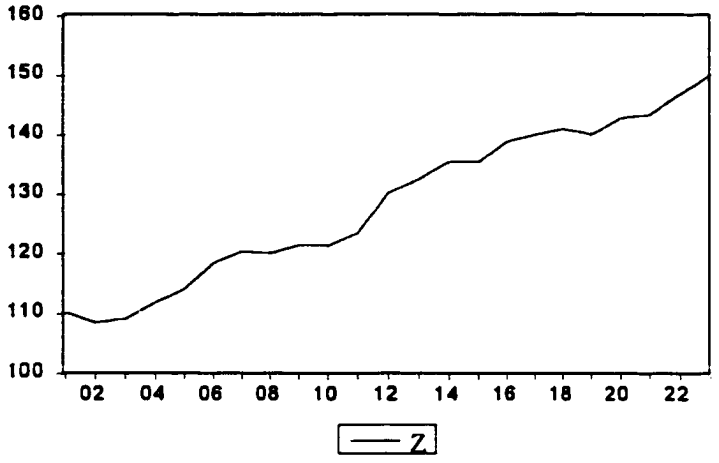


Figure 4.3 Non-stationary Variable

Under the following regression:

$$Y_t = a_o + a_1 Z_t + \epsilon_t$$

the assumption of the classical regression is that both Y_t and Z_t be stationary. The results of a spurious regression cause us to believe that there is a relationship between the two variables even though these results entail no economic meaning. Granger and Newblod tested many samples in the form above. They were able to reject the null hypothesis $a_1 = 0$ in 75 percent of the time. They found that the regressions had very high R^2 values and their estimated residuals exhibited a high degree of autocorrelation (Enders, 1995). If ϵ_t is non-stationary, the regression equation above will be meaningless. Moreover, if ϵ_t has a stochastic trend, any error in period t never decays, which means a deviation from the model will be permanent. One would not rely on a model that has permanent error (Enders, 1995).

As a result, we should be very careful when using non-stationary variables. It is important to test variables for non-stationarity before running a regression. One technique would be to manipulate the series by differencing them before using them in a regression. However, the practice of differencing integrated series to achieve stationarity is not without cost. Differencing may result in a loss of information about the long-run relationship among the variables.

Econometricians, therefore, came up with a model where one can run a regression between two non-stationary variables in levels. The argument is that even though any two variables to be regressed might be non-stationary, their linear combination would be stationary. Before we run cointegration test, we should test the variables for unit roots. The reason is that if the non-stationarity assumption is rejected, standard regression methods can be applied. Otherwise, we apply the cointegration test on the variables (Banerjee et al., 1993). The theory of cointegration, which was established in 1987 by Engle and Granger, provides a way of dealing with such variables when regressing time series variables (Pindyck and Rubinfeld, 1991). The following equation gives an example of the cointegrated variables:

$$Y_t = a + B\,X_t + \epsilon_t$$

Both Y_t and X_t are non-stationary, but the linear combination $Y_t - a - BX_t = \epsilon_t$ is stationary. Thus, the long run relationship between Y_t and X_t is a cointegrating relationship.

Since stock prices are an example of non-stationary variables, we used cointegration as a method for testing the efficiency in the stock markets under consideration. Before cointegrating the variables, it is necessary to pretest the variables for their order of integration, for one should not cointegrate variables of

different cointegrating orders. A number of tests could be run to determine the order of the variables. The Dickey-Fuller test (DF), Augmented Dickey-Fuller (ADF), Phillips-Perron tests (PP) and the Cointegrating Regression Durbin-Watson (CRDW) are all different ways of testing for the same thing. The importance of such tests stems from the fact that if the variables are stationary, it is not necessary to proceed with cointegration, for Ordinary Least Squares (OLS) models apply to stationary variables. If, however, the variables turned out to be integrated of different orders, one might conclude that they can not be cointegrated (Enders, 1995).

C: Engle-Granger methodology

A researcher should proceed with cointegration if both variables turn out to be CI (1,1) (means, cointegrated of order one). We estimate the long run equilibrium relationship in the following form:

$$Y_t = B_0 + B_1 X_t + e_t$$

then we use the estimated residuals ($\hat{e}_t$) of the long-run relationship. If $\hat{e}_t$ is found to be stationary, then Y_t and X_t are CI (1,1). We could perform a DF test on the residuals to determine their order of cointegration as follows:

$$\hat{e}_t = a_1 \hat{e}_{t-1} + \epsilon_t$$

Subtracting $\hat{e}_{t-1}$ from both sides yields:

$$\Delta\hat{e}_t = \gamma \hat{e}_{t-1} + \epsilon_t \quad \text{where} \gamma = (a_1 - 1)$$

The null hypothesis of a unit root (a_1) is equivalent to testing $\gamma = 0$; if it is not rejected, one concludes that the e_t contains a unit root. Thus, Y_t and X_t are not cointegrated. If, however, e_t in the equation above is not white noise, an ADF test can be used instead. We therefore estimate the following autoregression:

$$\Delta\hat{e}_t = \gamma \hat{e}_{t-1} + \sum_{i=1}^{n} a_{i+1} \Delta\hat{e}_{t-i} + \epsilon_t$$

When we determine that both variables are cointegrated, we construct the error-correcting model (ECM). Engle and Granger in 1987 developed the following ECM:

$$\Delta Y_t = \alpha_1 + \alpha_y \hat{e}_{t-1} + \sum_{i=1} \alpha_{11}(i)\, \Delta Y_{t-i} + \sum_{i=1} \alpha_{12}(i)\, \Delta x_{t-i} + \epsilon_{yt}$$

$$\Delta X_t = \alpha_2 + \alpha_x \hat{e}_{t-1} + \sum_{i=1} \alpha_{21}(i)\, \Delta Y_{t-i} + \sum_{i=1} \alpha_{22}(i)\, \Delta x_{t-i} + \epsilon_{xt}$$

where $\hat{e}_{t-1}$ is used as an instrument for the expression $(Y_{t-1} - B_1 X_{t-1})$ that could be used, too (Enders, 1995).

D: The test

There is wide agreement in the literature that stock returns follow a RW, which by definition is non-stationary. Since applying normal regression analysis on non-stationary variables might lead to spurious results, one is compelled to employ the increasingly popular cointegration methodology. Therefore, if cointegration exists some variables could be used as an unbiased predictor of stock returns movement. In this case, we would say that the Saudi stock market is informationally inefficient.

The notion is that these variables are hypothesized to be linked by some theoretical economic relationship and therefore should not diverge from each other in the long run (Banerjee et al., 1993). If there is cointegration among vectors of variables, it implies the existence of ECM. The ECM for a speculative market with expected equilibrium returns uncovers a clear violation of market efficiency because information embodied in past prices could have been exploited to forecast current prices (Macdonald and Power, 1993).

In this section we investigate the dynamic behavior of six sub-indexes of the Saudi stock market using the cointegration test. Granger (1986) suggests that

cointegration analysis is a valid way for examining the belief of long run equilibrium among time series variables. Therefore, while certain series might drift apart in the short run, they may move together in the long run as a result of common underlying economic phenomena (Ferret and Page, 1998). Since our purpose is to find a common trend among these series, the presence of cointegration indicates a linear combination of these non-stationary series. The strength of cointegration analysis stems from its ability to uncover dynamic co-movements among variables under investigation (Mukherjee and Naka, 1995). In this section we consider the extent to which the EMH is valid in an examination of monthly and weekly stock price indexes using the cointegration technique. As a common practice for multiple equations, we use the Johansen method because the single equation method does not allow us to test how many cointegrating relationships are in the model.

E: Data description and Hypothesized equilibrium relationship

We use the six market indexes in SA, namely banking index, industry index, service index, cement index, electricity index, and agricultural index. We obtained the data from SAMA. The sample period from February 1985 to May 1998 consisted of 160 monthly observations for each variable. Besides the monthly data, we used weekly data because increasing the frequency of observations while keeping the sample span fixed tends to increase the power of unit root tests (Maddala and Kim, 1998). Maddala and Kim state that "...in practice one should use the highest frequency data available."(p.229). Choi (1992) found out in his simulation study that using data generated by aggregating sub-interval data results in lower power of unit root tests. Hence, using monthly data is better than quarterly data and using weekly data is better than monthly.

We then take the log of both of the weekly and monthly six variables. The reason for taking their natural logs is that economic time series data tend to exhibit variation which increases mean and dispersion in proportion to their absolute level (Nelson and Plosser, 1982).

Our hypothesis is that the banking sector tends to be the leading sector of the stock market. The banking sector performance is enhanced due to strong regulation, efficient management and protection from competition, which leads the sector to be most profitable. The sector is perceived by traders as the real reflection of the Saudi economic health condition. In addition, these banks do pump liquidity through their financing of the Saudi budget deficit. Hence, their investment mechanisms are the safest even during time of recession.

These factors collectively made the banking sector the leading sector in the Saudi market. The absence of skilled financial advisers combined with poor management in other sectors convinced most of the Saudi investors, except those abiding by Islamic teachings, that investing in the banking sector is a safe haven. These investors therefore reckon in the banking sector's performance and use it as an indicator of market condition. New information in the market is incorporated first into the banking sector and then into the other sectors.

As a result, it is the banking sector that reflects the real condition of the stock market, as any normal person can tell by looking at that sector's index. Hence, we expect the other sectors to lag behind and follow the banking, rising when the latter increases and falling when it falls. The series, which independently may have theoretically infinite variance, will have a relationship which guarantees that they do not drift apart without limit. Hence, they are cointegrated. Cointegration among these

six variables suggests that these variables share a long-term equilibrium relation so that it forms a basis for profitable predictions made by traders (Mananyi, 1997). The market efficiency hypothesis suggests that market prices should reflect all available information so that there exists no strategy from which traders can profit by speculative use of other indexes.

F: Pretesting the variables for non-stationarity

In order to implement the Johansen procedure, we need to pretest the variables to check their order of integration. Many time series resemble I(1). In the stock market the unit root property follows from the fact that weakly efficient markets reflect the stochastic trend in economic fundamentals (Taka and Pekka, 1991). Our aim was to find variables with same order of integration. Among the very popular statistics tests for unit roots are the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP), which we applied here.

Applying the ADF, we tested the null hypothesis of a unit root by estimating an autoregression of Δy_t on its own lags and y_{t-1} using OLS as follows:

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{j=1}^{p} B_j \Delta y_{t-j} + e_t$$

The null hypothesis is: $H_o: \rho = 1$

which says that there is a unit root in the variable (Maddala and Kim, 1998). The null hypothesis would not be rejected unless there is overwhelming evidence against it (Maddala, 1992). The other is the Phillips-Perron (PP) test, which is a generalization of the DF test. While the DF test assumes that errors are statistically independent and have constant variance, the PP method allows for milder assumptions concerning the distribution of errors.

PP test statistics are basically modifications of DF t-statistics that take into account the less restrictive nature of the error process. It can be applied in the same way as the DF (Enders, 1995). Table 4.14 shows the results of both tests of all six variables for monthly data.

Table 4.14 Results of ADF and PP for Monthly Data

Panel A: Level Series *

Test		Agriculture	Banks	Cement	Electricity	Industrial	Service	Critical Values		
								1%	5%	10%
ADF	Intercept	-0.64	-0.65	-1.03	-2.5	-0.98	-1.78	-3.5	-2.9	-2.6
	Trend & Intercept	-1.23	-1.62	-1.08	-2.52	-1.96	-1.85	-4.1	-3.5	-3.2
PP	Intercept	-0.39	-0.44	-0.82	-2.43	-0.84	-1.55	-3.5	-2.9	-2.6
	Trend & Intercept	-1.07	-1.36	-1.95	-2.48	-1.64	-1.67	-4.1	-3.5	-3.2

Panel B: First Difference

Test		Agriculture	Banks	Cement	Electricity	Industrial	Service	Critical Values		
								1%	5%	10%
ADF	Intercept	-5.39	-5.14	-6.29	-6.99	-5.96	-5.96	-3.5	-2.9	-2.6
	Trend & Intercept	-5.49	-5.12	-6.24	-7.11	-5.94	-5.94	-4.1	-3.5	-3.2
PP	Intercept	-12.82	-9.54	-10.4	-13.04	-10.65	-11	-3.5	-2.9	-2.6
	Trend & Intercept	-12.9	-9.52	-10.38	-13.14	-10.61	-10.97	-4.1	-3.5	-3.2

*Monthly data series in log form for 1985:02 to 1998:05

Panel A of the table shows the results of level series while panel B shows those in first difference. As we expected, in panel A all the variables passed both tests of non-stationarity, ADF and PP, hence accepting the null hypothesis of a unit root at all significance levels. In panel B, using the first difference leads to stationarity. As it is clear from the table after differencing, we reject the null hypothesis of non-stationarity. Table 4.15 shows the same results for weekly data.

Table 4.15 Results of ADF and PP for Weekly Data

Panel A: Level Series *

Test		Agriculture	Banks	Cement	Electricity	Industrial	Service	Critical Values		
								1%	5%	10%
ADF	Intercept	-0.03	-0.39	-0.76	-2.42	-0.91	-1.31	-3.4	-2.9	-2.6
	Trend & Intercept	-0.82	-1.22	-1.83	-2.46	-1.47	-1.4	-4	-3.4	-3.1
PP	Intercept	-0.09	-0.32	-0.62	-2.41	-0.77	-1.38	-3.4	-2.9	-2.6
	Trend & Intercept	-0.89	-1.17	-1.64	-2.4	-1.38	-1.48	-4	-3.4	-3.1

Panel B: First Difference

Test		Agriculture	Banks	Cement	Electricity	Industrial	Service	Critical Values		
								1%	5%	10%
ADF	Intercept	-16.05	-13.09	-11.81	-13.51	-13.39	-14.17	-3.4	-2.9	-2.6
	Trend & Intercept	-16.16	-13.08	-11.8	-13.56	-13.39	-14.16	-4	-3.4	-3.1
PP	Intercept	-30.53	-26.03	-22.62	-25.81	-22.36	-28.48	-3.4	-2.9	-2.6
	Trend & Intercept	-30.6	-26.01	-22.61	-25.86	-22.35	-28.46	-4	-3.4	-3.1

*Weekly data series in log form for 1985:02 to 1998:06

This means the variables are I(1). As shown all variables rejected the null in all significance levels applying both the ADF and the PP. Thus, we conclude that the six variables show strong evidence of being non-stationary of order 1 when applying both ADF and PP.

G: Johansen multivariate method of cointegration

Unlike the univariate Granger methodology, the Johansen procedure allows for an estimation of a number of cointegrating relationships. The Johansen maximum likelihood procedure can deal with more than two I(1) variables. It is the most popular of the system methods (Phillips and Cutler, 1998).

In order to implement this method we need to pretest the variables for nonstationarity as we did above. Then we select the lag length (p) using the Akaike Information Criterion (AIC) or the Schwartz Bayesian Criterion (SBC) (Enders, 1995).

The Johansen procedure allows us to test for the number of cointegrating vectors (r) that exist among a number of time series (n) and to test various restrictions on these vectors (Eichhorn, 1999). This method enables one to estimate and test the equilibrium relationship among non-stationary variables while abstracting from short-run deviations from equilibrium. The approach attempts to find a linear combination of a set of variables such that the correlation among the variables is maximized (Lai and Lai, 1991). It can be shown from the general VAR model that is written as:

$$(1-L)X_t = \Gamma_1(1-L)X_{t-1} + \ldots + \Gamma_{k-1}(1-L)X_{t-k-1} + \Gamma_k X_{t-k} + \mu + \epsilon_t$$

where X_t is an n ×1 time series vector, L is the lag operator, μ is some constant vector, and ϵ_t is a vector of white noise with mean zero and finite variance. Johansen's method tests for the rank of Γ_k and the number of cointegrating relationships. Therefore, the coefficient matrix Γ_k contains the essential information about the cointegrating or equilibrium relationship among the variables examined. The rank of the matrix Γ_k indicates the number of cointegrating relationships existing between the variables in X_t. The hypothesis of cointegration is equivalent to the hypothesis that the rank Γ_k=1. If the rank = 0, then the variables under examination are not cointegrated (Lai and Lai, 1991).

The determination of the number of cointegrating relationships, r, is done through two tests. These two test statistics are the trace test and the maximum eigen value test. The trace test hypothesizes that there are at most [r] cointegrating vectors. It has the form (Eichhorn, 1999):

$$\lambda\text{-trace}_r = -T \sum \log (1 - \lambda_i) \text{ for } i = r + 1 \text{ to } n;\ r = 0, 1, \ldots, n-1$$

The maximal-eigen value test hypothesizes that there are [r+1] cointegrating vectors versus [r] cointegrating vectors (Maddala and Kim, 1998). It has the form (Eichhorn, 1999):

$$\lambda\text{-max}_r = -T \log (1 - \lambda_{r+1}) \quad \text{for } r = 0, 1, \ldots, n=i$$

H: Model selection criteria

Since adding more lags to the model reduces the sum of square errors, one is tempted to add more lags to his model. However, adding more lags entails a problem of an estimation of more coefficients, hence a loss of degrees of freedom (Enders, 1995). In addition, the model might suffer from a problem of over-parameterization, which reduces the forecasting performance of the model (Maddala, 1992). Therefore, there are some selection model criteria in the literature. AIC and SBC are the most commonly used information criteria in econometrics. While the two criteria can lead to different conclusions, both are asymptotically the same (Maddala and Kim, 1998). With monthly data of 160 observations, the AIC selects order two while SBC selects order one. By the same token, using weekly data of 670 observations, AIC selects order two while SBC selects order one.

I: The cointegration results

The Johansen procedure employs the maximum likelihood estimate (MLE) of the cointegration vectors. Following this method, an error correction model is estimated and auxiliary regressions are used to construct the matrices (Sephton and Larsen, 1991). In our six variable model using the natural log of the variables, the null hypothesis that there is at most zero cointegrating vector is rejected at 5% level of significance. Hence employing both weekly and monthly data, there is evidence of at least one cointegrating vector.

Table 4.16 shows the Likelihood Ratio tests based on both maximal eigen value and trace tests of the stochastic matrix. We estimate the model with both intercept and time trend following the recommendation of Engel and Granger (1991)[12].

Table 4.16 Cointegration Results:#

A. Monthly Data				B. Weekly Data			
Test	**Null**	**Alternative**	**Statistics**	**Test**	**Null**	**Alternative**	**Statistics**
Max. eigen values	r =0	r = 1	42.2**	Max. eigen values	r =0	r = 1	49.19*
Trace test	r =0	r => 1	94.23	Trace test	r =0	r => 1	115.72*

*significant at 5%. **significant at 10%.
#:cointegration with unrestricted intercepts and unrestricted trends in the VAR.

According to the results above, we could estimate one cointegrating vector for the six variable system. On the basis of maximal eigen value test of both monthly and weekly data, we can reject the null hypothesis that there are zero cointegrating vectors. On the other hand, based on the trace test only the results of the weekly data support the evidence of cointegration.

Results obtained from weekly data are stronger than those based on monthly data in support of Choi's (1992) argument that using data generated by aggregating sub-interval data results in lower powers of unit root tests and then cointegration. Our cointegration system reveals that there is at least one cointegrating vector among the six stock market indexes. The presence of cointegration suggests that the six indexes of the Saudi stock market share a long run equilibrium relationship. Although the variables are individually integrated of order one, the linear combination of these variables are integrated of order zero.

The above results therefore imply that the system follows an error correction representation. The equations of the error correction model may be thought of as the dis-equilibrium mechanism, which guides the system toward equilibrium (Engle and Granger, 1991). Hence the main characteristic of the ECM is the idea of an equilibrium long run relationship and the introduction of past dis-equilibrium as explanatory variables in the dynamic behavior of current variables. ECM describes short run dynamics (Maddala, 1992). In its simplest form, the ECM can be written as:

$$\Delta y_t = \lambda 1\ \Delta y^*_t + \lambda_2\ (y^*_{t-1} - y_{t-1}) \qquad \text{where: } \lambda_1>0\ ,\ \lambda_2>0$$

The last term represents past equilibrium. The partial adjustment model is given by

$$\Delta y_t = \lambda(y^*_t - y_{t-1}) = \lambda\ \Delta y^*_t + \lambda(y^*_{t-1} - y_{t-1})$$

With $\lambda_1 = \lambda_2$, the partial adjustment model corresponds to the ECM (Maddala and Kim, 1998).

J: Speed of adjustment analysis

The main characteristics of ECM is the notion of equilibrium long-run relationship and the introduction of past disequilibrium as independent variables in the dynamic behavior of current variables (Maddala and Kim, 1998). ECM provides a way of combining the advantages of modeling both levels (long-run) and differences (short-run). In the ECM, three dynamics of both long run and short-run are modeled simultaneously (Banerjee, 1993).

The power of the ECM is that the extent of adjustment in a given period of deviations from long-run equilibrium is given by the estimated equation without any further calculation (Banerjee, 1993). Speeds of adjustments are meant to capture the long-run relationship. Table 4.17 shows the speed of adjustment of the six variables:

Table 4.17 Speeds of adjustments

Variable	E_{ct-1} (Monthly)	E_{ct-1} (Weekly)
D(Lbnk)	0.006 (2.8)	-0.015 (-3.82)
D(Lind)	0.06 (3.12)	0.009 (1.3)
D(Lcem)	-0.14 (-4.01)	-0.012 (-6.06)
D(Lserv)	0.018 (0.96)	0.0008 (0.81)
D(Lelec)	-0.002 (-0.002)	0.00004 (0.52)
D(Lagr)	-0.028 (-2.7)	0.0016 (1.96)

This relationship is represented by the restricted coefficients of the cointegrating vector. The following equation shows the restricted equations for monthly data:

$$1.0\ LBNK + 10.5\ LIND - 18.7\ LCEM + 9.5\ LSERV + 1.0\ LELEC - 6.4\ LAGR = e_{cm1}$$

If $e_{cm1} > 0$, the market is above equilibrium. To return to equilibrium, the variables LBNK, LIND, LSERV and LELEC should fall or the rest of the other two variables in the equation, LCEM and LAGR, should rise or a combination of these movement should occur. In the speed of adjustment table, only the D(LELEC) has the right sign although it is insignificant. The rest of the variables are all have the wrong signs. Therefore, none of the variables of the monthly data seem to drive the market to equilibrium.

We therefore turn attention to speed of adjustment of the weekly data. This relationship is represented by the restricted coefficients in the following equation:

$$1.0\ LBNK - 2.2\ LIND + 0.74\ LCEM - 0.26\ LSERV + 0.31\ LELEC - 0.29\ LAGR = e_{cm1}$$

Again if $e_{cm1} > 0$, then the market is above equilibrium. To clear the market, the variables LIND, LSERV and LAGR should rise or the variables LBNK, LCEM and LELEC should fall or a combination of these movements should occur. Because the speed of adjustment of LIND, LSERV and LAGR have positive speed of adjustments with significant t-values and both LBNK and LCEM have negative speed of adjustment with significant t-values, the combination movement of these five variables seems to clear the market.

However, LELEC has wrong sign and insignificant coefficient. It is not driving the market to equilibrium. Unlike the monthly data speed of adjustment, all speed of adjustment of the weekly data, except LELEC, have a tendency to clear the market.

The fundamentals of the market might provide partial explanation to the speed of adjustment behavior. There are three strong performing sectors and three weak performing sectors. Whereas the banking sector performs the best, the electricity sector performs the worst. Therefore, it seems that the good performing ones are the sectors more likely to clear the market. This is manifest from the speed of adjustment table where both D(Lbnk) and D(Lcem) retain the strongest significant coefficients. Table 4.18 shows the annual performance of each sector measured by net income.

Table 4.18 Annual Net Income (,000s SR)*

Year	Sector					
	Banking	Industrial	Cement	Service	Electricity	Agriculture
1992	3,664,090	2,482,939	1,290,966	388,021	(-2,297,565)	169,335
1993	4,613,889	2,442,352	1,518,086	505,231	(-3,052,423)	(-44,313)
1994	4,229,248	4,762,824	1,810,624	443,612	(-2,982,343)	52,450
1995	4,868,889	6,878,369	1,841,810	412,253	(-3,003,349)	52,338
1996	4,984,365	4,986,970	1,919,956	411,108	(-3,226,810)	28,857
1997	5,544,787	5,186,145	1,663,857	722,226	(-3,038,750)	(-21,109)
1998	6,123,027	2,213,907	1,392,067	483,481	(-3,399,853)	(-26,928)

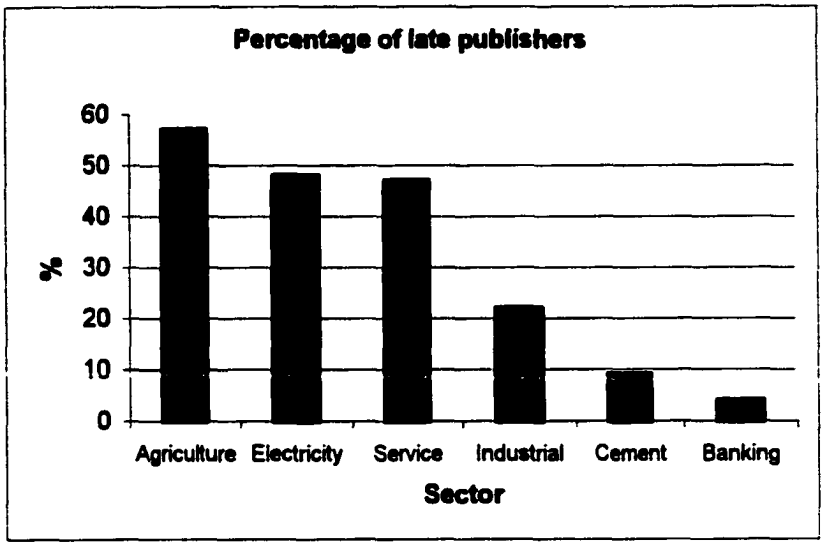
*source: Saudi Share Registration Company

Of the six sectors, only the banking sector achieves a phenomenal performance with a continuous increase in net income. On the other extreme is the ailing sector, electricity, which continues its increasing losses year after year. The other four sectors are in between. Yet, none of them has achieved continuous net income growth.

- **Conclusion of cointegration results**

We conclude that the six indexes have a unit root and thus are integrated process I(1). In addition, evidence was found that these indexes are cointegrated. The results above were expected in a new, thin and highly speculative market. They suggest that there is at least one common force tying the Saudi price indexes together during the period of study. Hence they exhibit long run market integration with each other. It is obvious that the share prices share the same systematic risk (market risk) factor for they operate in one economy. Their variability therefore is fundamentally linked. The result comes in violation of the efficient market hypothesis which hypothesizes the absence of any cointegration relationship among the variables in order for the market to be weakly efficient. Therefore, the investment diversification among the six sectors is not effective because the market lacks efficiency in the long run. The unsystematic risk cannot be reduced by diversification.

Several factors may be responsible for the existence of inefficiency in the SA market. The main culprit is the deficiency in the flow of information from those who own it, firms' managements, to all market participants. Information dissemination in the market is lax. According to a recent study about the Saudi market found that 37 percent of the SA publicly traded companies publish their financial statements late or do not publish them at all. Figure 4.4 shows the percentage of companies that delay in publishing their statements in each sector.



Source: Almajallah (2/19/2000)

Figure 4.4 Late Publishers in SA Market

In the agriculture sector, the electricity sector and the service sector 47 percent to 57 percent of the companies publish their financial statements after the official deadline put forth by the MOC. The other three, the banking sector, the cement sector and the industrial sector have achieved greater abidance in that matter with only 4 percent to 22 percent of these sectors' firms announce their financial results late. Hence, there seems to be a correlation between the degree of abidance in publishing information and obtaining significant coefficients in the speed of adjustment. Firms that adhere to the rules seem to lead the market to equilibrium.

Although we found evidence supporting the notion that the six market indexes are linked and raised some likely explanation for this linkage, we feel that further research is necessary to establish the statistical significance of these likely sources of cointegration.

4.5: Information disclosure in the market

The Saudi Arabian stock market is characterized by insufficient information disclosure and lack of transparency. Some researchers[13] claim that insufficient information disclosure is one cause of informational inefficiency in most emerging stock markets. Our findings of the Saudi market do not support this hypothesis. Despite the fact that a number of Saudi firms publish their financial reports very late, there is no clear correlation between the lack of information disclosure and inefficiency. Figure 4.5 shows the percentage of firms in each sector that publish their results late versus the percentage of stocks violating the EMH. Yet, this evidence is not so strong because the number of late publishers is for one time period only. The composition of that number is vulnerable to change from period to period.

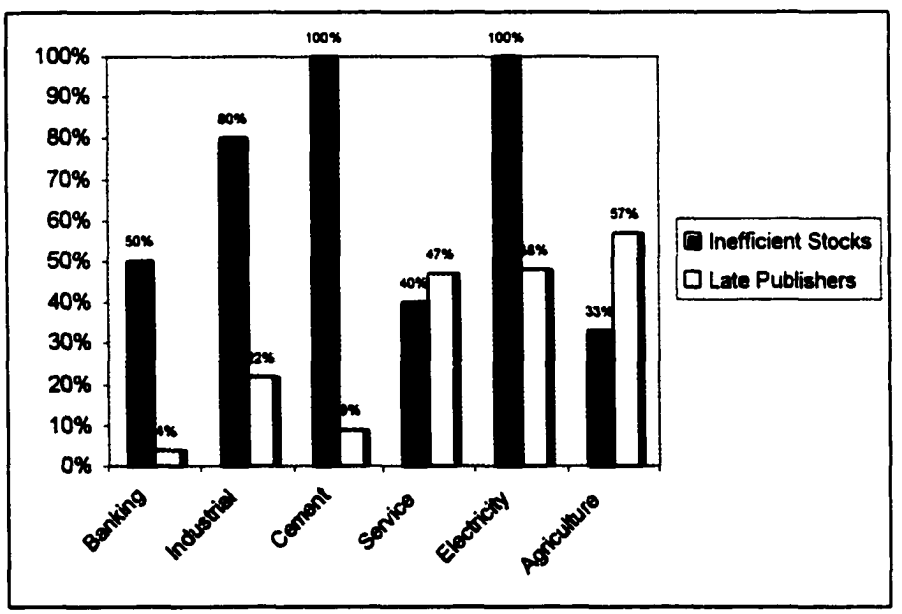


Figure 4.5 Inefficient Stocks and Late Publishers in Each Sector

4.6: Comparison of the findings

Table 4.19 summarizes the results of the four methods.

Table 4.19 Summary of the Four Methods Results

Test	Period	Data frequency		
		Daily	Weekly	Monthly
Autocorrelation	Jan.98-April 99	Strong	Strong	NA
Runs	Jan.98-April 99	Weak	Moderate	NA
Filter	Jan.98-April 99	Moderate	Moderate	NA
Cointegration	Feb. 85- May 98	NA	Strong	Moderate

Of the three tests, only the autocorrelation method produced strong results for both daily and weekly data frequencies. The runs test results are weak for the daily data and moderate for the weekly data. The filter technique results are moderate under both daily and weekly data. The last test, the cointegration method, produced strong results and moderate results for the weekly data and monthly data, respectively. Despite the variation in the strength of results obtained from each test, the overall results obtained support the hypothesis that the Saudi market violates the EMH.

Chapter V: Survey of the Saudi Market

5.1: Purpose and overview

Studies in financial economics are more likely to be concerned with outcomes of financial markets such as prices and dividends. More attention needs to be paid to stock market agents among which are investors. The study of behavioral finance, which began to flourish recently, does not take standard economic assumptions, such as rationality of economic actors, on faith (Thaler, 1998). There is a general belief that investors' behavior is not always well described by economic assumptions. For that reason I felt the importance of conducting a survey on a sample of investors in SA to study their behavior in action.

The purpose of the survey was to discover the respondents' attitudes about the market in general and to investigate the way these investors make investment decisions. What motivated me more to initiate such an effort is the lack of extensive research of the Saudi market. In addition, poor informational transparency in the market made such a questionnaire a must. In this chapter I would like to explore the results of the survey.

5.2:The sample

Sample of the survey consists mainly of investors, especially those commuting to the trading centers spread throughout the kingdom. The coverage area of the survey includes five cities: Riyadh, Dammam, Khobar, Jubail and Buraidah. One thousand questionnaire forms were distributed inside a number of the trading centers. Four

hundred and eight forms were collected , about 40 percent of the intended target. This overall response rate is considered good relative to other developing countries around the world. Of the forms collected, 15 were not usable because each had a substantial number of unanswered questions. Hence, the remaining 393 forms constitute the base for the following analysis.

5.3: Findings of the survey

In order to fully analyze the results, I classified the questions into five categories. First, I dealt with the demographical structure of investors with five questions, which describe categories of investors to have an idea of the type of investors participating in the Saudi market. Second, I shed some light on the background and experience of investors dealing in the market. Answers to these questions are crucial because they give us knowledge about the type of investors participating in the market in terms of sophistication level. Besides, it tackles the issues of day traders versus buy and hold type traders as well as the risk factor, which has been ignored by a number of investors. Third, trading arrangements and the market structure are dealt with in four questions. This category focuses generally on the trading system efficiency from the point of view of respondents. In addition, it sheds light on incentives for investing in the Saudi market, liquidity of the market and factors affecting the Saudi index.

The fourth category covers the issue of market information flow from the point of view of investors. This category also focuses on the importance of financial consulting firms, accounting disclosure, insider trading and the shortage of informative publications.

The fifth category consisted of two questions, which uncover some institutional matters to which investors pay close attention, mainly religious restrictions. Following the order portrayed above, I analyze the most significant findings of the survey. For general information, I provide the answers to all questions in five tables.

A: Demographical issues

Table 5.1 illustrates the results collected regarding the five questions.

Table 5.1 Demographical Statistics

Question	Answer		Frequency
1- Your age?	a	18 to 26 years.	9%
	b	27 to 40 years.	62%
	c	41 to 60 years.	27%
	d	61 or older.	3%
2- Your educational level?	a	High school or less.	32%
	b	College degree.	51%
	c	Higher education.	17%
3- Your average monthly income?	a	SR 5,000 or less.	9%
	b	Between SR 5,000 and SR 10,000.	42%
	c	Between 10,000 and 18,000.	28%
	d	More than 18,000.	18%
	e	Decline to answer	3%*
4-Your occupation?	a	Employee (public or private sector).	76%
	b	Businessman.	17%
	c	Student.	1%
	d	Others.	6%
5- How much you invest in the SA stock market?	a	Less than 50,000 S.R.	23%
	b	Between 50,000 and 150,000 S.R.	18%
	c	Between 151,000 and 400,000 S.R.	18%
	d	More than 400,000 S.R.	35%
	e	Decline to answer	6%*

*No answer provided

Row one of the table tracks the age structure of investors' pool in SA. About 90 percent of the respondents were between 27 and 60 years old, the age of the beginning and the end of the career ladder. Investors who reached retirement age

constitute 3 percent of the sample only, as seen in the table. On the other hand, the percentage of investors who have just finished their education and have begun their career ladder make up 9 percent of the sample. Row two classifies investors according to their educational attainment. More than 68 percent of the respondents have a college degree or above, while 32 percent of them have only a high school degree or less.

Row 3 demonstrates the average monthly income of investors participating in the market. 70 percent of the respondents get an average monthly income between SR.5,000 ($1,333) and SR.18,000 ($4,800). Those who fall in the upper bracket over SR. 18,000 ($4,800) constitute 18 percent of the sample while half of that figure fall in the lower bracket of less than SR.5,000 ($1,333).

To conclude this section, most of the SA investors are those who are actively working and economically independent. 70 percent of whom fall in the middle income stratum while more than 60 percent are from highly educated segment.

B: Investors' experience and background

Table 5.2 illustrates the results of category two. Row 1 illustrates the experience and background of investors. The largest segment of the sample claims to have reasonable knowledge of the stock market, as in any other market in the world. What is worthy of note, though, is that only 2 percent of investors gained their knowledge from formal education, despite the fact that 68 percent of our respondents are certified with college degree or higher education. It seems that trained people who understand the specifics of the Saudi market and how it is manipulated refuse to invest in the market in the first place.

Table 5.2 Investors Experience and Background

Question	Answer		Frequency
6- How do you classify yourself with regard to your experience in SA stock market?	A	Expert, since I am a long-practiced person in the market.	13%
	b	Expert, since I got formal training about stock markets.	2%
	c	Expert, because I got formal training and experience in market.	12%
	d	Reasonably knowledgeable about stock markets.	62%
	e	No experience at all.	11%
7- What type of investor you consider yourself?	A	I am a day trader who tries to get benefits from the ups and downs of the stock market prices through speculation.	32%
	b	I am a buy and hold kind of investor, I try to keep shares as assets for future returns.	21%
	c	It depends on the firm's activities as well as its financial situation.	21%
	d	I have no clear policy.	24%
	e	Decline to answer	2%*
8- Dou you consider risk when you invest in the SA stocks?	A	Yes.	70%
	b	Sometimes.	6%
	c	No.	23%
	d	Decline to answer	1%*
9- If your answer is "a" or "b" in question # 8, what is your measurement of risk?	A	I use technical ways such as the standard deviation of the stock return.	5%
	b	I use profit level as a criterion, because profitable firms have minimum amount of risk.	35%
	c	I think risk is in small-capitalized firms only, hence I am cautious when investing in such firms.	10%
	d	I just invest in companies in which the government has stakes because the ownership of the government minimizes risk.	9%
	e	I invest in companies whose board of directors and administration are well known and highly qualified	20%
	f	I don't follow a specific method.	15%
	g	Decline to answer	6%*
10- Rank your ability in reading firms' financial statements?	A	Excellent.	23%
	b	Good.	52%
	c	Poor.	25%

*No answer provided

The 11 percent who claimed to have no experience in the market and got engaged did so by and large without any advice from financial experts. They selected their portfolios depending on noise; hence their success relies on luck. In contrast, 13 percent mentioned that they got excellent experience from long practice in the market, whereas 12 percent mentioned that they obtained their knowledge from both market engagement and formal education.

As shown in row 2, 32 percent of respondents classify themselves as day traders, 21 percent as buy-and-hold type of investors. Twenty-one percent say that their investment strategies depend on the type of activity a firm pursues, its financial position and the stability of its stock price. The interesting point is the segment of investors who could not classify their investment strategy. Those are 24 percent of the sample.

Question 8 in row 3 of the table deals with the risk issue. Only 70 percent of our respondents mentioned that they consider risk when investing in the market. The rest either consider it only sometimes or never care about it. Ignoring risk factors is one of the herding behavior consequences. That behavior leads to more optimistic biased earnings forecasts, hence reducing perception of risk among investors (Olsen, 1996).

At the same time, those who consider risk use different risk criteria as answers to question 9 show. Thirty-five percent of them think that the profit criterion is the best measure for risk. They, therefore, would rather invest in profitable firms in order to avoid risk, regardless of the stability of such profits. About 10 percent think that risk is negatively related to the size of the firm; hence avoid investing in small-capitalized firms due to risk fear, while 20 percent invest only in firms whose

management are well known to them in terms of productivity and efficiency. Yet another segment of the sample, or 9 percent, think that firms that are partially owned by the government are far from being risky. Only 5 percent say they use technical methods known in the literature such as variance of investment return. A paradoxical result, however, is that 15 percent of those considering risk do not have any method for estimating the risk factor.

Question 10 of the table covers the issue of investors' ability to read and comprehend financial statements and reports published publicly about firm's status. While about 75 percent of our respondents mentioned that their ability is either good or excellent, the rest, 25 percent, admit their inability to read and understand these reports, let alone depend on these reports when making investment decisions.

In conclusion, it appears that Saudi investors rely more on experience they get from the market than from formal training. Also, the largest segment of the sample is traders who possess short run foresight. The existence of those traders along with those having no crystal-clear policy of trading is partly explained by the fact that knowledgeable investors are but a small segment in the market. The visionary or long-term investors are only 21 percent of the sample, which reflects the reluctance of investors to relinquish their life savings to the market. Moreover, disregarding risk of investment is one major problem of trading behavior, although there is no investment in the world free of risk. Hence, if 30 percent of our sample either does not consider risk or does so only sometimes, then there is a red light flashing about the sophistication of participating investors.

C: Trading system and market structure

In this section, four questions deal with the issue of trading system efficiency and market structure. Table 5.3 illustrates the results of such questions in percentage terms. Question number 11 invites investors' opinions of the sophistication of the trading system applied in SA. More than 76 percent of the sample expressed their satisfaction with the trading procedures. Though their rate of satisfaction varies from excellent to good, the rest of the sample expressed its dissatisfaction with the trading system.

Table 5.3 Investors' Opinions on Market Structure

Question	Answer	Frequency
11-What do you think of the stock circulation system through banks?	a Excellent.	16%
	b Very good.	28%
	c Good	32%
	d Poor.	23%
	e Decline to answer	1%*
12- What of the following factors encourages you to invest in the SA stock market?	a The high profits in the market.	12%
	b Lack of investment havens for small capital.	25%
	c The easiness of liquidating the stocks.	32%
	d The minimum amount of risk.	4%
	e I lack experience, hence I get benefited from the expertise of publicly traded firms management.	10%
	f I get the benefit of diversifying my investments.	16%
	g Decline to answer	1%*
13- How difficult is it for an investor to liquidate investments?	a It takes a long time, sometimes days, until a seller finds a buyer.	6%
	b A seller can sell stocks momentarily.	45%
	c It depends on the types of shares supplied.	20%
	d It depends on the timing of the sale and the general conditions of the market.	29%
14- In your opinion which of the following factors affect SA share index?	a International oil prices.	35%
	b International stock exchange indexes.	12%
	c Price of other assets as real estate.	21%
	d Firms performance.	2%
	e Rumors.	29%

*No answer provided

Row 2 of the table breaks down investors in the market according to their motives for engaging in the market. Twenty-five percent of the respondents admit that lack of other investment havens motivated them to invest their money in the market. While 32 percent think that the ability to liquidate their assets is the basic motive for engaging in the market, 16 percent mentioned that the market allows them to diversify their investment portfolios, and 10 percent declared that they lack experience in managing their money so they relinquish their savings to the stock market seeking profitable investments.

Despite the fact that 60 percent of the sample's inducements were profitability (12.a), liquidity (12.c) and diversification (12.f), there is a large segment of investors, 25 percent, whose grounds for investment in the market is the lack of other investment opportunities (12.b) for small investors in SA.

In terms of the liquidity issue in the market, question 13 of the table shows the opinion of market participants. Forty-five percent of the respondents think that an investor can liquidate his/her stocks instantly while 6 percent think the opposite. The rest of the respondents think that liquidity of the market depends on the timing of sale as well as the stocks being considered for sale. It thus shows the general agreement among investors that the market is more or less liquid. The last question in this section considers the factors most affecting the Saudi price index. According to 68 percent of the answers given by participants, systematic or market risk such as oil prices, international stock market indexes and prices of other assets do play the strongest role affecting the Saudi index. Among those, 35 percent relate variation in an index to oil prices alone. Only 2 percent of the respondents relate these fluctuations to firms' performance.

In conclusion, the ability to both liquidate investments instantly and diversify them are not the only factors attracting investors to participate in the market, but the lack of other investment means in the country is also one great factor. The latter factor has motivated 25 percent of the sample to participate in the market. Since corporate bonds do not exist and government bonds are not traded, the only way of investing personal savings in SA would be the stock market. The significant finding, though, is the general agreement among investors that market related factors rather than corporate specific factors drive SA stock market index. This shows strong evidence against efficiency in the SA stock market whereby corporate performance plays a trivial role in price fluctuations. In addition, rumors seem to play a significant role in the market as indicated by 29 percent of the sample. Finally, there is good understanding among investors of the large effect of oil prices in the SA price index. This fact is supported by empirical evidence as shown earlier in chapter one.

D: Information disclosure sources

Table 5.4 shows the answers to six questions related to information disclosure. Question 15 in this section tracks sources of information investors depend on in order to make investment decisions. Only 30 percent of the respondents say they rely on periodical financial reports disclosed by firms. Twenty-one percent indicate that they depend mostly on media analyses in general. While only 5 percent of the sample uses the advice introduced by consulting financial offices, 43 percent of them do depend on friends' and relatives' (15.d) or on their own personal analysis (15.e). Because of that, Saudi investors feel they need financial consulting houses, as revealed by answers to question 16.

Therefore, 74 percent of the respondents expressed their strong desire when answering question 16 that private consulting centers should be encouraged. This shows the eagerness of market participants for guidance.

Question number 17 seeks respondents' opinions about whether firms publish their financial reports clearly and timely. Forty percent of the respondents think that firms do not disclose their financial reports on time and clearly, while 9 percent of the respondents think they do. In addition, 42 percent think that firms publish their reports but either ambiguously (17.c) or late (17.d). The big segment of participants therefore agree that firms do not disclose their results on time (20 percent) and clearly (22 percent).

Table 5.4 Investors' Opinions On Information Disclosure

Question	Answer	Frequency
15- What is your source of information upon which you decide to buy or sell?	a Financial reports of firms.	30%
	b I consult financial advisers.	5%
	c I depend a lot on the periodical analyses of the newspapers and magazines.	21%
	d Most of the time I get the information from friends and relatives.	16%
	e I follow self-discretion.	27%
	f Decline to answer	1%*
16- Do you think there should be private consulting centers to advise investors?	a Yes.	74%
	b No.	18%
	c I do not know.	8%
17-Do you think that the joint stock companies in the SA market publish their financial reports and statements clearly and on time?	a Yes.	9%
	b No.	40%
	c On time, but they are not clear enough.	22%
	d The information they publish is clear, but not on time.	20%
	e I do not know	9%
18- Do you think there are some insiders who benefit from the private information they know?	a Yes.	79.2%
	b No.	6.3%
	c I do not know.	13.5%
	d Decline to answer	1.0%*
19-How hard is it to get information about any company or the market in general?	a Impossible.	12%
	b Difficult.	36%
	c Available if you search.	23%
	d It depends on the type of information.	27%
	e Decline to answer	2%*
20- Do you think a stock prices in SA really reflect firms' performance?	a Yes, I think so.	21%
	b No.	36%
	c Sometimes.	39%
	d I do not know.	4%

*No answer provided

This reflects the general attitude of investors toward the existence of an asymmetric information problem, which prevails in the market. Hence, there is a clear indication in the market that investors, in general, are not comfortable with the current situation of information disclosure. Information needs to flow from those who have it, firms' managements, to the general public in order to encourage more investment in the market, which would stimulate more market activity.

Question number 18 handles the issue of insider trading and whether insiders do benefit from their private information. About 80 percent of respondents believe that insiders do exploit their private information widely in the market. The percentage would increase substantially if we omit the "do not know" answers from our calculations. On the other hand, only 6 percent rejected the idea that insiders benefit from the information they own.

Question number 19 discusses the accessibility to investors of information other than that published periodically. Forty-eight percent think that access to such information is either impossible (19.a) or hard (19.b). About 23 percent think that such information is available to hard-working researchers. However, 27 percent of respondents think that it depends on the type of information being disclosed. In general, accessing information about any firm is seen to be hard.

The last question in this section captures investors' opinions of stock prices: whether they reflect real performance of firms or not. Only 21 percent of the respondents think that market prices do reflect fundamentals. Seventy-five percent, however, express suspicion of this preposition, of which 36 percent negate the idea that prices reflect market fundamentals, whereas 39 percent think they do, but only occasionally.

In conclusion, investors seem to lack sophisticated advising. They rather depend on themselves or on relatives and friends. A great many of these investors have indicated their strong need for private consulting firms to help them in selecting the right portfolios. Besides the lack of guidance, participants appear to have negative sentiment regarding periodically published financial results. They also have the same negative feeling toward the existence of insider trading. Finally, not a great number of investors believe that individual stock prices accurately reflect a firm's performance.

E: Institutions role in the market

Two questions in the survey deal with an important issue in an Islamic society, which is led by religious teachings. Table 5.5 covers two questions that tackle the issue of institutional or religious restrictions in Saudi Arabia. Question 21 is meant to get a hint of investors' adherence to Islamic laws and their refusal to deal specifically in bank stocks. Fifty-four percent of our respondents expressed their absolute resentment of trading in banking sector stocks while 35 percent see no sin in dealing with such stocks. The rest of the respondents do not refuse banking sector stocks totally, because they accept Islamic bank stocks only.

Table 5.5 Investors Adherence to Islamic Teachings

Question	Answer	Frequency
21-Do you abstain from investing in the banking sector for religious reasons?	a Yes.	54%
	b No.	35%
	c Sometimes.	11%
22- Do you abstain from investing in the stock market, in general, for religious reasons?	a Yes.	8.7%
	b No.	69.7%
	c Sometimes.	21.6%

A more general question is number 22, which tracks down the ultra-conservative segment of the sample who think they commit sin by engaging in stock market activities in general. Only 9 percent think such action is a sin, whereas 70 percent do not believe so. The rest, or 22 percent, occasionally feel annoyance over such issues.

To conclude this section, religion in Saudi Arabia affects a great number of the society. Since the banks' main source of earnings is seen to be usury, which is prohibited in Islam, no wonder we find the above results. Despite being the most profitable, banking sector shares are avoided by those following religion. There is, therefore, behavioral restriction in that regard. Furthermore, others consider not only owning bank shares is wrongdoing, but also owning any type of shares in the stock market. Their reasoning is that firms whose main activity is not banned by Islam do pay interest to banks when taking loans to finance their activities. Hence, these firms' whole funds are tarnished by the wrongdoing of interest giving. Yet, the segment of those who have such feeling is very small.

Chapter VI: Conclusion and Recommendations

6.1: Conclusion

From the empirical statistical results and the survey results obtained, a number of concluding remarks might be drawn:

- Despite the fact that the hypothesis of independent returns was not rejected for some individual stocks, the overall results of both statistical work and the survey uncover unsurprising outcomes that the market seems to be weakly informationally inefficient. That result is strongly supported by the large segment of respondents who showed strong agreement to the notion that corporate performance has a trivial relation, if any, to the SA share index, in general. Yet, 21 percent of the survey participants believe in Saudi market efficiency in which individual stock prices do reflect information. Despite that fact, a great number of market actors think that the market is inefficient and they can beat the market by exploiting such inefficiency through daily trading. Several factors may account for the inefficiency among which are institutional factors like the absence of effective regulation. In addition, the existence of price fluctuation limits[14] in trading may, to some extent, retard the full and swift reflection of new information by stock prices.

- Due to lack of interested buyers, but not liquidity, a number of stocks suffer from thin trading as seen before in table 4.1. Several of the SA stocks, during the period of study, did not trade for several days. Of the 71 listed stocks, 42 percent were traded for less than 55 percent of the total trading days. In fact, all stocks of both the electricity and agriculture sectors have never been traded for more than 96 percent and 90 percent of trading days, respectively. This is despite the fact that government-owned stocks, which constitute more than 34 percent ownership of the total market as of March 1997 (Azzam, 1997), are not circulated. The absence of efficiency is a vicious cycle phenomenon whereby thin (infrequent) trading is both a cause and an effect. Hence, to step closer to efficiency the authority needs to tackle the problem of thin trading and create an atmosphere of confidence.
- There is an information-related snag in the market. Besides the asymmetric information problem, the market suffers from a dearth of information. The pervasive asymmetric information problem, in the absence of regulation in the SA market, causes firms' managements to disclose whatever information they desire and withhold whatever they want. Investors need reliable information to appraise investments they make. Without adequate information they will be reluctant to do business and hence refrain from putting money into unfamiliar ventures.

This information snag caused rumors in the SA market to play a big role, as revealed by about 30 percent of the survey respondents. More information disclosure and transparency about the market conditions in general, as well as specific individual firms results, are necessary.

- Related to the previous point, the financial reporting mechanism, in addition to being inaccurate and often distorted, is not trusted by a large segment of shareholders as seen in the survey results obtained. More than 82 percent of the respondents think that corporate reports are not published timely and clearly.
- The market seems to be plagued by lots of unjust practices. For instance, the survey respondents in question 18 pointed out to the problem of insider trading. Eighty percent of the sample agreed that there are some insiders who benefit personally from information they own.
- Moreover, there is a shortage of financial market analysts. Most of the analysts in the SA market are non-Saudis who might not fully perceive the institutional framework within which the SA market operates.
- Besides the absence of financial analysts, a financial press is almost non-existent. There are a few pages about the stock market in a number of daily newspapers. But these are not sophisticated enough to be classified as financial press. Their main focus is to publish daily prices and indexes. They are mainly informative type of publications, and the information they publish is frequently already widespread among investors and hence is obsolete for interested market actors.

In addition, there are only a few business and economics publications, and they too lack profound and extensive analyses and investigation of market performance. Our survey findings indicate that more than 48 percent of respondents agreed that information, other than that published in accordance with law, is hard to find or even impossible.

Furthermore, the survey revealed that 25 percent of the sample admits their inability to read published corporate financial statements. Therefore, a more sophisticated financial press would help investors in comprehending periodical financial statements published by firms. The fact that more than 43 percent do depend on their own analysis or their friends' and relatives', as seen in answers to question 15, uncovers the need for a more active role played by the financial media and market professionals in educating people. Psychological research verifies that disagreement of opinions due to the non-professional guidance investors get creates anxiety and a desire for a unified opinion. It is no wonder we find that a big segment of Saudi investors seek each other's opinions about portfolio selection. This is assured by the fact that professional consultants are almost absent. The problem is that such herding behavior leads to more deficient market returns (Olsen, 1996).

- The absence of professional guidance, along with a wide participation of non-sophisticated investors, leads a great number of market actors to rely on noise because even if they are able to get information, they will not be able to process it and use it efficiently. Noise traders falsely think that what they have about future prices of risky assets is information. They

therefore feed their spirits with pseudo-signals from relatives and friends. Their irrational thinking leads them to believe that these signals carry real information about price fundamentals (De Long, 1990).

Since their reaction to market movements is bullish, noise traders' transactions lead to over valued stocks. Then, firm managements find it in their advantage to continue their risky way of management. De Long (1990) found that the bullish behavior of noise traders leads them to earn higher returns in the market than sophisticated traders. This does not rule out the result of high risk factor. One consequence of noise traders' behavior is a reduction of arbitrage activities as we saw in question 6 of the survey. Answers to that question indicated that sophisticated Saudi investors, at most, do not exceed 27 percent of the total respondents. The appreciation of stock prices due to noise trading causes concern among arbitrageurs who fear the increasing risk of liquidity.

As a result, arbitrageurs would be forced to have a short horizon in the market which might drive them out of the market or at least make them worry all the time even in the absence of fundamental risk. The case of noise trading leading to large divergence between market prices and fundamental values would persist.

- There is lax regulation in the SA market regarding trading manipulation, insider trading and information disclosure. In fact, there is no law which addresses the securities market directly. The market is rather regulated by a number of procedural and instructional directives by one of the three government bodies; MOC, MOF, and SAMA, each within its authority

limit. Besides, these government organizations are governmental which are overwhelmed by red tape and bureaucracy so that their outcomes are too slow to fit and satisfy the need of the market for a fast and efficient monitoring system. Efforts toward regulating the stock market need to be done. Strict regulation would help in eliminating situations such as market manipulation, guaranteeing more transparency through more requirements of higher quality information disclosure, and reducing insider trading.

- Judicial system-related snags raise some doubts as to the efficiency of that system in market participants, in general. The weak judicial system is seen as an obstacle to enforcing contracts and providing reliable business environment. The absence of such a basic institution offers a good base for market failure. The dual judicial system in SA has been in practice for a number of years. While the main judiciary authority are the "shariah" (Islamic) courts, other legal committees exist in order to settle disputes that are unenforceable in "shariah" courts. For instance, shariah courts do not enforce bank loan disputes that involve interest. Therefore, legal committees under the umbrella of the MOC[15] take the initiative to settle such disputes. In addition, these committees are the courts responsible for enforcing negotiable instruments such as bills of exchange, promissory notes and checks (Renton, 1986).

- A large number of investors in SA abstain from trading in the stock market, specifically in non-Islamic bank shares. Indeed such refraining would have negative effects in the whole economy in general, by keeping a large amount of savings idle, and in the stock market specifically. Hence, religion plays an especially important role in driving a great amount of the population's investment decisions. With only one Islamic bank in the country, people abiding by Islamic teachings have narrow means of investments in the stock market. I think these institutional factors provide a partial explanation for the current deficiency in stock market demand.

6.2: Recommendations

Faced with the problems explained above, one is tempted to provide recommendations based on these conclusions. I recommend the following possible policies to enhance the efficiency in the SA stock market:

1. Amelioration of market transparency: No one argues against the extreme importance of information flow among market participants. Stock markets are perceived to be expectation-oriented markets in which information plays a crucial role. Therefore, participants desire the availability and accuracy of information. The flow of information tends to lower uncertainty about either firm-related or market-related conditions, hence stimulating more trading. As a result, the Saudi authority should pay great attention to that matter[16]. Publicly traded firms should be forced to disclose their quarterly and annual financial statements on time. In addition, more explanations of these statements, such as footnotes, are necessary. External reports by firms serve dual purposes. They provide information to stockholders as well as protect

creditors. The importance of legal enforcement regarding the issue arises. Obscuring or hiding information does increase the problem of herding behavior at the same time it gradually depletes confidence in the market in general. Moreover, in order to suppress the uncertainty situation and the asymmetric information phenomenon, the authority should improve market conditions through the encouragement of establishing financial research firms and rating agencies.

2. Stock market regulation: Despite the fact that more and more markets throughout the world have enhanced their regulations, Saudi Arabia's is still behind. There is virtually no act that is especially tailored to regulate the stock market in SA, so the issue of regulation should be taken seriously. Vagueness in legal affairs would cause more deterioration to market mechanisms and hence performance. Under the current conditions, a lot of the SA investors are myopics who are unable to know their best interest regarding stock market investments. Given that situation, the "widows and orphans" approach to individuals' behavior would be appropriate to adopt (White, 1996). Regulatory laws taking such an approach would require that unsafe stocks be banned from the market. More clear and complete regulations would motivate not only domestic investors to keep their capital in the market, but also would lure non-Saudi investors to invest in SA as soon as the legal ban is lifted.
3. Enhancement of market liquidity: The current situation in SA is that stocks are traded in S.R. 0.25 increment. However, it would be much better in terms of liquidity if these increments were decreased to smaller decimals like S.R. 0.05 or S.R.0.01. Research shows that smaller increments tend to generate more

liquid markets through narrower bid-ask spreads. In addition, lower increments would be more cost effective for investors. The following example illustrates the situation. For instance, under the current situation, if an investor places his bid for 1,000 shares trading around S.R. 50, he may end up purchasing the stocks at, say S.R. 50.25 even if there are sellers willing to sell them at S.R. 50.01. Therefore, if the S.R. 0.01 increment were adopted, an investor might be able to buy those 1,000 shares for S.R. 50.01 a share. Hence, he would have saved S.R. 240 on the total deal. In addition, other buyers might find it easier to boost their bids had increments as low as S.R. 0.01 been adopted. Though this amount may not sound like much a windfall for a specific deal, it would make a great difference if one thinks of greater blocks of trades. Trading 50,000 shares using the same numbers above would save an investor S.R. 12,000 (US $3,200).

Besides generating a higher demand in the market, lower increments allow low price stocks, or "penny stocks", in the jargon of the Wall Street, to be more liquid. For example, if a stock is traded at about S.R. 9.00 and the buyer's bid for 1,000 shares is S.R. 9.25, he would end up paying S.R. 9,250 instead of S.R. 9,010 if increments of S.R. 0.01 were in use. Here, the S.R. 240 an investor saves as a result would constitute 2.5 percent of the deal.

Another way of stimulating market demand is through the removal of institutional barriers by encouraging the establishment of Islamic banks. When publicly traded, these banks' shares would offer additional means of investment to investors in general, and to those abiding by Islam, specifically.

4. Limitation of insider trading: The fact that about 80 percent of the participants agree that insiders do exploit their private information supports the existence of insider trading in the SA market. If insiders really do take advantage of such information, they will not consider releasing it to the public; otherwise their privilege is lost. It is therefore mandatory that insiders be prevented from such exploitation by law. Such a law would not only be just for investors (insiders and the general buyers/sellers), but also would reduce insiders' benefits for withholding information. As a result, sufficiency and accuracy of information released would be achieved.

5. Establishment of a unified monitoring agency: The current situation in which the authority for monitoring the market is held by three different governmental organizations seems to weaken the monitoring system. Establishment of one watchdog body similar to the US Security and Exchange Commission would unify the efforts and enhance the monitoring system.

6.3: Summary

The purpose of this study was to determine the informational efficiency of the SA stock market. I argued that the SA market is weakly informationally inefficient as is the situation in a number of other developing countries stock exchanges. Lack of rigorous research in the SA stock market was one strong motivation to study the market. By applying a number of empirical tests, namely the autocorrelation test, the runs test, the filter technique and the more modern approach, the cointegration test, I tested the efficiency of the SA stock market. In addition, I launched a survey among SA investors to have a better idea of market agents' behavior as well as the information flow mechanism in the market. Results of these tests, along with the

survey results, revealed that the SA stock market is not informationally efficient. Finally, based on the conclusions, a number of recommendations are suggested to minimize the informational inefficiency snags. Among these recommendations are the need for stock market law and more reliable financial reporting, creating a dynamic community of analysts and an independent financial press as well as establishing a unified watchdog body to monitor the market mechanisms.

Endnotes:

[1] Riyal is the Saudi main currency. In 1972 US$1 = SR 4.5, in 1974 US$1 = SR 3.55. In 1986 the Saudi currency was pegged to the US$. The current exchange rate is US$1 = SR 3.75.

2 Article 2 of the charter states " The Saudi Arabian Monetary Agency shall not pay nor receive interest..."

[3] GCC includes six Arab Gulf states; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

[4] Souk Almanakh crisis is the name of the unofficial share market in Kuwait which caused a collapse of the whole Kuwaiti market in August 1982. This was a result of speculative bubble that had been building for long time (Azzam, 1997).

[5] T+0 refers to delivery date. The T stands for trade and the number for the days it takes for delivery to take place. T+0 indicates that settlement and delivery take place at the same day while T+3 means the delivery takes place three days after trade.

[6] This law was modified in January 1999. This new law reduces the minimum amount of net assets to SR 50 million (US$ 13.3 million). It also reduces the percentage of R/E to 7% instead of 10 % for any three years before the IPO.

[7] Filter Rule is a timing strategy. It says to purchase a stock when it rises x% from the previous low and hold it until it declines by x% from its subsequent high. At this point, sell the stock short or hold cash.

[8] Among them Houthakkar (1961), Alexander (1961), and Fama and Blume (1966).

[9] The Random Walk Hypothesis assumes that successive returns are independent and that the returns are identically distributed over time. Hence, the period-to-period price changes of a security are statistically independent.

[10] In nonparametric tests, we make no assumptions about the distribution from which the observations were drawn (Gujarati, 1995 p.419).

[11] The reason for using weekly index returns, despite the massaging data problem, is to bolster results provided by daily ones. If filter technique outperforms the buy-and-hold policy in weekly data too, one concludes with great confidence against the independence hypothesis.

11 They state "In practice, one often must include an intercept...to reflect the possibility that under the alternative of stationarity , the intercept is not zero" and "A further variation introduces a time trend ... to allow the alternative to be trend stationarity."p.12.

[12] They state "In practice, one often must include an intercept...to reflect the possibility that under the alternative of stationarity, the intercept is not zero" and "A further variation introduces a time trend...to allow the alternative to be trend stationary."p. 12

[13] Ahmad and Erdem (1996), Butler and Malaikah (1992), Hsiao (1996).

[14] Article 2-5-3 of ESIS Instructions and procedures booklet states "Prices of supply and demand must not increase or decrease by more than (±10%) from the prior closing price during the same period of trading."

[15] Recent changes moved these committees under the authority of the grievance courts.

[16] Latest changes in that matter by the MOC have stipulated that firms should follow new accounting policies when they publish their quarterly and annual financial statements. Furthermore, they are required to explain any significant differences in their accounting methods (Alsharq Alawsat Newspaper, September 9, 1999).

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THE APPENDIX

Table 1.1 Market Indicators of some Developing and Developed Markets 1990 and 1997

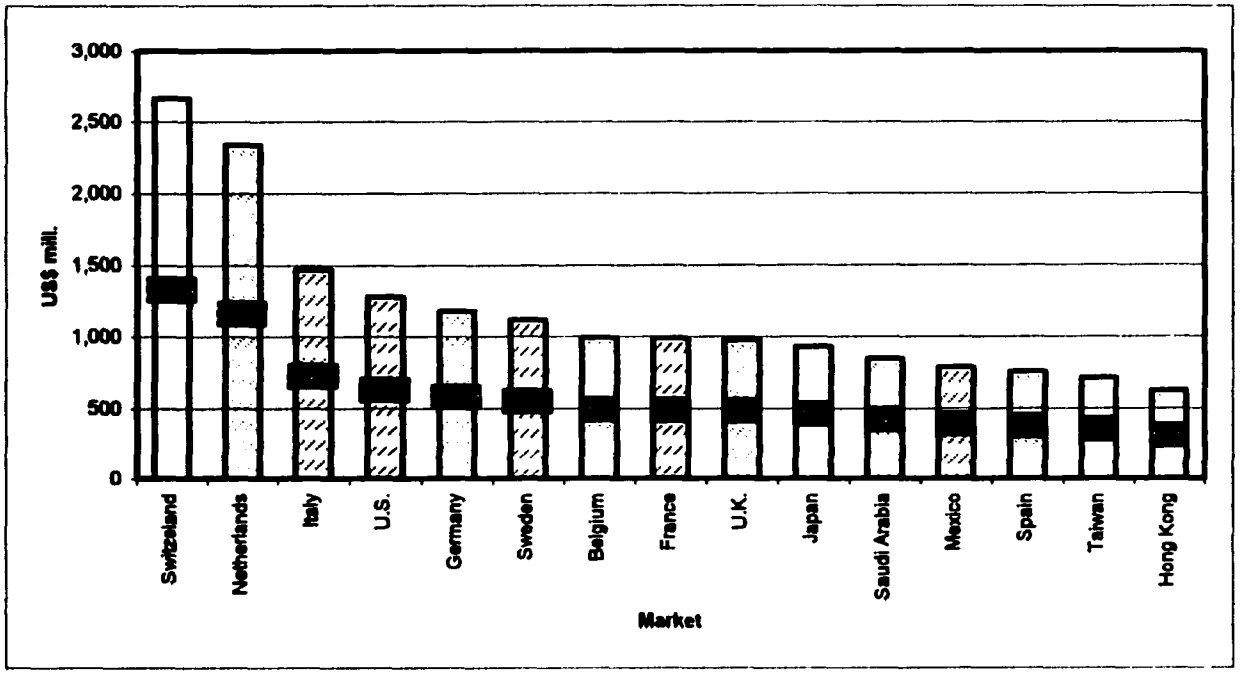
Market	Total Market Cap.in 1990 and 1997 (US$ mill.)		% Change	Total Value of Shares Traded (US$ mill)		% Change	Number of Listed Domestic Companies		% Change
	1990	1997		1990	1997		1990	1997	
Developing:									
Latin America:									
Argentina	3,268	59,252	1713%	852	25,702	2917%	179	136	-24%
Brazil	16,354	255,478	1462%	5,598	203,260	3531%	581	536	-8%
Chile	13,645	72,046	428%	783	7,445	851%	215	295	37%
Asia:									
Indonesia	8,081	29,105	260%	3,992	41,650	943%	125	282	126%
Taiwan	100,710	287,813	186%	715,005	1,297,474	81%	199	404	103%
Thailand	23,896	23,538	-1%	22,894	23,119	1%	214	431	101%
Africa & ME:									
Egypt	1,765	20,830	1080%	126	5,859	4550%	573	650	13%
Israel	3,324	45,268	1262%	5,535	10,727	94%	216	640	196%
Jordan	2,001	5,446	172%	407	501	23%	105	139	32%
Kuwait*	9,932	25,888	161%	2,543	34,576	1260%	65	74	14%
Morocco	966	12,177	1161%	62	1,048	1590%	71	49	-31%
S.A	26,053	59,386	128%	1,173	16,549	1311%	56	70	25%
Tunisia	533	2,312	334%	19	285	1400%	13	34	162%
Turkey	19,065	61,090	220%	5,841	59,105	912%	110	257	134%
Developed:									
Germaney	355,073	825,233	132%	501,805	1,029,152	105%	413	700	69%
Japan	2,917,679	2,216,699	-24%	1,602,388	1,251,750	-22%	2,071	2,387	15%
USA	3,059,434	11,308,779	270%	1,751,252	10,216,074	483%	6,599	8,851	34%

Source:IFC Factbook (1998) and SAMA
*1989 numbers.

Table 2.3 Emerging Market Rankings of Value of Shares Traded (1997)

Number	Market	Value of Shares Traded (US$ mill.)	GDP (US$ mill.)	Market Cap./GDP	Value of Shares Traded/GDP	Turnover Ratio*
1	Taiwan	1,297,474	265,119	109%	489%	462%
2	China	369,574	918,804	28%	40%	231%
3	Brazil	203,260	788,025	29%	26%	22%
4	Korea	170,237	318,170	65%	54%	47%
5	Malaysia	147,036	82,199	191%	179%	73%
6	Turkey	59,105	163,040	79%	36%	130%
7	India	53,954	388,726	24%	14%	43%
8	Mexico	52,646	398,430	15%	13%	40%
9	Soutn Africa	44,893	116,003	51%	39%	19%
10	Indonesia	41,650	165,490	36%	25%	69%
11	Kuwait	34,576	30,260	138%	114%	145%
12	Argentina	25,702	323,547	11%	8%	49%
13	Thailand	23,119	122,798	26%	19%	37%
14	Greece	21,146	117,881	25%	18%	72%
15	Philippines	19,783	69,804	37%	28%	35%
16	Saudi Arabia	16,549	143,550	16%	12%	31%
	Average	**161,294**	**275,740**	**48%**	**70%**	**94%**

*Value of shares traded in 1997 over average market cap
Source: IFC and IFS.



Source: IFC (1998)
*Total market cap./number of listed companies.

Figure 2.4 Average company size in different markets

Table 2.4 Arab Markets Rankings of Market Cap., Shares Traded and Average Comp. Size (1997)

Order	Market	Value of shares traded*	Order	Market	Market Cap.*	Order	Market	Average Company Size*
1	Kuwait	34,576	1	Saudi Arabia	59,386	1	Saudi Arabia	848.4
2	Saudi Arabia	16,549	2	Kuwait	25,888	2	Kuwait	349.8
3	Egypt	5,859	3	Egypt	20,830	3	Egypt	322.7
4	Oman	3,880	4	Morocco	12,177	4	Morocco	248.5
5	Morocco	1,048	5	Oman	7,108	5	Oman	68
6	Lebanon	640	6	Jordan	5,446	6	Jordan	62.4
7	Jordan	501	7	Lebanon	2,904	7	Lebanon	39.2
8	Tunisia	285	8	Tunisia	2,312	8	Tunisia	32
9	Palestine	25	9	Palestine	662	9	Palestine	NA
	Total	**63,363**		**Total**	**136,713**		**Total**	**1,971**

Source: IFC (1998) *Million US$

Table 4.2 Descriptive Statistics of Daily Returns

Sector	Code	N	Kurtosis	Skewness	st. D.	Average
Banking	1010	381	5.6712	-0.8387	0.0055	-0.0001
	1020	377	3.8753	-0.2879	0.0074	-0.0005
	1050	379	6.9848	-0.7346	0.0062	-0.0002
	1060	374	92.6256	-6.5681	0.0074	-0.0005
	1080	361	5.8929	-0.3735	0.0067	-0.0008
	1090	378	102.3736	-0.2318	0.0113	-0.0002
	1120	380	200.4607	-12.1403	0.0101	-0.0005
	1130	379	3.2716	-0.4095	0.0065	-0.0006
Industry	2010	379	7.9257	-0.7774	0.0059	-0.0005
	2020	377	117.4549	-7.8314	0.0116	-0.0012
	2050	377	7.0523	0.4229	0.0067	-0.0004
	2060	374	5.7801	-0.3622	0.0092	-0.0009
	2070	375	9.4920	-0.6698	0.0060	-0.0003
	2080	262	109.8578	-0.6142	0.0269	-0.0004
	2100	321	68.5698	0.0586	0.0155	-0.0009
	2110	337	26.3980	-2.5669	0.0110	-0.0007
	2130	370	2.9354	-0.1082	0.0080	-0.0006
	2140	259	4.6475	-0.1504	0.0099	-0.0004
Cement	3020	372	74.2586	-6.2127	0.0083	-0.0005
	3030	379	69.8640	-5.9606	0.0066	-0.0005
	3080	341	144.8685	-0.0776	0.0249	-0.0005
	3090	381	4.1101	0.1899	0.0055	-0.0005
Service	4030	373	1.0670	0.0896	0.0082	-0.0001
	4040	363	3.3958	-0.5006	0.0050	-0.0002
	4050	339	4.1860	-0.0190	0.0104	-0.0006
	4061	375	2.5496	-0.0796	0.0086	-0.0008
	4080	348	1.3719	0.0084	0.0082	-0.0004
	4090	367	3.7171	0.1002	0.0081	-0.0003
	4100	374	12.9563	-1.1706	0.0049	-0.0003
	4110	369	2.7189	0.5192	0.0077	-0.0008
	4130	300	1.9939	-0.0131	0.0122	-0.0009
	4150	380	1.5871	0.0854	0.0071	-0.0003
Electricity	5010	361	12.0728	0.5326	0.0065	-0.0003
	5020	345	8.8028	-0.2845	0.0062	-0.0003
	5030	252	4.4392	-0.0210	0.0090	-0.0004
Agriculture	6010	308	4.1891	0.1536	0.0049	-0.0003
	6020	309	133.5365	0.0421	0.0625	-0.0010
	6030	260	1.8448	-0.0924	0.0101	-0.0011
	6040	211	5.0435	-0.2231	0.0100	-0.0005
	6060	267	1.5808	-0.3081	0.0128	-0.0011
	6070	330	1.7501	-0.1468	0.0080	-0.0001
	Average		**31.2969**	**-1.1603**	**0.0104**	**-0.0005**

Table 4.3 Descriptive statistics of weekly returns

Sector	Code	N	Kurtosis	skewness	st. Dev.	Average
Banking	1010	381	8.19030	1.68997	0.02711	0.00005
	1020	377	4.80630	-0.26361	0.02926	-0.00290
	1050	379	94.82565	-8.18353	0.05856	-0.00336
	1060	374	18.64530	-2.30420	0.03632	0.00039
	1080	361	9.46004	-1.16047	0.04130	-0.00171
	1090	378	77.40034	-7.17716	0.06411	-0.00329
	1120	380	86.78109	0.13027	0.09631	0.00256
	1130	379	73.17171	-7.17693	0.06878	-0.00722
Industry	2010	379	25.41552	-0.05245	0.03278	0.00223
	2020	377	71.76663	-0.31556	0.06355	0.00377
	2050	377	8.63985	0.22594	0.01820	-0.00109
	2060	374	2.96731	0.82754	0.03382	-0.00188
	2070	375	10.05039	-0.17359	0.03001	-0.00370
	2080	262	3.89469	-0.28060	0.02358	0.00056
	2100	321	3.95891	0.72235	0.03080	-0.00308
	2110	337	12.23527	2.04217	0.04007	-0.00320
	2130	370	3.88429	0.70915	0.02897	-0.00199
	2140	259	3.08364	0.52027	0.03717	-0.00010
Cement	3020	372	7.44344	-0.70511	0.02140	0.00277
	3030	379	5.63948	-0.70040	0.02408	0.00075
	3080	341	87.26303	-1.69084	0.10712	0.00101
	3090	381	14.21326	2.52925	0.02463	0.00139
Service	4030	373	2.39374	0.02982	0.02424	-0.00420
	4040	363	38.32612	3.77374	0.02527	0.00017
	4050	339	1.38850	0.03182	0.02892	-0.00483
	4060	375	7.71113	-1.23990	0.04406	-0.01190
	4080	348	5.74527	0.85112	0.03129	-0.00246
	4090	367	2.43639	-0.32018	0.02714	-0.00524
	4100	374	14.44210	1.47022	0.03264	-0.00159
	4110	369	7.50964	0.22901	0.03891	-0.00591
	4130	300	9.00519	-0.37879	0.04915	-0.00347
	4150	380	4.66530	0.97899	0.02909	0.00039
Electricity	5010	361	21.43696	-0.89800	0.02973	-0.00086
	5020	345	30.36870	3.78325	0.02887	0.00048
	5030	252	8.59191	0.45257	0.03305	0.00050
Agriculture	6010	308	1.48338	0.10298	0.01873	-0.00159
	6020	309	3.77133	0.85361	0.03349	-0.00439
	6030	260	2.07451	0.22973	0.02288	-0.00499
	6040	211	1.86951	-0.69067	0.02509	-0.00235
	6060	267	6.69959	1.34355	0.03411	-0.00262
	6070	330	1.72683	-0.02178	0.02964	-0.00198
	Average		**19.64348**	**-0.24894**	**0.03718**	**-0.00183**

Table 4.4 Daily serial correlation coefficients for different

Number	Firm Code	Number of observations	Number of lags			
			1	4	9	16
1	1010	381	**0.1**	0.084	-0.099	-0.033
2	1020	377	**0.092**	-0.014	-0.06	0.014
3	1050	379	0.165	0.025	-0.04	-0.01
4	1060	374	**0.09**	0.033	0.03	-0.014
5	1080	361	**0.14**	0.06	-0.03	-0.08
6	1090	378	"-0.35"	0.015	0.01	0.014
7	1120	380	0.11	0.04	-0.007	0.0006
8	1130	379	0.09	0.05	0.04	0.03
9	2010	379	**0.12**	0.02	0.11	0.018
10	2020	377	**0.03**	-0.068	0.057	0.04
11	2050	377	**-0.045**	0.06	0.001	0.016
12	2060	374	"-0.14"	-0.06	0.063	0.06
13	2070	375	**0.002**	0.03	-0.1	0.1
14	2080	262	**"-0.4"**	-0.02	-0.048	-0.01
15	2100	321	"-0.38"	**-0.02**	-0.05	0.04
16	2110	337	**-1.07**	0.04	-0.024	0.02
17	2130	370	**-0.08**	-0.016	-0.05	0.032
18	2140	259	**-0.074**	**-0.03**	-0.01	-0.036
19	3020	372	**0.04**	**-0.045**	0.008	0.06
20	3030	379	**0.04**	**0.1**	-0.05	-0.02
21	3080	341	**"-0.45"**	-0.03	0.01	0.01
22	3090	381	**0.09**	**0.15**	0.017	0.024
23	4030	373	**-0.09**	-0.06	0.06	-0.08
24	4040	363	"-0.22"	-0.037	**0.11**	-0.01
25	4050	339	"-0.34"	-0.03	-0.004	-0.017
26	4061	375	"-0.17"	0.038	-0.05	0.031
27	4080	348	-0.09	-0.007	0.011	-0.01
28	4090	367	**"-0.16"**	-0.08	0.04	-0.08
29	4100	374	**0.025**	-0.06	0.07	-0.07
30	4110	369	"-0.19"	0.0007	0.06	0.093
31	4130	300	**"-0.14"**	"-0.18"	-0.01	"-0.13"
32	4150	380	-0.08	-0.018	-0.07	0.04
33	5010	361	**"-0.12"**	0.05	0.03	-0.039
34	5020	345	**"-0.13"**	-0.002	-0.0001	0.062
35	5030	252	**"-0.21"**	0.03	-0.06	-0.1
36	6010	308	"-0.28"	0.004	0.007	**0.14**
37	6020	309	"-0.49"	-0.03	0.02	0.004
38	6030	260	**"-0.26"**	-0.19	0.07	0.1
39	6040	211	"-0.24"	0.05	-0.017	0.11
40	6060	267	**"-0.3"**	-0.03	0.02	0.03
41	6070	330	"0.22"	0.02	-0.01	-0.04
average			-0.019	0.0013	0.0013	0.011

Bolded numbers indicate significance at .05.

Table 4.6 Weekly serial correlation coefficients for different lags

Number	Firm Code	Number of observations	Number of lags			
			1	2	3	4
1	1010	198	**0.318**	0.071	0.05	0.004
2	1020	198	**0.178**	0.039	0.042	0.07
3	1050	198	0.102	0.065	0.73	-0.03
4	1060	198	**0.235**	0.073	0.012	-0.04
5	1080	198	-0.066	0.09	0.07	0.06
6	1090	198	-0.06	-0.05	0.04	0.05
7	1100	183	-0.03	-0.028	-0.11	0.04
8	1110	198	**-0.45**	-0.007	-3E-04	0.012
9	2010	198	**0.16**	0.09	0.025	0.02
10	2020	198	**-0.40**	0.013	-0.007	0.035
11	2050	198	0.004	-0.027	**0.15**	-0.02
12	2060	198	**0.145**	0.09	0.009	-0.02
13	2070	198	**0.231**	-0.06	0.022	-0.06
14	2080	198	0.057	**-0.23**	-0.02	0.026
15	2100	198	**0.188**	0.1	-0.011	0.001
16	2110	198	**0.19**	0.004	-0.005	0.09
17	2130	198	**0.31**	**0.22**	**0.14**	-0.006
18	2140	198	**0.35**	**0.2**	**0.25**	0.12
19	3020	198	**0.265**	**0.153**	0.1	0.005
20	3030	198	**0.272**	0.095	**0.14**	0.099
21	3080	198	**-0.42**	-0.034	-0.003	-0.006
22	3090	169	**0.22**	-0.033	-0.1	-0.04
23	4030	197	**0.193**	0.04	0.07	0.12
24	4040	197	0.097	-0.074	0.046	0.04
25	4050	197	0.048	0.045	0.07	-0.02
26	4060	147	0.15	0.147	-0.06	-0.001
27	4080	197	-0.026	0.087	-0.009	-0.008
28	4090	197	**0.18**	-0.04	0.04	0.028
29	4100	197	**0.338**	-0.006	-0.09	-0.06
30	4110	197	0.02	0.032	0.08	-0.04
31	4130	197	**0.42**	0.125	0.028	-0.02
32	4150	185	0.094	0.108	**0.157**	-0.002
33	5010	197	**0.134**	0.017	-0.08	-0.136
34	5020	197	**0.306**	0.009	-0.02	-0.13
35	5030	197	**0.15**	0.041	-0.11	-0.1
36	6010	197	0.065	0.025	0.024	-0.01
37	6020	197	-0.072	-0.087	0.05	**0.21**
38	6030	197	**0.134**	0.02	0.11	0.11
39	6040	197	-0.08	0.049	0.09	0.1
40	6060	197	**-0.15**	-0.064	0.013	**0.206**
41	6070	197	0.119	0.071	0.01	0.012
average			0.183	0.0757	0.0474	0.0173

Bolded # are significant coefficients at 0.05

Table 4.11 Runs test results

Code #	Daily				Weekly			
	Ra	Re	P-value	Ra-Re/Re	Ra	Re	P-value	Ra-Re/Re
1010	169	183.7	0.1153	-0.0801	70	94.7	0.0002*	-0.2605
1020	159	172.6	0.1241	-0.0786	94	100.0	0.3933	-0.0599
1050	162	184.2	0.0181*	-0.1206	73	98.0	0.0003*	-0.2553
1060	175	184.9	0.2963	-0.0536	71	99.5	0.00*	-0.2865
1080	175	180.6	0.5507	-0.0312	88	99.4	0.1034	-0.1143
1090	189	189.7	0.9391	-0.0039	77	94.2	0.0093*	-0.1824
1120	155	189.3	0.0004*	-0.1812	77	99.2	0.0014*	-0.2236
1130	177	187.8	0.2585	-0.0577	82	89.2	0.2709	-0.0802
2010	159	183.5	0.0089*	-0.1334	93	100.0	0.3185	-0.0700
2020	170	184.6	0.1229	-0.0789	95	99.4	0.5323	-0.0438
2050	195	189.0	0.5364	0.0316	98	100.0	0.7800	-0.0196
2060	171	165.4	0.5098	0.0338	95	99.4	0.5323	-0.0438
2070	150	164.2	0.0914**	-0.0865	79	98.8	0.0043*	-0.2002
2080	138	118.5	0.0072*	0.1642	104	97.1	0.3096	0.0713
2100	166	150.2	0.0581**	0.1049	79	99.8	0.0029*	-0.2087
2110	147	150.6	0.662	-0.0236	89	99.2	0.1435	-0.1027
2130	155	139.2	0.0281*	0.1131	86	99.6	0.0511**	-0.1369
2140	119	112.3	0.3342	0.0593	86	100.0	0.0466*	-0.1397
3020	153	181.5	0.0023*	-0.1570	90	100.0	0.1557	-0.0996
3030	341	349.3	0.5132	-0.0237	80	96.0	0.0177*	-0.1663
3080	179	167.1	0.1838	0.0714	79	99.8	0.0029*	-0.2087
3090	174	179.2	0.5718	-0.0288	69	74.5	0.3295	-0.0737
4030	146	131.2	0.0274*	0.1131	86	99.3	0.057**	-0.1339
4040	149	144.1	0.512	0.0341	82	95.2	0.0481*	-0.1390
4050	97	90.4	0.1742	0.0727	97	98.4	0.8419	-0.0140
4061	133	125.7	0.2567	0.0580	66	74.4	0.1632	-0.1131
4080	149	145.2	0.6229	0.0261	101	99.5	0.8277	0.0153
4090	118	106.7	0.0395*	0.1061	84	98.8	0.0336*	-0.1495
4100	178	183.5	0.5593	-0.0300	76	99.2	0.0009*	-0.2338
4110	159	148.6	0.1754	0.0699	90	98.6	0.2158	-0.0871
4130	139	133.0	0.428	0.0453	65	81.2	0.0045*	-0.1991
4150	132	131.9	0.9837	0.0010	75	85.9	0.0796**	-0.1270
5010	157	156.3	0.9275	0.0048	98	95.6	0.7256	0.0247
5020	164	152.3	0.1494	0.0770	88	97.6	0.1600	-0.0988
5030	123	113.0	0.1553	0.0885	90	96.0	0.3722	-0.0627
6010	142	124.1	0.0104*	0.1444	87	96.7	0.1524	-0.1006
6020	117	95.2	0*	0.2286	92	92.9	0.8905	-0.0097
6030	122	110.2	0.0806**	0.1071	92	99.1	0.3103	-0.0714
6040	93	87.7	0.3758	0.0601	92	95.2	0.6291	-0.0340
6060	81	69.0	0.0038*	0.1737	104	89.4	0.0203*	0.1630
6070	119	106.6	0.0324*	0.1163	90	96.4	0.3457	-0.0663
Average	153.6	152.7	0.26923	0.0228	85.59	95.8	0.2318	-0.1059

*Significant at 5%. **Significant at 10%