TESTS OF WEAK FORM EFFICIENCY IN ISTANBUL STOCK EXCHANGE

A THESIS
SUBMITTED TO THE DEPARTMENT OF MANAGEMENT
AND THE GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
OF BILKENT UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION

BY

SELIM MURAT ALPARSLAN

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I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Business Administration.

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ABSTRACT

TESTS OF WEAK FORM EFFICIENCY IN ISTANBUL STOCK EXCHANGE

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The Weak Form Efficient Market Hypothesis claims that current stock prices fully reflect all stock market information, including the historical sequence of past prices, price changes, and volume data. Therefore the information in past prices or returns is not useful or relevant in achieving excess returns in the future.

In this study, the weak form efficiency tests are applied to the Istanbul Stock Exchange first common stock market's adjusted-price data. The period covered is in between January 10, 1986 and October 28, 1988.

There have been two groups of weak form tests recommended by the literature: statistical tests of independence (autocorrelation and runs tests) and tests of trading rules (filter rules). For the Istanbul Stock Exchange, these tests generated mixed results. The runs and autocorrelation tests could not refute the weak form efficiency fully. However, the results of the filter tests showed that an individual could have beaten the market especially for some of the stocks. These large discrepancies between the buy-and-hold and filter returns are supporting the views which are against the *efficiency* of Istanbul Stock Exchange.

ÖZET

ISTANBUL MENKUL KIYMETLER BORSASINDA ZAYIF PAZAR ETKINLIGI TESTLERI

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Haziran 1989, 39 sayfa

Zayıf Etkinlik Hipotezi, şimdiki hisse senedi fiyatlarının geçmişteki bilgileri de yansıttığını iddia eder. Bu yüzden, geçmişe ait fiyat, getiri ve işlem hacmi dizileri gelecekte normalin üzerinde bir kazanç sağlamada yardımcı olmamalıdır.

Bu çalışmada Zayıf Pazar Etkinliği testleri, Istanbul Menkul Kıymetler Borsası Birinci Hisse Senedi Pazarının düzeltilmiş-fiyat serisine uygulanmıştır. Kullanılan fiyat dizisi 10 Ocak 1986 - 28 Ekim 1988 dönemini kapsamaktadır.

Zayıf Etkinlik konusunda çoğunlukla kullanılan testler iki grupta toplanabilir: İstatistiksel bağımsızlık testleri (otokorelasyon ve sıralanma testleri) ve mekanik alım-satım kurallarını içeren testler (filtre kuralları gibi). Bu testler Istanbul Menkul Kıymetler Borsası için karışık sonuçlar vermiştir. Otokorelasyon ve sıralanma testleri olası bir zayıf-formda etkinliği tamamen çürütememiştir. Buna karşın, bazı filtre kuralları kullanılarak geçmişte aşırı kazançlar elde edilinebileceği de gösterilmiştir. Basit alım-satım ve filtre kuralları arasındaki bu büyük farklılıklar Istanbul Menkul Kıymetler Borsasının etkin olmadığı doğrultusundaki iddiaları güçlendirmektedir.

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1 INTRODUCTION

"Efficient Capital Markets" hypothesis has been the source of many academic research over the past twenty years. The subject attracted wide attention, because it has significant "real world" implications for investors and portfolio managers.

The Efficient Market Theory asserts that market prices fully and instantaneously reflect all available information. Therefore, the share prices can be looked upon as "correct" and provide accurate signals for the optimal allocation of resources. Thus, prices are determined in a way which equates the marginal rates of return (adjusted for risk) for all producers and savers. As a result, any trading rule which is using past price changes or any past market data should have little value in predicting future price changes. A probable doubt in price efficiency tends to make the investors focus on potentially wasteful ways of exploiting perceived inefficiencies and away from positively interpreting the messages in market prices.

1.1 Basic Concepts

The capital markets are expected to be efficient because of three main underlying assumptions:

i) In the market, there are a *large number* of profit maximizing participants who are concerned with the analysis and valuation of securities operating independently from each other. Hence, the market becomes perfectly competitive.

ii) New information about securities comes to the market in a *random* fashion.

iii) Investors adjust the security prices *rapidly* to reflect the effect of new information.

The combined effect of the three conditions listed above construct the most general basis for the efficiency tests in the sense that *in an efficient capital market the price changes are independent and random.*

1.1.1 Definitions and Their Importances

The early work in the area of efficient markets was based on the "random walk" hypothesis. It was a byproduct of a discovery by M.G. Kendall in 1953 . In fact, the idea was not completely novel. It had also been proposed by Louis Bachelier in 1900. But, Bachelier's work lacked the support of mathematical theory of random processes.

Eugene Fama made the first attempt to synthesize the theory and organized the empirical studies in an article in 1970 [15]. He presented the theory in terms of the "fair game" model. In his "fair game" efficient market, (being confident that the current prices "fully reflect" all available information consistent with the risk involved) investors could acquire securities at the prevailing rates. In addition, Fama divided the overall hypothesis and empirical tests into three subhypotheses depending upon the *information set* involved:

i) Weak Form Efficient Market Hypothesis; weak form efficient market hypothesis claims that current stock prices "fully reflect" all *stock market* information, including the historical sequence of past prices, price changes, volume data and other market-generated information (like specialist activities if significant in terms of the total exchanges in the stock markets). Therefore, no investor can earn excess returns by developing trading rules based on historical price or return information. In other words, the information in past prices or returns is not useful or relevant in achieving excess returns.

ii)Semi-Strong Form Efficient Market Hypothesis; The semi-strong form efficient market hypothesis assumes that security prices adjust rapidly to the release of all new public information; that is, stock prices "fully reflect" all *public* information. Obviously, this form of hypothesis encompasses the weak form hypothesis since all public information includes all market information, plus all nonmarket public information, such as earnings and dividend announcements, stock splits, issuance of common stock, economic news, political news, annual reports of companies, or advisory data in the press. A direct implication of

this hypothesis is that no investor can earn excess returns from trading rules based on publicly available information because the security prices already reflect the new information.

iii)Strong Form Efficient Market Hypothesis: The strong form efficient market hypothesis asserts that stock prices "fully reflect" *all* information (public or otherwise). Hence, no group of investors can have monopolistic access to information relevant to the formation of prices. This form of hypothesis encompasses both of the previous forms. Further, the strong form of hypothesis not only requires efficient markets (in which prices adjust rapidly to the release of new public information), but also requires perfect markets in which all of the information is available to everyone at the *same time*. This form of the efficient market hypothesis contends that, because all information is immediately available to everyone and is rapidly discounted by everyone, no group has monopolistic access to important new information; therefore, no group can consistently earn excess returns using any information, whether publicly available or not.

1.1.2 Findings, Their Implications and Trends

Empirical evidence for or against the hypothesis that capital markets are efficient takes many forms. Not all the articles in the literature completely support the efficient market hypothesis. Most agree that capital markets are efficient in the weak and semi-strong forms but not in the strong form. The majority of the studies are very recent, dating from the late 1960s and continuing up to the most recently unpublished papers. Usually, the tests have been done in the large and sophisticated capital markets of the developed countries. As a result, the conclusions must be confined in these areas from which they are drawn.

Research about the efficiency of all capital markets is an ongoing process, and the work is being extended to include assets other than common stock as well as to smaller and less sophisticated marketplaces. For example, there is evidence that

other markets are also efficient.[1]

As noted earlier, considerable controversy had surrounded the concept of efficient markets during the 1960s and 1970s. Even today, there is still some doubt too. However, empirical evidence firmly supports market efficiency. If one keeps in mind the assumptions of the theory it can be regarded as the accepted model of the share price behavior.

1.2 The Purpose and Main Guidelines of the Project

The purpose of this study is to apply the weak form efficiency tests to the Istanbul Stock Exchange first common stock market's adjusted price data.

The Turkish financial system has shown spectacular developments in the last nine years. The 1980 "stabilization programme" was aiming at changing Turkey's development strategy with greater reliance in market forces. During the post-1980 period, discussions on the efficiency of the financial system has gained importance. Studies testing the efficiency and effectiveness of the financial markets have attracted even wider attention since Turkey applied for a permanent membership in the EEC. The point became even more serious when the majority of the EEC countries decided to collide in a single market structure in 1992.

In this study, the controversy about the efficiency of the Turkish Common Stock Market —especially in the first market— is emphasized, although its relative share in the financial system seems to be insignificant.

As stated before, the efficient market hypothesis asserts that the prices of the securities instantaneously and fully reflect all available relevant information, such that no investor can earn excess returns using any information. As far as the weak-form efficiency tests are concerned, there have been two

[1]Roll (1970) showed that prices in the Treasury bill market obey a fair-game model. Stein (1977) examined the auction market for art and found it efficient. Larson (1960) looked at corn futures, and Mandelbrot (1964) investigated spot prices in cotton.

major groups of tests recommended by the literature. The primary objectives of these tests —which are also employed in this study— can be summarized as follows[2] :

i)Statistical Tests of Independence

a)Autocorrelation Tests;

Were there significant positive or negative correlations in price changes over time? i.e. Is the percentage of price change on day t correlated with the percentage of price change on day t-1, t-2, t-3,.....?

b)Runs Tests;

Are the elements of a past price change series independent of each other? In other words, is the past price change series random? To test for randomness, one compares the number of runs[3] for a given series and compares this with a table that provides the number of such runs that would occur in a random series.

ii)Tests of trading rules;

Is it possible to obtain considerable profits by applying filter techniques? Specifically, a (10,5) filter rule suggests that an investor should buy a security if its price rises 10% and he should also stay long until its price drops by 5% from a subsequent high. At that time the investor should sell and stay out of the particular stock.

The stock price changes may not appear to be independent and/or random. Moreover, significant and persistent profits can be observed to have been obtained via some trading rules with or without the prior statement already satisfied. If either one or both of the above can be verified, then the contended view that the stock market is efficient is suspect.

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[2]Details are presented in the methodology section.

[3]When a negative (positive) price change series is followed by a positive (negative) price change series, a run ends while the other begins. For example, there are three runs in this 10 period price change series: ++++---+++.

Following a brief review of the literature about Weak-Form Efficiency Tests, the discussion begins with the introduction of the Istanbul Stock Exchange in terms of its history and operations. After the explanation of the methodology pursued, a summary of the findings is presented in figures and tables. Finally, the analysis closes with a summary, its related conclusions, and comments about interpreting the outcomes of the study.

2 LITERATURE REVIEW

The efficient markets theory is a rational outcome of a well-run and competitive marketplace, and it could be taken as granted unless disproved. Surprisingly, however, the concept started to become popular only around 1960s and 1970s even among the academic community. In those days, the prevailing view was that the stock market is "inefficient" (in the sense that share prices could be mispriced and that above-average risk-adjusted rates of return could be earned) and that the supporters of the efficient markets theory had to prove themselves. This view was backed up by claims of superior investment performance and of anecdotal evidence of investors who had made fortunes on the stock market. Even though these claims *may be* true, they do not necessarily refute the efficient markets theory. Because, the theory asserts that it is not possible to earn superior returns *consistently* except by *chance*. The theory stresses upon the words "consistently" and "chance". For sure, many investors will earn excess returns in some periods, but this will be due to chance. In the longer term, the efficient markets theory alleges that their performance will not be superior, and that it is not possible to predict *when* certain investors and managed funds will be earning above/below average returns.

Most of the related research has been carried out in the United States where the availability of computerized databanks of stock prices greatly contributed to the program of research. However significant amount of research has also been conducted in the UK, Europe (in Turkey by Aydoğan [3] on the foreign exchange black market), Australia, etc. According to these studies, mostly carried out by academicians, major stock markets are efficient.

In the remaining parts of this chapter, while referring back to the classification of efficiencies which is basically attributable to Fama [15], some of the milestone studies in the literature about the Efficient Markets Theory, (especially in the field of weak form efficiency related research), will be reviewed.

2.1 The History and the Developments

Earlier classifications of efficient market literature tended to be dominated by the names of the models which were used to describe share price behavior. The most general of these models was the "fair game" model which expresses efficiency in terms of the opportunities for speculators to earn excess returns[4]. The "submartingale" and "random walk" models were two special cases of the fair game model, and are more specifically concerned with the sequence of price changes over time. For example, the submartingale model states that the expected value of tomorrow's share price in an efficient market should be greater than or equal to today's price. The better known random walk model, which has popularly been used at times to denote the whole area of efficient market research, defines market efficiency in terms of lack of dependence between successive price movements: The market is efficient in relation to the information set contained in the past history of prices if share price movements are independent of previous movements. On the whole, weak form tests of market efficiency were being conducted before the fair game models were developed. What are known as the weak form tests of the general theory of price efficiency were initially used as the tests of the random walk hypothesis.

Tests of weak-form efficiency generally consist of statistical investigations of the time series of share prices and of various mechanical trading strategies that are advocated by professional analysts. The major time series studies have examined the serial correlation between successive price changes in a security.

As noted before, the first study examining market prices was reported by Bachelier [4], even though his work was ignored for 53 years. He found that commodity price changes on the French Bourse (Stock Market) followed a random walk. However, he could not enjoy

[4]A thorough discussion and explanation about the mathematical background and evolution of these models can be found in the review article of Fama [15].

the benefit of the modern theory of stochastic processes. After him, Working [33] in the United States and Kendall [19] in the United Kingdom also found evidence that changes in market prices were random. However, it was not until the studies by Roberts [27] and Osborne [25] that research into stock market prices really got under way. Roberts' study compared movements in the Dow Jones Industrial Average (a stock market index) with the movements in a variable which was generated by a random-walk process. This comparison showed that the random-walk process produced patterns which were very similar to those of the Dow Jones index. From this evidence Roberts suggested that stock price movements may be random. Osborne's study similarly indicated that share price changes are random in nature and that past price changes have no predictive value.

Following these, Fama [12, p. 72] conducted the first comprehensive study of stock price behavior. He analyzed the behavior of daily price changes of the 30 common stocks in the Dow Jones Industrial Average over a period of approximately five years in terms of both correlation coefficients and runs. He found a very small positive serial correlation which was not statistically different from zero. The number of runs in daily price changes was slightly smaller than the expected number of runs, implying that runs tended to persist somewhat longer than expected. This was still consistent with his prior findings that there was some slight dependence, being very small and not significantly different from zero.

Generally speaking, Fama's results were also consistent with the findings of earlier, less detailed studies of stock price returns conducted by Cowles and Jones [10], Kendall [19], Osborne [25], Moore [24], Granger and Morgenstern [16], Cootner [7], as well as with Working's [33] findings on organized commodity markets. On the whole, these studies found little, *if any*, linear dependence in the series of price changes in competitively organized securities markets.

As might have been expected, Fama's findings did not receive noticeable interest. Critics were alleging that stock price

changes could exhibit much more complicated dependencies that could be exploited by those skilled in reading and interpreting charts (i.e. technical analysts), even though the serial correlation coefficients might be quite small. As a consequence, after Fama's study, the number of articles —showing that various types of mechanical trading rules could be used to earn returns greater than those available from the naive buy-and-hold strategy— proliferated.

The need for another type of test of weak-form efficiency —which takes into account the possible trading rules— arose at this point; especially after the studies conducted by Alexander [2]. He proposed a simple filtering technique producing higher returns than a naive strategy[5]. He had analyzed the closing prices for the Dow Jones Industrial Average during 1897-1929 and Standard & Poor's Industrials during 1929-1959 using filters of various sizes ranging from 5 to 50 percent. Unfortunately, Alexander's results were seriously biased in favor of his filter techniques, for several reasons. The most important reason was that he did not adjust the returns for transaction costs, which would have been quite substantial, especially at low filters. Allowance for transaction costs was important because some researchers like (Fama and Blume, [13]) have found, for example, that filter rules produce gross excess returns, but that a large number of transactions are generated. Once the costs of these transactions are included, however, the strategy no longer earns excess returns. Among the mechanical investment strategies tested are filter rules, moving averages, fixed-proportion maintenance, relative strength, and portfolio rebalancing strategy[6].

Another recent more sophisticated study was by Rosenberg and Rudd [29] published in 1982. Having observed the lack of serial correlation in the total returns of securities, they tested for serial correlation with respect to each of the major components of

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[5]His method will fully be explained later in Methodology section.

[6]For more information about these tests please refer to Levy (1967), Latane and Young (1969), Jensen and Benington (1970), Cheng and Deets (1970), and West and Tınıç (1973).

a security's return. A security's total return is generally recognized to be composed of two major elements, the return that is common to all securities and the return specific to the individual security. The study found a positive serial correlation for the common component and a corresponding negative correlation for the specific component, resulting in an increased predictability of the total returns. Although the findings suggest a violation of the weak form efficiency, the study ignored the impact of transaction costs, and there was no evidence that the results amounted to an exploitable inefficiency.

Opponents of weak-form efficiency argue that there are mechanical rules which can generate excess returns. However, not surprisingly, they will not disclose the nature of, and the parameters of, the trading rule —otherwise everyone would use the rule and the excess profits would disappear. Unfortunately, because of the necessary secrecy surrounding the mechanical rule, it can not be independently checked. One possible way of checking the validity of claimed "profitable rules" without affecting the secrecy of the rule is to examine the profits of the operators of the rule. So far, there appears to have been no research on this issue. This is probably due to operators' reluctance to publish data on their investment performance.

In summary, weak form tests have sometimes failed to uncover the significant inefficiencies in the pricing of the securities in the stock market. It is hard to deny that small dependencies may appear in series of stock price changes. But, the conclusion from the accumulated research studies is that these dependencies cannot be exploited to earn abnormal returns.

3 THE EVOLUTION OF THE TURKISH STOCK EXCHANGE MARKET AND ITS CHARACTERISTICS

The roots of the exchange markets in Turkey can be traced back to the 1860s in an informal and traditional sense. Around 1970s a bond exchange was formed that worked ineffectively.

Along with the deregulation attempts of the financial system in 1980, many non-bank financial institutions —so called bankers— were formed. Their primary action was to borrow public money by attractive yields. Later, they were lending the same money at high interest rates. However, in 1981-1982, the system collapsed when they fell into difficulty in collecting the loans they had made, and in fulfilling their obligations to repurchase the securities they had sold. There were no regulations to protect the investors either.

As an urgent reaction to the crisis, the legislating bodies enacted the Capital Market Law (CML) in 1981. The regulation and supervision responsibility of the primary and secondary markets was assigned to the Capital Market Board (CMB)[7] which had been established in 1982.

The Capital Market Law was essentially tailored for the primary market for securities in which *new* issues of bonds and common stock by various economic units to acquire *new* capital. Therefore, authorities enacted Decree Bylaw 91 in October 6, 1983 for the regulation of the secondary markets, where, there is trading in *currently outstanding* issues of bonds and common stock.

The Decree Bylaw 91 gave the Capital Market Board more authority to supervise and regulate the stock exchange, institutions and all operations in the secondary markets. In October 6 , 1984 a Council to Ministers' Decree, was issued (in accordance with the Decree Bylaw 91).

It set the main guidelines of the establishment and working principles of the stock exchanges and the provisions for the

[7]For the main duties of the CMB, see [9, p. 38].

membership, listing and trading procedures, and the oversight rules of the Capital Market Board. In addition, the framework of the legal and managerial operations of the ISE (Istanbul Stock Exchange) had been set when published in December 18 1985.

According to the regulations legislated in the 1982-1985 period, securities market operations could be performed by banks, stock exchange brokers (joint stock corporations) and individual brokers. There were some requirements for these institutions to operate in securities markets. Capital Market Law defines two other non-bank financial institutions, namely investment trusts and mutual funds[8].

ISE, as a secondary market, (in which securities are traded to provide liquidity to individuals who acquire securities in the primary market) started its early official operations in December 26, 1985. The prices were made public starting on January 10, 1986.

There is also OTC [9](Over the Counter) market where some of the secondary market operations are carried out. The off-board trading in listed securities was forbidden since January 1986. However, since public sector securities had not been listed, they were being traded outside the exchange. The formation of the "Securities Regulation Fund" by the Capital Market Board, channeled a substantial portion of the outside—trading to the Istanbul Stock Exchange.

Only the members may take part in trading on the Istanbul Stock Exchange. Membership is automatic for stock exchange brokers when they obtain the necessary permission to operate in securities markets, and is gained by banks upon application and by individual brokers upon the permission of Capital Market Board. As of 1987, there were 42 members; of which 24 were banks, 10 were incorporated stock exchange brokers and 8 were individual brokers.

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[8]For more information, see [9, p. 39].

[9]The Over the Counter market encompasses trading in all stocks either listed or not listed on the Istanbul Stock Exchange. It is not formal. Theoretically, it is possible to trade *any* security on the Over the Counter market as long as someone is willing to take a position in the stock.

In Turkish capital markets, Undersecretariat of Treasury and Foreign Trade and The Central Bank also have some regulatory powers.

There are three major markets in Istanbul Stock Exchange secondary market:

-Common Stock Markets.

-Private Sector Bond Market.

-Public Sector Securities Market.

The Common Stock Market itself, can further be divided into three as follows:

-1^{st} market.

-2^{nd} market.

-Over the Counter market.

The listed security exchanges are permitted in the first and second markets for the participants who are qualified for "listing" in the respective market. The "non-listed" stocks are traded in the Over the Counter markets established by Istanbul Stock Exchange whenever necessary. An important fraction of the common stock trading is done in the first market (as of June 1988) where 50 securities are traded.

Some more information about the Common Stock Market of Istanbul Stock Exchange according to [30] is given in Appendices A1,A2,A3, and A4. As it is seen in Appendix A1 the number of listed companies by Istanbul Stock Exchange is around 400. Among those, only 50 are qualified to be listed in the first market since September 1987. The market values of the first market companies has risen up to 3 trillion TL (approximately $3.2 billion, see Appendix A2). The price over earnings ratios (P/E) are now around 8-10. The turnover ratio has increased little; from 1.23 to 3.23 during the period 1986 to 1987.

If international comparisons are made, the P/E ratios in Turkey are close to the ones in developing markets but much lower than the ones in the developed markets (see Appendix A2). The market values of Turkish companies are much lower than those around the world.

According to the system in use, the daily opening price of a

stock is determined by calculating the weighted average price of the stock on the previous day. During the day, "multiple" pricing strategy is pursued in the sense that, any price can be asked for a particular stock[10]. On the contrary, for the bond tradings, the ISE acts just like a registrar. Once the parties agree on the terms of trading a bond, the ISE just formalizes the buying and selling operation.

The trade volume of the Common Stock Market was 1.9 billion TL in 1983. When Istanbul Stock Exchange started its operations in 1986 this figure climbed up to 8.7 billion TL (see Appendix A3). In the first half of 1988 the trade volume came out to be 102.2 billion TL, and it was expected to reach to 200 billion TL by the year end.

Since the establishment of Istanbul Stock Exchange, the share of common stock tradings over the total trading volume has been declining. The common stock trading over total trading volume was used to be around 4 % . However, in 1986 & 1987, the typical figures were around 0.4 % and 1.8 % respectively. In addition to the overall decline in common stock trading, it has been observed that most of the exchanges in the common stock market are done by the stocks of the first market companies. (The share of the second market has been around 5%).

If members of the ISE are examined, it is seen that the buying-selling volumes of the banks in terms of common stocks has been declining over time whereas the situation is reversed for joint stock corporations and individual brokers (Please see Appendix A4 for more information).

In terms of the sales volume in secondary markets (see Appendix A5), bank-channeled tradings account for about 90% of the total (including all markets). Their dominance in these markets are generally due to their sales of government bonds and Treasury bonds. This is generally attributed to the banks' recent policy of supporting bond issuance. For the better understanding of the

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[10]The prevailing system was formalized in August 1, 1988. More information about the "older" pricing strategy and transaction cost brackets is given in [30, p. 65].

magnitudes related to this topic, the funds supplied by financial system in Turkey is given in Appendix A6.

As far as the price movements are concerned, a graph showing the weekly market indexes in the period January 1986 - October 1988 is shown in Figure 1.

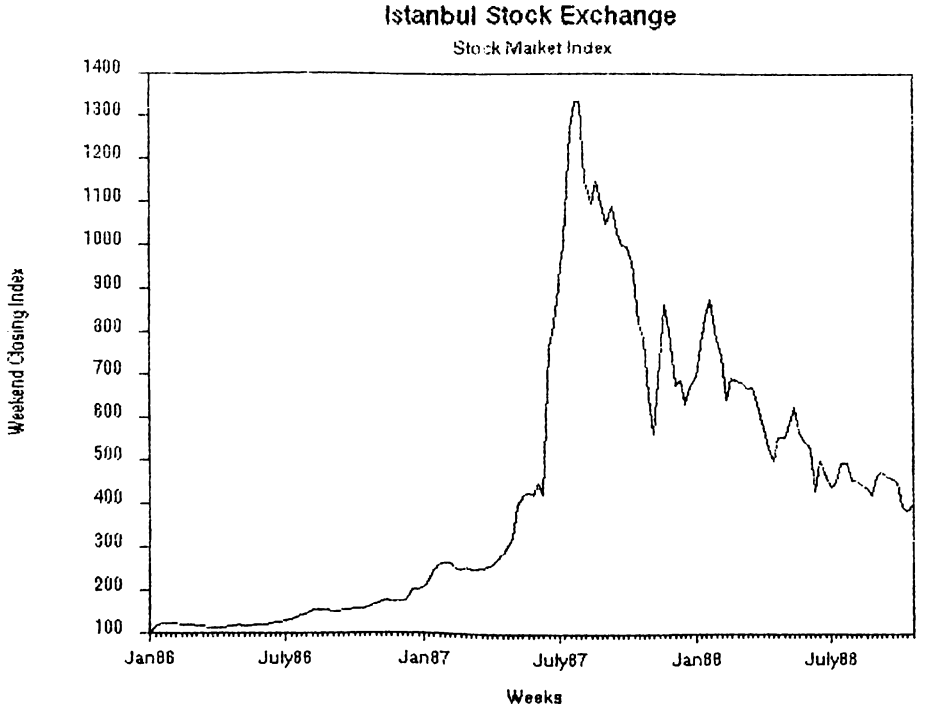

Figure 1. Weekly Market Index Values in the History of ISE

1986 was a stable year and the Istanbul Stock Exchange index increased only around 71%. The price increases in the early days of 1987 became more volatile during the summer of 1987 and the Istanbul Stock Exchange index reached to a value of 1149 by the end of August 1987 (compared to a base value of 100 in January 1986). It is believed that this abnormal price boom was a result of the people's expectations and statements made by some of the public sector and Istanbul Stock Exchange member officials. Later in September 1987, partly due to the shortcoming of expectations and also due to the announcements made about privatization, the prices started plummeting.

As far as the index itself is concerned, the formula used in the calculation of the ISE index reveals two major facts: There are no weights assigned to the individual stocks, and the index is not a "price index" but a "market value" index which shows the changes in the market values of the companies in the first common stock market of ISE[11].

3.1 More Comments About ISE

Although issuing common stocks is ideally a primary way in financing investments, the Turkish companies are not ready for such an approach. The reasons tied to their reluctance about common stock financing can be generalized under three main ideas:

i)Turkish companies are conservative. They are afraid of being acquired by another company in the sense that they perceive they might lose their discretionary powers in management and control. Most of them still preserve the identity of being a "family-owned" company[12].

ii)The companies have close relationships with banks. There is a tendency towards being a "holding" company so that they could establish their own banks. Therefore, bank credit financing is a widely pursued approach.

iii)The interest paid and the related expenses of credit and bond financing are deductable from taxable incomes of the companies. Hence, it is advantageous to use debt financing.

The common stock issuance of the Turkish companies in the period 1982 - January 1988 is given in Appendix A7. As it is seen, on the aggregate sense, the capital increases in cash constitute 59.1 % of the total. Approximately, 90-95 % of this total is through rights offering. Therefore, the new shareholders can only acquire 3-6 % of total. As a result, it cannot be easily said that the Turkish companies are "open" to public.

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[11] See [1] for a thorough discussion about this topic.

[12] In a study conducted by using CMB's data [11], more than half of the outstanding shares of 44 companies out of 164 appeared to have been owned by a single owner. In 50 of them, the majority of the shares are held by two shareholders. In only 27 of the total, 6 or more people are holding more than 50% of the outstanding shares.

Another interesting property of the Istanbul Stock Exchange common stock market is that it is thin and shallow [1]. It is thin, so that, slight changes in demand lead to drastical changes in the prices. Only a few of the listed stocks are traded frequently. Because it is shallow, the market orders are concentrated on the current prices.

The turnover ratio[13] figures which are summarized in Appendix A8, support the claims above.

Trading volume on the Exchange is still very low compared to the selected European exchanges. It is asserted that, if the development speed of Turkey is taken into account, this lower trading volume value should not be considered as disappointing [9, p. 60]. Typical share turnovers on some European Exchanges are given in Appendix A9.

A different measure of the level of financial development of a country is the ratio of common stock outstanding to GNP. It is reported that this ratio is around 0.02 for Turkey (in 1984) whereas it is .14, .65, .05, .04 and .05 for Germany, USA, Brasil, Greece, and India respectively.

On the demand side the investors are generally interested in less risky securities to hedge against inflation[14]. Their preferences are generally towards gold and bank deposits. In addition to public's lack of information about the investment tools (especially common stocks), the wide fluctuations in the stock price index during 1986-1988 have been discouraging to most of the potential investors.

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[13]The quantity of the yearly tradings divided by the yearly average number of common stocks outstanding.

[14]The inflation rates in Turkey have been varying around 30-100 % during 1980s. Assuming that the Turkish people are risk averse individuals, this is the expected mode of behavior.

4 METHODOLOGY

The approaches pursued in this study rely on the outcomes of statistical and correlational tests.

To begin with, the raw data —in terms of past prices and several declarations made by the corporations— is obtained. All the data covers the period between January 10, 1986 and October 28, 1988. Later, the price series is adjusted to remove the affect of stock splits and rights offering on prices which might lead to biased and/or incorrect results. Finally, the appropriate tests required by the Weak Form Efficient Markets Hypothesis are applied.

On the whole, the analysis is composed of 3 main studies: (1) Selection of the particular stocks, (2) Adjustment of the data, and (3) Tests.

4.1 Selection of the particular stocks

The following criteria were used to pick the specific 15 stocks under consideration which are used in the study:

—Whether the company has a straight and complete weekly past price data —in terms of Friday's closing prices; This check is done by observing the price series of the stocks. If the continuity of the data is frequently disturbed by unavailability of price(s) (i.e. no trading has been done within the week) the particular stock is discarded.

—Whether its past trading volume (in T.L.) is comparatively high. While considering the trading volume, are the number of shares exchanged significantly high? There is the slight chance that a highly traded stock's trading volume may represent an unimportant fraction of the total. The ranking of the ISE companies according to their shares' trading volume and quantity is presented in Appendices A10 and A11 respectively.

—Does the particular stock have a high trading frequency during a randomly selected time period? For this

purpose, the outcomes of a study performed by Akyüz [1], covering the period August 1, 1987 — March 7, 1988 are used. The results of this analysis are given in Appendix A12.

—Is the Turnover ratio —the number of exchanges done within the year over the yearly average number of common stock outstanding— of the candidate stock higher, with respect to the other stocks in the ISE first stock market list? The securities ranked using this notion (from highest to lowest) are listed in Appendix A13.

The application of the above criteria leads to the selection of the stocks depicted in Table 1.

1	Akçimento Ticaret
2	Bagfaş Bandırma
3	Çelik Halat
4	Çukurova Elektrik
5	Ereğli Demir Çelik
6	Kartonsan
7	Koç Yatırım
8	Kordsa Kord Bezi
9	Koruma Tarım
10	Lassa
11	Otosan Otomobil
12	Rabak Elektrolitik
13	Sarkuysan
14	Türk Şişecam
15	Türk Demir Döküm

Table 1 The selected Stocks for testing

4.2 Adjustment of the Data

All of the data used was taken from the weekly published official Bulletin of ISE. The missing prices in any of the time series were filled in with the most recent —previous weeks' closing prices. This step was required to avoid any biases because of the software used in performing the tests. In addition, the following three events which have been happening in time created

the necessity for smoothing each series with respect to a common ground:

i) Payments of cash dividends

ii) Increases made in the Corporate Capital, through issuance and distribution of common stock, to the existing shareholders at no cost.

iii) Increases made in the Corporate Capital by selling stocks through rights offering at par (nominal) value.

There used to be single announcements made whether the corporate capital world be increased or not. Practically, the latter two items listed above can not be classified separately. However, theoretically, they are two different concepts.

4.2.1 Adjusting for Payments of Cash Dividends

No specific adjustments were made with respect to the declaration of cash dividends.

Findings of Fama, Fisher, Jensen, and Roll (FFJR) [14] in terms of stock dividends —not cash but another type of dividend— support this approach.

In another study, Pettit [26] studied the effect of announcements of changes in the level of dividend payments on stock prices. The results indicated that the prices of securities reacted to information contained in dividend changes. In general, the abnormal performance of stocks that experienced an increase in their dividends was greater than those stocks that experienced a dividend omission or reduction. The performance of the stocks that did not have a change in their dividends was stable. His results showed that investors tended to anticipate events accurately and that the prices of securities adjusted in accordance with these anticipations. In most cases, a large part of the adjustment was completed before the announcement, although the greatest monthly change in the abnormal performance occurred in the month in which the dividend change was announced. For most stocks, the adjustment was completed by the end of the month in which the announcement

was made. Usually, the later revaluation of the stocks (after the payment was made) by the investors, tended to make the prices of the stocks represent the real market value of the corporation —through necessary adjustments— while not disturbing the sense of the evolving price series.

4.2.2 Adjusting to the Increases Made in Corporate Capital

As mentioned before, the Turkish corporations apply the notion of financing through the issuance of common stock in a slightly different sense. After the legislation of the new tax law in 1983, a new concept came into picture: "Revaluation Funds". According to this new regulation, the corporations are given the right of granting new issues of their stocks to their existing shareholders at no cost. This can be done every year, whenever the book value of the assets of the company is recalculated with reference to several criteria (like inflation). In order to compensate for the increase in the "assets" side of the balance statement, a new account is added to the "owner's equity and retained earnings" side under the name of revaluation fund. Later, an amount of shares totaling just as the same as the value of the revaluation fund is distributed to the existing shareholders. Therefore, this process is a means of achieving a balance and making up the non-corporation originated inescapable losses of the shareholder (basically due to inflation). On the other hand, if the company is seeking new funds for its investments, it can issue stocks for a price between its stock's market value and par (nominal) value[15].

Generally, every year, the corporations announce the date, amount and constituents (percent granted free and percent sold) of the *capital increases*[16] they are going to make after getting a

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[15]Very few number of sales (not capital increases) have been made in the ISE for prices greater than the nominal value of a security.

[16]The term "Capital Increase" is original to the Turkish Stock Market. It denotes the increases made in the capital of a corporation either in terms of shares distributed free or sold at a price.

permission from the Capital Market Board.

Since the "free granting" operation does not provide shareholders with additional assets, one might wonder whether it has any real value to the owners of existing shares. Theoretically, the per share market price of the stock should fall in direct proportion to the increase in the number of shares represented by a "free share issuance". Mathematically, an adjustment to the past price history can be made using the following formula:

$$P_{adjusted} = (1+n_{free}) \cdot P_{new}$$

A relevant adjustment for the capital increase through rights offering at par values can be made by

$$P_{adjusted} = (1+n_{sold}) \cdot P_{new} - N \cdot n_{sold} \cdot k$$

For a general type of capital increase, combining both yields,

$$P_{adjusted} = (1+n_{sold}+n_{free}) \cdot P_{new} - N \cdot n_{sold} \cdot k$$

Where,

n_{free} :number of shares granted free per existing share

n_{sold} :number of shares offered for sale per existing share at a price equal to its nominal value.

N :Nominal (par) value of a share which is generally 1000 T.L.

$$k = \begin{cases} 1 & \text{On the week where a major price change is observed due to a Capital Increase} \\ 0 & \text{Otherwise} \end{cases}$$

P_{new} :Unadjusted, prevailing market price of a stock just after the capital increase has been made.

$P_{adjusted}$:Adjusted value of P_{new} to the past price history.

Based on the adjusted prices the weekly return is calculated as follows:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

4.3 Tests

There have been two groups of tests of the weak form efficient market hypothesis. While one group involves statistical tests of the independence of stock price changes, the other group deals with specific testing of trading rules that include basic investment decisions on past market information as opposed to taking a simple buy-and-hold policy (that is, simply buying stock at the beginning of a test period and holding it to the end).

4.3.1 Statistical Tests of Independence

If new information comes to the market in a random, independent fashion, and furthermore, stock prices adjust rapidly to this new information, stock price changes over time should be independent. Therefore, in an efficient capital market, stock *price changes* should be *independent* and *random.* Two major statistical tests have been employed to verify this hypothesis:

4.3.1.1 Autocorrelation Test

While correlating the price changes over time, this test determines whether the changes were independent of each other. Is there significant positive or negative correlation in price changes over time? Is the percentage of price change on day t correlated with the percentage of price change on day t-1, t-2,..? If the correlation of price changes over time comes out to be insignificant, the capital market under consideration can be an efficient one[17].

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[17]For more information about the autocorrelation tests and functions, see Pankratz, A. (1983) *Forecasting with univariate Box-Jenkins Models: Concepts and Cases,* New York: Wiley and Sons Co.

For the Istanbul Stock Exchange the correlation among the weekly price changes is tested. Briefly, all of the significant spikes were identified and extracted while using the t-statistic during the test of the null hypothesis that the price series is not correlated for all of the lags. The autocorrelation and partial autocorreation functions were constructed and examined up to a maximum lag number of 24 (meaning almost 6 months). In addition, for an overall test of the autocorrelation functions, Q-statistic is calculated and tested for each of the series. Here, the null hypothesis "all autocorrelations are zero" is tested with reference to a Chi-square distribution having a degree of freedom of 6,12 and 24 [3, pp. 5-6].

4.3.1.2 Runs Test

The second statistical test of independence is based on the distribution of the "runs" within a series. Given a series of price changes, each price change is designated a plus (+) if it is an increase, or a minus (-) if it is a decrease. The result is a set of pluses and minuses as follows: +++---+--++----+. A run occurs when there is no difference between two changes; two or more *consecutive* positive or consecutive negative price changes constitute one run. When the price change is to a different sign (for example, a positive price change followed by a negative price change), the run is ended and a new run begins. To test for independence, one calculates the number of runs for a given series and compares this with a table that provides the number of such runs that would occur in a similar but also random series[18].

For the Istanbul Stock Exchange case, the null hypothesis that the sequence of positive and negative price changes occur in random order is tested. Since the observed positive or negative price changes in any of the series were greater than 20 in number, the *normal* distribution approximation is used for all of the

[18]For the details of a runs test, see Siegel, S. (1956) *Nonparametric Statistics for the Behavioral Sciences,* New York: McGraw-Hill.

samples, to calculate the test statistic.

4.3.2 Tests of Trading Rules

This second group of tests of the weak form hypothesis were originated from the work of technical analysts[19]. They assert that the statistical tests used (which are described above) are too rigid to pinpoint the very intricate price patterns examined by them. Their trading rules were too complicated to be simulated by rigid statistical tests. After these declarations, while the investigators were attempting to examine alternative technical trading rules, the advocates of an efficient market developed a new hypothesis: No investors using any technical trading rule (especially who are claiming that stock prices moved in trends) could derive abnormal profits[20]. While using these simulation based techniques of efficiency tests, one should be aware of three major pitfalls that can negate the results: (1) The investigator should use the *data which was publicly available* in selecting a rule. (2) When determining the returns from a trading rule one must *include all transaction costs* involved in implementing the trading strategy. (3) Since a trading rule may only help in the selection of high-risk high-return securities, *the results must be adjusted according to risk* before making any comments. Researchers have encountered several problems in the application of these tests. For instance, there are a lot of tests. Using all of them is impractical. Even if all could be used, there will be the problem of interpreting the results which is a highly unstructured task differing from person to person. Besides these, the market efficiency is dependent upon trading: the more the trading in a security, the more efficient the market should be. By the selection of cases involving very little trading activity, the

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[19]They are the people who study the past price records and look for cycles. Competition in this field tends to ensure that current prices reflect all information in the past sequence of prices and that future price changes cannot be predicted from past prices.

[20]Abnormal profits are defined as rates of return greater than the returns derived from a buy-and-hold policy adjusting for differences in risk, that is, above-average risk-adjusted returns.

market can be shown to be lacking of complete efficiency.

In applying this methodology for the ISE Common Stock Market data, the most popular trading technique was used: the *filter rules*. These simulation based tests can be attributed to Alexander [2]. Simply, his technique is a mechanical trading rule which identifies and makes use of the movements in stock prices. An x percent filter is defined as follows: If the daily closing price of a particular security —that is showing an upswing— 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 one simultaneously sells and goes short. The short position is maintained until the daily closing price rises at least x percent above a subsequent low when one covers and buys. Moves less than x percent in either direction is ignored.

The test had been designed more specifically than the Alexander's in the sense that, a generalized (x,y) percent filter was used. In this way, the probability of exploitation of any patterns was checked with widely applied 15 filters [3]. Similarly, a (x,y) filter suggests that the investor should buy and stay long after a price increase of x percent. The security should be sold if a price drop of y percent is observed from a subsequent high simultaneously when the investor also goes short. The filter rules were used on an "as is" basis while a hypothetical filter with short selling —not common in Turkey— construct was also tested on weekly prices. With regard to the sensitivity of the tests to the transaction costs, the bid and asked prices were corrected by 1% to represent the effect of the brokers' commissions.

The dividends have not been taken into account in the price adjustment process. This means that the offerings of the buy-and-hold will be understated. However, this can only be critical if the filter test results can only overperform the buy-and-hold in slight amounts. Should the case come out to be similar, the conclusions will be derived carefully.

5 FINDINGS

The outcomes of all the tests performed are presented in Appendix B in full detail. A summary of the outstanding parts of the results (which are extracted from Appendix B) is depicted in Table 2. In this table, the first four columns present the filter rule by which abnormal profits could have been obtained vis a vis buy and hold. The maximum percentage returns obtained by a specific rule are also given in columns 1 and 3 respectively. In column 4 the minimum return that can be obtained for a given strategy (i.e. filter, filter with short sale, buy and hold) is laid out. The fifth column shows the runs test results in terms of the z values as the outputs of a hypothesis test. Finally, in the last three columns most significant parts of the autocorrelation test results are shown. From columns 7 and 8 the highest autocorrelation coefficient and the lag it is observed can be obtained for a given stock and strategy (i.e. filter, filter with short sale, buy and hold). In column 6, the Q statistic values for the overall test of autocorrelation functions is given (for 24 lags). The values printed in bold represent the ones which have passed the critical statistical significance level (α=0.05).

The results of the autocorrelation tests indicated *insignificant correlations* in stock price changes for most of the time. In Appendix B1 a brief explanation of the autocorrelation function as well as the test results for all stocks are presented. Typical correlation coefficients ranged from +0.10 to -0.10. Although, the calculations for the majority of the 24 lags could not provide enough clue towards a market inefficiency, there were still some stocks for which significant correlations existed for some lags. These appeared at most in three lags out of 24 for the analyzed series of any stock (See any page in Appendix B1). Nevertheless, only 4 (the ones occurred in lags 1 and 2) out of the total 19 critically significant utmost cases for all stocks (See Table 2 column 8) are expected to carry any valuable

Column Number	1	2	3	4	5	6	7	8
	Filter				Runs	Autocorrelation		
Stock	max[1]		rule	min	z[2]	Q[3]	r[4]	lag
Akçimento	**1300**	F	8,4	517	-1.65	14.97	-0.186	**1**
Akçimento	**1256**	F&S	8,4	367			0.184	16
Akçimento	644	B&H		644				
Bagfaş	**9208**	F	5,3	**1275**	-1.40	29.50		
Bagfaş	363	F&S	10,5	222				
Bagfaş	925	B&H		925				
Çelik Halat	**353**	F	1,1	17	-0.83	35.20	0.288	6
Çelik Halat	70	F&S	10,5	-12			-0.217	18
Çelik Halat	208	B&H		208				
Çukurova	**4196**	F	8,4	747	0.46	14.75	-0.175	12
Çukurova	1015	F&S	8,4	393				
Çukurova	1853	B&H		1853				
Ereğli Demir	285	F	2,2	-73	-0.27	35.79	0.285	5
Ereğli Demir	107	F&S	10,5	18			-0.201	12
Ereğli Demir	351	B&H		351				
Kartonsan	**1167**	F	1,.5	266	-1.92	21.96	0.171	6
Kartonsan	90	F&S	8,4	33				
Kartonsan	323	B&H		323				
Koç Yatırım	**2405**	F	8,4	4	0.45	31.52		
Koç Yatırım	175	F&S	8,4	46				
Koç Yatırım	396	B&H		396				
Kordsa	**11831**	F	4,2	**2335**	**-2.73**	**50.52**	0.301	**1**
Kordsa	208	F&S	10,5	98			0.194	7
Kordsa	426	B&H		426			-0.246	13
Koruma Tarım	317	F	3,1	-90	0.94	21.43	-0.173	9
Koruma Tarım	146	F&S	10,5	16				
Koruma Tarım	335	B&H		335				
Lassa	**4844**	F	8,4	**977**	-1.51	25.12	0.202	**1**
Lassa	259	F&S	8,4	156				
Lassa	691	B&H		691				
Otosan	**7344**	F	2,1	**823**	-0.97	**38.45**	0.167	2
Otosan	297	F&S	10,5	163			0.208	7
Otosan	628	B&H		628			-0.206	12
Rabak	**2141**	F	2,2	339	-1.02	19.14	0.260	6
Rabak	184	F&S	10,5	33				
Rabak	375	B&H		375				
Sarkuysan	**1805**	F	8,4	312	**-2.28**	28.51		
Sarkuysan	178	F&S	8,4	52				
Sarkuysan	375	B&H		375				
Şişecam	**3265**	F	10,5	**303**	-0.67	29.98	0.232	6
Şişecam	118	F&S	10,5	29			-0.199	21
Şişecam	271	B&H		271				
Türk Demir Dök.	**4062**	F	10,5	**1820**	-1.09	16.95		
Türk Demir Dök.	412	F&S	8,4	148				
Türk Demir Dök.	929	B&H		929				
Index	**1498**	F	8,4	638	**-3.58**	23.39		
Index	176	F&S	10,5	58				
Index	289	B&H		289				

[1]The maximum percentage return which can be obtained with the listed (x,y) rule using either a bare filter (F) or filter with short sale (F&S) strategy. B&H stands for buy-and-hold policy.
[2]The critical z value for a two tailed 5% test is $\mp$ 1.96.
[3]For a 5% test with dof=24, Chi-square critical is 36.4151.
[4]For a two tailed 5% test t critical is 2. So, these correlation coefficients are all significant ones which are two times greater than their corresponding standard errors.

Table 2 Summary of the results

information since the price changes tested were the weekly ones[21]. The further examination of the autocorrelation and partial autocorrelation function plots did not give any idea about probable, persistent and previous patterns in price changes —apart from doubts about some stocks for which the inefficiency was also detected by the other two tests. In order to observe this clearly, see the Kordsa row in Table 2 while referring to page B1-9. Therefore, by the aid of the results of serial correlation tests, it can be inferred that, *stock price changes over time in ISE are in general statistically independent*; one cannot use past price changes alone to project future price changes. This view was also backed by the outcomes of the *overall* test of autocorrelation functions for the whole 24 lags: only 2 of the 15 calculated Q statistics are above the critical level (See Table 2 Column 5). The Q statistic values for 6 and 12 lags are also presented in Appendix B1, on page B1-18. According to these figures, the hypothesis that autocorrelation function is flat can be rejected at most 25% of the time (α=0.05).

Tests of stock price "runs" in ISE, likewise indicated a strong emphasis on the independence of stock price changes over time. The employed z statistic for large samples together with the calculated z values for each stock are given in Appendix B2. As also seen in Table 2 column 5, the null hypothesis that "the sequence of price changes is arranged in a random order" could be rejected only 2 times during the 15 trials (See column 5 in Table 2). In general, the actual number of runs for stock price series fell into the range expected for a random series supporting the notion that *stock price changes over time are independent*.

As far as the tests of trading rules are concerned, the results in terms of the percentage returns for the applied 15 filters to the pre-selected 15 stocks are wholly presented in Appendix B3. Moreover, this appendix gives the opportunity to

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[21] A significant positive correlation in a lag like *x* will mean the following: If, *x* weeks ago, the weekly price change was positive, then there would be a great tendency that the weekly price change of this week will also be positive and vice versa.

compare each strategy (i.e. Filter and Filter with Short Sale) with the corresponding buy-and-hold returns. In contrast to the implications of the two tests of statistical independence, filter tests surprisingly revealed another fact: If one had pursued *bare* filter strategies especially for some stocks, he could have earned much more than the offerings of the buy-and-hold policy. As seen in Figure 2, all of the 15 filter rules overperformed the buy-and-hold for 6 of the overall 15 stocks (namely, Bagfaş, Kordsa, Lassa, Otosan, Şişecam and Türk Demir Döküm).

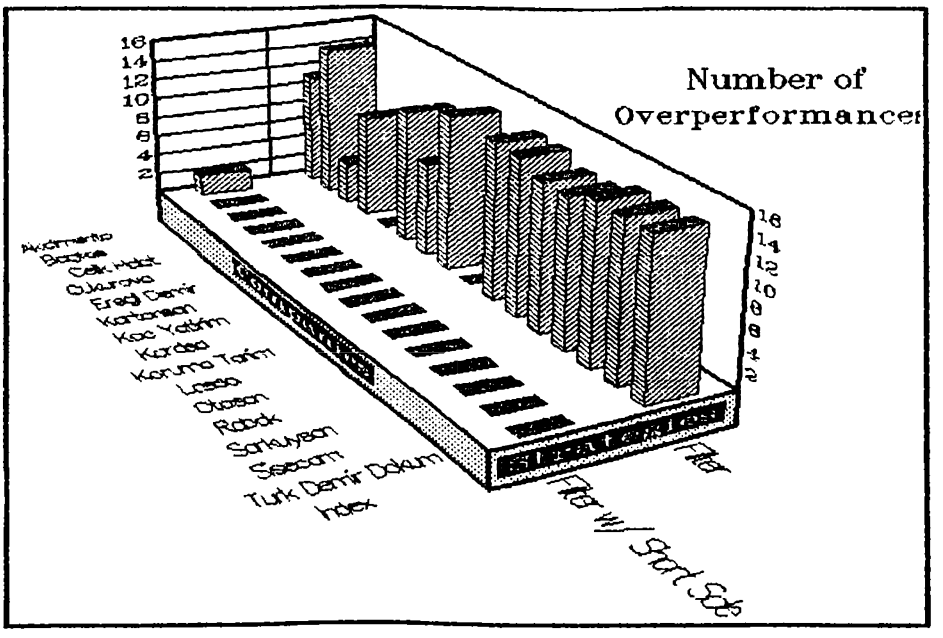

Figure 2. The Overperformance Record of Filter Rules
(out of 15 for a given stock)

The average of this overperformance came out to be 11 and 0.133 out of 15 for simple Filter and Filter with Short Sale strategies respectively. The most striking parts of this claim is summarized in columns 1 and 4 of Table 2 in terms of maximum and minimum returns. It can further be assessed from Table 2 and Figure 2 that

filter strategies employed together with short selling, did not show persistent and higher profits vis a vis buy-and-hold.

Figure 3 provides the opportunity of comparing both of the filter rules —the maximum returns that can be obtained by using them for each of the selected security— with the naive buy-and-hold strategy. The values in Figure 3 are taken from the first column of Table 2. The "K"s on the vertical axis mean thousands, and the axis by itself shows the percentage returns.

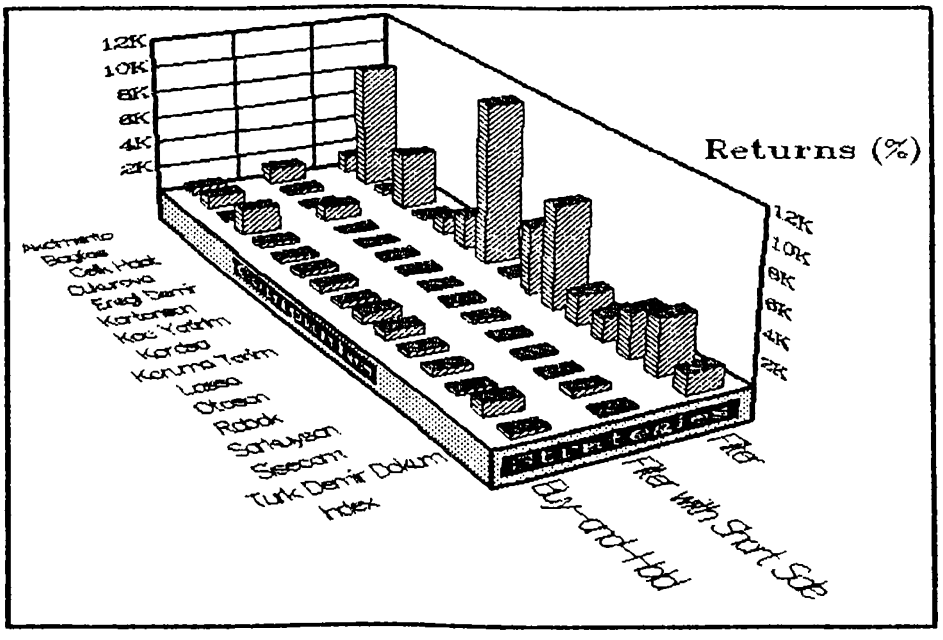

Figure 3. Trading Rules vs Buy and Hold Strategy
(The comparison of the Best Possible Returns)

It seems odd that the stocks pass almost all of the efficiency tests but the filter rule tests. A completely random nature should not permit the filters to be successful. Although, some probable hidden dependencies were also sensed by the 6 and 12 lag Q statistics tests, they are not explanatory for the extraordinary overperformance of filter rules. If these results

were lower in magnitude and the examples were less in quantity, it could be said that the outcomes are also consistent with the small correlation in price changes discussed earlier. Additionally, it can be asserted that the omission of dividends has led to understated buy-and-hold returns. However if the dividend yields in the history of I3E are analyzed (See Appendix A14 for 1988 case), it will be seen that they do not constitute considerabe amounts compared to the calculated filter returns.

In spite of the fact that the transaction costs were also considered (as 1%), filter rule profits exceeded those of a simple buy-and-hold policy. Therefore it is not safe to conclude that the evidence generated by simulating mechanical trading rules do not beat a buy-and-hold policy —*a conclusion that does not support the weak form of the efficient market hypothesis.*

6 CONCLUSIONS AND RECOMMENDATIONS

Most evidence suggests that capital markets are efficient in their weak and semistrong forms and that the strong form does not necessarily hold in the sophisticated capital markets of the developed countries. However, the tests of the weak form efficient market hypothesis for the Istanbul Stock Exchange Common Stock Market —specifically, the first market— generated mixed results. The bulk of the evidence did not support the hypothesis.

Although the runs and autocorrelation tests could not refute the weak form efficiency fully, the results of the filter tests showed that, using some trading rules, an individual could have beaten the market; especially for some of the stocks —with respect to the buy and hold returns. These large discrepancies between the buy-and-hold and filter returns are proving the doubts about the *efficiency* of Istanbul Stock Exchange.

Of course, it is possible to question the effectiveness of the filter rules from which the majority of the conclusions are filtered through as a final (rule of thumb) check. For example, the returns have not been adjusted with respect to risk. Therefore, a trading rule may only help in the selection of high-risk securities that would be expected to experience higher returns if we were aiming to form a portfolio of high-performance securities. This would inevitably lead to a conclusion not supporting the market efficiency. However, since each security is compared with itself, there was no need to adjust for risk. On the other hand, the market efficiency is dependent on trading: the more trading in a security, the more efficent the market should be. The selected stocks for the study are among the mostly traded stocks of Istanbul Stock Exchange. In other words, this approach has already brought a bias in the sense that the Istanbul Stock Exchange would come up as Weak Form Efficient. Therefore, it can be assumed that the potential advantages and disadvantages of each point cancel each other. Additionally, it can be asserted that the offerings of the buy-and-hold policy is understated. Since the

dividends could not have been taken into account in the price adjustment process, this is true. But out of the 15 filters employed, an average of 11 overperformed the buy-and-hold more than twofold for most of the time. If one also considers the dividend yields which remained far below the calculated level of filter profits in the history of ISE, it can safely be inferred that the inclusion of dividends in the analysis is not critical. Such an approach is not likely to have changed the results substantially.

After 1980, some policies have been implemented to increase the efficiency of the financial system. Considerable success has been achieved in this respect. Thus, while the sources of the financial system were mostly directed to the public sector before 1980, this tendency was reversed in the post-1980 period. Funds have been started to be channelled to institutions and instruments that will transfer these to the private sector.

However it is hard to say that these developments caused a structural change in the financial system. As the previous analysis of the system (in Chapter 2) has already notified, banking sector and the indirect instruments still dominate the system in collecting the available funds. Furthermore, the Turkish Corporations' tendency to preserve their structures as family based ones, inevitably led to very low turnover figures which are substantial obstacles for the markets to be efficient.

But, on the other hand, it can not be expected in such a short period as three years (1986-1989) for both the corporations and households to change the institutions and the instruments they are familiar with and that they trust. However, with reference to the blurred view about the efficiency of Turkish Common Stock Market (even in the weak form), it is suggested that some additional measures should be taken since the current ones cannot be considered satisfactory.

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APPENDIX A

Appendix A1

ISE Common Stock Market

First Market Companies

	Total Listed Corporations by ISE [1]	Number of Listed Corp. in First Market [1]	Market Value (mill. TL)	P/E Ratio	Turnover Ratio [3]
1985	422	40	382,293	8.3	-
1986	375	40	710,092	8.2	1.23
1987	335	50	3,181,764	10.2	3.23
1988	437 [2]	-	-	-	

[1] As of December 31, 1987
[2] As of August 8, 1988

[3] Turnover Ratio=Yearly Trading Quantity/The average number of common stock outstanding per year for all of the first market companies

Source: [30, p. 70]

Appendix A2

P/E Ratios and Market Values

	1985	1986	1987	Market Value (Bill. $)
Turkey (Istanbul)[1]	8.3	8.2	10.2	3.2
India	11.0	15.0		14.5
Korea	6.0			7.4
Mexico	4.0	10.0		4.2
Jordan		12.0		2.6
United Kingdom		15.0		328.0
Spain		15.1		19.0
France		16.0		79.0
Italy		19.5		65.0
Sweden		11.0		30.0
Japan		33.0		910.0
U.S.A.		15.0		2200.0

[1] 1st market averages
For Turkey 1987-end and for others 1985-end

Source: [30, p. 71]

Appendix A3

The Trade Volume of Bonds and Common Stock in the Secondary Market

	Gross Trade Volume	Trade Volume of Common Stock	%	Trade Volume of Bonds	%
1983	41.0	1.9	4.6	37.3	91.0
1984	73.0	2.5	3.4	35.8	49.0
1985	671.6	2.4	0.4	47.2	7.0
1986	2408.0	8.7	0.4	105.9	4.4
1987	5812.2	105.4	1.8	394.3	6.8
1987(Jan. - June)	2468.7	17.9	0.7	148.8	6.0
1988(Jan. - June)	5577.2	102.2	1.8	332.0	5.9

Source: [30, p. 72]

Appendix A4

The Common Stock Sales in ISE by Each Member

	1983	1984	1985	1986	1987
Banks	69.9	60.5	51.7	41.9	47.8
Joint Stock Corp.	13.7	31.6	44.8	44.0	32.0
Individual Brokers	16.4	7.9	3.5	14.1	20.2
Total	100.0	100.0	100.0	100.0	100.0

Source: [30, p. 72]

Appendix A5

The Trading Volume in the Secondary Markets

Common Stock	I	1.8	33.9	26.9	44.8
	II	3.5	66.1	33.2	55.2
Private Sector Bonds	I	40.1	38.4	94.3	23.9
	II	64.4	61.6	300.6	76.1
Government Bonds	I	6.2	1.1	6.5	0.4
	II	540.1	98.9	1513.6	99.6
Treasury Bonds	I	231.1	16.4	355.7	11.0
	II	1180.8	83.6	2864.1	89.0
Bank Bonds	I	8.6	27.6	44.1	46.1
	II	27.8	76.4	51.5	53.9
Income Shar. Certif.	I	0.0	0.0	2.7	0.6
	II	289.2	100.0	443.2	99.4
Financial Bonds	I	-	-	17.1	33.1
	II	-	-	34.6	66.9
TOTAL	I	287.8	12.0	547.3	9.4
	II	2105.8	88.0	5246.8	90.6

I Intermediaries
II Banks

Source: [30, p. 17]

Appendix A6

Funds Supplied By the Financial System

	1982	1983	1984	1985	1986	1987
Priv. Sec. Bank Credits	475.4	559.6	735.5	1932.2	3596.6	4623.2
Govern. Sec. Bank Credits	6.9	49.1	-13.1	488.1	881.0	1344.6
Priv. Sec. Bonds	10.7	14.7	12.1	33.3	75.1	338.0
Financial Bonds						52.3
Govern. Bonds	62.0	206.0	228.0	673.0	1269.4	2045.2
Treasury Bonds	258.0	79.0	495.0	1217.6	1787.9	3954.5
Income Sharing Certificates	-	-	10.0	140.0	220.0	660.0
Supplies by Special Finan. Found	-	-	-	43.2	96.6	205.0
Common Stocks	9.0	55.2	105.1	244.7	179.5	303.4
Profit and Loss Sharing Cert.	-	-	-	0.5	0.9	0.8
Turkish Central Bank-direct	27.5	66.4	-23.9	351.7	347.9	672.0
Restructuring Credits	-	-	-	-	-	-
TOTAL	849.5	1029.0	1548.7	5124.3	8454.9	14199.0

Source: [30, p. 18]

Appendix A7

Common Stock Issuings of Turkish Companies

Years	Cash	From Revaluation Fund	Other	Total
1982	9.0	-	-	9.0
1983	34.1	19.9	0.1	54.1
1984	43.0	62.3	0.2	105.5
1985	96.0	57.2	0.3	153.5
1986	100.0	78.7	1.5	180.2
1987	184.7	107.8	11.0	303.5
1988(1)	215.1	118.8	14.6	348.5
TOTAL	681.9	444.7	27.7	1154.3

(1) The period January--June

Source: [30, p. 44]

Appendix A8

International Turnover Ratios

	%
Mexico	72.0
Korea	55.1
Brasil	29.7
India	19.6
Jordan	6.7
Turkey	1.9
Nygeria	0.1

Source: [1, p. 4]

Appendix A9

Share Turnover on Some European Exchange Markets

	US $ (Thousands)
UK and Ireland	3531083
German Exchanges	2687750
Amsterdam	1888916
Paris	773417
Milan	307500
Bruxelles	208917
Cophenagen	13333
Luxembourg	4417
Istanbul	844
Athens	833

Source: [9, p. 63]

Appendix A10

Trade Volume Ranking of the Companies

1	Çukurova Elektrik
2	Kordsa Kord Bezi
3	Bagfas Bandırma
4	Koruma Tarım
5	Rabak Elektrolitik
6	Kartonsan
7	Türk Demir Döküm
8	Akçimento Ticaret
9	Koç Holding
10	Çelik Halat
11	Çimsa Çimento
12	Lassa Lastik
13	Sarkuysan
14	Türkiye İş Bankası
15	Ereğli Demir Çelik
16	Goodyear Lastikleri
17	Koç Yatırım
18	Türk Şişe Cam
19	Arçelik
20	İzocam Ticaret

Source: [1, p. 20]

Appendix A11

Traded Quantity Ranking of the Companies

1	Koruma Tarım
2	Rabak Elektrolitik
3	Ereğli Demir Çelik
4	Türkiye İş Bankası
5	Kartonsan Karton
6	Türk Şişe Cam
7	İzmir Demir Çelik
8	Metaş İzmir
9	Türk Demir Döküm
10	Bagfaş Bandırma
11	Kordsa Kord Bezi
12	Koç Holding
13	Gübre Fabrikaları
14	Çukurova Elektrik
15	Çelik Halat
16	Sarkuysan Elektrolitik
17	Otosan Otomobil
18	Koç Yatırım
19	Ege Biracılık
20	Nasaş Aluminyum

Source: [1, p. 21]

Appendix A12

The Ranking According to the Trade Frequency[1]

		Number of days during which a trading activity is observed
1	Kartonsan Karton	146
2	Türk Demir Döküm	145
3	Rabak	145
4	Lassa	145
5	Bagfaş Bandırma	145
6	Metaş İzmir	144
7	Koç Holding	143
8	Otosan Otomobil	143
9	Çukurova Elektrik	142
10	Koruma Tarım	142
11	Kordsa Kord Bezi	141
12	İzmir Demir Çelik	140
13	Koç Yatırım	139
14	Çelik Halat	139
15	Gübre Fabrikaları	138
16	Türk Şişe Cam	138
17	Akçimento	138
18	Ege Gübre	135
19	Olmuksa	135
20	Çimsa Çimento	134

[1]During a randomly selected period between Aug. 1, 1987 and March 3, 1988.

Source: [1, p. 24]

Appendix A13

The Ranking According to Turnover Ratios

	1986	1987
1	Koruma Tarım	Koruma Tarım
2	Çelik Halat	Yasaş
3	Rabak	Rabak
4	İzocam	Bafgaş
5	Eczacıbaşı Yatırım	Eczacıbaşı Yatırım
6	Makina Takım	Sarkuysan
7	Kartonsan	Çelik Halat
8	Sarkuysan	Pınar Süt
9	Türk Demir Döküm	Gübre Fabrikaları
10	Çukurova Elektrik	Ege Biracılık
11	Hektaş	Kartonsan
12	Akçimento	Metaş İzmir
13	Bagfaş	Makina Takım
14	Türkiye İş Bankası	Koç Yatırım
15	Gübre Fabrikaları	Akçimento
16	Ege Gübre	Türk Demir Döküm
17	Koç Yatırım	Kordsa
18	Ege Biracılık	Nasaş
19	Kav Orman	Güney Bira
20	Döktaş	Döktaş

Source: [1, p. 22]

Appendix A14

Dividend Yields[1]

Akçimento	0.18
Bagfaş	0.30
Çelik Halat	0.20
Çukurova	0.10
Ereğli Demir	0.07
Kartonsan	0.59
Koç Yatırım	0.31
Kordsa	0.12
Koruma Tarım	0.15
Lassa	0.13
Otosan	0.24
Rabak	0.52
Sarkuysan	0.19
ŞişeCam	0.72
Türk Demir Döküm	0.30

[1]As of October 28, 1988. $\left[\text{Dividend Yield} = \frac{\text{Dividend per share}}{\text{Market value per share}}\right]$

Dividend per share values are obtained from the Dünya newspaper, June 5, 1989 issue.

APPENDIX B

Appendix B1

Results of Autocorrelation Tests

In this Appendix, the numerical results of the autocorrelation tests, as well as the plot of these values are presented for the overall 24 lags in the coming pages. Moreover,the Q statistic is also given in a brief form together with the results of its application to the data.

The autocorrelation function is also explained below for convenience:

If the returns calculated from the past prices (P_t) are denoted as $z_b, z_{b+1}, \ldots\ldots\ldots\ldots, z_n$, then the autocorrelation (r_k) and its corresponding standard error (s_{r_k}) at *lag k* are represented by;

$$r_k = \frac{\sum_{t=b}^{n-k} (z_t - \bar{z})(z_{t+k} - \bar{z})}{\sum_{t=b}^{n} (z_t - \bar{z})^2} \qquad s_{r_k} = \frac{\left[1 + 2 \cdot \sum_{j=1}^{k-1} r_i^2 \right]^{1/2}}{(n - b + 1)^{1/2}}$$

where, $\bar{z} = \frac{\sum_{t=b}^{n} z_t}{(n-b+1)}$, $z_t = \frac{P_t - P_{t-1}}{P_{t-1}}$

and, b is standing for beginning time

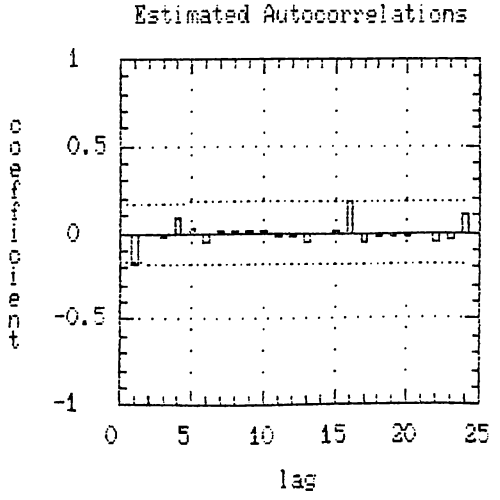
This quantity (r_k) measures the linear relationship between time series observations separated by a lag of k time units. A value of r_k close to 1 indicates that observations separated by a lag of k time units have a strong tendency to move together in a linear fashion with a positive slope, while a value of r_k close to -1 indicates that observations separated by a lag of k time units have a strong tendency to move together in linear fashion with a negative slope.

The significant values among all the correlation coefficients listed can be identified as follows: For a two tailed 5% test t critical is 2. As a result, the significant quantities are the ones which are two times greater than their corresponding standard errors.

Estimated Autocorrelations for Akcimento

Estimated autocorrelations for D:AKCIMC.VARO

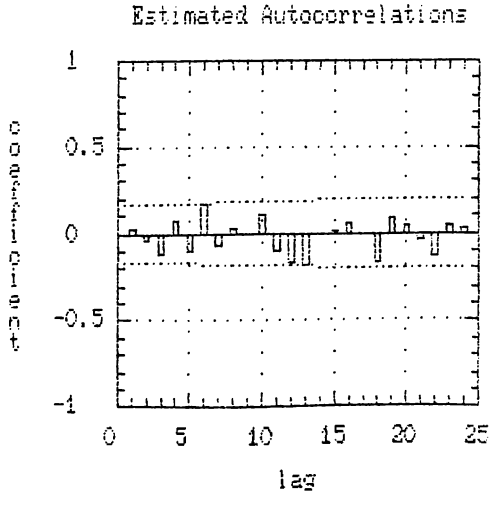
Lag	Estimate	Stnd. Error	Lag	Estimate	Stnd. Error
1	-.18639	.08362	2	-.00624	.08648
3	-.02290	.08649	4	.08153	.08653
5	.02959	.08706	6	-.04949	.08713
7	.00356	.08733	8	.01519	.08733
9	.01439	.08735	10	.00164	.08736
11	-.01397	.08736	12	-.02215	.08739
13	-.05386	.08743	14	-.01191	.08766
15	.01082	.08768	16	.18423	.08769
17	-.05895	.09035	18	-.01615	.09062
19	-.02408	.09064	20	-.02158	.09068
21	-.01310	.09072	22	-.06137	.09073
23	-.04536	.09102	24	.10124	.09118



Estimated Autocorrelations for Bagfas

Estimated autocorrelations for D:BAGFASC.VARO

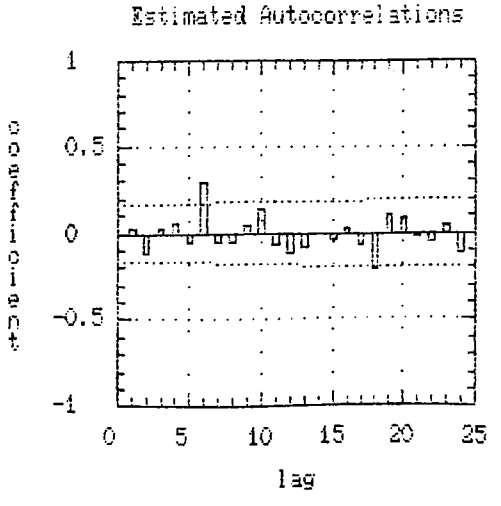
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.02060	.08362	2	-.04309	.08366
3	-.11199	.08381	4	.06907	.08485
5	-.09987	.08525	6	.16369	.08606
7	-.07673	.08837	8	.02627	.08883
9	-.01031	.08869	10	.10103	.08890
11	-.09998	.08970	12	-.16998	.09047
13	-.17408	.09268	14	-.01193	.09494
15	.00211	.09495	16	.05356	.09495
17	.00070	.09516	18	-.16695	.09516
19	.09462	.09719	20	.03966	.09783
21	-.03271	.09794	22	-.13091	.09802
23	.04328	.09923	24	.01822	.09936



Estimated Autocorrelations for Celik Halat

Estimated autocorrelations for D:CELIKHC.VARO

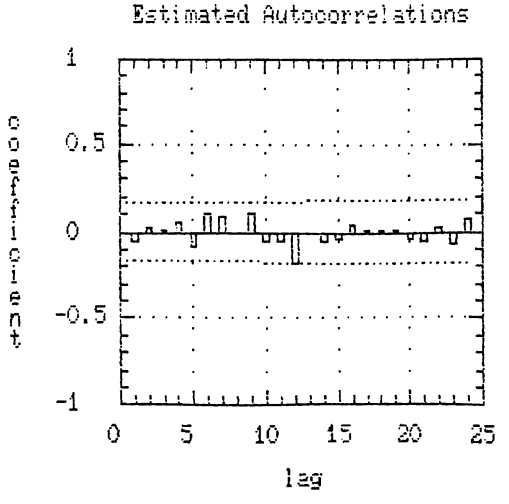
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.02465	.09276	2	-.11222	.09281
3	.02552	.09385	4	.04835	.09390
5	-.05262	.09409	6	.38922	.09432
7	-.05033	.09081	8	-.06144	.09100
9	.03883	.09129	10	.13226	.09140
11	-.06253	.09270	12	-.11387	.09300
13	-.08791	.09395	14	-.00396	.09451
15	-.08862	.09451	16	.02062	.09462
17	-.06872	.09465	18	-.21700	.09499
19	.10598	.09823	20	.08640	.09911
21	-.02936	.09962	22	-.04605	.09968
23	.04114	.09983	24	-.10904	.09994



Estimated Autocorrelations for Cukurova

Estimated autocorrelations for D:CUKURC.VARO

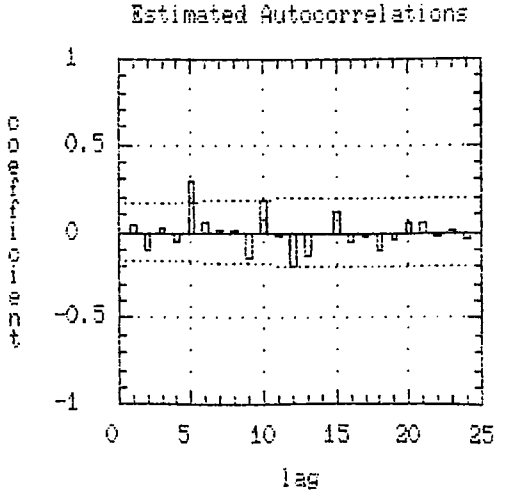
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	-.05058	.08276	2	.02743	.08297
3	.01075	.08303	4	.05022	.08304
5	-.08929	.08325	6	.10970	.08390
7	.09241	.08488	8	-.01136	.08557
9	.09880	.08558	10	-.05907	.08636
11	-.04830	.08663	12	-.17546	.08682
13	-.00291	.08921	14	-.04823	.08921
15	-.03100	.08939	16	.04355	.08946
17	.00284	.08961	18	.01031	.08961
19	.00305	.08962	20	-.04317	.08962
21	-.05400	.08976	22	.02321	.08998
23	-.06665	.09002	24	.07047	.09036



Estimated Autocorrelations for Eregli Demir

Estimated autocorrelations for D:ERDEMIRC.VARO

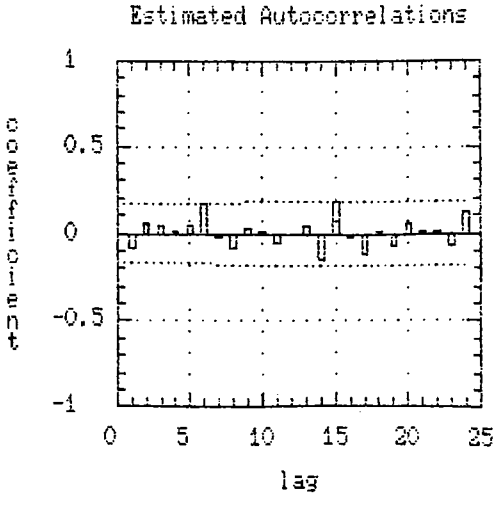
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.04417	.08305	2	-.10301	.08321
3	.03216	.08408	4	-.05486	.08417
5	.28514	.08441	6	.06175	.09081
7	.00622	.09110	8	.00941	.09111
9	-.14075	.09111	10	.17632	.09260
11	-.02625	.09489	12	-.20104	.09494
13	-.12707	.09783	14	-.00523	.09896
15	.11738	.09896	16	-.06049	.09932
17	-.01931	.10017	18	-.09782	.10020
19	-.03253	.10085	20	.05929	.10092
21	.04965	.10116	22	-.02469	.10133
23	.00264	.10137	24	-.04170	.10137



Estimated Autocorrelations for Kartonsan

Estimated autocorrelations for D:KARTONSC.VARO

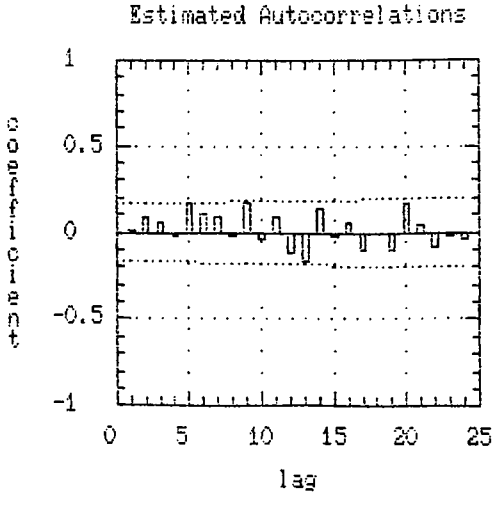
Lag	Estimate	Stnd. Error	Lag	Estimate	Stnd. Error
1	-.09218	.08276	2	.05988	.08346
3	.04774	.08375	4	.00369	.08394
5	.04424	.08394	6	.17099	.08410
7	-.01896	.08645	8	-.08156	.08648
9	.02438	.08700	10	.00186	.08705
11	-.06105	.08705	12	-.00513	.08734
13	.03254	.08735	14	-.14931	.08743
15	.17688	.08916	16	-.01476	.09153
17	-.11268	.09155	18	.01202	.09249
19	-.07097	.09250	20	.04846	.09287
21	.01335	.09305	22	.00745	.09306
23	-.06190	.09306	24	.11960	.09335



Estimated Autocorrelations for Koc Yatirim

Estimated autocorrelations for D:KOCYATC.VARO

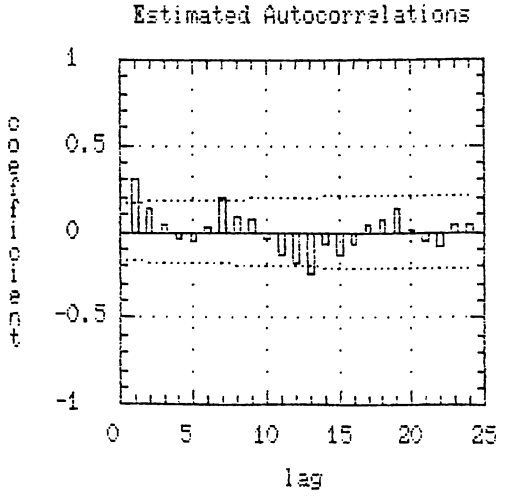
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.00574	.08276	2	.09164	.08276
3	.06065	.08346	4	-.02708	.08376
5	.15944	.08382	6	.10483	.08597
7	.07990	.08674	8	-.02518	.08724
9	.17307	.08729	10	-.04462	.08961
11	.08653	.08976	12	-.11355	.09033
13	-.15979	.09129	14	.13541	.09319
15	-.02206	.09452	16	.06118	.09456
17	-.10622	.09483	18	-.00187	.09564
19	-.09544	.09564	20	.17251	.09629
21	.04407	.09839	22	-.07787	.09852
23	-.01832	.09894	24	-.03099	.09896



Estimated Autocorrelations for Kordsa

Estimated autocorrelations for D:KORDSAC.VARO

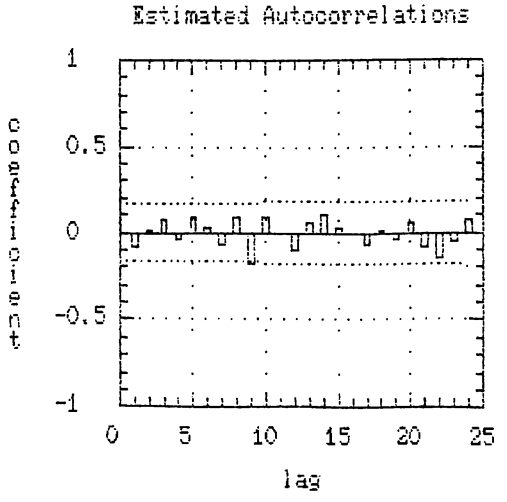
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.30100	.08276	2	.12950	.08995
3	.04727	.09121	4	-.04547	.09138
5	-.05891	.09154	6	.02474	.09180
7	.19398	.09184	8	.07964	.09461
9	.06726	.09506	10	-.04391	.09539
11	-.13259	.09558	12	-.18358	.09678
13	-.24550	.09914	14	-.06613	.10322
15	-.13946	.10351	16	-.06817	.10479
17	.03770	.10509	18	.06896	.10518
19	.13755	.10549	20	.00716	.10671
21	-.05648	.10672	22	-.09262	.10692
23	.04027	.10747	24	.03529	.10757



Estimated Autocorrelations for Koruma Tarim

Estimated autocorrelations for D:KORUC.VARO

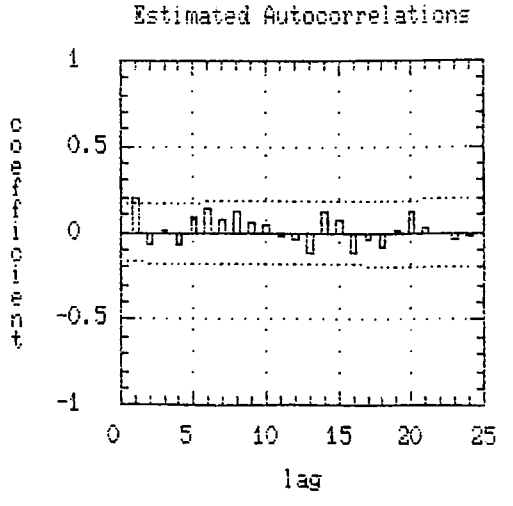
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	-.09140	.08276	2	.01487	.08345
3	.07409	.08347	4	-.03682	.08392
5	.08431	.08403	6	.02439	.08460
7	-.07114	.08465	8	.08585	.08506
9	-.17296	.08567	10	.08624	.08803
11	-.01030	.08860	12	-.10767	.08861
13	.06388	.08950	14	.10556	.08981
15	.03191	.09066	16	.00104	.09074
17	-.06758	.09074	18	.00673	.09103
19	-.03435	.09108	20	.05555	.09117
21	-.08796	.09140	22	-.14229	.09198
23	-.05457	.09348	24	.07695	.09370



Estimated Autocorrelations for Lassa

Estimated autocorrelations for D:LASSAC.VARO

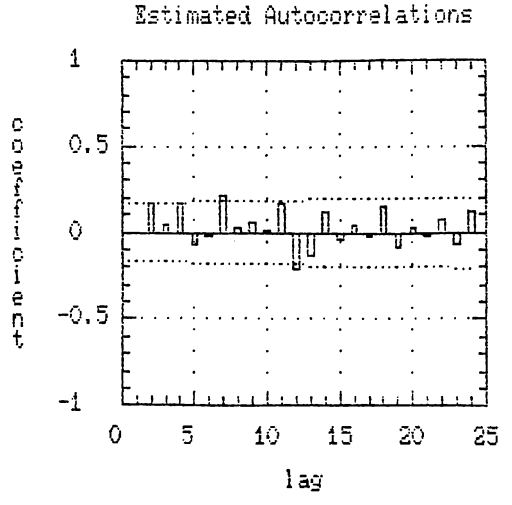
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.30210	.09276	2	-.06690	.09607
3	.01207	.09643	4	-.06673	.09644
5	.09980	.09679	6	.13316	.09743
7	.06950	.09861	8	.11532	.09918
9	.06108	.09919	10	.03333	.09948
11	-.02498	.09956	12	-.03817	.09961
13	-.11382	.09972	14	.11274	.09969
15	.06823	.09984	16	-.11819	.09998
17	-.04427	.10000	18	-.07919	.10015
19	.01492	.10020	20	.12357	.10022
21	.02728	.10032	22	-.01307	.10037
23	-.04259	.10038	24	-.02306	.10051



Estimated Autocorrelations for Otosan

Estimated autocorrelations for D:OTOSANC.VARO

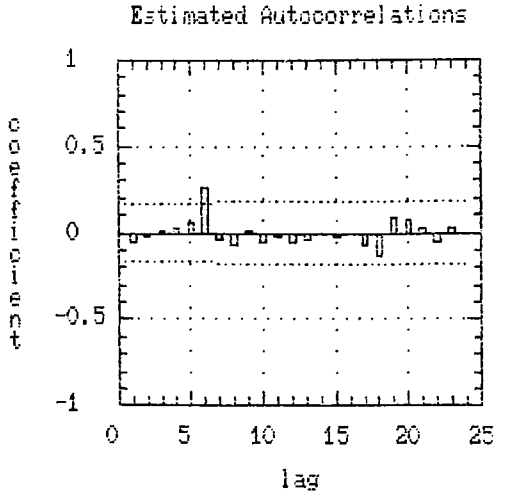
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	-.00165	.08305	2	.16700	.08305
3	.04062	.08533	4	.15739	.08546
5	-.06423	.08770	6	-.02068	.08802
7	.20777	.08805	8	.01750	.09137
9	.04884	.09139	10	.01215	.09157
11	.16206	.09159	12	-.20610	.09354
13	-.12945	.09662	14	.12187	.09781
15	-.03986	.09885	16	.04480	.09896
17	-.01549	.09910	18	.14590	.09912
19	-.08479	.10059	20	.02202	.10108
21	-.01641	.10112	22	.07310	.10113
23	-.07364	.10150	24	.11358	.10187



Estimated Autocorrelations for Rabak

Estimated autocorrelations for D:RABAKC.VARO

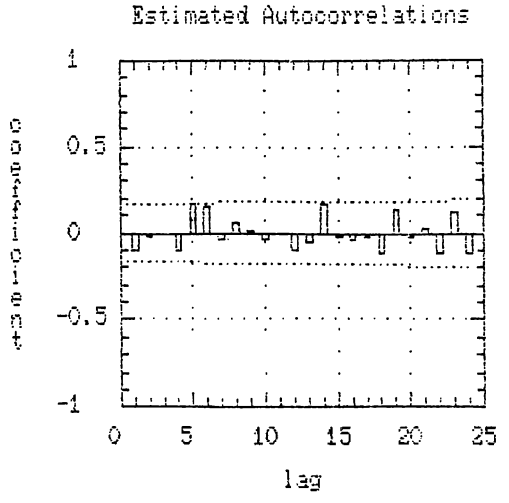
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	-.05934	.08275	2	-.01924	.08305
3	.01274	.08308	4	.02007	.08309
5	.05587	.08313	6	.35995	.08338
7	-.03813	.08876	8	-.07200	.08887
9	.01228	.08927	10	-.05917	.08928
11	-.02445	.08955	12	-.05394	.08960
13	-.04583	.08982	14	-.00590	.08998
15	-.02791	.08998	16	-.00831	.09004
17	-.06320	.09005	18	-.13386	.09035
19	.08637	.09170	20	.07201	.09225
21	.02606	.09264	22	-.05964	.09269
23	.01777	.09295	24	-.00719	.09297



Estimated Autocorrelations for Sarkuysan

Estimated autocorrelations for D:SARKUYC.VARO

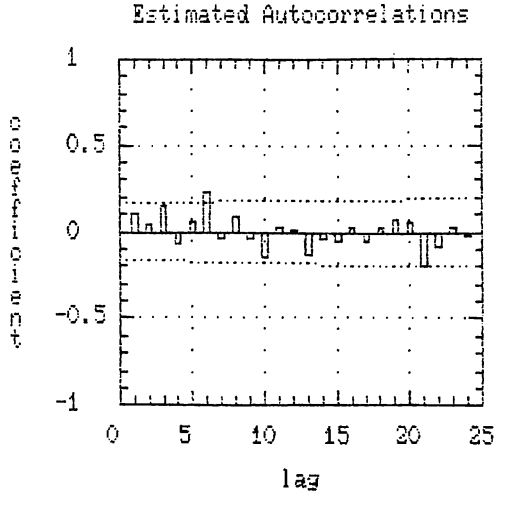
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	-.09936	.08276	2	-.02893	.08356
3	-.01106	.08363	4	-.10137	.08364
5	.17037	.08448	6	.15027	.08680
7	-.04240	.08857	8	.06383	.08871
9	.01467	.08902	10	-.04526	.08904
11	-.01241	.08920	12	-.10629	.08921
13	-.04833	.09007	14	.16022	.09025
15	-.02663	.09218	16	-.03077	.09228
17	-.01473	.09230	18	-.11428	.09232
19	.13363	.09328	20	-.01929	.09458
21	.02777	.09461	22	-.11725	.09466
23	.11163	.09565	24	-.12213	.09654



Estimated Autocorrelations for Sisecam

Estimated autocorrelations for D:SISEC.VARO

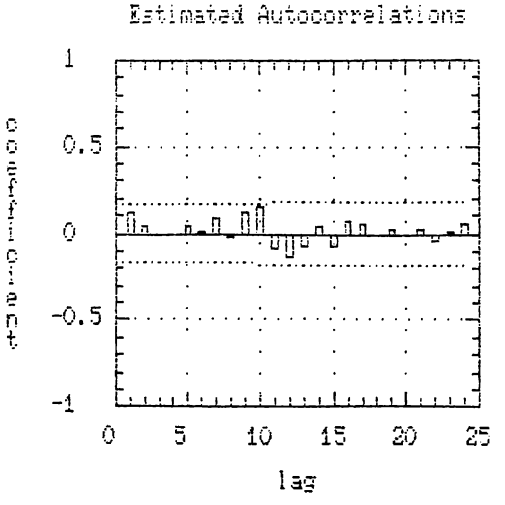
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.09865	.08305	2	.03401	.08385
3	.14541	.08394	4	-.06549	.08566
5	.05245	.08601	6	.23178	.08623
7	-.03721	.09042	8	.09454	.09053
9	-.03548	.09121	10	-.14338	.09130
11	.02688	.09284	12	.01506	.09289
13	-.12752	.09291	14	-.03511	.09411
15	-.06007	.09420	16	.01740	.09446
17	-.05619	.09449	18	.03060	.09472
19	.06623	.09475	20	.05165	.09507
21	-.19905	.09526	22	-.08758	.09809
23	.02676	.09862	24	-.02950	.09867



Estimated Autocorrelations for Turk Demir Dokum

Estimated autocorrelations for D:TDEMIRC.VARO

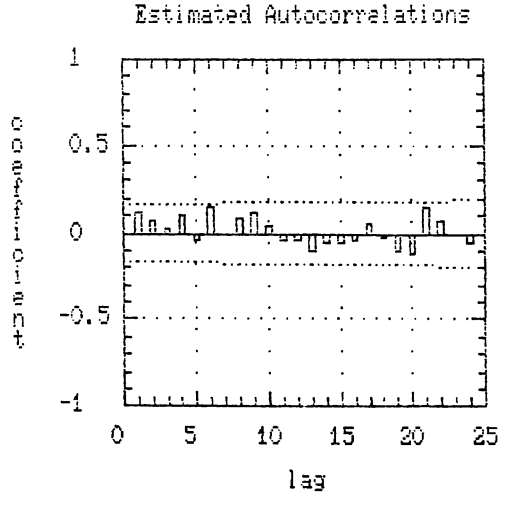
Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.12026	.08276	2	.04293	.08395
3	-.00466	.08410	4	-.00347	.08410
5	.04358	.08410	6	.00227	.08426
7	.08115	.08426	8	-.01465	.08479
9	.12234	.08481	10	.15328	.08501
11	-.08236	.08736	12	-.13704	.08839
13	-.06372	.08983	14	.04002	.09014
15	-.07614	.09026	16	.07663	.09070
17	.06083	.09114	18	-.01266	.09142
19	.03026	.09143	20	-.00101	.09150
21	.02564	.09150	22	-.03555	.09155
23	.00494	.09164	24	.05490	.09164



Estimated Autocorrelations for The Index

Estimated autocorrelations for D:INDEXC.VAR0

Lag	Estimate	Stnd.Error	Lag	Estimate	Stnd.Error
1	.11872	.08275	2	.07960	.08392
3	.02192	.08443	4	.11013	.08447
5	-.03442	.08545	6	.15059	.08555
7	-.00260	.08734	8	.08955	.08734
9	.11598	.08797	10	.03779	.08903
11	-.03627	.08914	12	-.04200	.08924
13	-.09519	.08938	14	-.05467	.09007
15	-.06070	.09029	16	-.03906	.09057
17	.04892	.09069	18	-.01835	.09087
19	-.10359	.09089	20	-.12010	.09170
21	.14952	.09277	22	.07613	.09441
23	-.01189	.09483	24	-.06032	.09484



The Q Statistic and the Calculated "Q" Values

	Q values[1] for lags of		
	24	6	12
Akcimento	14.97	6.47	6.66
Bagfas	29.50	8.34	16.32
Celik Halat	35.20	**14.89**	**21.07**
Cukurova	14.75	3.79	11.82
Eregli Demir	35.79	**14.74**	**28.11**
Kartonsan	21.96	6.65	8.31
Koc Yatirim	31.52	7.19	15.82
Kordsa	**30.52**	**16.90**	**31.75**
Koruma Tarim	21.43	3.38	12.38
Lassa	25.12	11.05	14.71
Otosan	**38.45**	9.01	**25.65**
Rabak	19.14	10.97	12.98
Sarkuysan	28.51	10.61	13.47
Sisecam	29.98	**13.46**	18.25
Turk Demir Dokum	16.95	2.66	13.00
Index	23.39	8.31	12.14

[1]The Q Statistic can be written as:

$$Q = N \sum_{i=1}^{24} r_i^2$$

Where N : number of observations in the series

r_i : estimated autocorrelation at lag i

and,

for a two tailed 5% test with dof=24, Chi square critical is 36.4151.Also for dof=6 and 12, the Chi square critical is 12.59 and 21.03 respectively.

Appendix B2

Results of Runs Tests

	z values[1]
Akcimento	-1.648
Bagfas	-1.398
Celik Halat	-0.834
Cukurova	0.463
Eregli Demir	-0.265
Kartonsan	-1.290
Koc Yatitim	0.450
Kordsa	**-2.728**
Koruma Tarim	0.940
Lassa	-1.509
Otosan	-0.971
Rabak	-1.024
Sarkuysan	**-2.280**
Sisecam	-0.669
Turk Demir Dokum	-1.087
Index	**-3.575**

[1] The z statistic used for large samples (n_1 or n_2 >20) is

$$z = \frac{r - \left[\frac{2n_1 n_2}{n_1+n_2} + 1 \right]}{\sqrt{\frac{2n_1 n_2(2n_1 n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}}}$$

where,

n_1= The number of pluses (price increases)

n_2= The number of minuses (price decreases)

r = The number of runs

and,

the critical z value for a two tailed α=0.05 test is $\mp$ 1.96.

Appendix B3

Results of Filter Tests

Filter Rules (x,y)→		10,5	8,4	5,5	5,3	4,4	4,2
F	Akcimento	1106.55	1299.86	814.68	984.45	820.04	682.41
F&S	Akcimento	1141.77	1255.98	574.54	574.54	549.29	500.39
B&H	Akcimento	644.23	644.23	644.23	644.23	644.23	644.23
F	Bagfas	1275.31	3601.22	3360.77	9207.52	3643.62	4650.22
F&S	Bagfas	363.20.	363.20	344.79	327.10	327.10	293.82
B&H	Bagfas	924.75	924.75	924.75	924.75	924.75	924.75
F	Celik Halat	177.81	175.49	113.54	16.59	95.68	186.81
F&S	Celik Halat	69.63	69.63	43.72	32.83	38.18	22.68
B&H	Celik Halat	207.88	207.88	207.88	207.88	207.88	207.88
F	Cukurova	747.40	4196.10	1238.62	1651.10	3522.24	2555.84
F&S	Cukurova	921.97	1015.46	926.19	805.51	926.19	771.73
B&H	Cukurova	1852.73	1852.73	1852.73	1852.73	1852.73	1852.73
F	Eregli Demir	-73.01	-4.49	-59.47	25.39	-30.14	27.54
F&S	Eregli Demir	106.61	106.61	98.29	98.29	75.27	75.27
B&H	Eregli Demir	351.49	351.49	351.49	351.49	351.49	351.49
F	Kartonsan	408.26	352.06	466.31	420.33	311.80	588.00
F&S	Kartonsan	87.48	89.72	74.74	60.94	60.94	54.46
B&H	Kartonsan	323.44	323.44	323.44	323.44	323.44	323.44
F	Koc Yatirim	1851.97	2405.38	1165.83	1528.28	1565.61	1714.33
F&S	Koc Yatirim	160.11	174.86	139.30	158.99	152.56	127.70
B&H	Koc Yatirim	395.93	395.93	395.93	395.93	395.93	395.93
F	Kordsa	9301.84	7265.69	4933.03	6447.15	5474.00	11830.60
F&S	Kordsa	208.23	198.82	163.68	163.68	163.68	194.04
B&H	Kordsa	426.21	426.21	426.21	426.21	426.21	426.21
F	Koruma Tarim	-90.05	164.42	301.22	-29.29	292.61	10.16
F&S	Koruma Tarim	145.62	135.23	88.86	67.55	102.51	80.10
B&H	Koruma Tarim	334.70	334.70	334.70	334.70	334.70	334.70
F	Lassa	1204.11	4843.78	977.22	3074.93	2024.27	4155.23
F&S	Lassa	243.13	259.22	249.04	211.00	223.26	211.00
B&H	Lassa	690.71	690.71	690.71	690.71	690.71	690.71
F	Otosan	1032.45	1411.18	1179.25	823.16	1644.84	1241.92
F&S	Otosan	297.29	264.82	264.82	249.60	264.82	249.60
B&H	Otosan	627.58	627.58	627.58	627.58	627.58	627.58
F	Rabak	338.91	1374.53	432.37	1392.53	1589.42	1589.42
F&S	Rabak	183.55	183.55	171.72	149.52	149.52	149.52
B&H	Rabak	375.49	375.49	375.49	375.49	375.49	375.49
F	Sarkuysan	585.62	1805.49	312.18	1124.37	756.46	720.17
F&S	Sarkuysan	130.44	177.71	114.57	114.57	106.48	83.79
B&H	Sarkuysan	375.20	375.20	375.20	375.20	375.20	375.20
F	Sisecam	3264.90	2627.34	345.95	303.38	631.87	558.94
F&S	Sisecam	118.45	106.97	74.95	67.75	74.94	60.85
B&H	Sisecam	270.67	270.67	270.67	270.67	270.67	270.67
F	Turk Demir Dokum	4062.41	2853.78	2934.19	3081.80	3154.97	2899.13
F&S	Turk Demir Dokum	372.29	411.81	294.35	251.81	279.72	225.70
B&H	Turk Demir Dokum	929.21	929.21	929.21	929.21	929.21	929.21
F	Index	1251.47	1498.09	820.50	1298.04	637.94	1068.28
F&S	Index	176.12	176.12	164.92	171.89	105.92	91.20
B&H	Index	288.98	288.98	288.98	288.98	288.98	288.98

Filter Rules (x,y)→		3,3	3,2	3,1	2,2	2,1	1,1
F	Akcimento	839.90	670.10	604.01	687.89	621.72	744.31
F&S	Akcimento	549.29	500.39	454.07	476.88	431.97	450.18
B&H	Akcimento	644.23	644.23	644.23	644.23	644.23	644.23
F	Bagfas	4650.22	4650.22	3357.04	3756.18	3139.66	4511.46
F&S	Bagfas	293.82	293.82	263.13	278.16	248.69	248.69
B&H	Bagfas	924.75	924.75	924.75	924.75	924.75	924.75
F	Celik Halat	131.28	210.51	126.55	297.82	201.53	352.72
F&S	Celik Halat	28.49	23.31	13.58	23.31	13.58	17.06
B&H	Celik Halat	207.88	207.88	207.88	207.88	207.88	207.88
F	Cukurova	1939.73	2467.70	3130.39	1857.69	3212.97	2558.54
F&S	Cukurova	733.04	735.88	705.98	508.76	463.07	476.21
B&H	Cukurova	1852.73	1852.73	1852.73	1852.73	1852.73	1852.73
F	Eregli Demir	36.32	98.29	68.57	284.76	227.29	56.44
F&S	Eregli Demir	68.21	68.21	68.69	68.21	61.80	22.82
B&H	Eregli Demir	351.49	351.49	351.49	351.49	351.49	351.49
F	Kartonsan	265.50	439.47	890.95	560.00	1080.16	968.74
F&S	Kartonsan	44.18	44.18	44.18	44.18	44.18	32.95
B&H	Kartonsan	323.44	323.44	323.44	323.44	323.44	323.44
F	Koc Yatirim	890.78	847.23	198.19	742.10	190.84	44.35
F&S	Koc Yatirim	147.28	127.22	108.78	100.14	83.90	53.07
B&H	Koc Yatirim	395.93	395.93	395.93	395.93	395.93	395.93
F	Kordsa	4480.25	7710.41	8941.79	6519.60	7504.87	5047.60
F&S	Kordsa	167.20	197.76	197.76	185.60	185.60	122.10
B&H	Kordsa	426.21	426.21	426.21	426.21	426.21	426.21
F	Koruma Tarim	259.88	292.56	317.40	193.29	208.33	259.74
F&S	Koruma Tarim	80.10	73.14	73.14	55.01	55.01	42.86
B&H	Koruma Tarim	334.70	334.70	334.70	334.70	334.70	334.70
F	Lassa	3400.63	4598.28	2845.73	4070.95	2530.37	2334.54
F&S	Lassa	211.00	211.00	176.64	199.14	165.98	155.70
B&H	Lassa	690.71	690.71	690.71	690.71	690.71	690.71
F	Otosan	1612.39	2483.27	5082.83	3965.28	7343.85	3076.91
F&S	Otosan	249.60	249.60	235.01	259.37	244.58	173.58
B&H	Otosan	627.58	627.58	627.58	627.58	627.58	627.58
F	Rabak	1346.78	1346.78	1217.78	2141.00	1727.48	1343.46
F&S	Rabak	154.91	154.91	144.35	90.12	75.81	50.15
B&H	Rabak	375.49	375.49	375.49	375.49	375.49	375.49
F	Sarkuysan	1223.91	981.95	1064.93	550.35	578.69	689.87
F&S	Sarkuysan	110.46	86.35	78.94	71.83	65.00	58.44
B&H	Sarkuysan	375.20	375.20	375.20	375.20	375.20	375.20
F	Sisecam	501.45	509.02	580.55	430.70	484.98	739.96
F&S	Sisecam	60.85	54.23	47.88	45.24	39.47	39.47
B&H	Sisecam	270.67	270.67	270.67	270.67	270.67	270.67
F	Turk Demir Dokum	3338.19	2805.78	2502.91	2737.06	2623.11	2529.59
F&S	Turk Demir Dokum	238.53	213.31	201.35	213.31	201.35	189.81
B&H	Turk Demir Dokum	929.21	929.21	929.21	929.21	929.21	929.21
F	Index	771.86	889.43	985.63	900.51	994.71	762.70
F&S	Index	98.47	77.23	64.10	77.23	64.10	57.85
B&H	Index	288.98	288.98	288.98	288.98	288.98	288.98

Filter Rules (x,y)→		1,.5	.5,.5	.5,.25	max	min
F	Akcimento	516.84	516.84	516.84	1299.86	516.84
F&S	Akcimento	366.61	366.61	366.61	1255.98	366.61
B&H	Akcimento	644.23	644.23	644.23	644.23	644.23
F	Bagfas	3255.68	2345.83	2345.83	9207.52	1275.31
F&S	Bagfas	234.83	221.52	221.52	363.20	221.52
B&H	Bagfas	924.75	924.75	924.75	924.75	924.75
F	Celik Halat	334.17	106.91	110.75	352.72	16.59
F&S	Celik Halat	7.88	-12.04	-12.04	69.63	-12.04
B&H	Celik Halat	207.88	207.88	207.88	207.88	207.88
F	Cukurova	2138.92	1320.55	1320.55	4196.10	747.40
F&S	Cukurova	432.94	392.75	392.75	1015.46	392.75
B&H	Cukurova	1852.73	1852.73	1852.73	1852.73	1852.73
F	Eregli Demir	73.09	55.22	63.40	284.76	-73.01
F&S	Eregli Demir	22.82	18.03	18.03	106.61	18.03
B&H	Eregli Demir	351.49	351.49	351.49	351.49	351.49
F	Kartonsan	1166.97	1166.97	1166.97	1166.97	265.50
F&S	Kartonsan	32.95	32.95	32.95	89.72	32.95
B&H	Kartonsan	323.44	323.44	323.44	323.44	323.44
F	Koc Yatirim	4.37	4.37	22.59	2405.38	4.37
F&S	Koc Yatirim	46.34	46.34	46.34	174.86	46.34
B&H	Koc Yatirim	395.93	395.93	395.93	395.93	395.93
F	Kordsa	5049.64	2335.07	2335.07	11830.60	2335.07
F&S	Kordsa	113.65	97.61	97.61	208.23	97.61
B&H	Kordsa	426.21	426.21	426.21	426.21	426.21
F	Koruma Tarim	176.46	81.32	-41.33	317.40	-90.05
F&S	Koruma Tarim	31.65	21.33	16.47	145.62	16.47
B&H	Koruma Tarim	334.70	334.70	334.70	334.70	334.70
F	Lassa	3154.34	3965.57	3965.57	4843.78	977.22
F&S	Lassa	155.70	155.70	155.70	259.22	155.70
B&H	Lassa	690.71	690.71	690.71	690.71	690.71
F	Otosan	5748.89	4716.93	4716.93	7343.85	823.16
F&S	Otosan	173.58	162.63	162.63	297.29	162.63
B&H	Otosan	627.58	627.58	627.58	627.58	627.58
F	Rabak	1057.18	1035.71	1058.74	2141.00	338.91
F&S	Rabak	38.71	38.71	33.30	183.55	33.30
B&H	Rabak	375.49	375.49	375.49	375.49	375.49
F	Sarkuysan	482.79	482.38	772.96	1805.49	312.18
F&S	Sarkuysan	52.15	52.15	52.15	177.71	52.15
B&H	Sarkuysan	375.20	375.20	375.20	375.20	375.20
F	Sisecam	2285.52	2092.98	1765.33	3264.90	303.38
F&S	Sisecam	39.47	33.92	28.61	118.45	28.61
B&H	Sisecam	270.67	270.67	270.67	270.67	270.67
F	Turk Demir Dokum	2048.79	1820.33	1820.33	4062.41	1820.33
F&S	Turk Demir Dokum	157.61	147.66	147.66	411.81	147.66
B&H	Turk Demir Dokum	929.21	929.21	929.21	929.21	929.21
F	Index	1002.58	917.88	917.88	1498.09	637.94
F&S	Index	57.85	57.85	57.85	176.12	57.85
B&H	Index	288.98	288.98	288.98	288.98	288.98

VITA

Selim Murat Alparslan, son of Ayla and Yurdakul Alparslan was born in 1965. After graduating from Ankara Fen Lisesi, he pursued in his career by earning a BSc degree in the field of Mechanical Engineering in the Middle East Technical University. Finally, he was granted an MBA degree as a result of his graduate level studies in the Bilkent University.