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Sosyal Bilimler Enstitüsü Müdürlüğü

Tez Onay Belgesi

İŞLETME Anabilim Dalı MUHASEBE FİNANSMAN(İNG) Bilim Dalı Doktora öğrencisi EMİN FERİDUN YALVAÇ nın EVENT STUDIES AND THE EFFICIENT MARKET HYPOTHESIS-EVIDENCE FROM TURKISH MERGER ANNOUNCEMENTS adlı tez çalışması ,Enstitümüz Yönetim Kurulunun 01.06.2011 tarih ve 2011-10/25 sayılı kararıyla oluşturulan jüri tarafından oybirliği/~~oyçokluğu~~ ile Doktora Tezi olarak kabul edilmiştir.

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ABSTRACT

In this study, the price effects of the merger initiation announcements that took place in the Istanbul Stock Exchange over the period from 2000 to 2008 were analyzed. Our aim was to find evidence on whether the responses of target firm stock prices were in agreement with the assumptions of the Efficient Market Hypothesis which states that any new information conveys a signal to the market and prices of related securities adjust rapidly to that information.

In order to derive statistical inferences, we conducted an event study in which we have constructed a sample of 45 merger announcements and calculated cumulative abnormal returns for an event period of 3 days, including the announcement day, one day before and one after the event day. The Cumulative Average Abnormal Return for the 3-day event period was 13.2% and the value of t-statistic was 8.2, therefore the null hypothesis that the event has no impact was strongly rejected. The results of nonparametric tests also confirmed the strong rejection of the null hypothesis that there was no abnormal return.

Our results provided evidence that the market responded the newly arriving news efficiently which was in line with the semi-strong form of market efficiency. Nevertheless, we also observed significant increases on the share prices of sample firms during the pre-event period indicating that private information was involved in price formation process. This was considered as evidence contrary to the strong form of market efficiency.

ÖZET

Bu çalışmada, İstanbul Menkul Kıymetler Borsası'nda 2000-2008 yılları arasında gerçekleşen şirket satın alma ve birleşme duyuruları analiz edilmiştir. Çalışmanın amacı, hisseleri satış konusu olan hedef şirketlerin hisse senedi fiyatlarının söz konusu duyurulara verdiği tepkinin Etkin Piyasalar Hipotezi'nin varsayımlarına uygun olup olmadığı hakkında kanıt bulmaktır. Etkin Piyasalar Hipotezi'ne göre yatırımcıların beklentilerini değiştirebilecek yeni bir bilginin ilgili finansal varlık fiyatlarına hızla yansıması gerekir.

Bu amaçla 45 satın alma duyurusunu içeren bir örnek oluşturularak vaka çalışması yapılmış ve şirket hisselerinin satışı hakkındaki duyurunun kamuya açıklandığı tarih ile bir gün öncesi ve sonrası olmak üzere 3 günlük bir dönemde gerçekleşen kümülatif olağanüstü getiriler hesaplanmıştır. Kümülatif Olağanüstü Ortalama Getiri %13,2 ve t-değeri 8,2 olarak bulunmuş, dolayısıyla vakanın hisse fiyatları üzerinde etki yaratmadığı hipotezi kuvvetle reddedilmiştir. Parametrik olmayan testlerin sonucunda da vakanın etkisi ile hisse fiyatlarında olağanüstü bir getiri artışı olmadığını öneren farksızlık hipotezi kuvvetle reddedilmiştir.

Çalışmanın sonuçları, hisse fiyatlarının piyasaya yeni ulaşan habere Etkin Piyasalar Hipotezi'nin orta düzey formuna uygun olarak tepki verdiği hakkında kanıt sağlamıştır. Diğer yandan, örnekte yer alan şirketlerin hisse senedi fiyatlarında, şirket hisselerinin satılması için girişimde bulunulacağının kamuoyuna açıklanmasından önce olağanüstü artışlar gözlenmiştir. Bu durum, kamuya açıklanmamış bilginin fiyat oluşumunda etkisi olduğunu göstermekte olup, Etkin Piyasalar Hipotezi'nin ileri düzey formuna aykırılık teşkil etmektedir.

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ABBREVIATIONS

EMH	Efficient Market Hypothesis
ISE	Istanbul Stock Exchange
NYSE	New York Stock Exchange
M&A	Mergers and Acquisitions
CAPM	Capital Asset Pricing Model
BE/ME	Book Equity/Market Equity
APT	Arbitrage Pricing Theory
AR	Abnormal Return
CAR	Cumulative Abnormal Return
CAAR	Cumulative Average Abnormal Return
OLS	Ordinary Least Squares
SPA	Share Purchase Agreement

INTRODUCTION

The objective of this dissertation is to analyze merger and acquisition announcements in the Istanbul Stock Exchange (ISE) in order to find evidence on whether the responses of target firm stock prices are in agreement with the assumptions of the Efficient Market Hypothesis (EMH). A quick adjustment of prices to merger announcements would be consistent with the concept of market efficiency.

Efficient capital markets are defined as markets in which current prices reflect all available information, public as well as private. This definition implies that current market prices reflect the underlying value of securities and thus it is not possible to make unusual or excess profits by using available information. It is important to acknowledge that the EMH doesn't imply that markets are always in equilibrium presenting complete efficiency; on the contrary, inefficiencies appear continuously but disappear almost instantaneously as investors find them and trade on them.

It is widely acknowledged that expectations play a crucial role in explaining price fluctuations, business cycles, and even a more crucial role in explaining financial crisis. According to the rational expectations theory informed predictions of future events are called "rational". The rational expectations theory states that the forecast errors of expectations will on average be zero and cannot be predicted ahead of time. One of the most important applications of the concept of rationality is the efficient markets theory of asset prices in which the expectations are presumed to be equal to optimal forecasts using all available information. Rational expectations theory is considered as a building block for the EMH.

The efficient market hypothesis is associated with the concept of a "random walk" which is used to describe a price series where all subsequent price changes are random departures from previous prices. The random walk concept leads to a key assumption for the EMH implying that the information is immediately reflected in stock prices and tomorrow's price change will be independent of the price changes today. The price changes are only dependent to new information which is unknown at present; hence movements from the present level of prices are unpredictable and random.

According to the assumptions of the EMH any new information which is capable to change expectations of investors conveys a signal to the market and prices of related securities adjust rapidly to that information. Information that affects security prices are generally classified in three types: information on past prices, publicly available information, and all private and public information. Three types of market efficiency concepts have been developed in parallel to above classification. In weak-form efficiency, the price of a security reflects the past price and trading history of the security. In semi-strong form efficiency, prices reflect all publicly available information. In strong form efficiency, prices reflect all public and private information.

It was widely believed in the 1970s that the markets were remarkably efficient in reflecting information as regards to the stock markets, however the theory lost some of its power as a consequence of evidences presented that future stock prices were at least partially predictable on the basis of past stock price patterns as well as certain fundamental valuation measures. Besides, many financial economists emphasized psychological and behavioral elements of stock-price determination, and they suggested that these predictable patterns enable investors to earn excess risk adjusted rates of return. Nevertheless, the EMH is still considered as a benchmark theory in explaining price movements in financial markets.

Event studies are one of the most widely used empirical methodologies in testing the semi-strong form of market efficiency. The aim of an event study is to measure security price changes in response to an event, and make assessments on how quickly and correctly the market has reacted to that event. Nonzero abnormal security returns which persist after a particular type of event are inconsistent with the EMH that security prices adjust quickly to fully reflect new information. The magnitude of abnormal performance and the significance of the impact are strongly related to the extent that the event is unanticipated.

In the study, we describe a merger announcement as an event. It is expected that the new information signaling a change in the value of stocks should be reflected in the market prices very quickly. On the other hand, a finding that the arrival of new information has had no significant effect or a slow adjustment of prices would imply flaws in the market.

With this study, we examined the price impacts of the merger announcements on the stock prices of target firms between the years 2000 and 2008. We are expecting to find that cumulative abnormal returns occurred around the date at which information is released to the public.

The study has a primary importance as being an original research on the price effect of merger announcements in the Turkish stock market. As a matter of fact, it was only possible with the encouragement of recent economic developments in the world and in Turkey that stimulated acquisitions in the Turkish market. The yearly composition of the merger announcements in the ISE is a clear explanation of this development. We have observed 55 cases of which 45 included in our sample. Among those 55 observations, 48 are found from 2004 onwards while the remaining cases took place between the years 2000-2003. Before 2000, there was no merger and acquisition activity in the history of the ISE which was established in 1984.

CHAPTER ONE

THE EFFICIENT MARKET HYPOTHESIS

In this chapter we will first review the early literature to give an adequate description on the development of the EMH. Then, we will present the principles of the rational expectations theory which constitutes the underlying concept for the EMH. The evaluation of the influential articles of Eugene Fama will constitute the backbone of this chapter. We consider that his 1965 article has the primary importance as being the most comprehensive original work lying the principles and foundations of the theory. The two subsequent articles of Fama which were published in 1970 and 1991 include very important evaluations on the market efficiency theory. The major criticism of the EMH and how theory evolved in response to those arguments will constitute a major part of this chapter. We will cover the empirical evidences and criticism under three headings in parallel to the different level efficiency categories of weak form, semi-strong form and strong form. These are related to time series predictability of stock returns, volatility tests, seasonality and anomalies which all have important theoretical implications on efficient market model.

II. FOUNDATIONS OF THE MARKET EFFICIENCY THEORY

A. From Early Literature to Random Walk Theory

There is an agreement among financial economists to start the market efficiency literature from Louis Bachelier whose study on mathematical modeling of stock price movements was submitted at the beginning of the 20th century, however was only noticed in the late 1950s. The stochastic process of price formation which is called as the martingale hypothesis constitutes the main idea behind the market efficiency theory. The martingale hypothesis states that tomorrow's price is expected to be equal to today's price plus a random error component. The expectation of the random part is zero; therefore, expected price change of the asset is zero when conditioned on the asset's price history. Thus, the probability of its price to rise is equal

to the probability of it's to fall[1]. The martingale property is considered as a necessary condition for an efficient asset market in which information contained in past prices is instantly and fully reflected into current prices. The martingale led to the development of the random walk hypothesis. The theory is called random walk because the random component in any period is supposed to be serially uncorrelated with the random component in any past period making the returns on assets unpredictable.

In this section we will review the essential market efficiency literature published until 1965 at which the theory reached to its maturity with the publication of the Fama's influential article. Although the EMH applies to all types of financial securities, discussions of the theory usually focus on common stocks.

Luis Bachelier's PhD dissertation which was submitted in the year 1900 named "The Theory of Speculation" is recognized as the first study that anticipated the concept of random walk theory and market efficiency. Bachelier developed a mathematical model based on random price movements pricing warrants trading on the Paris Bourse. He argued that the prospects in financial markets involve two kinds of probabilities: i) The probability which is observed in games of chance and can mathematically be determined a priori, ii) The probability which is dependent upon future events and cannot be foreseen mathematically. He states that it is the latter probability that the speculator is trying to predict by analyzing the reasons that can influence the up and down price movements in the market. The speculator's induction is absolutely personal which is also true for the counter party. Bachelier considers the market as an assembly of speculators in which the prices should neither go up or down any moment, and thus "*the expectation of the speculator is zero*"[2]. He then compared the statistical distribution of price behaviors expected from his theory with observed distribution of price changes of certain government securities and he found a close correspondence between the observed distribution and that to be expected from his theory. Bachelier expresses the random character of the stock market movements by saying that "*price changes in the stock exchange often presents no apparent relation to past, present and discountable future events echoing its own course"*[3].

[1] John Y Campbell, Andrew W. Lo and A. Craig MacKinlay, **The Econometrics of Financial Market**s, Princeton University Press, 1997, pp.28-30.

[2] Louis M. Bachelier, Théorie de la Spéculation, **Annales Scientifiques de l'E.N.S.**, 3^{e} série, tome 17, 1900, pp.31-32.

[3] Bachelier, p.21.

Karl Pearson introduced the term "random walk" in 1905 through a probability problem in which he described a man who starts from point "zero" and walks a certain length in a straight line, then repeats it many times each time changing angles. The question was "*where he would probably end his walks*"[4]. The answer was that his walk would end at the point where he has started. This was also implying that the next movement of a speculative price was independent of all past movements and events.

Working (1934) examined US stock prices and other economic series and stated that time series of commodity prices and stock indexes commonly possess in many respects the characteristics of series of cumulated random numbers and also the changes between successive terms tend to be largely random[5].

Kendall (1953) examined the behaviour of twenty two economic time series representing speculative prices. They were indexes of British industrial share prices, plus prices of cash wheat at Chicago and spot cotton at New York. Kendall found that each period's price change was not significantly correlated with the preceding period's price change nor with the price chance of earlier period. Therefore, he concluded that knowledge of past price changes yields substantially no information about future price changes. He states that there is no hope of being able to predict movements on the exchange for a week ahead without particular information unless individual stocks behave differently from the average of similar stocks[6].

Roberts (1959) argued that chance behavior itself produces patterns that may invite false interpretations and described a "chance model" to express his methodological suggestions for financial analysis. He states that "*weekly changes of the Dow Jones Index behave as if they had been generated by an extremely simple chance model*. *Likewise, all the classical patterns of technical analysis can be generated artificially by a roulette wheel or random-number table".* He suggests that to attain a predictive insight into stock-market behavior economic theory and knowledge of economic facts would be more valuable than the past history of market prices[7].

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[4] Karl Pearson, The Problem of Random Walk, **Nature**, Vol.72, 1905, p.342.

[5] Holbrook Working, A Random Difference Series for Use in the Analysis of Time Series, **Econometrica**, Vol. 29, 1934, pp. 11-24

[6] Maurice G. Kendall, The Analysis of Economic Time-Series-Part I: Prices, **Journal of the Royal Statistical Society**, Vol. 116, No. 1, 1953, p.11-13.

[7] Harry V. Roberts, Stock-Market "Patterns" and Financial Analysis: Methodological Suggestions, **The Journal of Finance**, Vol. 14, No. 1, Mar., 1959, pp.4-7.

Osborne (1959) argues that common stock prices and the value of money can be regarded as an ensemble of decisions in statistical equilibrium, with quite analogous to an ensemble of particles in statistical mechanics. Likewise, price changes of stocks follow a similar probability distribution as a particle in Brownian motion and the measures such as earnings, dividends, management and their future outlook have only secondary importance in influencing those price changes. He concludes that risk taking consequent to the expectations of a gain is equally shared between buyers and sellers and thus the stock market is a fair meeting ground between them[8].

Alexander (1961) reviewed the studies of Bachelier, Kendall and Osborn. He also run a set of tests of randomness of successive weekly or monthly price changes and then applied a technique called filtering. By filtering out movements smaller than a specified size (for example 5%), he aimed to discover if trends are exist in time series. The results of the application of various filters to the Dow Jones and Standard & Poor's industrial averages from 1897 through 1959 indicated the existence of positive serial correlation, i.e. trends in stock market prices. He suggested that the trends arise from lagged responses. He concluded that "*in speculative markets price changes appear to follow a random walk over time, but a move, once initiated, tends to persist. In particular, if the stock market has moved up x percent it is likely to move up more that x per cent further before it moves down by x percent*"[9].

Muth (1961) developed rational expectations hypothesis as an alternative to the adaptive expectations theory proposing that expectations are formed in a dynamic way in which people change expectations in the light of new information. He describes the term of "rational expectations" as informed predictions of future events. In other words, rational expectations are the statistically correct expectations conditioned on all of the information available to market participants and the forecast errors of expectations will on average be zero[10].

The rational expectations theory presents very important implications for the EMH, therefore we will elaborate on its main assumptions in the next section.

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[8] F.M. Osborn, Brownian Motion in the Stock Market, **Operations Research**, 7, March-April 1959, p.173.

[9] Sidney S. Alexander, Price Movements in Speculative Markets: Trends or Random Walks, **Industrial Management Review**, Vol. 2, 1961, pp.7-26.

[10] John F. Muth, Rational Expectations and the Theory of Price Movements, **Econometrica**, Vol.29, No.3 Jul., 1961, pp.315-316.

Mandelbrot (1963) proposed a new model based on stable Paretian distribution (*) by which he examined cotton prices in the US between 1880 and 1940 and concluded that successive daily changes were independent and large price changes could be explained by casual or random "contaminators". He argued that probability distributions of price changes were composed of casual and random areas of which their distinction is sharp in the Gaussian case and very diffuse in the stable Paretian case. He suggested that price changes can be described by both "trend" and "noise" that were aspects of same deeper truth (**). In this regard, it would be desirable to examine the "noise" more closely to explain large price variations in speculative markets. If one succeeded in eliminating all large changes, one would have a Gaussian-like remainder; however, it would not have any significance[11].

Samuelson (1965) provided the first formal economic argument for market efficiency by positing a general stochastic model in which neither short sellers nor long buyers of Chicago wheat stand to make either a gain or loss. In his study, next period's price differences are shown to be uncorrelated with previous period's price differences. He stated that, all chart methods attempting to read out the past sequence of known prices any profitable pattern of prediction is doomed to failure because the market has already discounted all knowable future information so that the present-discounted variable is itself a fair-game martingale[12].

Fama (1965) published the article named "The Behavior of Stock Market Prices" that is considered a seminal work on market efficiency in which he reviewed the random walk literature, examined the independence of successive price changes and probability distributions of price changes and concluded that his findings has presented strong and voluminous evidence in favor of the random-walk theory[13].

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[11] Benoit Mandelbrot, The Variation of Certain Speculative Prices, **The Journal of Business**, Vol. 36, No. 4, Oct., 1963, pp.415-419.

[12] Paul A. Samuelson, Proof That Properly Anticipated Prices Fluctuate Randomly, **Industrial Management Review**, Vol. 6:2, 1965, Spring, p.42.

[13] Eugene Fama, The Behavior of Stock Market Prices, **The Journal of Business**, Vol. 38, No.1, January 1965, p.98.

(*) Paretian type of distribution is characterized with extreme fat tails presenting leptokurtosis due to very high, sometimes infinite variances.

(**) "Noise" and "noise trading" concepts are widely used by financial economists to indicate market irrationalities arising from uncertainty, psychological and other factors.

B. Rational Expectations Theory

The rational expectations theory was first proposed by John Muth in the early 1960s. He used the term to describe the many economic situations in which the outcome depends partly on what people expect to happen. The price of an agricultural commodity, for example, depends on how many acres farmers plant, which in turn depends on the price farmers expect to realize when they harvest and sell their crops. Similarly, the price of a stock or bond depends partly on what prospective buyers and sellers believe it will be in the future. Economists have used the concept of rational expectations in relation to various situations in which speculation about the future is a crucial factor in determining current action. It is also applied the theory of the dynamics of hyperinflations, the "permanent income" and "life-cycle" theories of consumption, and the design of economic stabilization policies. Besides the efficient markets theory, the rational expectations hypothesis has many other applications in macroeconomic models to study decisions on consumption, investment and other macroeconomic variables.

1. Description

Rational expectations theory was developed as an alternative to the adaptive expectations model. According to the adaptive expectations theory, people develop their expectations based on what has happened in the past. Muth argued that adaptive expectations theory results systematic errors thus is not consistent with the economic theory. The key factor was that the agents always failed to notice their prediction errors by using the past prices as estimators of this period's prices in their forecast. This backward looking approach of the model results systematic errors once a forecasting error is made by agents, due to a stochastic shock[14].

Muth states that informed predictions of future events are called "rational". He opposes to the arguments that the assumption of rationality in economics leads to theories inadequate to explain actual observations especially in explaining changes over time. Muth claims that the inadequacy is not in the rationality, rather in the dynamic economic models which does not assume enough rationality.

[14] Frederic S. Mishkin and Stanley G. Eakins, , Financial Markets and Institutions**, Addison-Wesley**, 2000, p.158.

The probability of outcomes consists of two components; one is the objective probability, the second is the subjective probability which is based on each agent's experience, knowledge and senses. The less we have reliable data the more we utilize subjective factors in decision making. Muth states that the rational expectations hypothesis stand on three assumptions:

> "*(i) Information is scarce, and the economic system generally does not waste it, (ii) The way expectations are formed depends specifically on the structure of the relevant system describing the economy, (iii) A "public prediction" in the sense of Grunberg and Modigliani (*) will have no substantial effect on the operation of the economic system unless it is based on inside information"*[15].

The model is a supply demand equilibrium model for commodity markets based on expectations as stated below.

$$p_t = - - p_t^e - - u_t$$

Where; p_t is the market price in the t^{th} period,

p_t^e is the market price expected to prevail during the t^{th} period

γ and β are the supply and demand coefficients,

u_t is the random error term presenting variations

if the errors are uncorrelated $u_t = 0$, then

$$Ep_t = - - p_t^e$$

The rationality assumption implies that there would be no excess profit opportunities if the aggregate expectation of the firms is the same as the prediction of the theory. Then the expected price would be equal to the equilibrium price as stated below.

$$\text{If } \gamma/\beta \neq -1, \text{ then } p_t = p_t^e$$

[15] Muth, pp.15-16.

(*) Grunberg and Modigliani studied the effect of the public and predictions on the future course of economic events. Their work suggests that public reactions to the published predictions of a future event create disturbances. (The Predictability of Social Events, **The Journal of Political Economy**, Vol.62, No.6, December 1954, pp.465- 466).

Muth states that the cross-sectional differences in expectations do not affect the theory since their aggregate effect would be negligible. However, modifications are necessary if correlation of errors is large and depends systematically on other explanatory variables. The theory of rational expectations says that the actual price will only deviate from the expectation if there is an "information shock" caused by information unforeseeable at the time expectations were formed[16].

2. Implications of the Theory

The EMH requires that agents have rational expectations on average and whenever new relevant information appears, the investors update their expectations appropriately. According to the theory, it is not required that the investors are rational, and it is expected that some investors may overreact and some may under react when new information has arrived. The EMH only requires that reactions of investors be random and follow a normal distribution pattern so that changes in market prices do not result reliably exploitable patterns to make an abnormal profit.

According to the rational expectations hypothesis, the expectations formed by economic agents are the statistically correct expectations conditioned on all of the information available to them This is the foundation stone for the "random walk" or "efficient markets" theory because the theory states that outcomes such as prices of financial assets do not differ systematically from what people expected them to be. This does not mean that people do not make forecasting errors, however that errors will not persistently occur on one side or the other.

Lucas conducted a theoretical analysis to examine the stochastic behavior of equilibrium asset prices under the assumptions of the rational expectations hypothesis. He developed a functional equation of equilibrium asset prices as a generalization of the Martingale property of stochastic price sequences. His model suggested that asset returns need to be properly adjusted for dividends and for the discount factor, which is the risk coefficient, in order for the Martingale property holds (*). Then, the expectation of price series conditioned on all available information would be zero[17].

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[16] Muth, p.321.

[17] Robert E Lucas Jr., Asset Prices in an Exchange Economy, **Econometrica**, Vol. 46, No. 6, Nov. 1978, p.1443.

(*) The martingale property does not account for risk, which is certainly essential in return analysis.

C. Principles and Evaluation of the EMH

1. Description and Implications

Fama's seminal article entitled "The Behavior of Stock Market Prices" was published in 1965 in which he provided a detailed discussion for the theory underlying the random walk model and also examined the model's empirical validity. He argued that "the technical analysis" which is based on studying past trading patterns to increase expected gains has no predictive value because all past information already reflected into the current prices from which the departures to higher or lower levels follow a random path depending upon the flow of relevant information.

Fama described the model as below.

> "*The theory of random walks says that the future path of the price level of a security is no more predictable than the path of a series of cumulated random numbers. In statistical terms the theory says that successive price changes are independent, identically distributed random variables. Most simply this implies that the series of price changes has no memory, that is, the past cannot be used to predict the future in any meaningful way*"[18].

The key concept of the random walk is the unpredictability of asset prices. The theory says that all relevant information is immediately reflected in prices; therefore no one would be able to make a superior forecast for future directions of price changes. According to Malkiel, "*Tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today. But news is by definition unpredictable, and, thus, resulting price changes must be unpredictable and random*"[19].

It is assumed that by the EMH there is an intrinsic value for each security which ultimately reflects the earning prospects of a company. Intrinsic value reflects market fundamentals and can be defined as a value representing either market conventions or equilibrium price for a security. The EMH doesn't require that actual market prices are equal to intrinsic values. All it requires that deviations from intrinsic values fluctuate randomly; therefore, consequential error terms would be unbiased. Since the prices changes reflect the changes in expectations, the forecast error of

[18] Fama, The Behavior of Stock Market Prices, p.34.

[19] Burton Malkiel, The Efficient Market Hypothesis and its Critics, **The Journal of Economic Perspectives,** Vol.17, No.1, Winter 2003, p.60.

expectations will be zero on average and cannot be predicted in advance. Besides, intrinsic values can change across time as a result of new information or anything that affects expectations for the earning prospects of a company. According to the EMH, the randomness of deviations from intrinsic value implies that there is an equal chance that stocks are under or over valued at any point in time, and these deviations are uncorrelated with any relevant variable. Fama emphasizes that it is not possible to know the intrinsic values because of the uncertainty in the world, plus differing opinions of individuals on presumed intrinsic values. He states that uncertainty or disagreement concerning intrinsic values may generally be called as "noise" in the market[20].

The process of price formation in stock markets needs to be understood in a dynamic way as suggested by the rational expectations theory. Investors, whether or not well informed, continuously update their forecasts about the true value of the investments to reflect the continuously arriving new information. Investors explore all sources of information in their search to forecast prices including trading patterns that may be existed in past price movements. Investors buy stocks that they expect to have a higher-than-average return and sell those they expect to have lower returns. The prices of the stocks adjust until the expected returns, adjusted for risk, are equal for all stocks. Equalization of expected returns means an adjustment process in which forecasts of investors are built into the prices of stocks to reflect dividends, the time value of money, and differential risk.

An important implication of the EMH for corporate finance is related to issuing new equity which may be in the form of initial public offering (IPO) or seasoned equity offerings. It is usually considered that firms would face to a timing decision in issuing equity with a view of creating value for their existing shareholders. According to the EMH, all those efforts for timing the issuance of stocks in favor of the shareholders are useless since the securities are correctly priced at any moment. In an efficient market, firms should expect a fair value, which is the present value, for securities they issue.

There is a general agreement that the randomness is the best simple description of market efficiency leading to the conclusion that today's prices are the best unbiased forecasts for future prices. Roberts produced a simulated graph by using a published table of random numbers to describe a series of price changes for a

[20] Fama, The Behavior of Stock Market Prices, p.36.

hypothetical year. Then, he compared this diagram with the actual weekly changes of the Dow Jones Index for the year 1956. He realized that the artificial graph simulated closely the actual history of the stock price movements of that year. The major difference was that the actual index showed greater dispersion. Accordingly, he concluded that the usual method of graphing stocks represents an artificial appearance of "pattern" or "trend", and chance behavior itself produces "patterns" that invite false interpretations[21].

2. Statistical Evaluation

As Fama pointed out, market efficiency involves two separate hypotheses: (i) successive price changes are independent, and (ii) the price changes conform to some probability distribution. As Fama emphasizes "*Either successive price changes are independent (or at least for all practical purposes independent) or they are not; and if they are not, the theory is not valid*[22].The independence assumption relates to the most crucial principle of theory simply meaning that the series of price changes has no relation with the past; therefore, the past cannot be used to predict the future. The independence of price changes was tested intensively by many empirical studies, which will be discussed in the next section.

The shape of distribution of price changes is considered another major factor in terms of reliability of the market efficiency model and also regarding to the level of riskiness of investment in common stock. Therefore, it has been an important concern for market efficiency advocates to be able to explain large price changes occurring quite frequently. Fama considers that independence is the more important of the two hypotheses.

(a) Independence

Serial correlation is described as the correlation between the current return on a security and return on the same security over the subsequent period. Serial correlation coefficients for stock returns close to zero would be consistent with the independence assumption of the EMH. Significant serial correlation coefficients, whether positive or negative, are indications of market inefficiencies, implying the

[21] Roberts, pp.3-5.

[22] Fama, The Behavior of Stock Market Prices, p.41.

existence of predictable patterns in stock price movements. A positive coefficient of serial correlation for a particular stock indicates a tendency toward continuation. This means, a higher than average return at time "t" is likely to be followed by a higher-than-average returns at time (t+1, t+2 …). Similarly, a lower than average return at time "t" is likely to be followed by a lower-than-average returns at time (t+1, t+2 …). A negative coefficient of serial correlation indicates a tendency toward reversal.

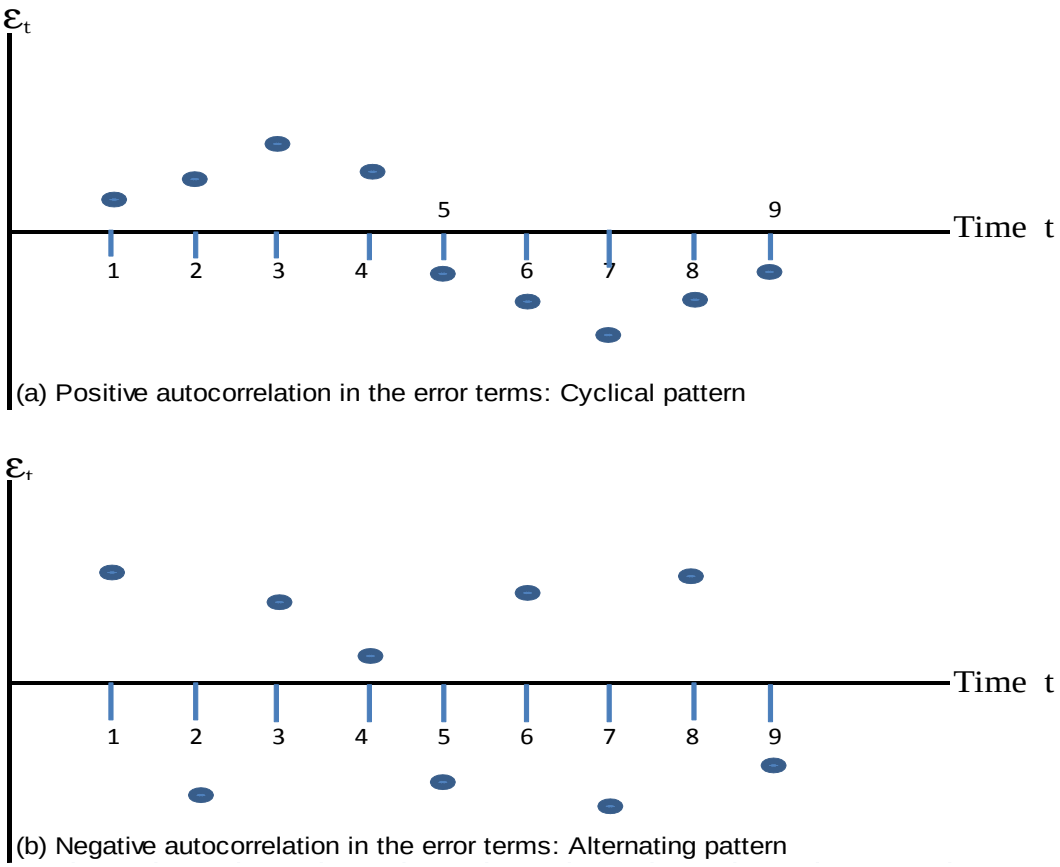

Figure 1
Positive and Negative Autocorrelation

Source: Bowerman Bruce L. and Richard T. O'Connel, Linear Statistic Models, PWS-KENT Publishing Company, 1990, pp.235-236

Fama states that a time series which is characterized by perfect independence can probably never be found in reality. Thus, the random walk theory cannot be a completely accurate description of reality. However, it is possible to assume a certain level of independence which is consistent with the purposes of the model. In this regard, the random walk model would be valid as long as the actual degree of dependence in the series of price changes is not higher to allow the past history of the

series to be used to predict the future in a way which makes expected profits greater than they would be under a naive buy-and-hold model[23]. (*)

Fama expresses the independence condition as below:

$$\text{Probability}\ (x_t = x \mid x_{t-1}, x_{t-2}, \ldots) = \text{Probability}\ (x_t = x)$$

Where x is the current price, x_t is the price at time t, and x_{t-1} is the previous price. The formula expresses that the probability of price at the time "t" will take the value x is equal to the probability of x conditional on the knowledge that previous price changes took the values of x_{t-1}, x_{t-2}, etc.

A simpler formula of independence is as follows:

$$E(P) = P + \varepsilon$$

Where E (P) is expected price, P is current price and ε is the random error term which has an expected value of zero, and is independent of the expectations. Thus, there is an equal chance that stock prices are under or over valued at any point in time, and that these deviations are uncorrelated with any observable variable. That is, analyzing the sequence of price changes cannot produce any useful information in assessing the probability distribution for future price changes.

Fama expresses this error term as "noise" which may come from differing opinions of investors or uncertainty. Nevertheless, the existence of noise does not constitute a violation of the market efficiency provided that the noise is generated in a randomly independent fashion. If the estimations of investors are dependent to the estimation made by others, error terms represent high degree of correlation and intrinsic values do not tend to follow any consistent pattern. This means that noise may be generated in a dependent fashion. Fama states that "*This type of dependence in the noise generating process would tend to produce "bubbles" in the price series, that is, periods of time during which the accumulation of the same type of noise causes the price level to run well above or below the intrinsic value"*. The arbitrageurs play a crucial role in preventing these "bubbles" from occurring. Therefore, the presence of

[23] Fama, The Behavior of Stock Market Prices, pp.35-38.

(*) Naïve models are considered as the simplest of all forecasting models, the basic naïve model assumes that the next period will be identical to the present.

an active market together with well informed investors are essential to neutralize the dependence in the noise-generating process, and thus successive price changes will be independent[24].

Fama argues that the economic rationale for this type of dependence arises from the nature of the information process in a world of uncertainty. Although the existence of this type of price behavior could not be used by the investor to increase expected profits, the behavior does fit into the statistical definition of dependence. That is, knowledge of today's price change does condition our prediction of the size, if not the sign, of tomorrow's change [25].

Mandelbrot has a similar view stating that "*both trend and noise are aspects of the same deeper truth, which may not be explainable today, but which can be adequately described"*. He suggests that the parts of noise (if it can be decomposed) may give the impression of a trend linking various series to each other. At present, until a model approximates the ideal of decomposing noise into parts, it is only possible to represent some trends as being similar to "noise"[26].

(b) Probability Distribution

The shape of probability distributions for security and commodity prices has been studied by many researches especially since 1950s on account of the utilization of computers that facilitated the processing of large amounts of data. The importance of the shape of distributions for the EMH is that the difficulty in explaining sharp price movements exhibited both in commodity and stock markets under the normal distribution assumption.

The normal distribution is the one most widely used by researchers in sampling, estimation and hypothesis testing. It is taken as a standard of reference for probability problems since its characters approximate well for many real life concerns. A normally distributed population indicates a normal probability curve with the mean corresponding to the highest point and a population symmetrical around the mean. A very peaked distribution with long tails is called leptokurtic. In this case, the population

[24] Fama, The Behavior of Stock Market Prices, pp.35-40.
[25] Fama, The Behavior of Stock Market Prices, p.85.
[26] Mandelbrot, p 415.

mean can be greatly affected by the extreme population values in the tail of the distribution. In such populations, median may be a better measure for central tendency than the population mean. Alternatively, the central tendency can be estimated by calculating the trimmed population mean(*).

Mandelbrot examined the cotton prices between 1880 and 1940 and proposed a new model of price behavior in speculative markets. He pointed out that sample distribution of returns had exhibited extreme moves more likely than would be predicted by the normal distribution. The shape of the distributions was highly leptokurtic with long tails having most values around mean and in tails. He also indicated that Bachelier's model, which assumes a zero mean for the price changes, can only represent the movement of prices once the broad causal parts or trends have been removed. On the account of this observation he suggested that asset returns can be modeled, not with the normal distribution assumed in the random walk hypothesis but with stable Paretian distributions. Mandelbrot explains that eliminating large price changes brings any distribution closer to the Gaussian distribution, however this kind of trimming would take away much of the significance of the analysis. Therefore, it is necessary for the correct estimation to avoid the elimination of periods of rapid price changes. He argues that a closer examination of “noise” is required rather than elimination of all large changes. In this way, it would also be possible to have a view on whether the “noise” is casually explainable[27].

Fama has extended the stable Paretian model to test Mandelbrot's hypothesis by examining the daily prices for thirty stocks of the Dow Jones index between 1957 and 1962. He observed more relative frequency in the center and in the extreme tails than normally would be expected under a Gaussian distribution. There were of some degree of leptokurtosis for every stock and the empirical distributions were more peaked in the center and had longer tails than the normal distribution. He therefore suggested that the Mandelbrot hypothesis seemed to fit the data better than the Gaussian hypothesis[28].

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[27] Mandelbrot, pp.403-419.

[28] Fama, The Behavior of Stock Market Prices, pp.68-89.

(*) Trimming is excluding extreme values from data by cutting certain percentages from both ends (i.e. 10% smallest and largest values).

The essential implication of taking a stable Paretian distribution as model for security prices is recognizing that such a market is more risky than a market described by a Gaussian distribution. Therefore, it is usual that price changes have a high degree of dispersion and prices move frequently with big jumps in both directions during very short time periods. Fama states that this also provides explanations for the price formation process that generate changes in intrinsic values across time. He states that intrinsic values change frequently depending upon the variability in the process generating new information. This conclusion is consistent with the EMH as long as prices adjust rapidly. However, it is more likely that as Fama stated "*the actual price will initially overshoot the new intrinsic value as often as it will undershoot it*"[29].

3. Sufficient Conditions and Market Microstructure

Fama describes sufficient conditions for capital market efficiency in three headings *"(i) there are no transactions costs in trading securities, (ii) all available information is freely available to all market participants, and (iii) all agree on the implications of current information for the current price and distributions of future prices of each security*"[30]. He also states that such a frictionless market in which all information is freely available and investors agree on its implications does not exist in reality, however all three conditions exist to some extent in practice.

There is an agreement among financial economists that the condition of costless information cannot be met in reality. Nevertheless, the controversy exists for the effect of the "costly" information on the soundness of the EMH and on its explanatory power of real world. In order to provide evidence on the effect of the cost of information, Grossman and Stiglitz developed an extension of the noisy rational expectations model (*). In their model, there are two types of traders, those who are observing the information (informed traders) and those who are observing only price (uninformed traders). The proportion of informed traders to uninformed ones decreases as the cost of information becomes higher. Since the participants are utility maximizing agents, the cost of the information is the only factor that affects the preferences of them to be in the one of the two categories. If the cost of being informed

[29] Fama, The Behavior of Stock Market Prices, p.94.

[30] Eugene Fama, Efficient Capital Markets: A Review of Theory and Empirical Work, **The Journal of Finance**, Vol. 25, No. 2, May, 1970, p.387.

(*) This model developed by Robert Lucas and applied to the study of flow of information by Grossman.

is greater than being uninformed some individuals switch from being informed to being uninformed (and conversely). The authors suggest that if prices convey all information, there is no incentive to purchase information. The only way informed traders can earn a return on their activity of information gathering is if they can use their information to take positions in the market which are "better" than the positions of uninformed traders. Nevertheless, if prices fully reflect all available information at any time as suggested by the EMH, then informed traders could not earn a return on their information. In this case, each informed trader feels that he could stop paying for information and do as well as a trader who pays nothing for information. In the absence of “noise” trade among investors occurs either because tastes (risk aversions) differ, endowments differ, or beliefs differ[31].

The authors conclude that due to the fact that information is costly, prices cannot perfectly reflect the information. Since costless information is a necessary condition for the market efficiency a modification of the theory is required. However, any modification in the assumptions of the theory to allow even a slight amount of information imperfection and a slight cost of information makes the traditional market efficiency theory invalid[32].

Fama affirms the importance of trading and information costs on market efficiency stating that those costs should always be zero in order for the extreme version of the EMH holds true. However, he considers those costs as potential sources of inefficiency He also argues that it is difficult to determine what are reasonable information and trading costs and suggests that more empirical works in this area are required to measure their effects on the process of price formation. Additionally, he states that market efficiency is a good approximation simplifying view of the world and deviations from the extreme version of the efficiency hypothesis are considered to be within information and trading costs. In this regard, the compensation of informed investors for the costs they incur makes the market less than fully efficient but in a way that is consistent with rational behavior by all investors[33]. The market may be efficient if "sufficient numbers" of investors have ready access to available information. In this

[31] Sanford J Grossman and Joseph E. Stiglitz, On the Impossibility of Informationally Efficient Markets, **The American Economic Review**, Vol. 70, No. 3, Jun., 1980, pp.393- 395.

[32] Grossman and Stiglitz, pp.404- 405.

[33] Eugene Fama, Efficient Capital Markets: II, **The Journal of Finance**, Vol. 46, No. 5, Dec., 1991, p.1605.

regard, disagreement among investors about the implications of given information does not in itself imply market inefficiency unless there are investors who can consistently make better evaluations of available information that are implicit in market prices.

Market microstructure is also an important concern for efficient financial markets. Market microstructure is described as the relationship between price determination and trading rules which is characterized by the level of trading costs, liquidity conditions, market-making mechanisms and the presence of competition. Thin markets or thin stocks which are described with less frequent trade are considered to be exposed to market inefficiency. Differential tax rates and transactions costs, bid-ask spreads are implications of imperfections in the market mechanism.

Dimson considers market microstructure in a larger content including the characteristics of the behavior of different class of investors, market makers, noise traders, and informed investors[34].

Bernstein states that three attributes "depth, breadth, and resiliency" are generally accepted as the basic requirements for good markets. Depth and breadth mean that sufficient interest exists on both the sell side and the buy side for traders to be able to execute a large number of transactions in a short period of time. Resiliency means that there is a large countervailing order flow whenever transaction prices change because of temporary order imbalances[35].

4. Investment Strategy

Both technical analysis and fundamental analysis have a common assumption that trends are exist in securities markets. Technical analysts study previous changes in price for indications of future changes in price. Fundamental analysts study macro economic variables and factors that may affect company earnings. On the other hand, if the markets are efficient, all relevant information is supposed to be already impounded into prices and the next move of a speculative price would be independent of all past moves. For that reason, the past information has no value in forecasting future prices. Therefore, no group of investors can consistently make excess profit by

[34] Dimson, A Brief History of Market Efficiency, p.100.

[35] Peter L. Bernstein, Liquidity, Stock Markets and Market Makers, **Financial Management**, Summer 1987, p.55.

following an investment strategy. The only factors that can change stock prices are random factors that could not be known in advance. Thus, current prices are an unbiased estimate of the true value of and changes in stock prices follow a random walk. Therefore, the best investment strategy is a naive buy-and-hold model.

According to the EMH, it is still possible that several investors will be able to beat the market consistently over long periods, not because of their investment strategies but because they are lucky. It would not, however, be consistent if a disproportionately large number of these investors used the same investment strategy. The interpretation of the news by investors about the direction, magnitude and duration of it will vary among investors. Plus, differing risk perception among them will also cause different behaviors which affect the price formation process.

In an efficient market, the expected returns from any investment will be consistent with the risk of that investment over the long term, though there may be deviations from these expected returns in the short term. Therefore, a rational investment policy for the average investor should be portfolio analysis. Fama says that "*The rational investor only concerns with the risk he/she is willing to take"*[36]*.* In an efficient market, a strategy of minimizing trading, i.e., creating a portfolio and not trading unless cash was needed would be superior to a strategy that required frequent trading.

Bagehot states that "*the securities business is a very poor game*" referring to the evidence presented by Jensen that professionally managed portfolios failed to perform better than amateurs[37]. His analysis is based on making a distinction between two types of gains (and losses as well); market gains and trading gains. Market gains are positive returns on stocks which happen only when market goes up as a whole. In this case everybody wins generally, and investors who are trading at times of rising markets fallaciously think that it's their decision that made them win. On the other hand, in times of falling markets investors as a whole lose from trading except informed investors. Therefore the right investment strategy is to buy a well diversified portfolio, and hold on to it. The investor will generally sell only to establish tax losses, or when he needs money. It is better to borrow against the invested portfolio when one needs

[36] Fama, The Behavior of Stock Market Prices, p.40.

[37] Michael C. Jensen, The Performance of Mutual Funds in the Period 1945-64, **The Journal of Finance**, Vol. 23, May 1968.

money, instead of selling, to avoid realizing capital losses. In this strategy, investment expenses, brokerage costs, and taxes will also be minimized. It is important for the investor to choose a well diversified portfolio, and it is important for him to choose a portfolio that fits his objectives, including his tax status and his ability to tolerate fluctuation speculative market setting of asymmetric information[38].

II. EVALUATION OF EMPIRICAL EVIDENCES

Early empirical studies were overwhelmingly supported the EMH, however, starting from late 1980s, many studies presented evidence that past return patterns and certain valuation parameters contained indicators for the possible direction of prices. Furthermore, many studies discovered psychological and behavioral elements of stock-price determination.

In this respect, we find that the assessment of Fama on findings of recent research is particularly important. He stated in his review article published in 1991 that "*With the CRSP daily data back to 1962, recent research is able to show confidently that daily and weekly returns are predictable from past returns. The work thus rejects the old market efficiency-constant expected returns model on a statistical basis*." However, he also emphasizes that the results of studies tend to confirm the conclusion of the early work that variation in daily and weekly expected returns is a small part of the variance of returns, but it grows as much as 40% of the variance of long term returns[39].

At this point, Fama states that it is difficult to identify to what extent the return predictability can be explained from a reflection of rational variation in expected returns or from irrational deviations of price from fundamental value. He points out that the EMH cannot give a full response to this problem due to the fact that market efficiency hypothesis is tested together with an asset pricing model such as CAPM. Therefore, the inability of explaining the market behavior may arise from the lack of a model correctly stipulates the required rate of return. He further states that market betas in Sharp-Lintner model have no explanatory power relative to the variables like size, leverage, earning/price (E/P) ratios, and book-to-market equity. Therefore, he

[38] Walter Bagehot, pseud. for Jack Treynor, The Only Game in Town, **Financial Analysts Journal**, Vol. 27, March/April 1971, pp.12-17.

[39] Fama, Efficient Capital Markets: II, pp.1580-1581.

concludes that "*the precise inferences about the degree of market efficiency are likely to remain impossible and the market efficiency literature should be judged on how it improves the ability to describe the time-series and cross-section behavior of security returns*"[40].

Below, we will review the empirical studies under three categories of efficiency as weak form tests, semi-strong form tests and strong form tests. It is important to notice that these three categories of efficiency are redefined in the 1991 article of Fama as tests for return predictability, tests for event studies and tests for private information. Fama states that the new titles are more descriptive, and also the return predictability tests have a broader coverage than weak form tests examining also the forecast power of variables like dividend yields and interest rates.

A. Weak Form Tests - Return Predictability

Weak form of efficiency states that past information is already incorporated into the current prices, thus future prices cannot be predicted by analyzing past patterns or trends. The critical term in this definition is the "return predictability", and we consider this term describes the issue remarkably well because most of controversy revolves around the question of the predictability of stock returns.

1. Predictability Based on Past Returns

The independence of successive price changes is the most important assumption of the EMH which requires that the expected value of serial correlation coefficient would be zero. Fama examined the serial correlations between the thirty stocks of the Dow Jones Industrial Average for a period between 1957 and 1962. He found that twenty-three out of thirty of the first-order correlation coefficients for the daily differences were positive. However, he argued that small absolute levels of serial correlation cannot be considered a violation of market efficiency as long as they cannot be used as the basis of substantially profitable trading system. He further argued that zero serial covariance was consistent with a "fair game" model, however nonzero serial covariance do not imply in the existence of profitable trading systems in certain other

[40] Fama, Efficient Capital Markets: II, pp.1576-1580.

models. This positive dependence may imply a less than completely strict interpretation of market efficiency, however cannot justify the rejection of the market efficiency[41].

Fisher examined the investment performances of the NYSE stocks for the period between 1926 and 1960 by constructing randomly selected portfolios and calculating three new indexes. He found positive serial correlation coefficients in the average rate of changes of all three indexes due to the lag in the changes of prices of stocks. He observed that the lag was shortest for large, active issues implying larger autocorrelations for small stocks[42].

Summers argued that the evidence for the autocorrelation of short-horizon returns were existing evidence for long temporary swings of prices away from fundamental values. Furthermore, large valuation errors were common in speculative markets and the inability of various tests to reject the EMH does not mean those tests provided evidence in favor of its acceptance. He suggested that a new approach incorporating errors into asset prices is required to explain the behavior of speculative prices rather than assuming that market valuations are always rational[43].

Lo and MacKinlay analyzed returns on equal-weighted and value-weighted indexes of NYSE stocks using 1216 weekly observations in a period between 1962 and 1985. They found significant positive serial correlation for weekly and monthly holding-period returns which led them to reject the random walk hypothesis. They repeated their analysis for size-based portfolios and again found significant positive serial correlation. The autocorrelation was stronger for portfolios of small stocks. Their conclusion is that the random walk model is generally not consistent with the stochastic behavior of weekly returns, especially for the smaller capitalization stocks. However, the rejection of the random walk model does not necessarily imply the inefficiency of stock-price formation[44].

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[41] Fama, Efficient Capital Markets: A Review of Theory and Empirical Work, pp.393-394.

[42] Lawrence Fisher, Some New Stock-Market Indexes, **The Journal of Business**, Vol. 39, No. 1, Part 2: Supplement on Security Prices, Jan.,1966 ,pp.205-206.

[43] Lawrence H. Summers, Does the Stock Market Rationally Reflect Fundamental Values?, **The Journal of Finance**, Vol.16, No.3, July 1986, pp.591, 592.

[44] Andrew W. Lo and A. Craig MacKinlay, Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test, **The Review of Financial Studies,** Vol.1 No.1, Spring 1988.

2. Return Reversals and Overreaction

Werner, De Bondt and Thaler examined NYSE stocks between the years 1926 and 1982, and found that over 3 to 5 year holding periods stocks that performed poorly over the previous 3 to 5 years achieve higher returns than stocks that performed well over the same period. Thirty-six months after portfolio formation, the losing stocks have earned about 25% more than the winners. They attribute these results to market overreaction to unexpected strong news about firms followed by inevitable reversal of prices that can be explained with the experimental psychological suggestions. The existence of such an overreaction implies the reversal of prices, so therefore the best investment approach would be "the contrarian strategy" based on selling overvalued winners and buying undervalued losers[45].

Jegadeesh and Titman focused on relative strength trading rules rather than contrarian strategies. They examined the monthly returns of the 32 portfolios they constructed in accordance with different investment strategies for the period between 1965 and 1989. They observed that buying of well performed stocks in the past and selling of stocks that have performed poorly in the past generated significant positive returns over 3 to 12 month holding periods. However, further tests suggest that the longer-term performances of these past winners and losers reveal that half of their excess returns in the year following the portfolio formation date dissipate within the following 2 years. The results of these tests indicated that the profits were due to the delayed price reactions to firm-specific information rather than the systematic risk of the trading strategies. The initial positive and later negative relative strength returns suggests that common interpretations of return reversals as evidence of overreaction and return persistence as evidence of underreaction are probably too simplistic and insufficient to explain systematically biased investor behaviors[46].

Lo and MacKinlay studied the weekly equal-weighed and value-weighted returns indexes for the sample period between 1962 and 1987 to investigate the relationship between contrarian investment strategies and market overreaction. The authors state that overreaction always implies price changes must be negatively

[45] F. M. Werner, De Bondt and Richard Thaler, Does the Stock Market Overreact?, **The Journal of Finance**, Vol.15 No.3, 1985, pp.793-804.

[46] Narasimhan Jegadeesh and Sheridan Titman. Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, **The Journal of Finance**, Vol. 48, No. 1, Mar., 1993, pp**.** 65-69.

autocorrelated for some holding period. Nevertheless, their findings indicate that individual stock returns were negatively autocorrelated serially, and were positively cross-autocorrelated with index returns. They also find the returns of large stocks lead those of smaller stocks. Evidently, this positive cross-autocorrelation reconciles the negative serial dependence in individual security returns. Their conclusion was that the majority of contrarian strategy gains were due to index gains and thus market overreaction cannot be the sole explanation for the profitability in contrarian portfolio strategies[47].

Fama and French examined autocorrelations of long term stock returns for the period between 1926 and 1985. They observed that a component of prices induces negative autocorrelation in returns that is weak for the daily and weekly holding periods common in market efficiency tests. But such a temporary component of prices can induce strong negative autocorrelation in long-horizon returns. The estimates for industry portfolios suggested that predictable variation due to mean reversion is about 35 percent of 3 to 5 year return variances. Predictable variation is estimated to be about 40 percent of 3-5-year return variances for small-firm portfolios indicating more predictability for small firms. Such large negative autocorrelations for return horizons beyond a year indicated mean-reverting behavior of stock prices. The authors argue that the predictability of long-horizon returns may reflect market inefficiency or time-varying equilibrium expected returns generated by rational investor behavior. In order for a more explanatory conclusion, more powerful statistical techniques would be required to control the effect of the macroeconomic driving variables[48].

Poterba and Summers examined the evidence on the mean reverting behavior of stock prices. They stated that mean reverting behaviors also indicate that stock prices contain transitory components that account for a large fraction of the variance in common stock returns. They analyzed the US data stock returns over the 1871-1986 period and evidence from seventeen other equity markets around the world over the period of 1957-1985. The results suggested the presence of transitory components in stock prices, with returns exhibiting positive autocorrelation over short periods but negative autocorrelation over longer periods. The point estimates suggested that the

[47] Andrew W. Lo and, C. A. MacKinlay, When Are Contrarian Profits Due to Stock Market Overreaction?, **The Review of Financial Studies,** Vol.3, No.2, 1990, pp.175-180.

[48] Fama and Kenneth French, Permanent and Temporary Components of Stock Prices, **The Journal of Political Economy**, April, 1998, Vol. 96, No. 2, pp.246-247.

transitory components in stock prices have a standard deviation of between 15 and 25 percent and account for more than half of the variance in monthly returns. Their conclusion is that such large variations in required returns can be explained by noise trading rather than through changing risk factors which probably implies market inefficiency[49].

3. Excess Volatility

LeRoy and Porter analyzed Standard & Poor's Composite Index of stock prices and the related earnings and dividends series over the period 1955 to 1973. They argued that market efficiency implies restrictions on the volatility of stock prices; however, the evidence presents that stock prices were too volatile to be justified with the variations in expected earnings. The volatility seems even higher due to the fact that expected earnings can plausibly be assumed to regress toward a mean in the increasingly distant future. Hence, they concluded that stock prices are more volatile than it would be consistent with the efficient capital markets model[50].

Shiller studied the relation between excess volatility in stock markets and the new information about subsequent optimally forecasted real dividends. He developed a simple model to interpret movements in price indexes in which refers to the assumption that real stock prices are equal to the present value of rationally expected or optimally forecasted future real dividends. He calls this model as the "efficient markets model" and argues that a sudden movement in stock price indexes can only be attributed to "new information" about future dividends. Nevertheless, it has been demonstrated historically that dividends simply do not vary enough to rationally justify observed aggregate price movements in stock returns The movements in stock prices over the last century was so large to be explained by the rational response to new information about anticipated future movements of dividends. Actually, observed dividend movements were many times smaller than it would be required to cause such a large volatility in stock prices. In view of that, if real stock prices are "too volatile",

[49] James M. Poterba and Lawrence E. Summers, Mean Reversion in Stock Prices: Evidence and Implications, **NBER Working Paper Series**, No.2343, August 1987, pp.29-33.

[50] Stephen F. LeRoy and Richard D. Porter, The Present-Value Relation: Tests Based on Implied Variance Bounds, **Econometrica**, Vol. 49, No. 3, May, 1981, pp.555-558.

then there may be some real profit opportunity. Thus, "*the efficient markets model is at best an academic model and does not describe observed movements in data*"[51].

French and Roll examined the daily variances for the common stocks listed on NYSE and American Stock Exchanges between 1963 and 1982 and compared the trading-hours variances with the overnight non-trading hourly variance. They found that the stock prices were more variable when the market is open. They considered three possible explanations for increased volatility: (i) More public information arrives during normal business hours, (ii) private information affects the process through informed trading investors (iii) The process of trading introduces noise (mispricing) into stock returns. Their conclusion is that the principle factor behind high trading-hours variances although a significant fraction of the daily variances is caused by trading noise[52]. Fama argued that this difference is caused by differences in the flow of information during trading and non-trading hours. However, the interpretation of Black on this issue is that the noise traders were cutting back on noise trading when the market is closed and this also cuts back on information trading plausibly causing pricing errors.

Black argued that short term excess volatility could be explained by noise trading in stock markets. He states that the value of a firm is only affected by the relevant information while its market price is composed of both the effect of information and the effect of noise. Therefore, the variance of percentage price moves from day to day will be the sum of variances induced by information and variances caused by noise. Since noise is independent of information in this context, when the variance of the percentage price moves caused by noise is equal to the variance of the percentage price moves caused by information, the variance of percentage price moves from day to day will be roughly twice the variance of percentage value moves from day to day. Anything that changes the amount or character of noise trading will change the volatility of price[53].

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[51] Robert J. Shiller, Do Stock Prices Move too Much to be Justified by Subsequent Changes in Dividends, **American Economic Review**, Vol. 71, 1981, pp.22- 23.

[52] Kenneth R French and Richard Roll, Stock Return Variances: the Arrival of Information and the Reaction of Traders, Graduate School of Management, **Journal of Financial Economics**, 17, 1986, North- Holland, pp.5-7.

[53] Fisher Black, Noise, **The Journal of Finance**, Vol. 41, No.3 July 1986, p.533.

4. Predictability Based on Valuation Parameters

Considerable empirical research has been conducted to determine the forecastability of stock returns on the basis of initial valuation parameters, such as dividend yields, price-earnings multiples, book to market equity and short-term interest rates.

Campbell and Shiller presented evidence for the ability of dividend yields to forecast future returns[54]. Similarly, Fama and French found that as much as 40 percent of the variance of future returns for the stock market as a whole can be predicted on the basis of the initial dividend yield of the market index[55]. Malkiel suggested that dividend yields may not be as meaningful as in the past as a useful predictor of future equity returns since "*the companies in the twenty-first century may be more likely to institute a share repurchase program rather than increase their dividends*"[56].

Basu constructed portfolios for different levels of P/E ratios from a sample of 753 NYSE stocks to examine the relationship between investment performance of equity securities and their P/E ratios for a period of 14 years between 1956 and 1969. He found that low P/E portfolios earn superior returns on a risk-adjusted basis. The study also indicated that there were lags and frictions in the adjustment process contrary to the assumptions of the EMH that publicly available information was instantaneously impounded in security prices. The conclusion of the study was that publicly available P/E ratios seemed to possess "information content" and may worth of investor's attention at the time of portfolio formation or revision[57].

Banz examined the relationship between the return and the total market value of NYSE common stocks by constructing size portfolios over the period 1931-1975. He found that small firms had, on average, higher risk-adjusted returns than the large firms. He calls this as "size effect" and suggests that it is probably not due to market inefficiency but it is rather evidence of a pricing model misspecification. To the extent that tests of market efficiency use data of firms of different sizes and are based on the

[54] John Y. Campbell and Robert Shiller, The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors, **Review of Financial Studies** 1, pp.195-228.

[55] Fama and French, p.12.

[56] Malkiel, p.65.

[57] S. Basu, Investment Performance of the Common Stocks in Relation to Their Price-Earning Ratios: A Test of the Efficient Market Hypothesis, **The Journal of Finance**, Vol. 32, No. 3, 1977, p.680-681.

CAPM, their results might be at least contaminated by the size effect. The results also considered that a stock's size can be taken as a valuable parameter to explain expected returns[58].

The small firm effect was analyzed by many studies suggesting that it may be due to low liquidity of small-firm stocks, large information costs, relatively larger transaction costs and improper measurement of risk for small-firm stocks.

Fama and French analyzed the "small firm effect" examining data from 1941 to 1990 and divided all stocks into deciles according to their size as measured by total capitalization. Decile one contained the smallest 10 percent of all stocks, while decile ten contained the largest stocks. The results presented evidence that the deciles made up of portfolios of smaller stocks were generated higher average monthly returns than deciles made up of larger stocks. The authors also argued that size and the ratio of the book value of common equity to its market value (BE/ME) were probably appropriate risk proxies in explaining the cross sectional variances of average stock returns. Furthermore, the book-to-market equity had a consistently stronger role in average returns than the size effect. An important conclusion of the study was that the relation between beta of CAPM and average return for the 50 years period studied was weak indicating that the model had no explanatory power for average stock returns[59].

5. Temporal Anomalies

Temporal anomalies are systematic tendencies of stock returns in particular times such as seasons, months or days of the year. Keim documented that almost fifty percent of the average magnitude of the "size effect" over the period 1963-1979 was due to January abnormal returns for shares of small firms[60]. A further study by Keim and Stambaug covering the period of 1927-1978 demonstrated that returns on small firm stocks and low grade bonds were higher in January than in the rest of the year concluding that seasonality should be a consideration in analyzing of changing expectations[61]. Lakonishok and Smith studied ninety years of daily data from 1897 to

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[58] Rolf W. Banz, The Relationship Between Return and Market Value of Common Stocks, **Journal of Financial Economics**, Vol.9, 3-18, North-Holland, 1981, pp.3-4.

[59] Eugene Fama and Kenneth French, The Cross-Section of Expected Stock Returns, **The Journal of Finance,** Vol.47, No.2, 1992, pp.427-428.

[60] Donald B. Keim , Size Related Anomalies and Stock Return Seasonality :Further Empirical Evidence, **Journal of Financial Economics,** 12, North-Holland, 1983, p.13.

[61] Donald B. Keim and Robert F. Stambaug, Predicting Returns in the Stock and Bond Market, **Rodney L. White Center for Financial Research, The Wharton School**, June 1985, p.26.

1986 on the Dow Jones Industrial Average and found evidence of persistently anomalous returns around the turn of the week, around the turn of the month, around the turn of the years and around holidays. They also found that the rate of return on Monday were usually substantially negative[62].

There is a general agreement in the literature that temporal anomalies constitute certain evidence against the EMH to some extent. According to Malkiel, the general problem with these predictable patterns or anomalies is that they are not dependable from period to period and some anomalies like "the January effect" tend to be disappeared soon after they were discovered[63].

6. Timing of Issuance of New Financing

According to the basic assumptions of the EMH, securities should always be correctly priced, and thus it should not be possible to price the new equities in favor of existing shareholders. Ibbotson documented that the stocks experienced zero abnormal returns in the five years period following their initial public offerings providing evidence in favor of this assumption. However, a more recent study has raised concerns against the assumption that stocks are correctly priced at the time of issuance. Loughran and Ritter presented evidence that the new equity issues and secondary public offerings significantly underperformed relative to non-issuing firms for five years after the offering date. This is considered an indication of the superior timing ability of the corporate managers. The authors suggest that the market appears to overweight the recent improvements in issuing firms reflecting the capitalization of transitory operating improvements. When the transitory nature of the operating performance becomes apparent the stocks underperform. The study also suggests that corporate insiders seem to be subject to the same misperceptions as of the market[64].

Fama suggests that the reason behind the underperformance of new issues are probably due to the fact that new issues tend to come after favorable recent events, but behave randomly in the months following the offering[65].

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[62] Josef Lakonishok and Seymour Smidh, Are Seasonal Anomalies Real? A Ninety-Year Perspective, **The Review of Financial Studies**, Vol.1, No.4, 1989, p.421.
[63] Malkiel, p.61.
[64] Tim Loughran and Jay R. Ritter, The New Issues Puzzle, **The Journal of Finance**, Vol. 50, No. 1, Mar., 1995, pp.46-47.
[65] Fama, Efficient Capital Markets: A Review of Theory and Empirical Work, p.409.

B. Semi-Strong Form Tests - Event Studies

Empirical tests for the semi-strong form of the EMH are related to the speed of adjustment of security prices to new information. The EMH assumes that security prices adjust quickly and fully to respond to new information. Therefore, event studies provide a direct test of market efficiency. The event should be unanticipated in order for the market to respond as suggested by market efficiency. Alternative reactions of stock prices to the arrival of new information are described in the chart below.

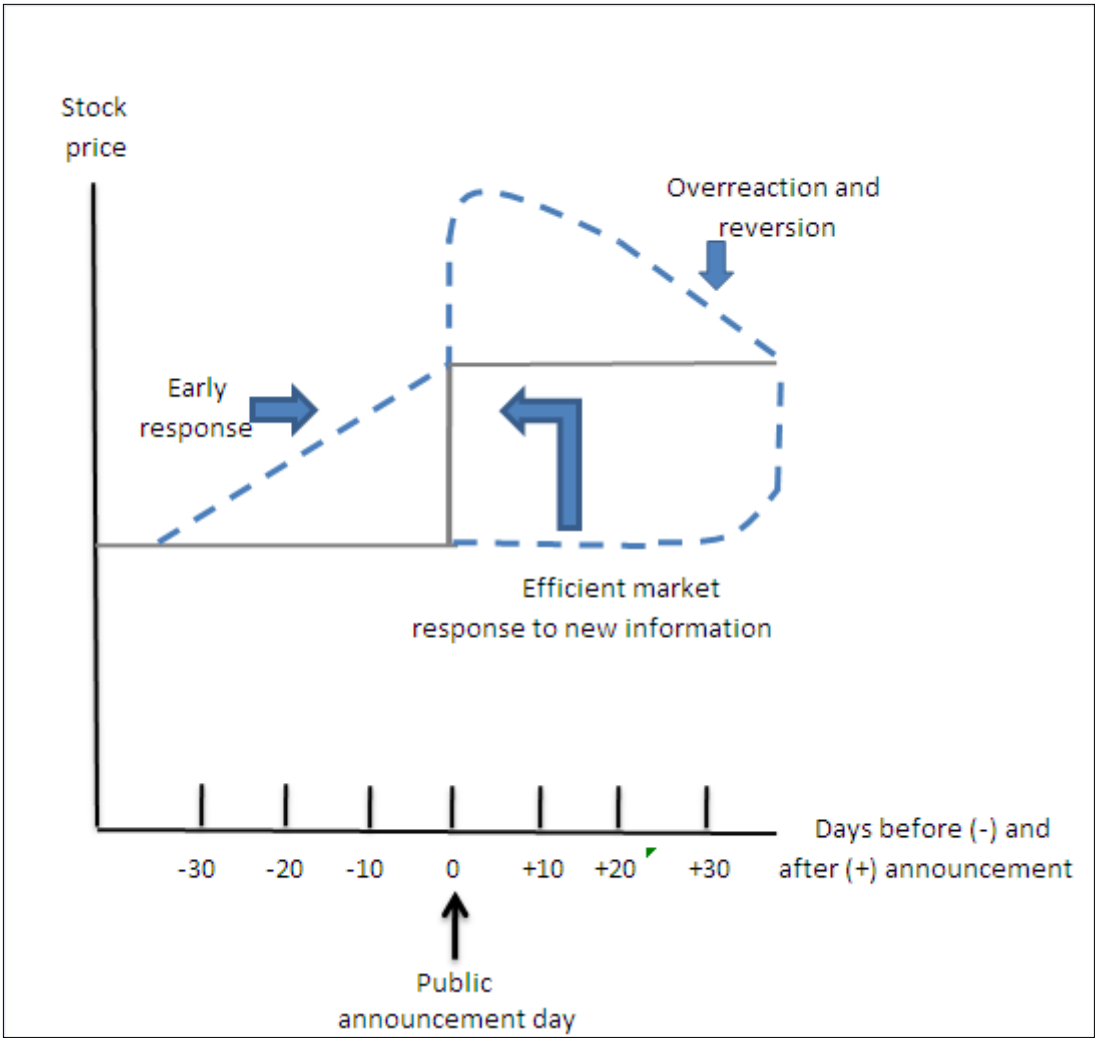

Figure 2: Reaction of Stock Prices to New Information
Source: Stephan A. Ross, Randolph W. Westerfield and Jeffrey Jaffe, Corporate Finance, The McGraw Hill Companies, 1996, p.337.

Efficient market response is that the price instantaneously adjusts to and fully reflects new information. Early response implies that the information is leaked and price responded before the public announcement. Overreaction implies that the price

overreacted to the new information. It is expected that a reversion would follow the initial overreaction.

Event study tests generally presented sufficient evidence for market efficiency; however, there is also indication that the news tends to leak out and be reflected in stock prices even before the official release of information.

The first event study was conducted by Fama, Fisher, Jensen and Roll on the effect of stock splits(*) occurred on the NYSE between 1927 and 1959. The authors examined the monthly returns on split securities to find evidence for "unusual" behavior of stock returns. The study had important conclusions. First, the market evaluated the stock splits as signals for future dividend increases. Second, the effects of stock split information were fully reflected into prices by the end of the split month (monthly data used in the study), but most probably almost immediately after the announcement meaning that the market responded efficiently. Third, the variances in returns on split shares increased substantially in the months around the split implying an increase in riskiness. And last, the highest average monthly rates of return occurred in the few months immediately preceding the split evidencing market's anticipation of substantial dividend increase which was not yet announced. Positive abnormal returns were observed before the stock split and around the time the split was announced, probably because firms tend to split in good times. After the split no further abnormal return observed. The study suggested that stock splits released information to the market as signals of future dividend increases[66].

Ball and Brown examined the effect of the earnings announcements publicized through annual income reports. They found that 85-90 per cent of the effect already captured before the announcements. It was evident that stock prices absorbed the news by more prompt sources like interim reports conveying information about earnings and adjustments made according to that market anticipation. The study concluded that the evidence was not in contradiction with the market efficiency,

[66] Fama et al., The Adjustment of Stock Prices to New Information, **International Economic Review**, Vol. 19, No. 1, February 1969, pp.1-3.

(*) The study concerns the information content of dividend changes. There is no suggestion that dividend policy affects the value of the firm.

however indicated that the market has turned to other data sources that can be acted upon more rapidly than annual reports of income[67].

Jensen and Ruback reviewed the merger and acquisitions literature to evaluate the market performance the bidder and acquiring firms. They stated that several studies showed indications of systematic reductions in the stock prices of bidding firms in the year following the event. The authors argued that these post event negative abnormal returns were inconsistent with market efficiency and suggested that changes in stock price during takeovers overestimated the future efficiency gains from mergers [68].

Agrawal et al. conducted a long run event study to evaluate the post-acquisition performance of acquiring firms by analyzing the mergers between NYSE firms by over 1955 to 1987. After adjusting for the firm size effect as well as beta risk, their results indicate that stockholders of acquiring firms experience a wealth loss of about 10% over five years after the merger completion date. The results of the study indicated that the market adjustment to the merger event was slow which is considered inconsistent with market efficiency. The study concludes that that the efficient-market anomaly of negative post-merger performance emphasized in the 1983 study of Jensen and Ruback is not resolved.[69].

Fama considers that event studies are powerful tools to test the EMH since the announcements of an event can be determined specifically and daily data allows precise measurement of the speed of the stock price responses. He also points out that the joint-hypothesis problem that market efficiency must be tested jointly with an asset-pricing model is reduced or eliminated through employing daily data in event studies. Thus, when the stock-price response to an event is large and concentrated in a few days, the model applied to estimate the daily expected returns (normal returns) in calculating abnormal returns has little effect on inferences. On the other hand, increased variances of returns around event dates are still an unsolved problem that is common in event studies. However, it is not possible to say what level of the residual

[67] Ray Ball and Philip Brown, An Empirical Evaluation of Accounting Income Numbers, **Journal of Accounting Research**, 1968, pp.166-167.

[68] Michael C. Jensen and Richard S. Ruback, The Market for Corporate Control: The Scientific Evidence, **Journal of Financial Economics**, Vol.11, 1983, p.20.

[69] Anup Agrawal, et al., The Performance of Post-Merger Acquiring Firms: A Re-examination of an Anomaly, **The Journal of Finance**, Vol. 47, No. 4, 1992, pp.1608-1618.

variance is rational since event studies focus on the average adjustment of prices to information. Similarly, the post-announcement drift (delayed stock-price responses) in abnormal returns in response of stock prices to earnings announcement may indicate market inefficiency; however that was strongest for small firms reflecting the sharp changes in earnings of those firms. Fama emphasizes that despite these unresolved issues, the results of event studies are the cleanest evidences on market efficiency and the effects of the joint-hypothesis problem in event studies were minimal[70].

C. Strong Form Tests - Private Information

Strong-form tests are concerned with whether certain individuals or groups have monopolistic access to any information that can be used to gain excess return. Fama identifies three groups that are supposed to have access to special knowledge relevant in price formation; (i) corporate managers and specialists, (ii) security analysts and (iii) professional portfolio managers. Empirical studies indicated that corporate insiders and specialists are the only groups who have monopolistic access to relevant information.

The study of Jensen on the performance of 115 open-end mutual funds over the ten year period from 1955 to 1964 showed that mutual fund managers don't have any special knowledge or information which allows them to earn returns above the market return. Those funds were on average not able to outperform a "buy the market and hold" policy. Among them only 5 percent demonstrated significantly better performance, and the explanation for their success, as Jensen stated, was "*merely because of random chance*"[71].

Bagehot classifies investors in three groups: "*one, transactors possessing special information; two, "liquidity-motivated" transactors who have no special information but merely want to convert securities into cash or cash into securities; three, transactors acting on information which they believe has not yet been fully discounted in the market price but which in fact has*". He argues that the stock market game is a poor game in which informed investors always gain against liquidity motivated investors and against investors who does not have special information.

[70] Fama, Efficient Capital Markets: II, pp.1600-1602.

[71] Jensen, p. 415.

Trading based on purely random selection rules will result neutral performance which is considered as market gain[72].

Kyle constructed a price formation model of insider trading. The model has three kinds of traders: a single risk neutral insider, random noise traders, and competitive risk neutral market makers. Market makers trade with everyone and earn on average zero profits. The insider makes positive profits by exploiting his monopoly power and noise traders provide camouflage for his trading from market makers which enables the insider to make profits at their expense. The study suggests that the strategic exercise of monopoly power by an insider is in no way inconsistent with prices being set efficiently in the semi-strong sense[73].

Jaffe analyzed the profitability of insider trading by examining the information in the Official Summary of Insider Trading (*) in the period 1962-68 for a sample of 200 large firms to find evidence with respect to the profitability of insider trading. The results indicated that insiders do possess special information and trading on inside information was widespread suggesting that insiders violate security regulations. Among the three samples constructed for 1, 2 and 8-month holding periods, only the intensive trading samples (samples with certain number of more purchasers than sellers in a month) with 8-month holding periods were earning statistically large returns, with transaction costs accounting for approximately 40 percent of the gross profits in these samples. The conclusion of the study is that the evidence was not significant that trading on insider information can consistently outperform a naive buy and hold model[74].

Seyhun investigated the profitability of insider trading and availability of abnormal profits to outsiders who imitate insiders by following the Official Summary of Insider Trading. He examined around 60,000 insider sale and purchase transactions from 1975 to 1981 and found that during the 100 days following the insider trading day, stock prices rose abnormally by 3.0% for purchases and declined abnormally by 1.7% for sales. This suggests that insiders purchase stock prior to the release of favorable

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[72] Bagehot, p.13.

[73] Albert S. Kyle, Continuous Auctions and Insider Trading, **Econometrica**, Vol.53, No.6, November 1985, pp.1315-1316.

[74] Jeffrey F Jaffe, Special Information and Insider Trading, **The Journal of Business**, Vol.47. July 1974, pp.421- 427.

(*) The official publication of the U. S. Securities and Exchange Commission that contains information on the stock exchange transactions of corporate insiders.

information and sell stock prior to the release of unfavorable information. The study also suggested that the abnormal return to outsiders net of the bid-ask spread plus the commission fee is negative. Outside investors cannot use the publicly available information about insiders' transactions to earn abnormal profits which constitutes evidence consistent with market efficiency[75].

Fama indicates that some security analysts have private information that results in small but statistically reliable price adjustments when revealed. He refers to the evidences presented about the performance of the recommended stock lists on the Value Line Investment Survey. The weekly periodical publishes rankings of 1700 common stocks into 5 groups in which Group 1 has the best return prospects and group 5 the worst. It was demonstrated that, adjusted for risk and size, group 1 stocks have higher average returns than group 5 stocks for horizons out to 1 year. The evidence indicates that the market is then less than fully efficient and there can be private information not fully reflected in prices. Fama states that the findings are consistent with the "noisy rational expectations model" of Grossman and Stiglitz because information generating has costs, thus informed investors need to be compensated for the costs they incur[76].

[75] Nejat H. Seyhun, Insiders' Profits, Costs of Trading and Market Efficiency, **Journal of Financial Economics**, No. 16, 1986, pp.207-211.

[76] Fama, "Efficient Capital Markets: II", p.1604.

CHAPTER TWO

EVENT STUDIES IN ECONOMICS AND FINANCE

This chapter focuses on design and statistical properties of event studies. Event studies in economics and finance are used to measure the effect of particular new information on the value of the related financial asset. Event studies examine the behavior of stock prices around corporate events and provide evidence on the effect of those events on the wealth of the security holders. The security is usually a common stock, although there are some studies concerning preferred shares or debt. The aim is to detect the presence of an abnormal return due to that specific event which is described as an unusual performance of a particular stock in a particular day or period.

Event studies focusing on announcement effects provide a direct test of market efficiency. A quick and full adjustment of stock prices in response to the announcement would be consistent with market efficiency. It is important that event in concern should not be anticipated in order for measuring correctly the sign and magnitude of its effect. It is also important to perceive that there may be some other news coming to the market at about same time which may also have an impact on the stock price in concern. In this case, certain procedures need to be applied to measure the effect of the event observed correctly. It is also crucially important to select an appropriate model to measure normal returns.

I. EVENT STUDY LITERATURE

According to MacKinlay the first event study published by James Dolley in 1933 in which he examined the price effects of stock splits[77]. Several improvements were developed in the following years including the removing of the general stock market returns from abnormal returns and separating out confounding effects. The essential event study methodology was introduced in the late 60s, by Ball and Brown (1968), Beaver (1968), and Fama, Fisher, Jensen and Roll (1969). Ball and Brown examined the effect of annual income report announcements on stock prices. Beaver studied the information content of earnings examining the volume and price movements of common stocks in the weeks surrounding the announcement date.

[77] A. Craig MacKinlay, Event Studies in Economics and Finance, **Journal of Economic Literature**, Vol.35, March 1997, p.13.

Fama et al. studied the information effect of the stock splits on the behavior of security returns[78].

Following these seminal studies several modifications and adjustments relating to statistical assumptions and complications suggested by researchers. Brown and Warner examined various methodologies in a simulated event study by random selection of securities and random assignment of an event date to each of them. They used monthly returns and concluded that a simple methodology based on market model performed well. The authors extended their work conducting a similar event study, this time using daily return data. In the study, they examined the effects of daily returns data and the methodology, and specified the potential problems in using of daily data in event studies such as non-normality of returns and excess returns, autocorrelation and variance increases in the event period[79].

There is a large literature for the choice of statistical tests applied to make inferences on event study results. Although, it is common to use parametric tests several authors also suggest the use of nonparametric tests since it is highly possible that normality assumption does not hold and results more frequent rejection of the null hypothesis. Brown and Warner examined the use of nonparametric tests versus parametric tests both with monthly and daily data and concluded that standard parametric tests are well specified. However, Corrado and Zivney argued that the nonparametric tests were better specified under the null hypothesis and often more powerful under the alternative hypothesis than a t-test [80].

Detailed reviews are provided afterwards by MacKinley (1997) and Binder (1998) and several modifications have been suggested by a number of studies. Generally, these modifications handle biases that arise from the violation of statistical assumptions used in the standard methods to calculate and test the significance of abnormal returns.

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[78] Ball and Brown, An Empirical Evaluation of Accounting Income Numbers.
William H. Beaver, The Information Content of Annual Earning Announcements, **Empirical Research in Accounting, Selected Studies**, 1968.
Fama et al., The Adjustment of Stock Prices to New Information.

[79] Stephen J. Brown and Jerold B. Warner, Measuring Security Price Performance, **Journal of Financial Economics,** 1980,
- Using Daily Returns; The Case of Event Studies, **Journal of Financial Economics,** 1985.

[80] Charles J. Corrado and Terry L. Zivney, The Specification and Power of the Sign Test in Event Study Hypothesis Tests Using Daily Stock Returns, **The Journal of Financial and Quantitative Analysis**, Vol. 27, No. 3, Sep., 1992.

Kothari and Warner surveyed five leading journals to determine the number of event studies published for the years 1974 through 2000. The total number of papers reporting event study results was 565 of which approximately 200 were long horizon studies with an event window length of 12 months or more. The authors stated that "*the basic format of event studies is still based on the classic stock split event study of Fama, Fisher, Jensen, and Roll (1969). The key focus is still on measuring the sample securities' mean and cumulative mean abnormal return around the time of an event".* An important change in methodology was the common use of daily data rather than monthly security return data[81].

Event studies can be classified as methodology papers and market efficiency tests. The main studies for the latter were reviewed in the previous chapter and we will evaluate the essential methodology below.

II. METHODOLOGY OF EVENT STUDIES

The methodology papers on event study techniques are numerous. In this respect, we consider that it is preferable to have a solid framework on which the statistical suggestions and modifications for various complications can be built upon in order for a comprehensive presentation. The framework described below is mainly based upon the works of Brown and Warner (1980 and 1985), Campbell, Lo, and MacKinlay (1997) and Binder (1969)[82]. We have incorporated essential discussions and contributions into relevant sections of the text. The properties of the event study tests and how these properties depend on variables such as security volatility, sample size, horizon length, and the process generating abnormal returns will be presented together with the basic methodology.

[81] S. B. Kothari and Jerold B. Warner, Econometrics of Event Studies, In **Handbook of Corporate Finance: Empirical Corporate Finance**, Elsevier /North-Holland, Ch. 1, 2006, pp.6-7.

[82] Brown and Warner, Measuring Security Price Performance.

Campbell et al., **Econometrics of Financial Markets**, **Chapter 4.**

John J. Binder, The Event Study Methodology Since 1969, **Review of Quantitative Finance and Accounting**, Kluwer Academic Publishers, Boston, No.11, 1998.

A. Structure

The main steps in measuring the impact of the event is first to compute the coefficients in the estimation period, then to compute variance/covariance information for a period, aggregate across firms and lastly make inferences about average effect. The structure of an event study can be described in steps as follows:

- Definition of the event and determining the selection criteria: The initial task is to define the event of interest. The selection criteria need to be established for the inclusion of firms in the sample. The criteria may involve certain restrictions such as size, industry representation and data availability. It is important to notice that any potential bias can be introduced through sample selection.

- Estimation procedure: This step involves identifying the event date and determining the relevant period in which the event will be examined to see if anything unusual happened. The event might take place at different points in time or it might be clustered at a particular date (for example, an event affecting an industry or a subset of the sample firms).

- Measuring and analyzing abnormal returns: The impact of event can be measured first determining the normal return and then measuring the abnormal return on the basis of this “normal return”. The normal return is defined as the return that would be expected if the event did not take place. The abnormal returns for individual firms are calculated by applying the parameter estimates obtained from the normal model to the returns gained during the event period.

- Testing procedure: Testing requires the definition of the null hypothesis and aggregating the abnormal returns across firms and across time. Whether the abnormal returns are significant is determined according to the resulting test statistics. It is almost a standard to test the hypothesis by applying nonparametric tests together with t-test or standardized z-test.

- Interpretation of results: It is expected that the empirical analysis will lead to indications about how and to what extent the event affected security prices. It is necessary to examine the periods before and after the event takes place to infer implications of market efficiency.

B. Models for Estimating Normal Returns

A security's price performance can only be considered 'abnormal' relative to a particular benchmark. Thus, it is necessary to specify a model generating normal returns before abnormal returns can be measured.

The normal return is defined as the expected return without conditioning on the event taking place. For firm j and event day τ the abnormal return is calculated as below.

$$\mathbf{AR_{j\tau} = R_{j\tau} - E\,(R_{j\tau} \mid X_{\tau})}$$

Where $AR_{j\tau}$ is the abnormal return,
$R_{j\tau}$ is the actual return,
$E\,(R_{j\tau} \mid X_{\tau})$ is the normal return (or predicted return) and,
X_{τ} is the conditioning information for the normal model.

A number of expected return models have been used in event studies. All models require statistical assumptions and some of them also add economic arguments. The mean adjusted and market adjusted return models are statistical models whereas risk adjusted models are economic models. For each model, the abnormal return for a given security in any time period is defined as the difference between its actual ex post return and the predicted return under the assumed return-generating process. Across alternative methods, both the bias and precision of the expected return measure may differ, affecting the properties of the abnormal return measures.

Brown and Warner examined the performance measures based on the alternative three normal return generating models. In their simulated experiment, they constructed 250 samples, each containing randomly selected 50 securities and generated a hypothetical event month for each security in order to test the capability of detecting the Type I and Type II errors for each methodology. First, they tested the null hypothesis of "no abnormal performance" when there is no abnormal performance. In this case, the rejection of the null hypothesis when it is true would result a Type I error. Subsequently, a certain level of abnormal performance was introduced into every sample security and the null hypothesis of "no abnormal performance" tested again. In this case, the rejection of the null hypothesis when it is true would result a Type II error.

The conclusion of the analysis was that all three methodologies performed almost equally well to detect abnormal performance. With 5% abnormal performance, all three models were able to detect the abnormal return 100 percent of time in the 5% level of significance. Interestingly, the mean adjusted model, which is the simplest, performed slightly better with 1% abnormal performance both on 1% and 5% significant levels. The study suggested that the essential criterion in selection a model for normal return is the explanatory power, rather than including several parameters[83].

1. Mean Adjusted Return Model

The mean adjusted return model assumes that the ex ante expected return for a given security is equal to its mean return plus a disturbance term. In this model, a firm is expected to generate the same return averaged during the estimation period if the event didn't occur.

$$\mathbf{R_{j\tau} = \mu + \varepsilon_{j\tau}}$$

Where $R_{j\tau}$ is the return in period τ,
μ is the mean return,
$\varepsilon_{j\tau}$ is the disturbance term with $E(\varepsilon_{j\tau}) = 0$, $var(\varepsilon_{j\tau}) = \varepsilon_{j\tau}^2$

The mean adjusted returns are calculated by subtracting the normal return from the actual return during the event period. Compared to other models, this approach is the simplest because only one parameter is used and no market returns are required. In this model, the abnormal return estimator contains greater variances than market model disturbances since the market return is not controlled.

2. Market Model

The market model assumes a linear relationship between the return of the overall market portfolio and the return of individual stock. In applying the model, statistical parameters are estimated during the estimation window with ordinary least square regression. Then, the abnormal returns are calculated by employing these parameter estimates to the event period stock returns and market portfolio returns. It is essential that a proper market proxy for market portfolio is used.

[83] Brown and Warner, Measuring Security Price Performance, pp.214-216.

$$\mathbf{R_{j\tau} = \alpha_j + \beta_j R_{mt} + \varepsilon_{j\tau}}$$

Where $R_{j\tau}$ is the normal return,
α_j and β_j are the parameters of the model,
$R_{m\tau}$ is the market portfolio return in periodτ,
$\varepsilon_{j\tau}$ is the disturbance term with $E(\varepsilon_{j\tau}) = 0$, $var(\varepsilon_{j\tau}) = \varepsilon_{j\tau}^2$

Market model represents a potential improvement over constant mean return model because it controls for the risk of the stock and the variation of the market. This is normally expected to increase the ability to detect the effect of the event. However, as Campbell et al. pointed out the benefit from using a market model would depend on the R^2 of the regression. A higher R^2 would mean a greater variance reduction of the abnormal return which increases the explanatory power of the model[84].

The market beta of the security used in the event period is the parameter estimated during the pre-event period. Therefore, this may lead to incorrect estimation of the abnormal return if there is a steep change in beta during the event period. In this case, a beta coefficient can be estimated from data following the event period can be used[85].

3. Market Adjusted Return Model

In market models the return of any given security relates to the return of the market portfolio. The market adjusted return model is a restricted market model with α_j constrained to be zero and β_j constrained to be one.

$$\mathbf{R_{j\tau} = R_{m\tau} + \varepsilon_{j\tau}}$$

Where $R_{j\tau}$ is the return in period τ,
$R_{m\tau}$ is the period τ market portfolio return,
$\varepsilon_{j\tau}$ is the disturbance term with $E(\varepsilon_{j\tau}) = 0$, $var(\varepsilon_{j\tau}) = \varepsilon_{j\tau}^2$

The market adjusted return is calculated by subtracting the market return ($R_{m\tau}$) from the stock return ($R_{j\tau}$). This model is simpler than estimating market model abnormal returns since there is no need to estimate statistical parameters.

[84] Campbell et al., p.155.
[85] Binder, p.118.

This model is also applied in situations with limited data. For some events it is not possible to have a pre-event estimation period (for example, initial public offerings), then a market-adjusted abnormal return is used.

4. Capital Asset Pricing Model and Arbitrage Pricing Model

The CAPM is an economic model with imposing restrictions on the statistical models. When the CAPM is used as a benchmark model of normal return the intercept in the market model return becomes as shown below.

$$\mathbf{R_{j\tau} = R_{f\tau} + \beta(R_{m\tau} - R_{f\tau})}$$

Where $R_{f\tau}$ is the riskless interest rate (*)

$$\mathbf{\alpha_j = (1 - \beta_j) R_{f\tau}}$$

Where α_j is the parameter in the market model.

The CAPM has been used widely in the estimation of normal return in the 1970s. However, the evidences presented for the existence of anomalies raised questions on the validity of restrictions imposed on mean returns by the CAPM. Since these restrictions can be released in the market model, the CAPM is no longer used in event studies[86].

In the APT, the expected return is a linear combination of multiple risk factors. This model behaves like a market factor model and additional variables add relatively little explanatory power. Brown and Weinstein examined the multifactor models and suggested that market model may perform better in practice. Besides, the factors beyond market indicators may have little explanatory power and adding more factors introduces more complication[87]. The multifactor models, including the APT, can estimate abnormal return well only with the correct estimation of the factor betas. Fama and French suggested that a properly chosen APT model can be used in event studies; however the implementation of the study becomes more complicated[88].

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[86] Campbell et al., p.156.

[87] Stephen J. Brown and Mark Weinstein, Derived Factors in Event Studies, **Journal of Financial Economics**, September 1980.

[88] Eugene Fama and Kenneth French, Multifactor Explanation of Asset Pricing Anomalies, **The Journal of Finance**, March 1996.

(*) Black CAPM model uses the expected return on zero beta portfolio instead of the riskless rate in the Sharpe-Lintner model.

5. Control Portfolio Returns

In the control portfolio model, the returns of the test portfolio are compared with a control portfolio and the abnormal return for each security is measured as its actual return minus the return on a portfolio with the same risk in that period. The companies in the control portfolio should be similar to the sample firms except for the absence of news about the firms in the control portfolio. They might be in the same industry as the sample firms or they might be of the estimated risk value (beta)[89].

Brown and Warner discuss a particular type of control portfolio where sample firms are assembled into unit-beta portfolios, i.e., portfolios with betas of one. Regardless of the risk level of each sample security, the portfolio thus formed should have the same risk as the market portfolio. The abnormal return is the difference between the return this control portfolio and the average return on the market portfolio during the time sample securities experience the event. The study indicates that the control portfolio method performs noticeably worse, relative to both itself and to the other methods, when beta departs from one toward either direction[90].

The control portfolio approach is not limited to matching betas to the market. It is also possible to use industry indexes as proxies for the return on control portfolios. Both these approaches assume that a one factor model (with the market portfolio return as the factor) determines expected returns.

C. MEASUREMENT AND STATISTICAL ANALYSIS

In this section, we will first present the standard procedures to calculate the abnormal return during event period for individual firms. Then we will review methods for aggregating abnormal returns both across firms and across time. The issues related to data, constructing of the sample, statistical parameters, and assumptions of the regression model will be reviewed along with the solutions proposed by relevant studies. We will also present the essential nonparametric tests that are commonly used in event studies and discuss their usefulness to increase the power of the analysis.

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[89] Binder, p.120.

[90] Brown and Warner, Measuring Security Price Performance, p.223.

1. Calculation of the Abnormal Return and Aggregating

The aim of an event study is to draw general inferences on the behavior of prices during the event period. For this purpose, the abnormal returns during the event period need to be calculated for each firm; subsequently individual observations must be aggregated across firms. The aggregation across time is also necessary if the event window comprises multiple periods.

The abnormal return is the difference between the observed return and the predicted return. Following the selection of the model, the parameters that would be used to calculate the abnormal returns are estimated from the normal performance model.

In the market model, the abnormal return for the individual firm j on day τ is defined as follows:

$$AR_{j\tau} = R_{j\tau} - (\ _j + \ _jR_{mt}) = \varepsilon_{j\tau}$$

The next step is aggregation across securities and across time. One alternative is first to carry out the cross sectional aggregation to calculate the mean abnormal return. This is simply aggregating and averaging the abnormal returns for all firms in the sample on a given day. In the case that event window is consist of one period and the Cumulative Abnormal Return (CAR) is the test statistic.

$$CAR_{j\tau} = \frac{1}{N}\sum_{N=1}^{N} AR_{j\tau}$$

Where CAR is the cumulative mean abnormal return,
τ is the event period,
N is the number of securities,
$AR_{j\tau}$ is the abnormal return for each security j.

It is most likely that the effects of the event will extend more than one period. The periods are time intervals that are generally days, weeks or months. In the event studies that uses daily stock returns, the period of interest is often extended to multiple days, including at least the announcement day and the day after. The periods prior to

and after the event may also be included in the event period. In this case, it is preferable firstly to aggregate across time for an individual security to calculate CAR and then aggregate CARs across firms.

$$CAR_j\ (\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_j\ (\tau_1,\tau_2)$$

Where CAR is the cumulative abnormal return for security j,
(τ_1,τ_2) is the multiple event period between time τ_1 and τ_2,
$AR_j\ (\tau_1,\tau_2)$ is the abnormal return for the security j in the multiple event period.

After calculating CARs for individual securities, the cross section aggregation is carried over to obtain Cumulative Average Abnormal Return (CAAR). In this case, the CAAR is the sum of all of the abnormal returns from τ_1 to τ_2 and it is the test statistic.

$$CAAR\ (\tau_1,\tau_2) = \frac{1}{N} \sum_{\tau=\tau_1}^{\tau_2} CAR_j\ (\tau_1,\tau_2)$$

.

Where CAAR is the cumulative cross sectional average abnormal return,
N is the number of securities,
$CAR_{j\tau\ i}\ (\tau_1,\tau_2)$ is the cumulative abnormal return for the security j in the period from τ_1 to τ_2.

In aggregating abnormal returns across firms, it is possible that cross correlation occurs between error terms. In our study, the event periods are different across firms and we used larger time intervals, thus we assume that the disturbances within event periods are uncorrelated. Thomson suggested proceeding in steps as a general solution to this problem. First, for any firms that share event periods, estimating parameters and variance measures using portfolio aggregation and time-series portfolio regression, then averaging in cross-section all of the non-overlapping firms[91].

[91] Thomson, p.166.

2. Standardization

The variance increase during the event period and its implications has been emphasized by many studies. Brown and Warner stated that the most obvious implication of a variance increase is that standard procedures using a time-series of non-event period data to estimate the variance may cause too many rejections of the null hypothesis that the mean excess return is equal to zero. Their study indicated that additional procedures may increase the power of event study inferences by reducing the unexplained component of returns due to variance increases[92].

Standardization of abnormal returns is suggested as a modification to the basic approach to accommodate the possibility of variance increases. The purpose of standardization is to ensure that each abnormal return will have the same variance. This is applied by dividing each firm's abnormal residual by its standard deviation obtained over the estimation period that results each residual has an estimated variance of one. Beaver studied the earning announcements of the NYSE firms and indicated that the variance of the residuals during the event period was not equal to the variance during the nonevent period and this was a violation of the assumptions of the classical regression model. He suggested that the residuals should be squared and divided by the variance of the residuals calculated during the nonevent period inducing a constant level of abnormal performance[93]. Patell carried out a similar study in which he analyzed the stock price behaviors in response to annual earnings forecasts disclosed by NYSE firms during the years 1963-1968. His study outlined the procedures of standardizing residuals using the variance calculated over the estimation period[94].

The standardized abnormal returns are calculated as below:

$$SAR_{j\tau} = \frac{AR_{j\tau}}{s\,(AR_{j\tau})}$$

Where $SAR_{j\tau}$ is the standardized abnormal return for security *j*,

[92] Brown and Warner, Using Daily Returns; The Case of Event Studies, pp.22-24.

[93] William H. Beaver, The Information Content of Annual Earnings Announcements, **Empirical Research in Accounting, Selected Studies**, 1968, pp.80-81.

[94] James M. Patell, Corporate Forecasts of Earnings per Share and Stock Price Behavior: Empirical Tests, **Journal of Accounting Research**, Autumn 1976, pp.256-259.

$AR_{j\tau}$ is the abnormal return in the event period,

$s(AR_{j\tau})$ is the standard deviation of the abnormal returns calculated over the estimation period.

The test statistic is given by:

$$z = \frac{\frac{1}{N}\sum SAR_{j\tau}}{s(\overline{SAR_{j\tau}})}$$

Where SAR is the standardized abnormal return each security *j*,

N_τ is the number of firms included in the sample,

$s(\overline{SAR_{j\tau}})$ is the standard deviation of the average SARs.

Considering independence across firms and assuming that $AR_{j\tau}$ and $SARj\tau$ are normally distributed the standard error of the average standardized residuals is given by:

$$s(\overline{SAR}) = 1/\sqrt{N}$$

And the test statistic becomes:

$$z = 1/\sqrt{N} \sum SAR_{j\tau}$$

3. Definition of Hypothesis and Testing Procedure

Our aim is to search whether the cross sectional distribution of returns at the time of an event is abnormal presenting systematically difference from predicted returns. This is equivalent comparing the distributions of actual returns with the distribution of predicted returns and investigating whether the distributions are the same. In the event study literature, the focus almost always is on the mean of the distribution of abnormal returns. Therefore, the null hypothesis to be tested is whether the mean abnormal return at time *t* is equal to zero. The null hypothesis is rejected if the test statistic exceeds a critical value, generally corresponding to the 5% or 1% tail region.

The standard approach to testing hypothesis is the statistical t-test. A t- test is used when testing the mean value of one or two groups. The aim is statistically test whether or not the mean of the sample is significantly different from zero, i.e. if the abnormal returns are significant.

$$t = \frac{\overline{X} - \mu}{s_x / \sqrt{N}}$$

Where $\overline{X}$ is the sample mean,

μ is the mean of the population

s_x is the sample standard deviation,

N is the sample size (number of securities in the sample),

An alternative would be to apply a test using standardized abnormal returns as explained above. As indicated by Brown and Warmer, a test using standardized abnormal returns can provide more robust results under certain conditions, however empirically in short-horizon event studies it typically makes little difference and the t-tests on data transformed to approximate independently and identically distributed returns yields test statistics well conformed to its theoretical distribution.

4. Non-parametric Tests

Several studies have presented evidence that distributions of daily returns are fat tailed and skewed to the right. This constitutes a violation of the assumption of normality resulting that parametric tests reject too often when testing for positive abnormal performance. Non-parametric tests are well-specified and more powerful at detecting a false null hypothesis of no abnormal returns. The most common non-parametric tests are the sign test and the Wilcoxon rank test.

Brown and Warner argue that the non-normality of daily returns has no obvious impact on event study methodologies. Although daily excess returns are also highly non-normal, there is evidence that the mean excess return in a cross-section of securities converges to normality as the number of sample securities increases. Standard parametric tests for significance of the mean excess return are well-specified[95].

Corrado and Zivney evaluated the performance of the sign test compared with a parametric t-test and a nonparametric rank test by simulating an experiment as in the Brown and Warner study. The sign test statistic examined in the study does not require

[95] Brown and Warner, Using Daily Returns; The Case of Event Studies, p.25.

a symmetrical distribution of security excess returns for correct specification. Simulations with daily security return data showed that the sign test is better specified under the null hypothesis and often more powerful under the alternative hypothesis than t-test. When abnormal performance was present, sign test power was greater than that of a t-test in detecting 0.5-percent abnormal performance, but less than that of a t-test in detecting 1-percent abnormal performance. The rank test was more powerful than both the sign test and the t-test in detecting both 0.5-percent and 1-percent abnormal performance. Their results suggested that the rank test is preferable to the sign test in obtaining nonparametric inferences concerning abnormal security price performance in event studies[96].

Campbell and Wasley evaluated the performance of alternative test statistics in event studies that included NASDAQ daily security returns. The study indicated that both portfolio and standardized test statistics were misspecified due to substantial degree of non-normality in the daily returns. In particular, the commonly-used standardized test statistic rejected the null hypothesis too often in the absence of abnormal performance. They concluded that the rank statistic was the most powerful test statistic overall in NASDAQ samples[97].

Cowan examined the nonparametric tests and proposed to employ the generalized sign test rather than the sign test taking into account of a possible asymmetric return distribution under the null hypothesis. The generalized sign test compares the proportion of positive abnormal returns around an event to the proportion from a period unaffected by the event. However, the sign test judges the proportion of positive and negative abnormal returns against an assumed 50 percent split under the null hypothesis of no reaction to the event. The study indicated that, the rank test performs better than the generalized sign test under ideal conditions, nevertheless the generalized sign test was more powerful than the rank test under the conditions of lengthy event windows, increases in return variance, and in cases involved thin trading. He suggested that nonparametric tests were especially suitable for NASDAQ stocks because thin trading makes violations of parametric test assumptions more likely[98].

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[96] Corrado and Zivney, p.477.

[97] Cynthia J. Campbell and Charles E. Wasley, Measuring Security Price Performance Using Daily NASDAQ Returns, **Journal of Financial Economics**, North-Holland**,** Vol. 33, 1993, p.91.

[98] Arnold. R Cowan, Nonparametric Event Study Test, **Review of Quantitative Finance and Accounting**, No.2, Kluwer Academic Publishers, Boston, 1992, p.356

In our study we will use the sign test and the rank test that are often used together with parametric tests in event studies.

(a) Sign Test

The sign test is a simple binomial test of whether the frequency of positive abnormal residuals equals 50%. In order to run the sign test, we first determine the proportion of securities in the sample that should have positive abnormal returns under the null hypothesis of no abnormal performance. The value for the null hypothesis is estimated as the average proportion of stocks with positive abnormal returns in the estimation period. If abnormal returns are independent across securities, the number of positive values of abnormal returns has a binomial distribution with parameter p. The test statistic is calculated as shown below.

$$z = \frac{|p_0 - p|}{\sqrt{p(1-p)N}}$$

Where p_0 is the proportion of positive abnormal returns,
p is the assumed probability which is 0,5,
N is the sample size (number of securities in the sample),

(b) Wilcoxon Signed Rank Test

Rank test has the same null hypothesis as the sign test that median difference between two populations equals zero. However, this test considers both the sign and the magnitude of abnormal returns. These magnitudes are first ranked according to their absolute values, then each ranks is given either a (+) sign or a (-) sign. If the null hypothesis is true, we expect that the sum of those ranks with positive signs to be equal to the sum of those ranks with negative signs. The test statistic is given below;

$$z = \frac{T - E[T]}{\sigma_T}$$

$$E[T] = \frac{n(n+1)}{4} \qquad \sigma_T = \sqrt{\frac{n(n+1)(2n+1)}{24}}$$

Where T is the sum of the ranks with positive values,

E [T] is the mean of the population

α_T is the sample standard deviation,

n is the sample size (number of securities in the sample),

CHAPTER THREE

PRICE EFFECTS OF MERGER ANNOUNCEMENTS IN THE ISTANBUL STOCK EXCHANGE

The terms of merger, acquisition or takeover (M&A) are used in this study interchangeably indicating a sale of a significant percentage of shares of the firm concerned. The process generally starts with a declaration to the public that the firm has an intention to sell majority of its shares or it has a plan to form strategic partnerships with other firms. When a merger initiation is disclosed properly to the public through an official announcement, it is considered as an event whether or not the process has been successfully concluded.

The aim of the study is to measure the effects of announcements on the mean return around the time of the merger announcements in the ISE and test the results statistically for significance. It is widely accepted that event studies provide a direct test of market efficiency since given markets are efficient, newly announced information relevant to the company would be reflected into its share prices immediately. We expect that the arrival of the news would result an abnormal increase in the stock prices which can measured as the difference between the return conditional on the event and the expected return unconditional on the event. Our aim is to find evidence on whether or not the market responded to the news promptly as suggested by the EMH.

In this chapter, we will first describe the sample construction and data collection, then we will explain the process in determining the event window. The implementation procedure involves estimation of the parameters for normal return and calculation of the abnormal return by using those parameters. Test statistic is calculated through aggregation of abnormal returns across time and across securities. The final step is testing the null hypothesis that the sample securities' mean and cumulative mean abnormal return around the event period is zero.

I. DESIGN OF THE STUDY

In order to assess the full impact of the arrival of information it is necessary that the news has not been expected. If the market was expecting the news it would be very difficult to identify the correct event day and this would result the effects spread over a longer time interval. We have not taken into account any unconfirmed information for the possibility of a merger, nor have we included any subsequent announcements about ongoing merger negotiations. In cases of multiple announcements, we focused on solely the initial announcement with which the market was informed about the strong possibility of a takeover made by a firm for a possible takeover before the official announcement. We didn't also take into account whether or not the takeover process has been completed successfully since our aim is only to measure the unexpected effect of announcements on stock prices. On the other hand, the studies measuring the wealth effects of mergers naturally extends the period until the date when the takeover is finalized.

A. Construction of the Sample

1. Sample Selection

Our key focus is on measuring the sample securities' mean and cumulative mean abnormal return around the time of the merger announcement. In order for the test statistic to be unbiased, it is required to use a large sample of unrelated securities. In the case of smaller samples, more serious consideration should be given to event date clustering in calendar time.

A larger sample size is also important to detect abnormal returns when we have larger event periods extending to several days. With small samples, the measurement error in both mean returns and variances may be so large that it takes away any potential efficiency gains from more precise specification of the return generating process. Kothari stated that the power to detect abnormal performance decreases substantially as the length of event period extended and a larger sample size required. His study demonstrated that an abnormal return of 10% occurred entirely in one day can be detected 100% of the time through a sample comprised only six stocks. Nevertheless, if the same abnormal performance occurs over six months, a

sample size of 200 is required to detect the abnormal performance even 65% of the time[99].

In order for determining the merger announcements that would be included in the sample, we have examined the official disclosures of the companies listed on the ISE National Market. In this respect we have not taken into account any news, nor rumors that were not confirmed through a public disclosure by the company. We considered that the firms listed on other markets of the ISE were not eligible for the purpose of our study because they were all had very small daily volumes experiencing nonsyncronous trading.

There were cases that a company has made more than one merger initiations during the period examined. In this case, we have excluded the subsequent announcements in order for avoiding any possible confounding effects from the previous announcements.

When a merger initiative is announced, it is assumed that a sale of a majority of the shares is involved. There were two cases that resulted in sales of minority shares. In line with the general practice, AKBANK and GARANTI didn't mention in their official disclosures the percentage of shares involved in negotiations. In the end, 20% of AKBANK shares and 25.5% of GARANTI shares were sold to strategic investors. We included these two cases in the sample because the mergers were properly announced consistent with our definition of event.

In the study we have observed that 55 takeover announcements made by 53 companies. They are listed on the Appendix 1. However, we have recognized that 10 of those 55 cases were not qualified to be included in the sample mostly due to the existence of confounding effects during the estimation period as explained in the Appendix 2. The selection of this set of firms and the elimination of announcements with confounding announcements or missing information resulted in a data set of 45 firms.

The first merger announcement included in our sample occurred on the 23th April, 2000. We have not found any M&A activity before then besides a few

[99] Kothari and Warner, p.1.

unsuccessful tenders conducted under the privatization program. Our coverage goes until the end of the year 2008. Below is a summary of our research to construct the sample.

Table 1
Summary of the M&A Announcements (01.06.2001 - 31.12.2008)

Number of announcements examined	55
Number of exclusions	10
Number of announcements included in the sample	45
Number of companies included in the sample	53
Number of successful completions	38
Number of failures	15

It is important to note that there were 284 firms listed on the ISE Primary National Market as of 31st of December 2008. When we subtract the number of mutual funds that are not included in the market index, the number of firms goes down to 248 of which 53 of them were experienced a merger process during the observed period. This specifies that our sample composed of 53 firms included one fifth of all ISE National Market firms.

2. Data

The initial event studies used monthly security returns in their data (Ball and Brown and Fama et al.). Afterward, various measurement intervals were used, the most common ones being monthly, weekly and daily intervals.

Morse has examined the effects of monthly and daily data on the bias and efficiency of estimates of expected abnormal returns. The results of the study generally support the choice of a shorter measurement interval to detect information effects except for the case where there is uncertainty over the precise announcement

date of the information. Hence, the use of daily return data is preferred over monthly data except when there is uncertainty about the announcement date[100].

Brown and Warner conducted a simulation study to examine the effects of using daily stock returns in event studies on the power of analysis. The results indicated that event studies with daily returns perform at least as well in practice as those with monthly returns. That is, the potential problems with daily returns are unimportant or easily corrected in the standard event study and, when the event date is known, tests with daily data have a greater signal to noise ratio than those with monthly data[101].

Fama emphasized the usefulness of daily return data in testing of the EMH. The speed of adjustment is the central issue for market efficiency and the daily data allows precise measurement of the promptness of the stock price responses. Another powerful advantage of daily data is that they can diminish or eliminate the joint-hypothesis problem of the unavoidable testing of market efficiency jointly with an asset-pricing model[102].

We used daily closing stock prices, and we took the ISE 100 index as market proxy. The data is found in the daily bulletins on the web site of the ISE (*). In preparing the data suitable for our analysis, we have made all the necessary share price adjustments for capital increases and distribution of bonus shares.

B. Determining Time Line of the Study

The time line of an event study is essentially consists of the event and estimation windows. The event window is the period over which the security prices of the firms will be examined. The ability of the study to measure the effect of the event is significantly affected with the accurate determination of the event window and relevant periods. Therefore, the length of an event window is determined according to the characteristics of the event examined. In our case, we expect that the effect will take place in a few days. However, there might be same cases like insider trading events

[100] D. Morse, An Econometric Analysis of the Choice of Daily Versus Monthly Returns in Tests of Information Content, **Journal of Accounting Research**, Vol. 22, Autumn 1984, p.619.

[101] Brown and Warner, Using Daily Stock Returns; The Case of Event Studies, pp.4-5.

[102] Fama, Efficient Capital Markets: II, pp.1601-1602.

(*) http://www.ise.org/DailyBulletin/DailyBulletin.aspx

might be known to have occurred only sometime during a one-month window. In our study, we also employed a 46 day pre-event window over which we investigated the stock price movements to detect possible abnormal performance.

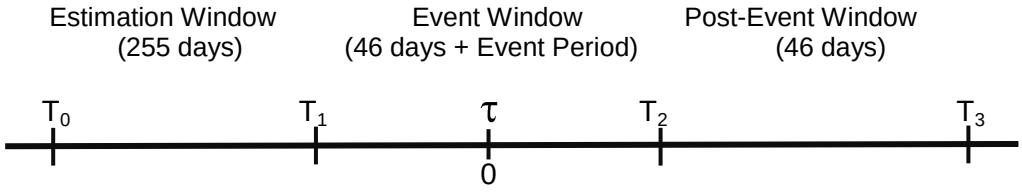
The table below presents the mathematical definitions of time periods that need to be defined in an event study. Returns are indexed in event time using τ as time indicator.

Table 2
Mathematical Definitions in an Event Study

Event Date	$\tau = 0$
Event Window	$\tau = T_1 + 1$ to $\tau = T_2$
Length of Event Window	$L_2 = T_2 - T_1$
Estimation Window	$\tau = T_0 + 1$ to $\tau = T_1$
Length of Estimation Window	$L_1 = T_1 - T_0$
Post-event Window	$\tau = T_2 + 1$ to $\tau = T_3$
Length of Post-event Window	$L_3 = T_3 - T_2$

Source: John Y. Campbell, Andrew W. Lo and A. Craig MacKinlay. **The Econometrics of Financial Markets**, Princeton University Press, 1997, pp.157 (Derived from the mathematical equations given in the text)

Defining $\tau=0$ as the event date, $\tau=T_1+1$ to $\tau=T_2$ represents the event window. Time line of the event study is shown below.



The event window is the period in which abnormal returns are investigated focusing on the days when the related information is released. The event period is the event day plus or minus some number of days, weeks or months that is used to calculate abnormal returns. The length of the event period may be one day or longer depending upon the perception of the market for the effect of event on the value of shares in concern.

The crucial point here is that the event day is not necessarily the official release date of the information. It is also likely that the market may have an access to that information before it is disclosed to public. Alternatively, it may take some time for the market to reflect its entire reaction on the share prices and turn back to its normal course. Therefore, in determining the length of the event window, we have observed the share prices by looking for unusually high or low returns, unusually high trading volume or unusually high fluctuations in price. It is possible that returning to a typical day may take only 2-3 days; however, it is also possible to use an event window as long as a year depending upon the event in concern.

The estimation window is used to calculate the ordinary least squares estimates of the market model parameter coefficients α_j and βj focusing on "normal" trading days. These estimates are used to define expected or normal returns for each firm during the event window. It is also important to distinguish between estimation and event windows, thus the estimation and event windows do not overlap in order to avoid potentially biasing parameter estimates. McKinlay proposes larger estimation windows to avoid additional variances due to the sampling error in α_j and βj which leads serial correlation of the abnormal returns. As the length of the estimation window becomes larger the additional variance component becomes zero and the abnormal return observations will become independent through time. McKinlay suggested a 250 trading day period prior to the event window and 41 day event window comprised of 20 pre-event days and 20 post-event days[103].

Brown and Warner used a maximum of 250 daily return observations for the period around its respective event, starting at day - 244 and ending at day + 5 relative to the event. The first 239 days in this period (- 244 through - 6) is designated the 'estimation period', and the following 11 days (- 5 through + 5) is designated the 'event period'[104]. Cowan suggested an estimation window of 255 trading days ending 46 days before the event date[105].

Examination of post-event returns provides information on market efficiency since systematically nonzero abnormal returns following an event are inconsistent with

[103] MacKinlay, Event Studies in Economics and Finance, pp.17- 21.

[104] Brown and Warner, Using Daily Stock Returns; The Case of Event Studies, p.6.

[105] Arnold R. Cowan, "Software for Event Studies User's Guide for Eventus® Version 7 March 2002 http://www.eventstudy.com/ p.5.

efficiency and imply a profitable trading rule. There is no specific time interval suggested for the length of post-event period and it can be determined according to the purposes of the research.

On the other hand, if accurate risk estimation for the parameters of OLS regression is difficult with historical estimates, those estimates can be calculated from post-event performance data. Kothari and Warner suggest that is crucial that abnormal-performance measurement be on the basis of post-event, not historical risk estimates, in long-horizon event studies[106].

According to the ISE rules, any material information that may affect the share prices should be sent to the ISE through a Disclosure Form in order to be announced in the ISE Daily Bulletin. In this regard, a firm whose shares may be subject to a takeover should disclose this information immediately. In such circumstances, the general practice is that that firms either give an authorization to the management or to an intermediary to implement negotiations. Any progress made in negotiations with prospective acquirers should also be disclosed instantaneously. The disclosures of firms are subsequently published in the web site of the ISE [(*)].

In order to determine the event day, we focused on the day of the official announcement. We also carefully examined the volume and price indicators mentioned above. In most cases the disclosures are sent to the ISE after the market has closed, thus the announcements are made on the following day. According to the ISE regulations, any information sent to the Exchange after 17:15 hrs shall be disseminated through electronic means on the following working day before the opening of the session.

Taking all the particulars into consideration we decided to use a three-day event period. We defined the official announcement date as the event day and the day before and after the event day included in the event period. For each security we used an estimation window of 255 days ending 46 days before the beginning of event day.

[106] Kothari and Warner, p.1.

(*) http://www.imkb.gov.tr/companynews/companynews.aspx

II. IMPLEMENTATION OF THE STUDY

In the implementation stage, we have calculated abnormal returns for each of the 45 firms included in our sample. Subsequently, we have aggregated the abnormal returns over time for each stock and also across firms and tested the CAAR for significance. Findings are presented as mean abnormal returns and mean cumulative abnormal returns expressed in percentages. We have also explored the data further in the pre-event window and post-event window to infer implications for the semi-strong form of market efficiency.

A. Estimating Parameters for Normal Return

It is generally accepted that the market model has an improvement potential in event studies since the variance of the abnormal return is reduced by removing the portion of the return that is related to the market. In our study, we have used the market model as a benchmark to estimate a firm's normal return. Besides, we have also applied market adjusted model which performed well as for our purposes.

The null hypothesis, H_0 is that, the event has no impact on the mean and variance properties of returns. Excess returns are measured by the difference between actual and expected stock returns. The expected stock return is measured conditional on the realized return on a market index calculated on out of sample basis. The essential application of the market model to calculate excess returns is given below.

$$\varepsilon_{j\tau} = R_{j\tau} - \alpha_j - \beta_j R_{m\tau}$$

Where $\varepsilon_{j\tau}$ is the abnormal return of the stock of the j^{th} firm on day τ,
$R_{j\tau}$ is the actual rate of return of the stock of the j^{th} firm on day τ,
$R_{m\tau}$ is the rate of return of the ISE 100 index on day τ,
β_j is a parameter that measures the sensitivity of R_{jt} to the ISE 100 index,
α_j is a constant.

We have calculated the parameters of normal return model for each firm running an OLS regression analysis using the SPSS 16.0.

In addition to the market model, we have also employed the market adjusted model to calculate the abnormal returns by applying the formula as below.

$$\varepsilon_{j\tau} = R_{j\tau} - R_{m\tau}$$

Where $\varepsilon_{j\tau}$ is the abnormal return of the stock of the j^{th} firm on day τ,
$R_{j\tau}$ is the actual rate of return of the stock of the j^{th} firm on day τ,
$R_{m\tau}$ is the rate of return of the ISE 100 index on day τ,

Although this model is considered simpler, both models performed well in detecting abnormal returns and we obtained almost identical results.

B. Aggregation Across Time and Across Securities

We first aggregated the abnormal returns occurred during the 3-day event period to obtain Cumulative Abnormal Returns for each security included in the sample.

$$CAR_j\ (\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_j\ (\tau_1,\tau_2)$$

Where CAR is the cumulative abnormal return for security j.
(τ_1,τ_2) is the multiple event period between time τ_1 and τ_2,
$AR_j(\tau_1,\tau_2)$ $_i$ is the abnormal return for the security j in the event period.

After calculating CARs for individual securities, the cross section aggregation is carried over to obtain cumulative average abnormal return (CAAR). In this case, the CAAR is the sum of all of the abnormal returns between time τ_1 to time τ_2 and it is the test statistic.

$$CAAR\ (\tau_1,\tau_2) = \frac{1}{N} \sum_{\tau=\tau_1}^{\tau_2} CAR_j\ (\tau_1,\tau_2)$$

Where CAAR is the cumulative cross sectional average abnormal return,

N is the number of securities,

$CAR_j\ (\tau_1,\tau_2)$ is the cumulative abnormal return for the security j in the period from τ_1 to τ_2.

The abnormal returns occurred in the 3-day event period are calculated by using the Market Model (Appendix.3). The Market Model is the benchmark model in our study with which we have carried out the testing procedure, However, we also implemented calculations according to Market Adjusted Model. The summary of our results is presented below.

Table: 3
Average Abnormal Returns in the 3-day Event Period

	Market Model	Market Adjusted Model
AR $_{t-1}$	1.71%	1.97%
AR $_{t\ 0}$	6.66%	6.33%
AR $_{t+1}$	4.83%	4.58%
CAAR$_{(\tau1,\tau2}$	13.20%	12,88%

The Cumulative Average Abnormal Returns occurred during the pre-event and post-event periods are calculated by employing both Market Model and Market Adjusted Model are presented in the Appendixes 4, 5, 6 and 7. We obtained similar results in both models. The time series of abnormal returns demonstrated that the CAAR started to increase particularly starting from day minus (-) 11 and positive gains accumulated until the event day where the biggest single day abnormal return occurred. The CAAR continued to increase moderately during the post-event period.

C. Statistics and Hypothesis Testing

According to semi-strong form of the EMH all public information is instantly and appropriately valued by the market and is reflected in share prices. In order to find evidence on the behavior of the market upon arrival of the "unexpected news" we have analyzed the effect of 45 merger announcements disclosed by 45 firms listed on the ISE. We calculated the mean cumulative abnormal return during the 3-day event window as 13.20% which was in line with our expectations.

The specific null hypothesis to be tested is whether the mean abnormal return between time τ_1 and τ_2 is equal to zero and the test statistic is the CAAR.

H_0 : CAAR(τ_1,τ_2) = 0 There is no significant abnormal return during the event period.

H_a : CAAR(τ_1,τ_2) ≠ 0 There is significant abnormal return during the event period.

We assume that the individual abnormal returns are independent and identically distributed. The formula to calculate the t-statistic is presented below.

$$t = \frac{CAAR}{s / \sqrt{N}}$$

Where CAAR is the Cumulative Average Abnormal Return (It is the same as $\overline{X} - \mu$ in the formula given before),

s is the sample standard deviation,

N is the sample size (number of securities in the sample).

The t-tests we have performed are one-tailed tests as a consequence of our assumption that the sign of the abnormal performance would be positive. As presented below, given the 3-day Cumulative Average Abnormal Return is 13.20%, the value of t-statistic is 8.2 and the null hypothesis that the event has no impact is strongly rejected.

The t-test conclusions are given below.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
AR.1	45	,0170733	,05129570	,00764671
AR.2	45	,0665889	,07488674	,01116346
AR.3	45	,0483533	,08332056	,01242070
CAAR	45	,1320022	,10767395	,01605109

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
AR.1	2,233	44	,031	,01707333	,0016624	,0324843
AR.2	5,965	44	,000	,06658889	,0440904	,0890874
AR.3	3,893	44	,000	,04835333	,0233211	,0733856
CAAR	8,224	44	,000	,13200222	,0996534	,1643511

D. Nonparametric Tests

1. Sign Test

In the sign test, the number of positive values of abnormal returns has a binomial distribution with parameter p. The null hypothesis is that the proportion of sample securities having positive abnormal performance is equal to 0.5; the alternative hypothesis for any particular level of abnormal performance is that the proportion of sample securities having positive performance measures is greater than 0.5.

H_0: p = 0.5. The two population distributions are identical.

H_a: p ≠ 0.5. The two population distributions are not identical and proportion of sample firms with abnormal return is greater than 50 percent.

In testing the hypothesis we used the SPSS 16.0. The test is a two-tailed z-test and the test statistics is given below.

Frequencies

		N
NORMAL.RT - CAAR	Negative Differences[a]	4
	Positive Differences[b]	41
	Ties[c]	0
	Total	45

a. NORMAL.RT < CAAR

b. NORMAL.RT > CAAR

c. NORMAL.RT = CAAR

Test Statistics[a]

	NORMAL.RT - CAAR
Z	-5,367
Asymp. Sig. (2-tailed)	,000

a. Sign Test

The results confirmed that the differences between the actual and assumed distribution was substantially large, thus the null hypothesis is strongly rejected as the value of the test statistic is 5.367 at asymptotic significance level.

2. Wilcoxon Signed Ranks

This test has the same null hypothesis as the sign test that the relative frequency distributions are identical between two populations. In the Wilcoxon signed test, both the sign and the magnitude of the abnormal returns are taken into account in computing the test statistic. These magnitudes are first ranked according to their absolute values, then each rank is given either a (+) sign or a (-) sign. If the null hypothesis is true, we expect that the sum those ranks with positive signs to be equal to the sum of those ranks with negative signs.

In testing the hypothesis we used the SPSS 16.0. The test is a two-tailed z-test and the test statistics is given below.

Ranks

		N	Mean Rank	Sum of Ranks
NORMAL.RT - CAAR	Negative Ranks	4[a]	5,50	22,00
	Positive Ranks	41[b]	24,71	1013,00
	Ties	0[c]		
	Total	45		

a. NORMAL.RT < CAAR

b. NORMAL.RT > CAAR

c. NORMAL.RT = CAAR

Test Statistics[b]

	NORMAL.RT - CAAR
Z	-5,593[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

The results confirmed that the differences between the actual and assumed distribution was substantially large, thus the null hypothesis is strongly rejected as the value of the test statistic is 5.593 at asymptotic significance level.

III. RESULTS AND IMPLICATIONS FOR MARKET EFFICIENCY

Jensen and Ruback documented that targets of successful tender offers and mergers earn significantly positive abnormal returns on announcement of the offers and through completion of the offers. Targets of unsuccessful tender offers earn significantly positive abnormal returns on the offer announcement and through the realization of failure. However, those targets of unsuccessful tender offers that do not receive additional offers in the next two years lose all previous announcement gains. Targets of unsuccessful mergers appear to lose all positive returns earned in the offer announcement period by the time the market acknowledges the failure[107 (*)].

In our study, we found that target firms experienced significant abnormal returns upon the announcement of the merger initiation. The results are consistent with our expectations of efficient market response. In this section, we will also present results of our analysis for the share performances of sample firms during the pre-event and post-event periods.

A. Price Movements in the Event Period

1. Cumulative Abnormal Returns on the 3-day Event Period

The cumulative average abnormal return was 13.20% for the 3-day event period in which the average abnormal return on the event day was 6.7% as the highest single day increase. As regards to the individual performances, 40 stocks experienced abnormal gains while 4 stocks recorded losses. One stock recorded gain however, performed worse than its normal course. Among those who had abnormal returns, 27 stocks gained more than 10%, 9 stocks gained between 5% and 10%, and remaining 4 firms gained less than 5%. These results constituted evidence in accordance with the semi-strong form of the market efficiency that the stock prices responses to the event was remarkably large and concentrated in a few days. The scattergram of the performances of sample firms during the 3-day event period is presented below.

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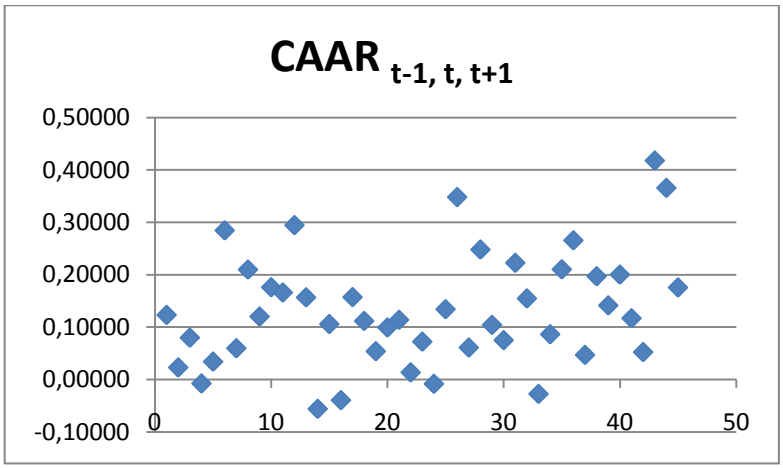
[107] Jensen and Ruback, p.14.

(*) The authors make a distinction between tenders and mergers describing tenders as offers made by prospective buyers while mergers describe the action of two firms to merge. In our study, all events are similar to tenders, describing an initiation of a firm to invite bids for the sale of its shares.

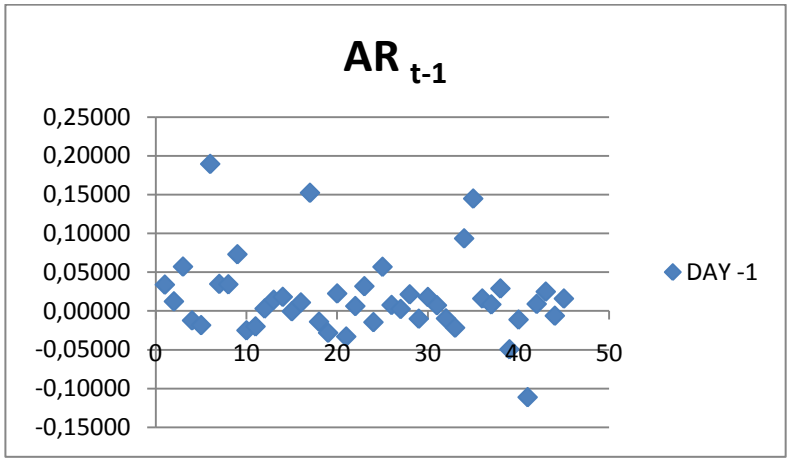
Figure 3
Cumulative Abnormal Returns on the 3-day Event Period



2. Abnormal Returns on the Previous Day of Announcement

The average abnormal return was 1.71% on the previous day before the announcement day. As regards to the individual performances, 29 stocks experienced gains while remaining 16 stocks recorded either zero gain or losses. Among those who gained abnormal returns, three stocks gained more than 10%, 4 stocks gained between 5% and 10%, and remaining 22 stocks gained less than 5%. This result implies certain information leak might have occurred, especially for the stocks that had substantial gains just before the official disclosure. We will elaborate this issue further when we examine the price movements along the pre-event window which includes 46 days before the event day. The scattergram of the performances of the sample firms in the first day of event period is presented below.

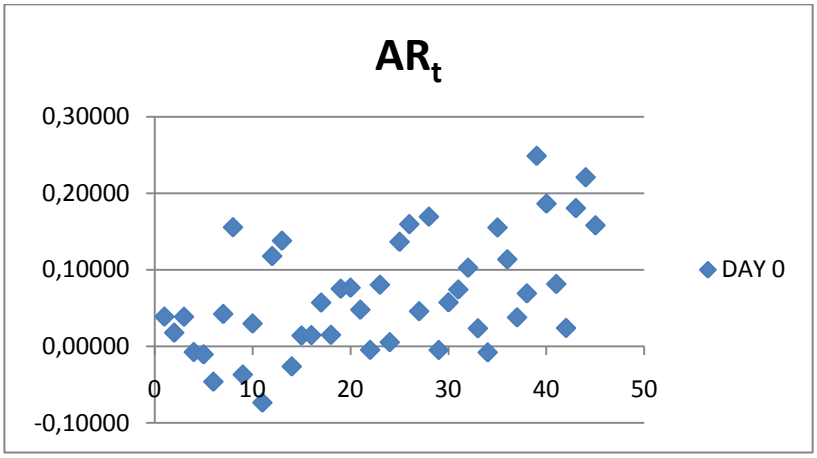
Figure 4
Abnormal Returns on the Previous Day of Announcement



3. Abnormal Returns on the Day of Announcement

The average abnormal return was 6.66% on the day of the announcement. As regards to the individual performances, 36 stocks experienced gains while remaining 9 stocks recorded either zero gain or loss. Among those who had abnormal returns, 14 stocks gained more than 10%, 8 stocks gained between 5% and 10%, and remaining 14 stocks gained less than 5%. This result implies that the market response was very much in line with the assumptions of the EMH. The scattergram of the abnormal returns of individual firms on the second day of event period is presented below.

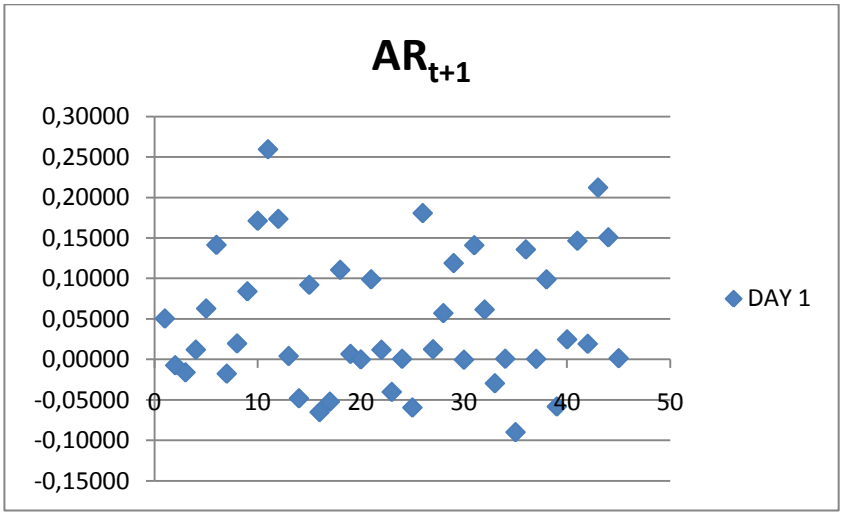
Figure 5
Abnormal Returns on the Day of Announcement



4. Abnormal Returns on the Day of Following Announcement

The average abnormal return was 4.83 on the day following the announcement. As regards to the individual performances, 32 stocks experienced gains while remaining 13 stocks recorded either zero gain or loss. Among those who had abnormal returns, 12 stocks gained more than 10%, 8 stocks gained between 5% and 10%, and remaining 12 firms gained less than 5%. This result implies that the market continued to absorb the effect of the merger announcement as abnormal returns for the stocks continued. The scattergram of the abnormal returns of the sample firms on the 3rd day of event period is presented below.

Figure 6
Abnormal Returns on the Day Following Announcement

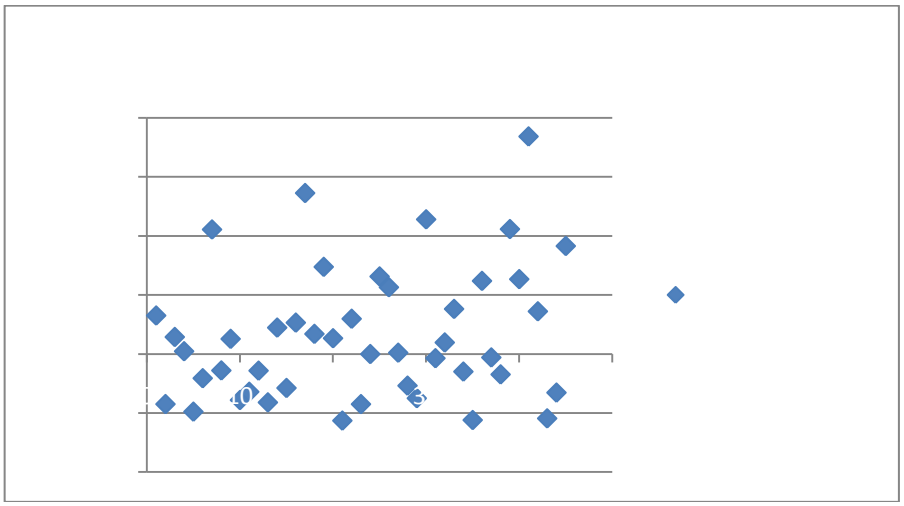


B. Price Movements in Pre-event and Post-event Windows

In designing the time line of our study, we have specified the pre-event period as 46 days before the beginning of the event period. We examined the movements of the share prices of sample firms during pre-event period in order to find indications whether or not significant early response occurred. Accordingly, we set the post-event window covering a period of 46 days following the end of event period in which we examined the price behaviors to have a view on the occurrences of immediate reversals or continuing abnormal performances. The cumulative abnormal returns of individual sample firms are presented in the Appendix.8.

The results of our analysis documented that 24 firms in the 45-firms sample gained cumulative positive abnormal returns during the pre-event window of which 16 of them recorded more that 10% abnormal gains. Among those firms, 6 small capitalization firms recorded abnormal gains within the range of 40% to 70%. The average abnormal returns were particularly started to increase from the day minus (-) 11 and accumulated until the event day. Such early responses indicated that private information was involved in the process and some investors were probably had access to the relevant information before the public disclosure. We think that thin trading along with some information leakage were important factors to explain these extraordinary performances. The scattergram of the performances of pre-event period is presented below.

Figure 7
Share Price Movements in the Pre-event Window



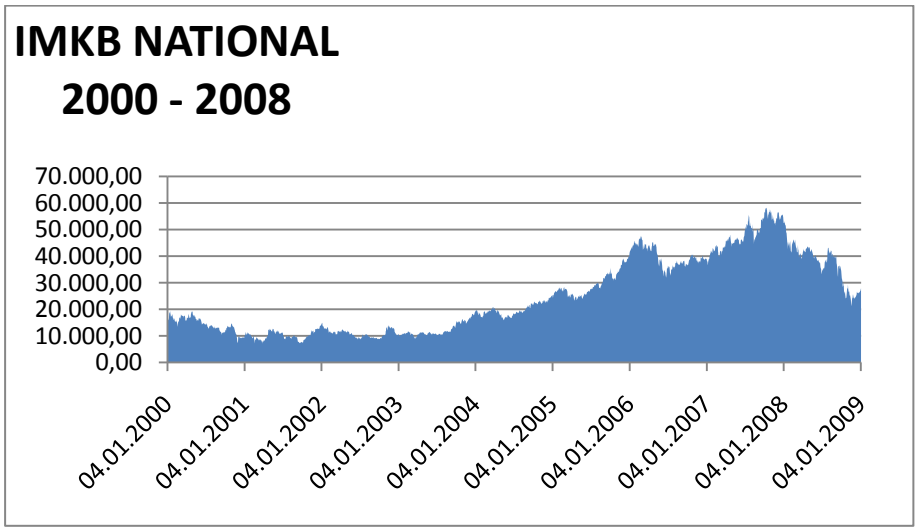
The CAAR continued to increase moderately during the post-event period. The shares of 8 firms out of 45 lost all of their abnormal gains accrued during the event period of which one firm completed the sale procedure in the post-event period and 2 merger attempts failed afterwards. On the other hand, 15 firms continued to gain substantial abnormal returns during the post-event period within the range of 11% to 81%. We consider that neither the decreases in share prices nor continuation of increases of positive abnormal returns are not in contradiction with our expectations. As suggested by various event studies, the shares that experienced the event may resume their normal relationship to market returns after some time has passed. Additionally, the completion of mergers generally requires a lengthy process during which investors may have different opinions about the outcome of the negotiations. In this case, there may be some excess profit opportunities, however associated with extra risk. Therefore, we are in the opinion that the evidences do not particularly imply that the occurrence of the event created profitable opportunities in the period following the announcement.

As regards to the unusually high returns on the sample firm shares in the period immediately preceding the merger announcement, we consider that the market was anticipating the news, however further research is required for the appraisal of the full effects. Such a research would provide detailed explanations on why certain stock prices moved to substantially high levels while others recorded modest gains or losses

during the pre-event period. This research may involve analyzing particular firm characteristics such as size, utilization of leverage and industry specific positions.

In view of the general tendency during the period examined in the study, we plotted the movements of the ISE 100 National Market index on the chart below between 2000 and 2008. Evidently, Turkish stock market experienced significant returns especially for the period between 2004 and 2008 in which majority of merger initiatives took place.

Figure 8
ISE National 100 Index Performance (01.01.2000 - 31.12.2008)



It is a widely observed phenomenon that the number of merger activity increases dramatically during “boom” periods of economy in concurrence with a general rise in stock prices. It is also quite reasonable that merger initiations affected in such times would motivate further the investors’ expectation for good prospects about the firms in concern. We would like to emphasize that it is necessary to take into consideration all components of a time series: long-term trend, cycle effect and random variation to explain the behaviors of security prices in order to make the analysis as complete as possible.

CONCLUSION

In this study, we analyzed the price effects of the merger and acquisition announcements that took place in the ISE over the period from 2000 to 2008. Our aim was to find evidence on whether the responses of target firm stock prices were in agreement with the assumptions of the EMH. In order to derive statistical inferences, we conducted an event study describing that a properly made merger initiation announcement as an event.

The EMH requires that security prices fully and correctly reflect all relevant information. The price changes are only dependent to new information which is unknown at present; hence movements from the present level of prices are unpredictable and random. According to the assumptions of the EMH any new information which is capable to change expectations of investors conveys a signal to the market and prices of related securities adjust rapidly to that information. Nonzero abnormal security returns which persist after a particular type of event are inconsistent with the EMH.

In our study we have constructed a sample of 45 merger announcements and calculated cumulative abnormal returns for an event period of 3 days, including the announcement day, one day before and one after the event day. The Cumulative Average Abnormal Return for the 3-day event period was 13.2% which is in line with the assumptions of the EMH. We performed one-tailed t-tests for the test statistic CAAR as we assumed that the sign of the abnormal performance would be positive. Given the 3-day CAAR, the value of t-statistic is 8.2 and the null hypothesis that the event has no impact is strongly rejected. The results of nonparametric tests, the sign test and Wilcoxon rank test, also confirmed the strong rejection of the null hypothesis that there was no abnormal return. This result is considered as evidence that the market responded the newly arriving news efficiently.

Nevertheless, the performances of the shares of sample firms in the pre-event period indicated that private information was involved in the price formation process since we observed that stock prices responded before the public announcement. During the pre-event period, 24 firms out of 45 firms gained cumulative positive abnormal returns of which 16 of them recorded more that 10% abnormal gains. Among those firms, 6 small capitalization firms recorded abnormal gains within the range of 40

to 70 percent. The average abnormal returns were particularly started to increase 10 days before the official disclosure and accumulated until the event day. We think that thin trading along with the possibility of some information leakage were important factors to explain these extraordinary performances.

Our results are consistent with the empirical evidences presented in several event studies that tested the semi-strong form of the EMH. Our analysis of pre-event period suggested that further research is necessary to detect the effects of private information on the sharp movements of stock prices around the occurrences of firm-specific events.

As regards to general soundness of the EMH, we are in opinion that the theory has solid grounds as a benchmark model in explaining price behaviors in financial markets. However, it is not possible to support the argument of complete efficiency in view of the empirical evidences indicating the existence of predictable patterns enabling investors to earn excess returns. Additionally, it is a widely observed phenomenon that there are psychological and behavioral elements in stock price determination, however empirical testing of particular facts presents certain difficulties.

As we keep evidencing increasingly large fluctuations in security prices all over the world and crisis are becoming a part of usual finance conversations, we would like to conclude this study by quoting a famous phrase from Keynes.

> "*In abnormal times in particular, when the hypothesis of an indefinite continuance of the existing state of affairs is less plausible than usual even though there are no express grounds to anticipate a definite change, the market will be subject to waves of optimistic and pessimistic sentiment, which are unreasoning and yet in a sense legitimate where no solid basis exists for a reasonable calculation*."

APPENDIX 1

M&A ANNOUNCEMENS IN THE ISE NATIONAL PRIMARY MARKET
01.06.2001 - 31.12.2008

#	Name of the Company	IMKB Code	Date of Announcement	Date of the SPA- Acquirer
1	Acıbadem	ACIBD	01.06.2007	16.08.2007 - Almond Hldg.
2	AFM Sinemaları	AFMAS	04.06.2007	24.10.2007 - AIG Fund
3	Afyon	AFYON	15.02.2008	02.04.2008 - OJSC Holding
4	Akbank	AKBNK	14.02.2006	17.10.2006 - CITI Bank
5	Ak Enerji	AKENR	01.11.2007	08.10.2008 - CEZ
6	Alternatifbank	ABANK	03.10.2006	Failed
7	Alyağ	ALYAG	09.11.2005	Failed
8	Arena	ARENA	04.10.2007	Failed
9	Atakule	AGYO	09.10.2007	05.10.2009 - I.Tarman
10	Bossa	BOSSA	31.07.2008	05.08.2008 - Akkardan
11	Boyner	BOYNER	15.05.2006	13.02.2007 - CVCI
12	Burçelik	BURCE	06.11.2007	Failed
13	Çelebi	CLEBI	20.08.2008	Failed
14	Çimentaş	CMTAS	13.04.2000	11.06.2001- Cementir SA
15	Dardanel (*)	DARDL	08.06.2005	Failed
16	Denizbank	DENIZ	15.02.2006	30.05.2006 - Dexia
17	Deva Holding	DEVA	29.12.2005	25.05.2006 - Advent Pharma
18	Dışbank	FORTS	11.06.2004	12.04.2005 - Fortis
19	Doğan Yayın (**)	DOYOL	19.11.2008	Failed
20	Döktaş	DOKTS	12.06.2006	02.11.2006 - Componenta
21	Dyo Boya	DYOBY	18.04.2008	Failed
22	Eczacıbaşı İlaç	ECILC	06.07.2006	05.03.2007- Zentiva N.V.
23	Ege Seramik (**)	EGSER	09.04.2008	Failed
24	Ereğli	EREGL	10.08.2004	04.10.2005 - Oyak
25	Finansbank	FINBN	22.11.2005	03.04.2006 - Bank of Greece
26	Garanti	GARAN	25.08.2005	25.08.2005 - GM
27	Garanti GYO (**)	GRGYO	30.10.2006	02.11.2006 - Doğuş-GE
28	Gima	GIMA	22.04.2005	03.05.2005 - Carrefoursa
29	Güneş Sigorta	GUSGR	15.05.2008	Failed
30	Işıklar	ISAMB	10.11.2006	10.09.2007 - Segezha
31	İzmir Demir Çelik	IZDMC	03.12.2003	23.09.2005 - Sahin/Koç Çelik
32	İzocam (**)	IZOCM	12.06.2006	06.09.2006 - St. Gobain
33	Kent	KENT	14.08.2001	21.02.2002 - Cadbury

34	Kipa	KIPA	02.08.2002	25.03.2003 - Tesco
35	Klimasan	KLMSN	20.07.2006	Failed
36	Logo	LOGO	31.05.2007	Failed
37	Migros	MIGRS	18.06.2007	14.02.2008 - Moonlight Capital
38	Petkim	PETKM	26.07.2006	17.10.2007 - Socar/Turcas
39	Petrol Ofisi (**)	PTOFS	29.08.2005	02.09.2005 - Doğan Holding
40	Ray Sigorta	RAYSG	08.02.2007	20.03.2007 -TBIH Financial
41	Şeker Bank	SKBNK	14.12.2004	22.06.2006 - Turan Alem
42	Tansaş	TNSAS	31.03.2005	19.08.2005 - Koç-Migros
43	TEB	TEBNK	28.06.2004	23.11.2004 - BNP
44	T. Demir Döküm (**)	TUDDF	12.06.2006	28.05.2006 - Vaillant
45	Tekstil Bank	TEKST	05.05.2008	Failed
46	Tire Kutsan	TIRE	06.12.2006	06.07.2007 - Mondi
47	Toprak Faktoring (**)	TPFAC	29.01.2003	23.10.2003 - Altınbaş
48	Tüpraş	TUPRS	03.04.2003	Failed
49	Tüpraş (**)	TUPRS	01.03.2005	Global, Nordic, Baer (14.76%)
50	Tüpraş (**)	TUPRS	28.04.2005	13.09.2005 - Koç-Shell
51	Türk Tuborg	TBORG	23.05.2001	31.05.2001 - Carlsberg
52	Viking Kağıt	VKING	16.07.2004	Failed
53	Yapı Kredi Bank (**)	YKBNK	Not identified	31.01.2005 - Koç Finansal
54	Yapı KrediKoray	YKGYO	16.05.2008	Failed
55	Yapı Kredi Sigorta	YKSIG	22.02.2008	Failed

(*) Dardanel was transferred to the secondary market on 12.06.2008.

(**) These announcements were excluded from the sample (Reasons explained in the Appendix 2).

APPENDIX 2

ANNOUNCEMENTS EXCLUDED FROM THE SAMPLE

	FIRM	**EXPLANATION**
1	DOGAN YAYIN HOLDING	Sales Purchase Agreement (SPA) announced one week later than the initial announcement for a sale of 9.8% of the shares. We consider that the agreement was reached before the disclosure to the public violating our **"event criteria"**. There was also **confounding information** during the estimation period such as negotiations for joint venture establishments and sales of subsidiary shares.
2	EGE SERAMIK	There was a large credit agreement ($ 50 Million) signed with the acquirer (Morgan Stanley) in the estimation period entitled share purchase options. This is regarded as **confounding effect**.
3	GARANTI GMYO	50.98% share purchased by its parent company and GE REAL ESTATE, Sales Purchase Agreement announced directly including a purchase price close the market price. This case doesn't satisfy **"event criteria"** definition.
4	PETROL OFISI	Before acquisition the company was managed jointly by DOĞAN and ISBANK each has 40% shares of the company. DOĞAN acquired ISBANK shares with a purchase price close the current market price. SPA announced 3 days later than the initial announcement. This case doesn't satisfy **"event criteria"** definition.
5 6	IZOCAM T. DEMIR DOKUM	KOC HOLDING disclosed in the same announcement its decision to sale the shares of **three subsidiaries**. Only DOKTAS is included in the sample, the other two, IZOCAM and T. DEMIR DOKUM were excluded.
7	TOPRAK FACTORING	The company was purchased by ALTINBAŞ Holding under the liquidation procedures of the Saving and Deposit Insurance Fund (TMSF). Due to the lengthy procedures involved we were **unable to identify the event day**.
8 9	TUPRAS (01.03.2005) TUPRAS(28.04.2005)	The company made three announcements of which only the first one included in the sample. The latter two announcements were excluded because of the continuing tender process and the sale of 14.76% of the company shares in between two tender announcements. This caused **overlapping estimation periods** resulting that the "normal returns" **to be contaminated.**
10	YAPI KREDI BANK	The company was purchased from the Saving and Deposit Insurance Fund (TMSF) under the liquidation procedures. Due to the lengthy procedures we were **unable to identify the event day**.

APPENDIX 3

EVENT PERIOD ABNORMAL RETURNS (Market Model)

#	FIRMS	AR_{t-1}	AR_{t0}	AR_{t+1}	$CAAR_{t-1, t,}$
1	ACIBADEM SAĞLIK	3,39%	3,89%	5,04%	12,32%
2	AFM FİLM	1,24%	1,79%	-0,73%	2,31%
3	AFYON ÇİMENTO	5,72%	3,87%	-1,60%	7,98%
4	AKBANK	-1,21%	-0,74%	1,20%	-0,75%
5	AK ENERJİ	-1,82%	-1,04%	6,28%	3,41%
6	ALTERNATİFBANK	18,94%	-4,61%	14,13%	28,45%
7	ALTINYAĞ	3,49%	4,24%	-1,77%	5,96%
8	ARENA BİLGİSAYAR	3,44%	15,57%	1,96%	20,97%
9	ATAKULE GMYO	7,30%	-3,68%	8,40%	12,02%
10	BOSSA	-2,49%	2,98%	17,11%	17,60%
11	BOYNER	-1,99%	-7,35%	25,93%	16,60%
12	BURÇELİK	0,32%	11,80%	17,34%	29,46%
13	ÇELEBİ	1,45%	13,82%	0,41%	15,67%
14	ÇİMENTAŞ	1,82%	-2,62%	-4,81%	-5,61%
15	DARDANEL	-0,04%	1,42%	9,20%	10,58%
16	DENİZBANK	1,10%	1,47%	-6,51%	-3,94%
17	DEVA HOLDİNG	15,22%	5,72%	-5,22%	15,72%
18	DIŞBANK	-1,38%	1,50%	11,05%	11,17%
19	DÖKTAŞ	-2,80%	7,53%	0,67%	5,40%
20	DYO BOYA	2,26%	7,67%	-0,01%	9,92%
21	ECZACIBAŞI İLAÇ	-3,29%	4,79%	9,88%	11,38%
22	EREĞLİ DEMİR CELİK	0,64%	-0,46%	1,19%	1,36%
23	FİNANSBANK	3,19%	8,06%	-4,02%	7,22%
24	GARANTİ BANKASI	-1,44%	0,55%	0,07%	-0,82%
25	GİMA	5,69%	13,67%	-5,95%	13,41%
26	GÜNEŞ SİGORTA	0,78%	15,98%	18,06%	34,81%
27	IŞIKLAR	0,26%	4,59%	1,25%	6,10%
28	İZMİR DEMİR ÇELİK	2,14%	16,95%	5,71%	24,80%
29	KENT GIDA	-0,99%	-0,47%	11,88%	10,42%
30	KİPA	1,80%	5,75%	-0,05%	7,51%
31	KLİMASAN KLİMA	0,74%	7,43%	14,09%	22,26%
32	LOGO YAZILIM	-0,95%	10,28%	6,15%	15,47%
33	MİGROS	-2,15%	2,36%	-2,95%	-2,75%
34	PETKİM	9,35%	-0,79%	0,08%	8,64%
35	RAY SİGORTA	14,48%	15,53%	-8,98%	21,02%
36	ŞEKERBANK	1,61%	11,38%	13,57%	26,56%
37	TANSAŞ	0,85%	3,79%	0,05%	4,69%
38	T. EKONOMİ BANK.	2,90%	6,93%	9,87%	19,70%
39	TEKSTİLBANK	-4,93%	24,90%	-5,82%	14,14%
40	TİRE KUTSAN	-1,11%	18,66%	2,46%	20,02%
41	TÜRK TUBORG	-11,10%	8,15%	14,64%	11,69%
42	TÜPRAŞ	0,91%	2,40%	1,92%	5,23%
43	VİKİNG KAĞIT	2,50%	18,07%	21,21%	41,78%
44	YAPI KR KRY GMYO	-0,61%	22,10%	15,07%	36,56%
45	YAPI KREDİ SİGORTA	1,60%	15,82%	0,14%	17,57%
	CAAR (1/N * CAR, N=45)	**1,71%**	**6,66%**	**4,83%**	**13,20%**

APPENDIX 4

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Model)

Event Day - /+ 20 Days

Event Day	Average Abnormal Returns	Cumulative Average Abnormal Returns
-20	0,23%	0,23%
-19	-0,23%	0,00%
-18	0,03%	0,03%
-17	0,80%	0,82%
-16	0,05%	0,87%
-15	-0,40%	0,47%
-14	0,38%	0,85%
-13	-0,04%	0,81%
-12	-0,25%	0,56%
-11	0,75%	1,31%
-10	0,66%	1,97%
-9	0,70%	2,66%
-8	0,52%	3,18%
-7	0,61%	3,79%
-6	-0,12%	3,68%
-5	0,20%	3,88%
-4	1,19%	5,07%
-3	0,89%	5,96%
-2	0,86%	6,82%
-1	1,71%	8,53%
0	6,66%	15,19%
1	4,83%	20,02%
2	0,59%	20,61%
3	1,34%	21,95%
4	-0,77%	21,18%
5	0,28%	21,47%
6	0,98%	22,44%
7	0,40%	22,84%
8	0,86%	23,71%
9	0,29%	24,00%
10	-0,13%	23,88%
11	0,07%	23,95%
12	0,14%	24,09%
13	0,11%	24,20%
14	0,20%	24,40%
15	0,69%	25,08%
16	0,10%	25,18%
17	1,18%	26,36%
18	0,18%	26,54%
19	-0,57%	25,97%
20	-0,40%	25,57%

APPENDIX 5

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Model)
Event Day - /+ 46 Days

Event Day	Average Abnormal Return	Cumulative Average Abnormal Return
-46	0,87%	0,87%
-45	0,21%	1,09%
-44	-0,02%	1,07%
-43	0,61%	1,67%
-42	-0,49%	1,19%
-41	-0,11%	1,08%
-40	-0,38%	0,70%
-39	0,12%	0,82%
-38	0,97%	1,80%
-37	-1,31%	0,49%
-36	-0,29%	0,20%
-35	-0,19%	0,01%
-34	-0,15%	-0,15%
-33	0,09%	-0,06%
-32	0,35%	0,29%
-31	0,24%	0,53%
-30	0,07%	0,61%
-29	-0,73%	-0,13%
-28	-0,51%	-0,63%
-27	-0,36%	-0,99%
-26	-0,10%	-1,10%
-25	-0,13%	-1,22%
-24	0,14%	-1,08%
-23	-0,18%	-1,26%
-22	0,32%	-0,94%
-21	0,22%	-0,73%
-20	0,23%	-0,50%
-19	-0,23%	-0,73%
-18	0,03%	-0,70%
-17	0,80%	0,09%
-16	0,05%	0,14%
-15	-0,40%	-0,26%
-14	0,38%	0,12%
-13	-0,04%	0,08%
-12	-0,25%	-0,17%
-11	0,75%	0,58%
-10	0,66%	1,24%
-9	0,70%	1,93%
-8	0,52%	2,45%
-7	0,61%	3,07%
-6	-0,12%	2,95%
-5	0,20%	3,15%
-4	1,19%	4,34%
-3	0,89%	5,23%
-2	0,86%	6,09%
-1	1,71%	7,80%

APPENDIX 5 (Continued)

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Model)
Event Day - /+ 46 Days

Event Day	Average Abnormal Return	Cumulative Average Abnormal
0	6,66%	14,46%
1	4,83%	19,29%
2	0,59%	19,88%
3	1,34%	21,22%
4	-0,77%	20,45%
5	0,28%	20,74%
6	0,98%	21,71%
7	0,40%	22,12%
8	0,86%	22,98%
9	0,29%	23,27%
10	-0,13%	23,15%
11	0,07%	23,22%
12	0,14%	23,36%
13	0,11%	23,47%
14	0,20%	23,67%
15	0,69%	24,35%
16	0,10%	24,45%
17	1,18%	25,63%
18	0,18%	25,81%
19	-0,57%	25,24%
20	-0,40%	24,84%
21	0,02%	24,86%
22	-0,34%	24,52%
23	-0,26%	24,26%
24	0,19%	24,45%
25	0,29%	24,74%
26	-0,04%	24,70%
27	-0,14%	24,56%
28	0,74%	25,31%
29	-0,33%	24,98%
30	0,63%	25,61%
31	0,52%	26,13%
32	1,01%	27,14%
33	-0,38%	26,76%
34	0,60%	27,36%
35	-0,03%	27,33%
36	-0,29%	27,04%
37	0,35%	27,39%
38	0,18%	27,57%
39	-0,51%	27,06%
40	-0,72%	26,34%
41	-0,30%	26,04%
42	0,37%	26,41%
43	0,55%	26,96%
44	-0,38%	26,57%
45	-0,38%	26,20%
46	-0,16%	26,04%

APPENDIX 6

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Adjusted Model) Event Day - /+ 20 Days

Event Day	Average Abnormal Return	Cumulative Average Abnormal Return
-20	0,45%	0,45%
-19	-0,29%	0,16%
-18	0,08%	0,24%
-17	0,76%	1,00%
-16	-0,14%	0,86%
-15	0,07%	0,93%
-14	0,57%	1,50%
-13	0,05%	1,55%
-12	0,09%	1,64%
-11	0,49%	2,13%
-10	0,59%	2,72%
-9	0,56%	3,28%
-8	0,65%	3,93%
-7	0,59%	4,52%
-6	-0,08%	4,43%
-5	0,23%	4,67%
-4	0,92%	5,59%
-3	0,84%	6,43%
-2	0,76%	7,19%
-1	1,97%	9,16%
0	6,33%	15,49%
1	4,58%	20,07%
2	0,90%	20,97%
3	1,16%	22,13%
4	-0,71%	21,42%
5	0,26%	21,68%
6	0,78%	22,46%
7	0,40%	22,86%
8	0,72%	23,58%
9	0,47%	24,04%
10	-0,23%	23,81%
11	0,04%	23,85%
12	0,04%	23,89%
13	0,18%	24,07%
14	0,04%	24,11%
15	0,50%	24,62%
16	-0,27%	24,35%
17	0,97%	25,33%
18	0,32%	25,64%
19	-0,41%	25,23%
20	0,20%	25,43%

APPENDIX 7

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS
(Market Adjusted Model) Event Day - /+ 46 Days

Event Day	Average Abnormal Return	Cumulative Average Abnormal Return
-46	0,87%	0,87%
-45	0,30%	1,16%
-44	0,14%	1,30%
-43	0,60%	1,90%
-42	-0,24%	1,66%
-41	-0,10%	1,56%
-40	-0,44%	1,12%
-39	-0,15%	0,97%
-38	0,65%	1,62%
-37	-0,91%	0,71%
-36	-0,24%	0,47%
-35	-0,20%	0,27%
-34	0,03%	0,30%
-33	0,23%	0,53%
-32	0,11%	0,63%
-31	0,26%	0,89%
-30	-0,15%	0,74%
-29	-0,90%	-0,16%
-28	-0,35%	-0,51%
-27	-0,17%	-0,68%
-26	-0,09%	-0,77%
-25	-0,11%	-0,88%
-24	0,41%	-0,47%
-23	-0,19%	-0,66%
-22	0,53%	-0,13%
-21	0,22%	0,09%
-20	0,45%	0,54%
-19	-0,29%	0,25%
-18	0,08%	0,33%
-17	0,76%	1,09%
-16	-0,14%	0,95%
-15	0,07%	1,02%
-14	0,57%	1,58%
-13	0,05%	1,63%
-12	0,09%	1,72%
-11	0,49%	2,22%
-10	0,59%	2,81%
-9	0,56%	3,37%
-8	0,65%	4,02%
-7	0,59%	4,61%
-6	-0,08%	4,52%
-5	0,23%	4,76%
-4	0,92%	5,68%
-3	0,84%	6,52%
-2	0,76%	7,28%
-1	1,97%	9,25%

APPENDIX 7 (Continued)

DAILY AND CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Adjusted Model) Event Period - /+ 46 Days

Event Day	Average Abnormal Return	Cumulative Average Abnormal
0	6,33%	15,57%
1	4,58%	20,16%
2	0,90%	21,06%
3	1,16%	22,22%
4	-0,71%	21,51%
5	0,26%	21,77%
6	0,78%	22,55%
7	0,40%	22,95%
8	0,72%	23,66%
9	0,47%	24,13%
10	-0,23%	23,90%
11	0,04%	23,94%
12	0,04%	23,98%
13	0,18%	24,16%
14	0,04%	24,20%
15	0,50%	24,70%
16	-0,27%	24,44%
17	0,97%	25,41%
18	0,32%	25,73%
19	-0,41%	25,32%
20	0,20%	25,52%
21	0,26%	25,78%
22	0,15%	25,93%
23	-0,16%	25,77%
24	0,16%	25,94%
25	0,27%	26,20%
26	-0,09%	26,11%
27	-0,22%	25,90%
28	0,58%	26,48%
29	-0,18%	26,29%
30	0,59%	26,89%
31	0,31%	27,19%
32	0,69%	27,89%
33	-0,38%	27,50%
34	0,14%	27,65%
35	-0,18%	27,47%
36	-0,37%	27,10%
37	0,15%	27,25%
38	0,04%	27,29%
39	-0,58%	26,71%
40	-0,58%	26,13%
41	-0,36%	25,77%
42	-0,07%	25,70%
43	0,25%	25,95%
44	-0,62%	25,33%
45	-0,27%	25,07%
46	-0,14%	24,92%

APPENDIX 8

PRE-EVENT AND POST-EVENT PERIODS CUMULATIVE AVERAGE ABNORMAL RETURNS (Market Model)

#	Firms	Pre-event Period	3-day CAR	Post-event Period
1	ACIBADEM SAĞLIK	13,00%	12,32%	-11,54%
2	AFM FİLM	-17,01%	2,31%	5,06%
3	AFYON ÇİMENTO	5,73%	7,98%	-21,84%
4	AKBANK	0,89%	-0,75%	-2,17%
5	AK ENERJİ	-19,59%	3,41%	6,35%
6	ALTERNATİFBANK	-8,25%	28,45%	-6,95%
7	ALTINYAĞ	42,16%	5,96%	61,11%
8	ARENA BİLGİSAYAR	-5,62%	20,97%	-6,23%
9	ATAKULE GMYO	5,09%	12,02%	4,92%
10	BOSSA	-15,66%	17,60%	22,90%
11	BOYNER	-12,84%	16,60%	-67,18%
12	BURÇELİK	-5,69%	29,46%	12,27%
13	ÇELEBİ	-16,44%	15,67%	21,83%
14	ÇİMENTAŞ	8,90%	-5,61%	12,67%
15	DARDANEL	-11,56%	10,58%	19,11%
16	DENİZBANK	10,59%	-3,94%	6,61%
17	DEVA HOLDİNG	54,52%	15,72%	51,00%
18	DIŞBANK	6,78%	11,17%	-11,91%
19	DÖKTAŞ	29,49%	5,40%	23,89%
20	DYO BOYA	5,30%	9,92%	-19,55%
21	ECZACIBAŞI İLAÇ	-22,62%	11,38%	17,29%
22	EREĞLİ DEMİR CELİK	11,90%	1,36%	0,97%
23	FİNANSBANK	-17,03%	7,22%	-15,64%
24	GARANTİ BANKASI	-0,06%	-0,82%	-4,77%
25	GİMA	26,25%	13,41%	-6,67%
26	GÜNEŞ SİGORTA	22,58%	34,81%	19,55%
27	IŞIKLAR	0,39%	6,10%	-9,19%
28	İZMİR DEMİR ÇELİK	-10,78%	24,80%	-7,29%
29	KENT GIDA	-15,02%	10,42%	-7,42%
30	KİPA	45,60%	7,51%	29,20%
31	KLİMASAN KLİMA	-1,47%	22,26%	11,26%
32	LOGO YAZILIM	3,86%	15,47%	1,86%
33	MİGROS	15,24%	-2,75%	-5,99%
34	PETKİM	-6,00%	8,64%	-9,88%
35	RAY SİGORTA	-22,42%	21,02%	57,18%
36	ŞEKERBANK	24,73%	26,56%	31,25%
37	TANSAŞ	-1,21%	4,69%	6,13%
38	T. EKONOMİ BANK.	-6,96%	19,70%	8,39%
39	TEKSTİLBANK	42,30%	14,14%	1,16%
40	TİRE KUTSAN	25,33%	20,02%	6,87%
41	TÜRK TUBORG	73,70%	11,69%	81,13%
42	TÜPRAŞ	14,42%	5,23%	9,26%
43	VİKİNG KAĞIT	-21,86%	41,78%	0,75%
44	YAPI KR KRY GMYO	-13,13%	36,56%	-15,61%
45	YAPI KREDİ SİGORTA	36,56%	17,57%	3,64%
	Average Abnormal Return	**6,09%**	**13,20%**	**6,75%**

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